A

PRACTICAL TREATISE

ON

MEDICAL JURISPRUDENCE,

WITH SO MUCH OF

Anatomy, Physiology, Pathology,

AND THE

PRACTICE OF MEDICINE AND SURGERY,

AS ARE ESSENTIAL TO BE KNOWN BY

MEMBERS OF PARLIAMENT, LAWYERS, CORONERS, MAGISTRATES, OFFICERS IN THE ARMY AND NAVY, AND PRIVATE GENTLEMEN;

AND

ALL THE LAWS

RELATING TO

MEDICAL PRACTITIONERS;

WITH

Explanatory Plates.

BY J. CHITTY, ESQ.

BARRISTER AT LAW.

FIRST AMERICAN EDITION,

WITH NOTES AND ADDITIONS ADAPTED TO AMERICAN WORKS AND JUDICIAL DECISIONS.

PART I.

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TO

THE RIGHT HONOURABLE

LORD DENMAN,

The Chief Justice of England,

&c. &c. &c.

THIS WORK IS DEDICATED,

WITH

THE DEEPEST RESPECT

FOR THOSE

AMIABLE QUALIFICATIONS AND THAT INDEPENDENT

PUBLIC CONDUCT

WHICH SO EMINENTLY DISTINGUISHED HIM

AS

AN ADVOCATE,

AND

ULTIMATELY RAISED HIM

TO

THE HIGH JUDICIAL SITUATION

HE NOW FILLS

WITH NO LESS HONOUR TO HIMSELF

THAN

BENEFIT TO THE COMMUNITY.

PREFACE.

THE principal object of this work is to present to *Lawyers* and others occasionally concerned in the administration of justice, such a condensed *practical view* of *Anatomy*, *Physiology*, *Pathology*, *Surgery*, *Chemistry*, *Medicine*, *Medical Jurisprudence* and *Police*, as is essential to be known by them in practical connexion with their professional avocations; and to *Medical Men*, so much of the *Law* connected with *their* departments, as ought to be *intimately known* by them; and especially all the Law relating to *their own Rights*, *Privileges*, *Conduct*, *Duties*, and *Liabilities*. A general knowledge of these subjects is essential to the perfect education of all *Officers* in the Army and Navy, and of *every Gentleman*, and especially so to *Legislators*, *Judges*, *Coroners*, *Magistrates*, *Barristers*, and, indeed, to every member of the legal profession, and to all persons who may become *Jurors* or *Witnesses;* so as to enable *Legislators* more scientifically and practically to determine upon the expediency of *improving* the existing laws relating to Public Health, and the protection of the persons of individuals, and *all* to give due effect to the existing regulations. By a knowledge of these subjects, the present laws will be better understood and applied, and preferable enactments with regard to the preservation of Health and Police and Punishments may be introduced.—That science is of primary importance which most conduces to the perfect and permanent happiness of mankind; Theology and Moral Philosophy, as calculated to ensure future as well as present *mental happiness*, stand pre-eminent; but the next in substantial and universal importance, are Physiology, Pathology, and Surgery, since these tend to improve or secure Health and Happiness, or to restore them when afflicted by corporeal or mental disorder.

Objects of th[e] work.

The outline, division, and arrangement of the subject. First part.

The *First* Part of the work, after explaining technical terms, and referring to the sources of information, proceeds to describe the Structure of Man in the *healthy state*, and which comprises Anatomy and Physiology. At the same time are in general noticed the principal diseases affecting each Organ or Function. The component parts, whether fluid or solid, and the divisions into Organs and Functions, and certain general properties, are first considered. Then is taken an Anatomical and Physiological view of every Organ and of each Function in particular. The Bones, Joints, Ligaments, Muscles, Tendons, Arteries, Capillaries, Veins, Absorbent and Secernent Vessels, and Nerves, and all other parts, are separately examined. Then are described all the *Functions* whether of *Motion*, *Respiration*, *Circulation*, *Digestion*, *Absorption*, or *Secretion*. The Brain and its parts, the Nerves, the entire *Nervous System*, and the organs of the *External* Senses, are fully considered. An attempt has been made concisely to examine the Temper, Passions, and Emotions, and the *Intellectual Faculties*, and to show that the latter are capable of enlargement and improvement, *even hereditarily*, by due mental exercise and attention; and it has been shown that certain mental diseases and injuries are capable of medical or philosophical relief beyond our present experience; and that injuries to the mental faculties ought to be the direct objects of *legal regulation*, though at present many are only subject to censure.

Then follows a description of the *Function of Generation*, and of the principal distinguishing peculiarities between the Sexes, and the progress of the Fœtus, and all circumstances that may tend to explain the too numerous offences connected with Miscarriage, Abortion, Premature Birth, Infanticide, and concealment of Birth, and to show the inexpediency of some parts of the existing law.

Then are considered the *Integuments* or *external* covering of the whole frame, including the three *skins*, and the *hair* and *nails*, with an account of the principal diseases and injuries to which they are subject.

Then is taken a medical and legal view of the different *Ages*, with their physical and legal differences, incidents, and consequences. *Lastly* is given an outline of the circumstances to be observed medically, as well as legally, to secure *Health* and *Happiness*, whether bodily or mental.

Plates, with explanations.

In the *First* Part now published will be found *several plates*, intended to explain and illustrate the subjects, namely, Frontal and Posterior views of the Bones of the Skeleton, at, p. 54; of the action of the Biceps Muscle, at p. 88; of the Trachea, Lungs, and other Organs of Respiration, at p. 94; of the Heart, Arteries, and other Organs of Circulation, at p. 140; the Front view of the Heart, at p. 125; of the right Ventricle and other parts of the Heart and other Vessels opened, at p. 127; of the Diaphragm, Abdominal Muscles, Stomach, Intestines, Liver, Gall-Bladder, Spleen, and Bladder, &c. at p. 94; of the Kidneys and Bladder, &c. at p. 140; Plates relating to Phrenology, as the Facial Angle, &c. at pp. 247, 248, 251; of the disarticulated Bones of the Head, at p. 259; Bones at the Base of the Skull, at p. 261; Vertical Section of the Skull, Brain, and Medulla Oblongata, at p. 264; of the Base of the Brain, the Origin or Roots of the Cerebral Nerves, at p. 278; Plates in explanation of the Eye, at p. 291, 292; of the Ear, at p. 301; and of the Female Pelvis, at p. 387. Most of these, with their explanations, were prepared in the dissecting room, from nature, under the careful directions of Mr. Skey, of whose valuable assistance I will presently take further notice. Any want of perspicuity or effect in these plates, is attributable to the great difficulty in fully depicting intricate organs without the aid of distinguishing colours.

In the *Second* Part, I have endeavoured to take a *practical* view of *Pathology* and *Surgery*, (being a view of the Human Frame in its *defective, morbid, diseased,* or *injured state,*) with a Medical and Surgical view of *Disorders, Diseases,* and *Injuries,* and their Medical and Surgical *Remedies,* interspersed with statements and observations upon some important rules of law connected with this part of the subject. Second part.

In the *Third* Part a view is taken of the *Laws* relating to *Public Health* and *Police*, to *Injuries* affecting the *Person*, whether corporeal or mental, with all the regulations, as well for the preservation as for the punishment of each, and a comprehensive view of *Medical Jurisprudence, Police,* and *Evidence,* with the decisions upon Medical liabilities for error or want of due care. Some other branches of Law connected with the subject of *Insurances* on *Lives* and *Properties,* and some suggestions for the melioration of the Law connected with these subjects, are also considered. Third part.

The *Fourth* Part states the *Laws* relative to the *Members* of the *Medical Profession* in particular, namely, their *Qualifica-* Fourth part.

tions, Rights, Privileges, Duties, and *Liabilities,* whether as *Physician, Surgeon, Apothecary, General Practitioner, Surgeon Dentists, Accoucheurs* or *Midwives, Cuppers,* or *Nurses;* and also relating to *Chemists, Druggists,* and *Herbalists,* with a legal and medical view of the regulations respecting *Medicines* and *Drugs,* and some suggestions for the more secure distribution of each, and for *Heads* of *Families* more effectually providing immediate means of relief in cases of emergency.

Fifth part.

Lastly is given a view of *Medical Evidence,* and this rather to *limit* any direct professional education as regards the *manner* of giving evidence, and to suggest the higher importance of each individual stating his *own genuine testimony,* rather than studying *to agree* with other practitioners, a system which, though recommended by some eminent Physiologists, has of late progressed too far, and become rather injurious to the cause of truth and justice.(*a*) All these, with a very full Index, will be comprised in one volume of the same dimensions as the present.

Importance of the knowledge of the subjects to legislators.

An accurate knowledge of all these subjects connected with the health, comfort, and happiness of mankind, bodily as well as mental, is obviously highly important and essential to every *Member of the Legislature;* for they have to enact laws relating to Public Health, Nuisances, Quarantine, Degrees of Punishments, Prison Discipline, Regulations restrictive of excessive labour by Factory and other children, and affecting the Medical Profession themselves, with all improved regulations respecting extended education, or otherwise affecting the community at large. Should individuals attempt to legislate upon matters concerning Public Health or Police, unless they be acquainted with the *principles* applicable to the subject, and the probable consequences of supposed injuries; and ought

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(*a*) In some of the best works on Medical Jurisprudence, as in Dr. Gordon Smith's Forensic Med. 583, it has been suggested, that medical men should meet and compare their intended evidence, *so as in effect to avoid disagreement or discrepancy in Court.* It is to be feared that this recommendation, although well intended, and accompanied with a caution as regards the necessity for a strict adherence to truth, is sometimes abused, though without any criminal intention. Politeness and deference to the opinion of a senior practitioner, will often induce the suppression of at least a *doubt* upon some physical phenomenon or result, and the medical witnesses will be brought over too readily seemingly to *concur in opinion* for the sake of maintaining the credit of their profession; Counsel and Jurors should elicit, by questions, whether such a meeting and concurrence have not taken place, and the latter should give credit to the testimony accordingly.

they, by statute, to prescribe punishment for injuries unless they know their natural or probable consequences? Would Members of the legislature tolerate the many absurd existing regulations, especially that of making the crime of causing miscarriage capital, or a mere transportable felony, to depend on the question whether the fœtus were four or five months old, or rather quick or not quick, if they sufficiently considered that the child is equally alive and equally in progress towards maturity at all times after conception; or would they hastily enact prohibitory clauses or laws of quarantine, so materially injurious to foreign commerce, on an ill-founded ground that a supposed disease is infectious. Mere allusion to a few such instances will establish the great importance that these invaluable members of society, who gratuitously sacrifice their time zealously for the benefit of the community, should be well informed upon these subjects.

To all persons acting *judicially.*

It is obviously the imperative duty of all persons who have to act as *Judges* or *judicially*, to obtain such a knowledge of Anatomy, Physiology, Pathology, and Surgery, as to be able *themselves* accurately to appreciate the value of any evidence respecting Injuries to the Person, and so as not to be implicitly governed by the testimony of any medical witness. If there be no Counsel for the prisoner, or an inefficient Counsel, the Judge should be able to put appropriate questions to the witnesses, and fully to observe to the Jury upon the effect of their testimony. Suppose a medical witness should swear that a blow or wound had been given on the Clavicle (vulgarly called the Collar-bone,) or the Scapula (vulgo Shoulder-blade,) or in any other technically described part of the body, would it not be desirable that the Judge should instantly, without stopping to inquire, not only know the name of the part affected, but also be able to judge for himself what would be the probable consequences of the injury; for otherwise his mind would be occupied in seeking information merely on the import of terms, or in explanation of probable results, when he should be proceeding with more important considerations; and few minds are so powerful as to be able simultaneously efficiently to consider two different subjects;(*b*) or suppose an attempt should be made

(*b*) See post, the observation of Professor Amos, that even some *Judges as well as Counsel are not unfrequently very shallow men in science,* and therefore *too apt* to attack medical witnesses for using technical terms unknown to them; a just reflection, at least, upon Counsel, that it is to be hoped will ere long be shown to be no longer well founded.

before him to prejudice a prisoner or witness by the application to his countenance and supposed character, of the doctrine of Phrenology or Physiognomy, the Judge should be able efficiently to explain to the Jury that such observations are unfounded, or by no means conclusive, and even to adduce some of the many historical instances of unquestionable amiability and benevolence having been concealed under the most forbidding countenance, and by such observations prevent the consequences of any undue prejudice which might otherwise be fatally influential.(*c*)

To coroners.

To *Coroners* also, very considerable knowledge of these subjects is of the very utmost practical importance, especially as they may not be attended by the best informed medical witnesses, and probably will not have the assistance of any Counsel.

To magistrates.

To *Magistrates* in particular, such information will be most extensively important. It is their duty instantly, and before a fresh story can be invented, to take down accurately, in written depositions, all that is sworn or can be elicited before them; and they ought, when the facts, or their result, might hereafter appear in the least doubtful, to put appropriate eliciting questions, and perspicuously state the answers. If previously wholly uninformed upon the subjects, they would naturally shrink from investigation, lest the putting questions that might turn out ignorant or idle should lead to their own exposure. Hence no Magistrate should venture to act before he has obtained a considerable knowledge of these interesting subjects.

To barristers.

With respect to *Barristers*, or at least all who practise at the Criminal Bar, or hold a brief in a life policy cause, or in an action against a surgeon for alleged misconduct, it is as much their professional duty as their interest to obtain a complete and perfect knowledge of every branch of these subjects so intimately interwoven with each other. How disastrous to his credit, and how painful to his feelings, would it be to hear it asserted, after the execution of a prisoner, that the conviction was attributable to his Counsel not having put, or having injudiciously put, a particular medical question, or generally

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(*c*) See instances, post.

proper questions connected with the subject; and yet such omission or blunder might have been probably attributable to mere ignorance of subjects which were not directly connected with the more ordinary and daily object of his *legal* study.(*d*) It was recently severely observed by a gentleman, (as distinguished for his literary and legal talents, as for the justness of his sentiments, and the impossibility of his making an illiberal remark,) in his lectures upon Medical Jurisprudence, and when cautioning medical witnesses against employing technical expressions in giving evidence, such as *syncope* for *fainting*, &c. that *Counsel are generally very shallow men of science*, and that consequently they are apt to raise a laugh at persons whom they would represent to be using hard names for common things.(*e*) It is impossible to deny the justness of such remark, at least as regards *some* Barristers, and surely then each should study to constitute *himself* at least an exception to such alleged ignorance, more especially as it has been ably demonstrated how easy is the attainment of an adequate knowledge of all sciences by a due application and distribution of time.(*f*) It is recommended to all Students, and even Barristers, to examine an outline of the subject, and then to attend a short

(*d*) In Mary Wright's case, convicted at the Spring Norwich Assizes, A. D. 1833, of murdering her husband, the counsel, Mr. J. Sidney Taylor, so ably drew the attention of the learned Judge to the absurdity of executing a woman with child, though *not quick*, that he contributed towards saving her life; and after a jury of matrons had upon her plea of *pregnancy* in delay of execution, *erroneously* found her not to be quick with child, she was delivered of a mature child at a time which clearly denoted that she must have been quick at the time of the trial, and the woman was finally transported instead of executed. See the case stated post, 406, and very fully in the last part; and see index, tit. *Pregnancy*.

(*e*) Lectures on Medical Jurisprudence, Med. Gaz. A. D. 1831, vol. vii. 614; Ryan's Med. Juris. 315. On a late trial in the Court of King's Bench, a Barrister unfortunately exposed his ignorance or forgetfulness even of the dead languages, by his incapacity in the least to explain the meaning of the term *Pneumonia*, used by a medical witness in describing an affection of the lungs, and stated post, 117, note (*t*,) and 118.

(*f*) See the excellent observations of Dr. Arnott, in his Elements of Physics or Natural Philosophy, Introduc. *per tot.*; a work which it would be desirable for every gentleman, as well as persons studying sciences professionally, to read with the utmost care, as highly conducive to the enlargement of his knowledge, and consequently of his true happiness. Dr. Adam Smith observes, there is no necessity for an apprenticeship of *seven years* exclusively devoted to watch-making, or any other department; nor is there any occasion for the waste of *seven*, still more *ten years*, upon the sole study of the dead languages. Much of the time ought to be occupied in the examination of other branches of science and literature, and which would infinitely more interest and improve the minds of youth, and enlarge their intellectual powers and attainments.

course of demonstrating anatomical lectures, judiciously selected for their particular information and advantage; and which I understand will ere long be offered to their attention.

To grand jurors and other jurors.

Grand Jurors, who have to find or ignore bills for murder or other injuries to the person, or for nuisances, &c. ought to be well informed upon these subjects, and it is therefore incumbent on *all Country Gentlemen* who may be called upon to act in that capacity, to study them. *All Jurymen* also in *actions* and *prosecutions* for blows or wounds or other bodily injuries, cannot justly appreciate the damages to be awarded, unless they can understand from the evidence (the value of which they themselves should be able to appreciate) whether the consequence of the blow or wound would be only *temporary* pain, or any and what *permanent* injury; and in actions upon Policies upon Lives, Jurors have frequently to decide upon conflicting evidence, whether the deceased was, at the time of the insurance, afflicted with any *organic* or other disease or disorder *tending to shorten life,* events against which there is a warranty in most life insurances: they should therefore be able to understand what is *an organic disease,* and what is a defect or disorder dangerous in its tendency. In *Criminal* cases, all Jurors ought to be able to understand *ordinary* technical terms, and the names of all the principal parts of the body, where injuries may be inflicted, and to decide upon some intelligence of *their own,* and not merely to be governed by what may have been sworn; they may frequently have to decide whether death was attributable *solely* or *principally* to a blow or a wound, or entirely or *partly* to some other cause for which the prisoner is not responsible; and his conviction or acquittal may depend on their opinion of the weight of evidence upon those subjects.

To witnesses.

Witnesses who have not a competent knowledge of these subjects, independently of their frequent inability, with any degree of *accuracy,* to describe what they have seen, may expose their ignorance in a degree which will be most unpleasant, if not prejudicial, if they aspire to rank amongst the well educated branches of society.

To military and naval officers.

As affording the means of more effectually relieving the wounded or diseased soldier or sailor, it is particularly essential that all *Military* and *Naval Officers* should have considerable knowledge of Anatomy, Pathology, and Surgery, especially as regards Fractures, Dislocations, Wounds, and the suppression of Hemorrhage. The British officer is not more distinguished for his bravery in the battle, than for his humanity and anxious care of his wounded soldier or sailor. Contrast the exertions of our celebrated Admiral Curtis, at the siege of Gibraltar, in saving the wounded enemy, to the heartless apathy of the celebrated French general even towards his own troops during the Russian campaign.(*h*) But a sympathizing heart, and anxious solicitude to relieve the distresses of others, would be practically unavailing if ignorance incapacitate us for useful exertion. Hence, in particular, *all Officers* should anxiously endeavour to acquire such a competent knowledge of these subjects, as at least to be able to assist, if not direct, in the emergent cases that are the unhappy incidents of war.

With respect to every *Private Gentleman*, we shall only repeat the just observation of a powerful advocate for extended education, that in the present day a knowledge of Physics or Natural Philosophy, in general, and in particular of Physiology and Pathology, is indispensable, not merely to all persons engaged in scientific pursuits, but *to all who pretend to a moderately good education.*(*i*) To all *Country Gentlemen* in particular, many of whom reside at a considerable distance from any medical practitioner, it will be highly important to be able on emergencies, either to *direct* or *assist* in recovering a person in suspended animation, or in reducing a dislocation, or in stopping hemorrhage, or performing numerous other acts, as hereafter pointed out, or at least to *assist* a medical practitioner in many of his endeavours.(*k*) In the country, some at least of the *Medicines* and *Apparatus* usually required on emergen- To private gentlemen.

(*h*) During the last war in the Peninsula, a General Officer, in his despatch to Government, after an unassuming description of a brilliant victory obtained by him, and the troops under his command, entitled himself even to higher commendation than for his valour by his pathetic description of the diseased state of the *enemy's* troops, and his powerful appeal to the consideration of our Government, urgently soliciting to be afforded an immediate supply of Peruvian bark, which his experience had taught him was the only medicine to check the baneful disorder; and our Government having immediately, generously, and in the true spirit of war, complied with such request, that distinguished officer was enabled, in ten days, to save more lives of the enemy than his troops had destroyed during the battle and two antecedent years of warfare.

(*i*) Dr. Arnott's Elements of Physics, &c. Introd.

(*k*) In the conclusion of the Second Part will be found an enumeration of the several instances in which a private individual may venture usefully to interfere, and *how* he may safely do so.

cies, should be kept in each gentleman's house, and from time to time renovated, so as to be ready for immediate application by the medical adviser in case of accident or sudden illness, as the saving even of life may frequently depend on the promptness of the remedy; a general knowledge of the outline of these subjects would enable *Heads of Families* to afford in many cases immediate and effectual relief, and at all events would enable them more distinctly to explain to the medical adviser antecedent symptoms and appearances, and to understand and apply his directions, and thereby greatly contribute to the cure and comfort of every member of his family.(*l*) So, independently of accidents and sudden occasion for assistance, the instances are innumerable in which unprofessional but well informed individuals may greatly alleviate the sufferings of their fellow-creatures, as by suggesting various instruments or means of cure, or at least of mitigating pain or annoyance, wholly independent of medicine; as the use of the *hydrostatic bed* for an invalid,(*m*) or the use of various other discoveries at present wholly unknown to the bulk of society;(*n*) and surely no one who can anticipate the gratification incident to relieving a fellow-creature in danger or pain, should refrain from cultivating such useful and important knowledge.

But admitting that men may pass through life without having occasion for the practical application of any knowledge of these subjects, yet it has been well observed, that considering how often Physic and Anatomy are talked of in public companies, it seems to be somewhat proper that people should know a little of the subject of their conversation, rather than descant on matters of which they are entirely ignorant.(*o*) Besides, as

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(*l*) See at the end of the Second Part, a list of the recommended medicines, &c. which country gentlemen should have in their houses, and directions how to renovate their medicine chest.

(*m*) See a short account of that valuable invention by Dr. Arnott, in his Elements of Physics; and see post of Fractures, &c.

(*n*) A very distinguished surgeon, justly celebrated as well for his skill as his excellent humour, states an anecdote of a patient whom he had long attended, and who was incapable of sitting up in a chair, but upon calling one morning, she suddenly exclaimed, "Well, my dear sir, I am now quite able to enjoy myself in my chair;" and upon his congratulating her and himself upon having at length discovered the efficient *medicine;* she exclaimed, "Oh, no, it is not the medicine, but the patent air cushion you recommended." One of my own family, by using such air cushion, travelled from London to Vienna without any intervening rest, and without inconvenience, whilst his companion, who had not adopted the precaution, suffered severe indisposition.

(*o*) Conversations on Animal Economy, edit. A. D. 1827, vol. i. p. 4.

the extension of knowledge necessarily enlarges the scale of human happiness, and as the study of man, the highest production of the Beneficent Creator, is calculated in a peculiar degree to enlarge and improve the mind, the expediency of the study of these subjects cannot be too deeply impressed on the minds of all individuals, as most essential to their own individual happiness, independently of their increased utility to others.

To medical students.

With respect to *Medical Practitioners*, although I cannot anticipate that my observations upon *Medical* subjects will be regarded as of any authority, yet as respects *Students* in Medicine or Surgery, I venture to hope that the analytical summary and condensed view of most of the present doctrines may be found useful; at all events, as regards the former, it is of the utmost importance that they should be fully informed of *the laws* respecting all injuries by violence, poison, or otherwise, to the person, and many other branches of the law, and which have been greatly, and in many respects entirely altered since the publication of the previous treatises upon Medical Jurisprudence. It is, therefore, hoped that the work may be found useful to *them*, as affording a view of the *law*, to which their attention and testimony is to give due effect; and the pages respecting the peculiar *laws* affecting the *Medical Profession* and its branches may be found important even to their pecuniary interests and welfare.

I have, with considerable care and anxiety, collected, condensed, and arranged in analytical order, the best improved modern doctrines and authorities, *Medical* as well as *Legal*, upon every part of the subjects, and have constantly referred to some of the best works, so as to ensure accuracy, and enable students, whether in *Law* or *Physic*, to resort to the highest sources for further information. A few valuable communications from some of the most eminent Physicians and Surgeons will be found introduced. But to one gentleman in particular, Mr. F. C. Skey, of Charter-house Square, (who has so much distinguished himself as a Demonstrator and Lecturer upon Anatomy, as well as by his skill in his practice as a Surgeon,) I am very deeply indebted for much of the new information that is interspersed, and for his numerous valuable suggestions; but I take to myself exclusively the demerit of any errors that may be discovered.

As I anticipate that there will probably be but very few who will have either time or inclination to read through a work of this nature, but will at most only wish to refer to particular parts practically applicable to the case before them, I have been anxious to adopt an accessible arrangement, and have, therefore, prefixed a general analysis of each part, and at the commencement of every Chapter have introduced a Table of its Contents, and at the end of the present Part a *temporary Index* is given of its contents, so as to render it complete in itself, in the event of death preventing the completion of the undertaking; and at the conclusion of the Work will be found a very full Index, containing an extensive Glossary in explanation of Technical Terms. By these means it is anxiously hoped that the work may be found of some practical utility.

J. CHITTY.

Chambers, 6, Chancery Lane,
1st June, A. D. 1834.

PRELIMINARY OBSERVATIONS

TO THE

AMERICAN EDITION.

The high standing of the Author of this work is too well known, to render it necessary for the publishers to introduce it to the American public with a laboured commendation of its merits. The medical and legal professions have long felt the want of such a treatise, and although it is not as full and satisfactory in the discussion of some of the disputed questions in Physiology as could be wished, the ample references appended will always enable the reader to judge of the validity of the proofs adduced by the advocates on each side.

In preparing this edition for the press, the publishers have spared no pains or expense to render it generally available to those classes of the community to whom it is specially addressed: with this view, the text has undergone a thorough revision, and the various inaccuracies which existed have been carefully corrected; no change, however, has been attempted in the language or opinions of the Author: where the latter appeared at variance with the received doctrines of the day, additional references have been made at the bottom of the page.

The principal alterations required, were in the citation of authorities, which have, as far as possible, been adapted to the American editions of the works quoted by the Author; added to which, additional references to our own standard treatises on Anatomy and Physiology have been made with the greatest care.

As several editions have at different times appeared of many of these works, the following list of those employed may prove useful:—

Bostock, John.	An Elementary System of Physiology. Boston, 1828. 3 vols. 8vo.
Horner, W. E.	A Treatise on Special and General Anatomy. 3d edition. Philadelphia, 1833. 2 vols. 8vo.
Good, J. Mason.	The Study of Medicine. New York, 1829. 5 vols. 8vo.
Jackson, Sam'l.	The Principles of Medicine, &c. Philadelphia, 1832. 8vo.
Broussais, F. J. V.	A Treatise on Physiology, applied to Pathology. Translated by J. Bell, M. D. and R. P. Laroche, M. D. 3d American edition. Philadelphia, 1832. 8vo.
	Principles of Physiological Medicine, &c. Translated by I. Hays, M. D. and R. E. Griffith, M. D. Philadelphia, 1832. 8vo.
	History of Chronic Phlegmasiæ, &c. Translated by I. Hays, M. D. and R. E. Griffith, M. D. Philadelphia, 1831. 2 vols. 8vo.
Chapman, N.	Elements of Therapeutics and Materia Medica. Philadelphia, 1825. 4th edition. 2 vols. 8vo.
Cooper Sam'l.	A Dictionary of Practical Surgery. From the 6th London edition. By D. M. Reese, M. D. New York, 1832. 2 vols. 8vo.
Turner, Ed.	Elements of Chemistry, &c. 4th American, from the 3d London edition. By F. Bache, M. D. Philadelphia, 1832. 12mo.
Dunglison, R.	Human Physiology. Philadelphia, 1832. 2 vols. 8vo.
Ryan, M.	A Manual of Medical Jurisprudence. 1st American edition. By R. E. Griffith, M. D. Philadelphia, 1832. 8vo.
Ellis, B.	The Medical Formulary, being a Collection of Prescriptions. Philadelphia, 1834. 8vo.
Rush, B.	Medical Inquiries, &c. 3d edition. Philadelphia, 1809. 4 vols. 8vo.
	Medical Inquiries, &c. upon Diseases of the Mind. Philadelphia, 1812. 8vo.
Arnott, N.	Elements of Physics, &c. 2nd American edition. By I. Hays, M. D. Philadelphia, 1831. 2 vols. 8vo.
Dewees, Wm. P.	A Compendious System of Midwifery, &c. 3d edition. Philadelphia, 1828. 8vo.
	A Treatise on the Physical and Medical Treatment of Children. 2nd edition. Philadelphia, 1826. 8vo.
	A Treatise on the Diseases of Females. 2nd edition. Philadelphia, 1828. 8vo.
	A Practice of Physic, &c. 2nd edition. Philadelphia, 1833. 8vo.

Elements of Surgery. 2nd edition. Philadelphia, 1818. 2 vols. 8vo. Dorsey, J. S.

The Institutes and Practice of Surgery. 3d edition. Philadelphia, 1832. 2 vols. 8vo. Gibson, Wm.

A System of Anatomy. Philadelphia, 1811. 2 vols. 8vo. Wistar, Caspar.

The Principles of Midwifery. 4th American, from the 3d London edition. By T. C. James, M. D. Philadelphia, 1817. 2 vols. 8vo. Burns, John.

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PART FIRST.

OF ANATOMY AND PHYSIOLOGY.

CHAPTER I.

OF THE LANGUAGE OF ANATOMY, PHYSIOLOGY, PATHOLOGY, SURGERY, CHEMISTRY, AND MEDICAL JURISPRUDENCE.

Subjects of this work and importance of the knowledge of the derivation, etymology, and meaning of terms.

THAT the medical and legal student may not, when considering the subsequent practical details, be embarrassed or interrupted by ascertaining the import of terms, it is proposed in this chapter to clear the ground by explaining the meaning of some of the principal and general scientific terms connected with the subject. This is necessary, even for the use of classical students, however well acquainted with the dead languages, and with the etymology and derivation of all words from Greek and Latin; for where is the individual who is also thoroughly well informed in the French, German, and all the other modern European languages, from most of which much of the present learning, and many modern terms have been derived? The subjects of this work are, *First*, Anatomy and Physiology; *Secondly*, Pathology, and the science and practice of Medicine and Surgery, or the remedies for diseases, defects, and injuries; *Thirdly*, Medical Jurisprudence and Police, and the Laws relating to Public Health, and Injuries to the Person, and to Medical and Surgical evidence; and, *Fourthly*, The Laws relating to all Members of the Medical Profession. It will be obvious that these subjects are of great practical importance, and require most attentive consideration.

Anatomy.

Anatomy, (from the Greek *ανα*, "apart," and *τεμνω*, "to cut," or "to cut apart," or dissect,) in its most extensive sense, is the science of organization, or a complete knowledge of every part of the human frame. It is the science which describes the mechanical structure of the body and of each part in particular, and the physical relations which such parts bear to each other, and how they may be locally affected by operations of every description; not only by those which are deemed surgical and affected by the scalpel, but also by injections, macerations, desiccations, CHAP. I. LANGUAGE. or chemical re-agents, though it is principally concerned with the *solid* parts.(*a*)

Physiology *Physiology*, (from the Greek φυσις, "nature," and λογος, "discourse,") in its most extensive signification, is synonymous with physics or *natural philosophy;* but it has long been used in a more limited sense, and is restricted to that branch of science which treats of the *natural* and ordinary *actions* and *functions of the living animal body* in its *Healthy state*, and of the *powers* by which those functions are exercised;(*b*) and whilst anatomy, we have seen, is principally concerned with the *solid* parts, both the *solids* and the *fluids* are equally within the province of the physiologist, whose business it is to study the nature of *all* the substances and fluids that enter into the composition of the animal frame, and the nature and utility of each organ and function.(*c*)

Pathology. *Pathology* (from the Greek παθος, "disease," and λογος, "discourse,") is the practically useful science which teaches the knowledge of all *Morbid* or *Diseased* changes of structure, and of every disease, disorder, or derangement that can affect the human frame. The *remedies* are the provinces of the Physician and the Surgeon, according to the nature of the deviation or injury.(*d*)

Surgery. *Surgery* or *Chirurgery* (from the Greek χειρ, "the hand," and εργον, "work,") is that branch of knowledge which principally relates to the cure of *defects* and *injuries*. Its extended application demands much acquaintance with the science of pathology.(*e*)

By some writers, indeed, *physic* is said to have for its object the treatment of *internal* diseases, and *surgery* that of *external* diseases; but it has been well observed that this definition, however good and plausible it may at first appear, can only be received with very numerous exceptions, in regard, at least, to modern practice: for instance, the psoas abscess, stone in the bladder, polypus, and scirrhus of the uterus, stricture of the œsophagus, and an extravasation of blood within the skull in consequence of accidental violence, are universally allowed to be strictly *surgical* cases; and yet no man would call these disorders *external*.(*f*) Surgery

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(*a*) Bost. Phy. Introd.; Horner, Special Anat. Introd.

(*b*) Bost. Phy. Introd. 1; Good, Pref.

(*c*) Bost. Phy. Introd. 15, and Jackson, Princ. Med. 14, Horn. Anat. Introd. xx.

(*d*) 1 Good, Pref. 1: Broussais' Phy. Pref. *Nosology* and *Therapeutics* are mere subdivisions of pathology. *Nosology* (from the Greek *nosos*, "disease," and *logos*, "discourse,") means the doctrine of the classification or arrangement of diseases, so that a thorough knowledge of one description may facilitate, if not afford the knowledge and proper treatment of others of the same class. 1 Good, Pref. 1; Chapman, Therap. Pref. viii. Whilst *Therapeutics* (from the Greek *therapeuo*, "to heal,") is the doctrine of the treatment and cure of diseases. 1 Good, Pref. 1.

(*e*) See the excellent observations in Cooper's Dict. tit. Surgery. The *obstetric* art (from the Latin term) or *Midwifery* and *Dentism* are branches of surgery. The former especially, with reference to the numerous incidental diseases and maladies, is a science as important as it is universally interesting, although in England unscientific women called midwives, and, in France, *sages femmes*, (but they are there better instructed,) are still permitted, without adequate control, to *assist nature* in the mere delivery. The classical student may refer to his Terence for a description of these women, and which nearly accords with their present characteristics; see Terence's Andria, act 1, scene 4, et post. With respect to Dentism, especially as regards the *preservation* of teeth, the science has become important; see the interesting and useful work on the Teeth, by Thomas Bell, F. R. S., Philada. repub. 1831; and observations on Lizar's work and post. And even as regards mere tooth drawing, in general a most torturing operation, yet when performed skilfully it is scarcely felt. A distinguished Duke, immediately after the operation, observed, "It is really quite *delightful* to have a tooth drawn by Cartwright." However, the terms Obstetric art, Midwifery, Dentism, and Teeth; are not usually allowed a place even in a surgical dictionary.

(f) Coop. Dict. tit. Surgery, 320.

indeed, is a branch of that science and art which has very numerous *diseases* for its object, and that science, considered generally, embraces the whole physical history of man; it investigates the construction of the human body and its living actions; it inquires into the purposes executed by each part, and into the general results of their combined exertions; it observes the human organization under all the various modifications impressed upon it by surrounding influences of every kind; and it draws from these sources the rules for preserving health and removing disease. The practical application of these rules constitutes the art of healing, or rather of treating disease; while the assemblage of facts and reasonings on which these principal proceedings are grounded, make up the science of *medicine*. Nature has connected the external and internal parts so closely, that we can hardly say where one ends and the other begins; and therefore it would be absurd to say that surgeons must be confined to the external parts or any defined depth from the surface; therefore, although the practical parts of physic and surgery are very frequently disunited, their theory and principles are indivisible, since they truly constitute one and the same science. It must be admitted, however, that the treatment of fevers, internal inflammatory affections, and general diseases of the viscera, are considered as belonging exclusively to the province of the physician.(*g*)

Chemistry.

Chemistry, or *Chymistry*, is derived, as some insist, from Χυμος "juice," or σοω, "to melt," and, according to others, from the oriental word *kema*, "black." It has been defined to be the art of *separating* bodies by *fire*, because so many of the chemical changes are effected by means of heat or fire. But this is much too limited a definition.(*h*) It is the science by which we obtain a knowledge of the nature and properties of the constituent parts of all bodies, whether in liquid, solid, or aëriform state; most bodies, as they present themselves to our observation, naturally are in a *compound* state, and it is by chemistry that we are enabled to *separate* them into simple or primitive parts. Even air and water, which were for a long time treated only as simple bodies, are now known to be compounds of different gases, and the alkalies have been also proved by Sir Humphrey Davy to be metallic oxides. It is by chemistry alone that all natural phenomena are explained; rain, hail, snow, &c., being chemical operations on a large scale. Many of the processes in our manufactories, such as porcelain, glass, the smelting of ores, &c. &c., are chemical. To the medical profession, the science is highly essential, for without it errors would constantly occur, as many medicines, when given conjointly, have an effect directly opposite to what they would have in a separate state. In criminal prosecutions, chemistry is necessary to enable us to detect poisons, &c., where death has been caused, or persons' lives have been endangered by poison, &c.

Chemists are the professors of chemistry, persons who make that science their study, so that they are enabled to explain the various changes which are constantly going forward around us upon chemical laws and principles; also to separate all compound bodies into their simple and primitive parts, so as to determine the exact proportions of each, and, by the assistance of known re-agents and tests, to detect the most minute particle of any poison or other matter in the mixture or otherwise. *Galvanic Electricity* and fire are both powerful agents in the hands of the chemist, but as the various compounds submitted to his observations are

(*g*) 2 Coop. Dict. tit. Surgery, 320, and see post, Second Part, title Diseases and Injuries.

(*h*) See also Johnson's and Webster's Dictionaries, tit. Chemistry; and 1 Arnott's El. Phy. Introd. xxi.

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innumerable, so also are the means he makes use of to separate them. It is clear that a perfect practical knowledge of all that belongs to *chemistry* is absolutely essential to enable physiologists, by experiments, to extend their knowledge of the still numerous undiscovered subjects relating to the human frame; and in relation to *Poisons* in particular, chemical knowledge is the great distinction as to the qualification of medical practitioners to clear up the obscurities of poisoning by minerals,(*i*) since it is frequently to be lamented, in criminal prosecutions, that so few medical practitioners, without the assistance of a professed chemist, can give satisfactory information in many cases requiring most explicit evidence. The practical knowledge of chemistry, therefore, requires extension.(*k*)

Druggists.

Druggists are merely venders of drugs, and compounders of pharmaceutical preparations.(*l*)

Medical Jurisprudence.

Medical Jurisprudence, in its most extensive signification, is the science by which anatomy, physiology, pathology, and surgery, and their collateral branches are made subservient to the preservation of *Public Health*, and the *protection of the Person from injury*, and to the formation, construction, elucidation, and administration of *the laws* relative to the same subjects; and it therefore resolves itself into two great divisions; namely, into *Forensic Medicine*, comprehending the *Evidence* and opinions necessary to be delivered in courts of justice relating to criminal and other matters to be there determined; and, secondly, into what has been termed *Medical Police*, embracing the consideration of the policy and efficiency of legal enactments and regulations, for the purpose of preserving the general health and physical welfare of the community.(*m*.) It combines, as well an acquaintance with so much of medical science as is necessary for the elucidation of legal subjects and a knowledge of the existing law, and the rules of evidence as applicable in all cases where medical science and its subjects can become the object of inquiry in courts of justice. It is a combined view of the two sciences of law and physic, showing their mutual relevance, and constitutes the principal object of the following work.(*n*)

Works to be read and sources of information.

With regard to the *sources* of information upon these subjects, the *medical* student may perhaps obtain directions from his preceptor what elementary books he should *read;* but the *legal* student may not have that advantage, and perhaps the suggestion of a few works may be found useful to all. The valuable work upon the *Elements of Physics or Natural Philosophy*, by Dr. Arnott, should be first studied, as, indeed, indispensable to the education of every gentleman, and is as instructing as entertaining. Then should be read Dr. Turner's Elements of Chemistry, or, at least, so much as relates to animal chemistry.(*o*) Next, as regards *Anatomy* in particular, [Horner's Special Anatomy; Wistar's Anatomy;] Cloquet's Descriptive Anatomy, translated by Dr. Knox, with Tuson's Compendium and work on Dissection, and his plates, and the recent Tables of bones, joints, muscles, nerves, &c.,(*p*) should be examined with atten-

(*i*) G. Smith, Med. Juris. 81, 532.

(*k*) See Dr. Turner's Elements of Chemistry; Med. Gazette, vol. 8, Dr. Prout's Lectures.

(*l*) We have not formally enumerated many other branches of science, such as *Botany, Mineralogy, Pneumatics, Hydrostatics, Mechanics,* and various branches of *Natural Philosophy*, which will be found occasionally noticed.

(*m*) 1 Par. & Fonb. Introd. 1; Beck. Introd.

(*n*) See note 1 Par. & Fonb. Introd. 1.

(*o*) Pages 532 to 579.

(*p*) Published, A. D. 1830, for the use of students, by Burgess and Hill, Great Windmill Street, Haymarket, London.

tion. Dr. Quain's valuable works, with his plates, now in course of publication, should also be read, as containing a good practical detailed account of every part of the human frame; and, upon any particular subject on Surgery, Cooper's Surgical Dictionary, arranged alphabetically, may be consulted with utility.

As regards *Physiology*, [Dr. Dunglison's human Physiology,] Blumenbach, with the excellent notes of Dr. Elliotson, Majendie's Physiology, [Broussais' Physiology,] and Dr. Bostock's Physiology should be carefully studied; the latter is invaluable as an able examination and exposition of most of the modern discoveries and opinions.

With respect to the *practical application* of medical practice, Dr. Good's Systematic Study of Medicine, [Dr. Dewees' Practice of Physic] will be found of most extensive utility; to which may be added, the recent valuable publications of the [American Cyclopædia of Practical Medicine and Surgery,] and Dr. Copland's excellent Dictionary on the same subject.

These several works will also have afforded the student an outline of *Surgery*. He may then, for more practical information, study the works of Sir Astley Cooper and of Mr. Brodie on fractures, dislocations, and diseases of bones and joints; also Guthrie or Dr. Hennen on gunshot wounds; and Mr. S. Cooper's Surgical Dictionary before referred to.

As respects the *Obstetric Art*, or *Midwifery*, and the numerous diseases incidental to child-bearing, [Dr. Dewees'] and some other elementary works should be read, in addition to the general works before referred to.

Upon *Chemistry*, the student has already been referred to Dr. Turner's Elements of Chemistry, (4th edit.) and he should now study the whole of Gray's Elements of Pharmacy, &c. [the American and United States Dispensatories,] and Thompson's Conspectus of the Pharmacopœia (9th edit.;) and, as regards *Poisons* in particular, M. Orfila and Dr. Christison's works must be carefully examined.

As regards *Anatomy* and *Chemistry*, the legal as well as the medical student, having read these works, will do well to attend lectures and demonstrations on anatomy, and also attend the laboratory of some eminent chemist, to see some chemical experiments, especially those relating to analyzing different poisons by the double process, namely, of separating the particles, and then again reuniting them, which *double tests* are unquestionably desirable, as most clearly and unequivocally demonstrating the presence of poison.(*q*)

Upon *Medical Jurisprudence, Police*, and *Medical Evidence*, the works of Farr, Fordyce, Beck, Gordon Smith, Paris and Fonblanque, and Ryan, should be read. But as regards these enumerated works on medical jurisprudence, and the laws respecting public health and offences against the person, it must be kept in view that these works were published before the recent very considerable alterations in the criminal law, and therefore might mislead.

The *rights, privileges, duties* and *liabilities*, of every member of the *Medical profession* may be collected from all the above works, and especially from the treatises of Paris and Fonblanque, and Ryan, and also from that of Mr. Wilcock. But as the law and regulations in this respect have since these publications been considerably altered, these subjects will be found fully considered in the following pages.

The student, anxious to extend his inquiries, will, by a perusal of the above works, be led to others on particular branches, and his communication with others will assist him in deciding upon what works in par-

(*q*) See the importance of the *double tests*, 2 Paris & Fonbl. Med. Jur. 250 to 252, and very fully, post, and Index, tit. Poisons.

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ticular, he should select. But, at least, every *practising lawyer* should have in his library the works above enumerated: and much instruction as well as entertainment will be derived from the medical periodical publications of the day.

The necessity for the use of proper technical terms.

Even from the foregoing concise outline of the subjects, it will be obvious that the language to be adopted in explaining these sciences must necessarily be complex; and although many of the names and signs are borrowed from the Greek or Latin languages, yet many have been fixed in more modern times. In every science peculiar technical terms must necessarily be adopted, in order to describe and duly distinguish every part; and when we consider that in the human frame there are upwards of 245 bones, numerous joints, upwards of 450 muscles, besides their tendons; many hundred arteries; three times as many veins, besides capillaries and minor vessels; with nerves, viscera and other organs,(*r*) each of them more or less essential to life, and all of which it is important to distinguish from each other by *different names;* and that they are an infinite variety of *diseases* and *injuries*, and for their cure *numberless herbs*, *minerals*, *medicines*, *chemical preparations*, *instruments* and *apparatus*, and each of which has its peculiar function, office, and name, it will be obvious to every one (not too prone to ridicule sciences of which he is ignorant) that a complex language of almost innumerable words has been properly and necessarily formed and continued; and that as new discoveries may from time to time be made, it will continue necessary to invent appropriate distinct new terms, so as to distinguish them from others, and to diffuse their utility for the benefit of mankind.

Most of the terms describing the bones and other parts of the human frame, are derived from the Greek, and some from the Latin languages. The ancient Greeks and Romans, being the most cultivated nations who first examined and named the principal parts of the human frame and the various herbs and materials for medicine, and being the most scientific men of the time, assigned to each that term, which, with reference to the proper application of their language, they thought the best and most accurately descriptive. Thus the bones of the *head* were termed κρανιον, *cranium;* the heart καρδια, *cardia;* and when there was a surrounding, investing, or adjoining membrane, or coat belonging to the principal organ, they described it by the compound name περι, or *peri*, around, and called it *peri-cranium*, *peri-cardium*, &c., as the membrane surrounding the head or the heart. So in more modern times, many newly discovered organs or parts have been described in the language of the discoverers, as according to the French and other modern European languages; and as the words, when in the original language, in general best explain the meaning, they have been properly retained, because they are thus explanatory in themselves, and, at least, enable those who have received an extended education to discover the meaning of the term; and a well educated person will, therefore, by his knowledge of languages, be greatly assisted in comprehending the language of anatomy and physic, and be enabled to understand the more ancient authors. And though there may be an English term for the same subject, yet it is still advisable to retain, at least amongst medical men, as well as in any judicial inquiry, the ancient and technical term, because that has received and obtained a well defined and limited meaning, whilst vulgar terms of unknown origin and arbitrarily used are of much more uncertain application, and, at least, unscientific men, instead of attacking medical witnesses, should regret their own ignorance.

(*r*) As to the precise number of each of these and their names and particular descriptions, see farther post.

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It is farther admitted that the import of words is not always to be strictly *confined* to the classical derivation, but may be extended according to the definition affixed to it by established usage, especially amongst eminent professional men.(*s*) Thus the term *Asphyxia*, derived from the Greek, and properly meaning a privation of *pulse*, is now universally allowed to extend to every apparent cessation or suspension of vitality, as fainting;(*t*) and it has been well observed, that many of the terms of medicines which were transmitted to us from antiquity in the language of the people as well as of science, have become in process of time, as it were, by *common consent*, applicable to many different affections much beyond their strict derivative meaning. As the word Asthma, strictly meaning a particular *spasmodic* difficulty of breathing, recurring in paroxysms, is now used even professionally to include *all cases* of difficult breathing.(*u*) So, many terms have gradually become established and tolerated by common consent, though perhaps better might have originally been selected. Thus in describing certain membranes of the abdomen constituting divisions or separations from other parts, the Latin term *paries* or *parietes* (strictly, importing a wall or *partition wall*,) is universally adopted; so the word *articulation* (from the Latin *articulo*) is used in describing the *joints*, though originally uncertain, and importing in Latin as well a junction, as also sound or voice, or articulation in the English more limited sense. So the word *exhibit* is in common use as importing the causing medicine to be swallowed, though in common understanding that word would seem merely to import that the medicine was to be *shown* to the patient.(*x*) The term *regions* is also technically used as importing certain well defined parts of the thorax and abdomen, and is useful as assisting in the discovery of the seat of disease or injury, though an unscientific reader would naturally conclude he was about to consider some important grand division of the globe.(*y*.)

But certain deviations long adopted may be admitted.

Much difficulty has arisen in the language of Physic from the circumstance of many organs and parts having been named *after the person who first discovered or described them*, as Pons Varolii, Eustachian tube, and the *Rete-mirabile Malpighi* in the lungs, from the same having respectively been first described by the anatomists of those names, and this without regard to any etymology, or derivation, or local situation or property;(*z*) and still more difficulty and confusion has arisen with respect to the *muscles*, namely, in naming some according to the bone which they move, others according to their operation, and others still more arbitrarily; so that frequently there is not any scientific accuracy in the nomenclature.

Some names of organs, &c. from first discoverer or describer.

Confusion arising from the non-observance of one uniform principle in nomenclature.

It has been justly observed, that when once the meanings of medical terms have been fixed by their etymology, or by a long course of practice amongst medical men, they ought not to be changed to another term, though the latter might have originally been more appropriate, because nothing more tends to confusion than a variety of names for the same thing.(*a*) Thus the name of *Rectum*, anciently given to the lowest part of the intestinal canal by the oldest anatomists, on account of *their*

Impropriety of changing established terms, though not originally the most correct.

(*s*) 1 Par. & Fonb. 105, as to irritability, &c.; and see 1 Good, 459.

(*t*) American Cyclop. Prac. Med.; 2 Par. & Fonb. 35; Good, 428.

(*u*) American Cyclop. Prac. Med. tit. Asthma.

(*x*) In law the offence of "*administering poison*," is committed by causing another to take any part, although he immediately after spit it out, and do not absolutely swallow it into his stomach. *Rex* v. *Cadman*, 1 Ry. & M. 114.

(*y*) The term *region* is certainly in many cases useful. A patient may be told the pain or affection is in the *region* of the bladder, as importing that the seat of the disorder is *thereabout*.

(*z*) Horn. Anat. Pref. xvi.

(*a*) 1 Bost. 192 to 196, where he observes, that he prefers the word *sensation;* and sensitivity of a nerve, to the term sensibility; and Broussais, 41.

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having described from the *brute* creation (with reference to which it was correct,) ought, it has been observed, still to be retained (although in its application to that part of the digestive canal in *man* it is incorrect, and should be termed *curvum* rather than *rectum*,) because that application of the term having long been fixed and become well known, the introduction of another might lead to confusion.(*b*)

Unless a new nomenclature should be universally prescribed and enforced.

A creation of a great many new terms, as if derived from the Greek, has been suggested in Good's Nosology or Classification of Diseases, and by other writers, as expedient to be adopted for the sake of uniformity, so that the generic terms may be all derived from a single tongue; and in the Pharmacopœia Londinensis, many new terms have of late been authoritatively introduced, especially as respects medicines, better corresponding with the nature and properties of each;(*d*) and it has been contended to be desirable that the whole nomenclature applicable to the science should be reviewed and corrected where improper, and the uniform use thereof *imperatively* and universally *prescribed*, with English terms applied to each, especially of the names and characters of unmixed articles, composing medicines prescribed authoritatively, to prevent the confusion and melancholy mistakes that too frequently occur. The *change* of well established and well known names has, however, been objected to by the ablest physiologists, as Blumenbach,(*e*) Bostock, and others. Thus Dr. Bostock (speaking of Dr. Barclay's New Anatomical Nomenclature, (*f*) and also of Dr. Prout's valuable observations on Digestion,) (*g*) has observed that the *partial* adoption of a new language in any department of science, tends to embarrass the memory, and its *general* adoption would have the serious objection of rendering the old standard authors in a great measure unintelligible; and in another valuable work it has been objected, that the use of new names, classifications and arrangements, whilst we must also retain the old, would add much to the intricacy of demonstration.(*h*) The former remark somewhat resembles Lord Ellenborough's objection to the statute, requiring pleadings, proceedings and records to be in English, which enactment he observed had rendered attorneys and their clerks still more ignorant of the Latin language, and had caused the literature of the inferior part of the profession of the law to recede;(*i*) and a similar objection has been made in favour of the continuance of the practice of examining students in physic in the *dead languages;* and such examination has recently been abandoned in the Scottish Universities, upon the supposition that an examination in the *dead* languages is not calculated to advance the knowledge of science; and because a perfect knowledge of the dead languages, and the ready ability to read ancient authors may be otherwise enforced in the liberal education of the professor, and is therefore quite collateral and independent of the knowledge and uniform use of a modern and improved general nomenclature, as regards the practice of medicine. But, on the other hand, it ought to be considered of great utility, if not of indispensable importance, that such valuable sciences as Medicine and Surgery should have one continued classical language common to professors, and that Latin being familiar to all educated persons on the *continent* it should be here equally valued, unless education is to be made a mere portion of the Boutiquier system.

(*b*) Dunglison, Phy. 434. See post, another probable reason for the term has been assigned; namely, the absence of cells or sacculi, which exist in other parts of the intestinal canal, but not in this.

(*d*) Tuthill's translation of Pharmacopœia, preface, viii.

(*e*) Blumenbach, by Elliotson, 9.

(*f*) 1 Bost. 273; [see also Pharm. U. S. Pref. xvii.]

(*g*) 2 Bost. 378.

(*h*) 2 Bell, Anat. 470.

(*i*) 4 Geo. 2. c. 26; 1 Maule & Selw. Rep. 710.

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Absurdity in the unnecessary adoption of obscure terms.

It must be admitted, that from an *affected* adoption of obscure words not in general use, the language of physic has been rendered less intelligible than is essential for the support of true science, and that, excepting amongst scientific men themselves in their own communication with each other, unquestionably, when a more common term would be more explicit or better understood, it should be used, especially when there is the least ground to apprehend any mistake. Thus the word *Region* has been extended by some, who affect to appear learned, to the smallest part of a finger,(*k*) and so prescriptions will sometimes direct a dose of physic to be "*exhibited*," which would vulgarly be supposed to mean *shown* to the patient.(*l*) These and other terms, when long used, may be tolerated among scientific men themselves, but certainly ought not to be *extended* when likely to be misunderstood or misapplied by the vulgar.

Simplicity in medical language recommended by the ablest physiologists, especially in judicial inquiries.

Subject to the legitimate use of words of art, which have long received a popular generally well known meaning, a sensible practitioner should study to *simplify* his language, and render it plain and intelligible *to all mankind*, so that in *private* the patient and his attendants, and in *public* the judge, the counsel, the witnesses, and still more the jury, may be able to comprehend every word of his evidence; and at least in all judicial inquiries, when describing a particular part of the human frame, or the action of the muscles or other part, or the action or progress of disease or injury, by its correct and generally used scientific terms, he should be prepared to identify each by its vulgar name, and by which it will probably be better known, at least by the jury.(*m*) And this so easily and familiarly that he may accompany the technical term with its meaning in ordinary acceptation, without the appearance of giving a formal translation. As thus, the sternum, commonly called the breast bone; the pericardium, or, in other words, the membrane or coat that surrounds the heart; the stomach, or part in which the food is received and digested before it passes into the small intestines or bowels. Men of science should recollect, that terms, however familiar to themselves, in consequence of long peculiar study, are not always so to others, and should therefore descend to a more simple language; for otherwise their hearers will be attending to and considering the import of particular words rather than the substance of the sentences, and by confusion may mistake the most important part of the evidence or statement. This is the more necessary when a medical practitioner is giving evidence in a court of justice, when, as was observed by a learned advocate, judges as well as counsel are strongly disposed to raise a laugh at persons, whom they would represent to have unnecessarily used hard names for common things; (*n*) though, on the other hand, it should be remembered by such critics, that it is most natural for scientific persons to use approved technical terms familiar to themselves, and in effect their common parlance, and more precise in meaning than any other expressions; and that too captious objections to such terms rather evince the ignorance

(*k*) See post, 10, n. (*o*;) and 2 Bell, Anat. Introd xxiv.

(*l*) Even in scientific works the term *exhibit*, for administering or taking medicine, is constantly given; thus, in Cooper's Surg. Dict. it is said, "when alterative medicines are requisite, a grain of calomel may be *exhibited* daily, " and a case is recorded by Dr. Phillips, in which he states that in tetanus, the jaw suddenly fell upon the *exhibition* of an "enema, with oil of turpentine." Suppose the chemist had written on the dose "to be *exhibited* to the patient immediately," might not the attendants have naturally supposed they were merely to show it? Surely at least no extension should be admitted to the already too numerous list of unintelligible or unnecessarily ambiguous terms for common purposes.

(*m*) 1 Bost. Pref. viii.; id. 273, note.

(*n*) Amos, Lectures on Medical Jurisprudence, Med. Gaz. A. D. 1831, vol. 7, 545, 610; and see Ryan, Med. Jur. 315.

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and shallowness in science of the party objecting than any demerit in the witness.

It has been justly observed, with well directed irony, by a sensible and learned author, that although medical men may properly use a foreign or dead language, yet they should avoid a peculiar style and phrase which no one can understand, unless he be initiated, and has studied the science itself so intensely that he has also learned the jargon in which it is conveyed. He observes, that no one but a thorough anatomist can understand the adulterated language of anatomy, nor can even he understand it without some labour, for anatomists have *buried* their science under the rubbish of names; and there is not a difficult or hard-sounding word upon which they have the least pretence of claim that they have not retained; they have *choked* their subject with useless minutiæ; they have *polluted* their language by *transferring* to it from the Latin many words which, by their continual inflections in that language, were beautiful, while their unvaried, uncouth termination in ours is barbarous in the utterance, and tends but to interrupt and puzzle the sense; they have impressed into the service of their science a great many poor words that would get their *habeas corpus* from any court in Christendom.(*o*)

Question as to the expediency of continuing *Latin Prescriptions.* Argument against such Prescriptions.

It has been objected by many, that it is singular in this age of improvement no *alteration* has been introduced in the practice of *Physicians*, viz., in writing their *Prescriptions* in *English* instead of *Latin*, avoiding contractions and figures, so subject to mistakes, even by physicians themselves, and still more so by chemists and their apprentices;(*p*) and it has been objected, that if all the innumerable instances that have occurred of blunders and deaths attributable to this practice were laid before the public, every individual would, in the language of the statute relating to attorneys, insist on having an English prescription, and not merely in Latin, with figures almost hieroglyphical, but in words at length, stating the names and precise quantities of each component part of the medicine, with the exact measured quantity to be taken at a time, and at what hour, and under what circumstances, and at what time or times to be repeated, or increased, or diminished, in any and what degree, with other explicit instructions as regards diet and conduct, so that the intended effect of the

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(*o*) 2 Bell's Anat. Introd. xxiv., where there are some amusing instances. Thus, an anatomist, for example, will describe an artery as, "*going to the radial edge of the second* metacarpal bone; then supplying the abductor and flexor muscles; then going along the bone of the first phalange, seated upon this second metacarpal bone," with many other distortions, ambiguities, and little contrivances to conceal (as one would believe) that he is describing so simple a matter as the *artery of the fore finger*, which the reader at last finds out, either by some lucky chance, or by reflecting how many metacarpal bones there are, and then reckoning them first forwards, and then backwards, that he may be sure which it is that the author means; for his author may count from the little finger towards the thumb, or from the thumb towards the little finger; or he may have a fancy of leaving out the thumb, and reckoning only four. What must be the surprise of any well educated young man when he reads in those books, which he must, of the *regions* of the *elbow* or *thumb* or *fore finger*? And if an anatomist understand such things with difficulty, how distressing must they be to the student? The same author observes,

"This is the scholastic jargon which has so long been the pride of anatomists, and the disgrace of their science, which has given young men a dislike for the most useful of all their studies, and which it is now full time to banish from our schools. These are the authors who avoid plainness as if it were meanness; who are studious of hard words, as if they constituted the perfection of science: 'it is their trade, it is their mystery to write obscurely;' and full sorely does the student feel it."

(*p*) See a collection of prescriptions with contractions, Pereira, p. 16, 30, 67. edit. A. D. 1829. As "*pro re nata*," or "Repetatur mistura *pro re nata* si opus erit ad vomitum Sedandum," Pereira, 16, 67. See also the very valuable collection in Ellis, Medical Formularies.

medicine may not be neutralized by want of proper direction in that respect. So it has been insisted, that a surgeon, who has reduced a dislocated or fractured bone, should give the most explicit directions for subsequent diet and rest, and well defined prohibitions against locomotion, excepting that which may be essential for health, without endangering a recurrence; directions which, it is contended, would prevent, or at least diminish, the possibility of blunders; and it has been observed, that any physician who would resolutely break through the old fashioned and absurd practice would give the greatest satisfaction to the public, and ensure his own fortune.(*q*) It has also been sarcastically urged, that perhaps a mouthful of nonsense sounds better in Latin, or other dead language, than in English, and that is the only reason for continuing the prescriptions in Latin; but that the science of Physic is too noble to excuse any argument that it requires to be kept mystified and impenetrable but to its members, and that as regards the study of the dead languages, and the derivations of anatomical and physical terms, they may be readily enforced and kept up without fear of any simplification too powerfully tending to a neglect of the dead languages.

Arguments in favour of the continuance of the practice.

On the other hand, the experienced and the wise are naturally averse to innovation, the full consequences of which, especially in so extensively important a subject as physic and medicine, it may be difficult to anticipate. They observe, that *by the usual* education of every branch of medical practitioners, they ought to have become well informed in the Greek and Latin languages, and that afterwards, during a five years' apprenticeship and by the enjoined attendance on courses of lectures, accompanied

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(*q*) Some forcible observations on this subject will be found in the Medical Gazette of 29th January, 1831, p. 566. It is an acknowledged principle, that the language of a physician should be simple, unaffected, and intelligible to the meanest understanding, (2 Bell. Anat. Intro. xxiv.; 1 Bost. Pref. viii.,) and that the profession is much too learned, too important, and too dignified to be prejudiced by the adoption of the English language in a document so highly important to be clear and free from doubts or mistakes. Let the mystic figure ♃ or ℞ (which, in truth, is nothing but the continuance of the heathen invocation to Jupiter, and seeking *his* blessing upon the medicine) be continued by *Quacks*, as may be the "*Laus Deo*," by notaries' clerks, or "shipped by the *Grace of God* one bale of flax in the good ship, &c.," by ship brokers in their bills of lading; but let there be no contemptible obscurity or affectation in a *Physician's Prescription*. That it should be intelligible to all who can read, and so clear, that the nurse who attends the patient may know its import; that the quantities should be written in words, and not in the usual characters; for suppose in some powerful medicines, in the hurried way of almost all affected bad writing in prescriptions, there should be an extra z at the top of a drachm, or in other words there should be an ℥ (an ounce) instead of a ʒ (a drachm,) being only the *eighth part* of such ounce, how fatal might be the consequences, as in prescribing prussic acid, four drops of which in a day is a powerful medicine! By way of illustration, the report of a recent trial has been referred to, where an action of slander arose between two medical practitioners, the plaintiff an apothecary, and the defendant a physician, entirely proceeding from the latter having prescribed some laxative medicine for a nervous and costive old lady. The prescription, after directing the particulars of the medicine, added, "*Repetatur si opus sit.*" The apothecary being absent, and his apprentice just from school, where he had but half learned Latin, instead of properly construing the prescription, "to be repeated *if occasion should require*," or in effect, "if the first dose should *not* operate," wrote on the label "to be repeated *if it operates*." The old lady, consequently, after experiencing the effect of the first dose, immediately took another, and repeated it again and again, until she swooned from exhaustion; and, in alarm, the physician being sent for, incautiously exclaimed, and afterward unnecessarily repeated to others, "Coleman has killed my patient," and for which the action was brought, and 40*s*. damages, and about 200*l*. costs were recovered. *Coleman* v. *Smith*, Maidstone Assizes, A. D. 1820, and see also the case of *Rex* v. *Heath*, acquitted of the manslaughter of Captain Burdett, at Brighton, at Sussex Assizes, A. D. 1832; see also 3 Rush, Med. Inq. 321.

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by study, most members of the profession, in every department, must imperatively have become familiar with most of the usual materials of medicine, and of their powers and proportions, and of all the most approved prescriptions, and at all events of the language and signs in which all prescriptions would usually be expressed by any duly licensed physician, and that, therefore, the frequency of mistakes in the prescriptions themselves must be inconsiderable; and they object, that if prescriptions were in English, the patient and their attendants would too frequently ascertain the dangerous tendency of the suspected disorder, which, according to acknowledged principles and rules, it may be most important to his welfare, and consequently the duty of the physician, to keep secret, lest the patient should become alarmed, and thereby impede, if not endanger, his recovery.(*r*) Again, that patients and their attendants, by the exact knowledge of the components of a medicine fully prescribed in English, and which they had perceived in one or more instances had succeeded, would become apt, without due regard to the variations in disorders and in constitutions and other varying circumstances, to administer the same medicine on other occasions when wholly inapplicable, and thereby produce the most baneful consequences. These observations are certainly entitled to grave consideration, and upon the whole it would seem that no inconvenience would result from the continuance of the existing practice, if there were better regulations introduced and strictly enforced with regard to chemists and druggists and persons having the care of drugs and medicines, and allowed to mix and prepare medicines from Latin prescriptions: but still, for greater precaution, it would be laudable if physicians would avoid all contractions, and would, when there is the least ground to fear the consequence of ignorance or mistake, subscribe a translation in English, at least as regards the names and exact quantities of ingredients, with English directions as to the quantities and times of administering the aggregate preparation.

Recommended alterations.

Plan of Work as regards explanation of physical terms.

To assist medical students and legal practitioners, especially on the circuit, where Greek and Latin works may not be accessible, we have in general anglicised each foreign term, and we have in the index printed in italic most of the technical terms used in anatomy and physic, with their origin and meaning in the Greek or Latin or other languages; and with reference to the parts of the work where authors of authority have used them in the same sense; and we have introduced a few *Plates by a superior artist*, pointing out the principal parts of the human frame, with their technical terms, referring at the same time to the best works to enable the student to enlarge upon each subject.

Foreign admeasurements.

It will be found, that frequently our English physiologists, translating or borrowing from the continental authors, refer to *their* modes of *admeasurement*, and very frequently to the term "*line*," which throughout the continent means the twelfth part of an inch.(*s*) A scale of all admeasurements and weights, as applicable to medical subjects, will be given when the subject of medicines is considered.

(*r*) Dr. G. Smith, 537; Lizar's Pref. ix.; 2 Bell, 190; Sir J. Halford, Med. Gaz. 600 to 603. The depressing passions may produce fever, 1 Par. & Fonb. 197; and see effect of grief, 2 Par. & Fonb. 26, 29, 30, 100; 4 Good, 96; also Rush on the Mind, 318. Effect of mental emotion, the fear of death may occasion it, 3 Rush, Med. Inq. 4. The same duty in a surgeon, Coop. Surg. Dict. tit. Apparatus. It may be otherwise as regards preparing a patient for death, Sir H. Halford, Med. Gaz. 600 to 603; 2 Bell, 90.

(*s*) Horner's and Bell's Anatomy, &c.

CHAPTER II.

OF THE MATERIALS, COMPOSITION, STRUCTURE, ORGANS, FUNCTIONS, PROPERTIES, AND POWERS OF THE HUMAN FRAME IN GENERAL.

CHAP. II. IMPORTANCE OF KNOWLEDGE, &c.

I. Importance of a knowledge of the subject, and a general outline.

WE propose in this chapter to examine of *what Materials* the human frame is composed, and what are its *Properties*, and a *general* division of the subject.

A common observer might suppose that the human frame is composed, *externally*, merely of the integuments, (comprehending the skin, hair, and nails,) and *internally*, the bones, blood vessels, with the brain, and general viscera and the blood. But the analyzing powers of chemistry have enabled us to discover that so general a description would be wholly insufficient to enable us to ascertain diseases, or apply with any degree of precision the various remedies for the numerous deviations from the healthy state.

Of atoms, attraction, and cohesion, and of repulsion or separation of atoms.

In physics or natural history, no points are better established than that man, like vertebrated animals, is composed of certain imperceptibly small *atoms* or globules, all of the same size, namely, each in diameter about the 7500th part of an inch,(*a*) which, although cohering by attraction, have not in reality any connecting texture, and the same by chemical analysis may readily be separated from each other; and it has been established beyond contradiction, that in man and in most male animals in a perfect adult state, there are, in a certain fluid, hereafter described, *living animalcules*, so imperceptibly small to the unassisted eye, that 10,000 of them

(*a*) Dr. M. Edwards' observation on the elementary structure of the body, as stated in 3 Bost. 273. [But authors differ in their views on this subject, 1 Dunglis. Phy. 29.]

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may exist in a space not larger than a grain of sand.(*b*) By a law of nature, called *Attraction*, these atoms would naturally cohere or cling together in masses of various forms and magnitudes; and were it not for the counteracting influence of another law, that of *Repulsion*, occasioned by heat or *caloric*, the whole materials of creation would rush into close contact, and form one huge solid mass of stillness and death.(*c*) But heat or caloric, constituting the cause of such *repulsion*, counteracts attraction and induces atoms, more or less, to separate from each other, and singularly modifies the result, so as to render them cellular or porous, and no where in actual contact, though apparently so to the naked eye.(*d*) By attraction on the one hand and repulsion on the other, all atoms are thus more or less approximated according to the quantity of intervening heat or caloric.(*e*) It will be found that these laws of nature are constantly practically applicable to the living human frame, so as to render it more or less subject to the influence of physical causes.(*f*)

Atoms in man consist principally of carbon, hydrogen, oxygen, nitrogen, with sulphur, &c.

The *essential atoms* or *constituents* of the human frame, as indeed of all animate compounds, are principally *carbon*, *hydrogen*, *oxygen*, and *nitrogen*, also sometimes called *azote*,(*g*) besides which there are in general, in small quantities, phosphorus, sulphur, iron, and earthy and saline matters; and all these are variously *combined*, and then have other names, such as *albumen*, *&c.*(*h*) These will be explained as we proceed.

General combined composition, *externally* of integuments, *internally* of skeleton of bones, joints, ligaments, muscles, tendons, blood, and other vessels and nerves.

The human body is *composed externally* of the *Integuments*, which consist of *skin*, in three distinct layers of different materials and properties, and of *hair* and *nails*. (*i*) The *skeleton* is composed of about 260 bones, with joints, ligaments, and cartilages of various construction; *Muscles*, from 450 to 500, with numerous tendons, giving motion to the bones thus united by their joints and ligaments, whilst *Cellular Tissue* intervenes in all parts, and fills up and gives roundness to the appearance of the whole. There are also many hundred arteries with their innumerable capillary hair-like ramifications or terminations: about three times as many veins with their numerous *valves;* also *lacteals*, and *lymphatic* vessels, with *glands* and *ducts;* also *secernent* organs and vessels, which perform the function of *secretion*, such as the kidneys, ureters, &c. All these vessels contain their appropriate *fluids*, being either *blood* in its inceptive or perfect state, or *other fluids* secreted *from it.*

Superiorly the *Head* contains the *Brain*, to which is connected the spinal marrow, and from the two arise the nerves of the five organs of *Sense*, namely, sight, hearing, smell, taste, and touch. Next, in the *Neck and Thorax* or chest are the organs of *Respiration*, the trachea or windpipe and the lungs, with their investing membrane, called the pleura. Then are the organs of *Circulation*, the *Heart*, and its pericardium or sur-

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(*b*) See the works of Leeuwenhoek, tom. 1. p. 49, &c. and other authorities post, 3 Bost. 8 to 10, and 58 to 60.

(*c*) 1 Arnott's El. Phys. 69.

(*d*) Ibid. 70.

(*e*) 1 Arnott's El. Phys. 48, 56 to 75. 2 vol. page 40. Dr. Turner's El. Chemistry, 29. Attraction influences all substances, whether animate or inanimate, and in a more powerful or less degree at all distances. Hence, however dispersed the parts of a wreck of the ship may be pending a storm; still, when it has subsided, it will frequently be found that numerous parts will by *attraction* be collected and floating together; hence also, although the Moon is 240,000 miles from the Earth, yet it attracts the ocean, and forms what we term *Tide.* 1 Arnott, El. Phys. 16.

(*f*) 1 Dunglis. Phy. 6.

(*g*) Dr. Turner, El. Chemistry, 532.

(*h*) See post, the description of membrane.

(*i*) See a full description of the skin, hair, and nails, post.

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rounding sac. And again, in the *Neck* and *Abdomen* is the alimentary canal; namely, the *Œsophagus* or gullet, and the *Stomach*, with the small and large intestinal *Canal or Entrails*, and the *Collateral viscera* or organs called the *Liver*, *Gall-bladder*, and *Pancreas*, with the *Spleen*, the organs of assimilation, or conversion of the aliment into blood, and one of the great emunctories or cleansers of the body, the kidneys. In the bony cavity below the abdomen, called the Pelvis, (from its form resembling a basin,) are placed the organ for the collection and discharge of urine,—namely, the bladder, and some of those of generation, as the vesiculæ seminales, &c., and the organs of *Absorption* and *Secretion*, including in the latter the *Kidneys* with the *Bladder* and its vessels.

All these will, in the following chapters, have *distinct* consideration, since each is subject to peculiar diseases and injuries, and has its appropriate remedies; whilst the *whole* of the organs are scientifically divided and arranged into *different functions*, the principal of which are *Respiration*, *Circulation*, *Digestion*, *Absorption*, *Secretion*, and the *Nervous Function*, including that of *Motion*.

General outline and importance of the knowledge of the component materials and properties of the human frame.

It has been well observed, that the magnitude of a disease or of an injury is in proportion to its deviation from the healthy state, not only as regards the *whole* of the human frame, but also of *each* part in particular; and the extent of that deviation can only be correctly ascertained by him who is perfectly acquainted with the healthy state.(*k*) In other words, whether to *prevent* or to *cure* disease or injury, a perfect knowledge of *eight different points* should be acquired: *First*, The usual *healthy* or perfect state of the body or part affected: *Secondly*, The usual state in the *morbid* or diseased or injured condition of the body: *Thirdly*, The usual causes of the deviations: *Fourthly*, The *usual* appropriate remedies; *Fifthly*, The diseased or injured state in the *particular* case or patient: *Sixthly*, His temperament and habits: *Seventhly*, The particular cause of the patient's apparent disease or injury: *Eighthly*, The application of the best remedy in that particular case, with reference to the constitution, temperament, and existing strength of the patient, and his consequent probable ability to bear any sudden or powerful change that might be effected by medicine or operation.(*l*)

First, To every member of the medical profession.

Thus, if the cause of inflammation be the *defect* or *want* of energy in the ordinary healthy state of the blood vessels, *stimulants* may be proper to be administered; but, if the cause be undue *increased* action, then *sedatives*;(*m*) and if we know the healthy state of the blood, and detect a particular deviation, we may then know the appropriate remedy.(*n*) To be well acquainted with the healthy state, *every composition* and *every function* of each *fluid* and *solid*, or, in other words, of every *atom*, must be well known, and then the particular temperament and state of the patient. Having ascertained these, we may then be led to the discovery of the appropriate medicine or remedy; thus, if the blood, in fever or disease, be found deficient in saline principles, the administering saline medicines probably will be efficacious.(*o*) It has been observed, how

(*k*) It was the maxim of Celsus, and indeed almost too evident to need observation, that *he* can best cure diseases who can best discover their cause; and see Park's Inquiry, p. 345; and, indeed, it seems almost self-evident that the *manner* in which any particular function is deranged can never be understood so long as the function itself is not understood, &c. Park's Inquiry, 358. Jackson, Prin. Med. xvii.

(*l*) Galen's Methodus Medendi. Blumenbach, by Dr. Elliotson, Preface. Good's Study of Medicine, 1 vol. Preface. Broussais' Physiology, Pref.

(*m*) 1 Bost. Phy. 341. Quære if not "*antiphlogistics*" instead of "*sedatives*."

(*n*) 2 Dunglis. Phy. 116.

(*o*) Dr. Stevens' Observations on the Healthy and Diseased State of the Blood; and Good's Study Med. *per tot.*

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fatal may become the practice of medicine if not founded on sound physiology.(*p*) And suppose that from the actual state or cause of a disorder being unknown, *stimulants* instead of *sedatives* should be erroneously administered, how fatal might be the consequences.(*q*) Hence, the absolute necessity for all members of the *medical profession* to be well informed upon anatomy, and of the physical and chemical properties of *every particle;* and yet it has been observed how lamentable it is that so little is as yet known, and especially of the *functions of secretion and absorption*, and hence the great uncertainty and incessant disputes still prevailing, even as to the properties of so important a fluid as the blood. It has been well observed, that by ascertaining the composition of a particular part, and its appropriate remedy in disease or injury, we are taught that another *similarly* composed part, although in quite a different part of the body, will be equally affected by the same remedy. Thus the lungs are surrounded by a serous membrane, called the *pleura*, well known to form its coat and to be placed in the cavity of the thorax, and which, *in respect of its component materials*, is subject to certain peculiar diseases, and principally to an *inflammation called pleuritis.* Now the study of anatomy informs the physician that the *peritonæum*, which surrounds the whole of the intestinal canal and the viscera of the *abdomen*, is also composed of the *like materials*, and which are consequently subject to a *similar* inflammation. Hence, he may be led to expect, and he actually finds that the *same remedies* appropriate for the cure of the former are applicable to the latter, and he will proceed accordingly. So it will be found throughout, that when there is a striking similarity in structure, properties and anatomical characters of membranes, although situate in different parts of the body, they may be properly ranged under one head and form one class, and that their diseases also form one group, and the like remedies may be successfully applied. Hence, the advantages resulting from a systematic knowledge of anatomy.(*r*)

Importance to lawyers and others.

Nor is the importance of these subjects confined to the medical profession, they are essential to *all* concerned in *legislation* or *administering* or *construing* or *giving effect* to *the laws* respecting *health* or *offences* against the person, and to all whose philanthropy interests them in the welfare of mankind. Supposing that any epidemic disease, such as the plague or the cholera, recently so prevalent, be *not*, as supposed, *infectious*, but erroneously supposed to be so, how uselessly detrimental may have been the regulations affecting them, to commerce, in requiring the performance of quarantine. So why should the absurd *distinction* in punishment, even of death, for endeavouring to cause miscarriage at certain periods be continued, if it be established that the fœtus is, at all times, whilst in the uterus, equally alive, and ought, on principle, to be equally entitled to the protection of the law? Again, when we have ascertained that not less than a certain quantity (as 600 cubic feet) of air should be supplied for each individual in a closed apartment, and that below that proportion it is impossible to maintain, for any length of time, the requisite purity of the air, and that a man cannot live more than an hour in five cubic feet of confined air, we shall know, practically, how to have hospitals and other buildings constructed, and individually should cautiously avoid the risk incident to remaining long in too limited a confined atmosphere.(*s*) So by the application of a knowledge of the course of nature in certain functions, feigned diseases whether of madness or otherwise, and

(*p*) Jackson, Prin. Med. Pref.

(*q*) 1 Bost. 341. Quære "*antiphlogistics*" for "*sedatives.*"

(*r*) Amer. Cyclop. Prac. Med. tit. Anatomy.

(*s*) 2 Bost. 49 to 98; 2 Par. & Fonb. 48, 111, n. 6.

impositions may frequently be detected and truth established; and, indeed, there is no limit to the importance of an intimate knowledge of all the parts and functions of man to every well educated member of society.(*t*) These are only a few of the numerous instances in which it will be obvious that an extended knowledge of anatomy and physiology, in every individual, is highly essential for the well being and improvement of society, and by which it is to be hoped that a great melioration of our laws will, ere long, be introduced, not only for the *protection* of the person from various external or forcible injuries, but also for enlarging the mental faculties, and for preventing or punishing many injuries to the mind which at present are dispunishable.(*u*)

CHAP. II. IMPORTANCE, &c.

Summary from the Bible and Revelation.

With respect to the *composition* of the human frame in general, and the *functions* with which we are endowed, much might be collected from *Holy Writ*. But as the Old Testament was intended rather as *historical* than philosophical, and as the New Testament is to be read as a Divine *Revelation*,(*v*) we think it preferable to confine our observations in this work to the doctrines and discoveries of different philosophers, anatomists and physiologists; and we will therefore merely state a summary of what we undoubtedly learn from the Bible, viz. "That in the beginning God created man in his own image, and, as it were, from the *dust*, endowed him with life, superior bodily and intellectual faculties; and gave him dominion over the universe, and every thing therein; formed woman as his helpmate, and ordained that they should increase and multiply. That in punishment for the first disobedience of God's will, man became subject to diseases, bodily sufferings, and to death, and that his *body* should return to dust; that though, in the beginning, life continued even for centuries, yet afterwards it was limited to 120 years, and finally ordained that our years should, generally, be only threescore and ten, and that if, by reason of peculiar strength, man should attain fourscore, yet should that strength be but labour and sorrow, and he be soon cut off, and his soul depart.(*x*) But that the *Soul* should be *immortal*, and man rise again to be punished or rewarded in a future state, according to his conduct here on earth; and that, therefore, during this transient state we should pray God so to teach us to number our days that we may apply our hearts unto wisdom, so that by the observance of his precepts, and through the mediation of our Redeemer, we may hereafter enjoy life everlasting." We know from the same Divine authority, that to soften and remedy those *bodily ailments* and injuries to which man in his fallen state is subject, God has provided herbs, minerals, and various other medicines and remedies, capable of being improved and applied by the intelligence of man; and that to fit and prepare the *Soul* for eternal reward, God has gifted man with conscience and superior intellectual and reasoning faculties, and blessed us with divine precepts on true philosophy, morality, and religion; so that it will be our

(*t*) See the singular case of Elizabeth Canning, 10 Harg. St. Tri. 205; 19 Howel's St. Tri. 262; 1 Par. & Fonb. 369, 370; &c.

(*u*) See post, the Nervous System and Intellectual Faculties.

(*v*) The Holy Bible is here referred to as affording an historical outline of our creation, our superior properties, and our ultimate destinations. But the celebrated Bacon, and the most enlightened divines, have observed that the Bible is not to be read as, or intended to be, a work of philosophical instruction, but the earlier part merely as a history, and the latter (the New Testament) as a *revelation* of *religious duties* to be observed, fitting us for a future state, and enjoining us so to live as to deserve everlasting happiness. See Blumenbach by Elliotson, 78, 79, in notes; and see 3 Bost. Phy. 227. The book of Genesis does not lay claim to any superhuman source of information with respect to natural phenomena, and only proposes to adopt the opinions which were current amongst the contemporaries of the author. 3 Bost. Phy. 227.

(*x*) Psalm xc. ascribed to Moses by most Biblical scholars.

CHAP. II. Importance, &c.

own fault if the body or the soul perish from the omission to avail ourselves of those bodily and mental remedies with which we have been blessed.

The cultivation and improvement of the *bodily* remedies is the province of *medical professors;* those of the *soul* the *clerical:* but the remedies for the *latter* are, purposely, so simple and evident that no man can err or excuse himself by ignorance for deviation from the straight path to truth and life everlasting. The former are not to be cultivated by professional men only, or as a mere abstract science limited in its utility to the cure of diseases or injury, but by all mankind, as highly calculated to extend knowledge, and to induce admiration and gratitude to the all-wise Creator of the wondrous machinery of man. Philosophers have long enjoined the study of animated nature, and how pre-eminently worthy of attention are the sciences of anatomy, physiology, pathology, and of the intellectual faculties?

Although we know that the Almighty has thought fit to ordain that the various functions of the human frame shall be performed as they are, and that we cannot add one cubic foot to our stature, or control the course of nature; yet we are instructed that we are at liberty to inquire and examine to which of the great laws impressed upon matter each action of the human frame can be referred; and, with reference to *physiology* and *pathology,* (the study of the causes of the animal functions and of their disorders,) it is of the highest importance to attain a perfect knowledge of every physical cause of the performance and misperformance of the different functions, in order more effectually to afford relief against pain and diseases; and we are farther taught that our inquiries may be extended even to the intellectual faculties, and to the attributes and immortality of the Soul.(*y*)

Outline of the practical study of subject, and reason for comparative ignorance.

We will now proceed to take a concise and practical view of the structure of the human frame in general, and then examine each part in particular, and the organs and principal functions. In this inquiry the student must anticipate that, although much has been ascertained and agreed upon with certainty of accuracy, yet, upon some subjects, there is still much contradiction, discrepancy, and uncertainty. These have arisen from the impracticability of trying some experiments upon the *living* human frame, especially in the internal vital parts, and from the difference between a living and *post mortem* examination; and even in experiments upon *living animals,* the structure of which, in regard to bones, muscles, and vital parts, may appear most analogous to man, they are exceedingly uncertain, and rarely applicable to the human frame in a quiescent natural state, on account of the state into which the animal must necessarily be reduced during painful experiments;(*z*) as in the instance of those relating to respiration, where the loss of blood, the pain inflicted, and the general derangement of the ordinary actions of the system, cannot fail so to affect the organs of respiration as to render it impossible to learn by such experiments, with any degree of certainty, what effect their ordinary changes would produce upon the circulation and the other functions.(*a*) So as regards the experiments that can be made without pain, yet, on account of some excitement, or other cause, they are too frequently attended with uncertainty;(*b*) and these observations apply

(*y*) 1 Bost. Phy. 262; 3 Id. 227. 1 Dunglison, Phy. 230 to 281.

(*z*) See infra, and 2 Bost. Phy. 445, as to experiments on living animals.

(*a*) 2 Bost. 40 to 42: see the singular differences, not only of opinion, but also as regards experiments, as to the quantity of external air *inhaled* at each inspiration, some contending upwards of forty cubic inches, others less than twelve each time. See post. Respiration, and 2 Bost. 19.

(*b*) See 2 Bost. 58, 63.

CHAP. II. IMPORTANCE, &c.

with still more force as regards the brain and the nerves, and especially if we attempt to penetrate the intricacies of metaphysical subjects, the very conception of which it is difficult to attain where we have nothing to guide our researches but imperfect deductions and doubtful analogies.(c) Some persons, in despair of arriving at accurate conclusions, give up the inquiry, unphilosophically asserting that no good could result from success; but let the aspiring student at least ascertain the existing opinions, and endeavour to add to and improve the stock of aggregate information;(c) for it is an indolent method of philosophy to stop at whatever is not easily understood.(d) It is the author's object, in the following pages, to state the prevalent opinions upon the most important branches of the subject, referring to the sources of information, so that the student may instantly see the authorities, and enlarge upon all or any of the subjects.

Division of the subject.

Before we consider each different part, organ, and function *in particular*, it will obviously be essential to consider the *composition* and *properties* in *general*, as, *First*, Of *what materials* is the entire human frame composed, and then of what materials each part. *Secondly*, In what consists its *general vitality and resistance* of *putrefaction*, which we know speedily destroys inanimate flesh. *Thirdly*, In what consists the power of motion. *Fourthly*, What gives *mental* volition and *direction* to those powers. *Fifthly*, In what consists the *mental* faculties. Any inquiry respecting the *soul* belongs to the *metaphysician*, and has been supposed to be beyond the province of the anatomist or the physician.

Blumenbach observes, that it will be found that the composition and powers of the perfect living system depend upon *four principal requisites*, namely: first, the composition of the *fluids;* secondly, of the *solids* duly formed from the fluids; thirdly, the invigorating influence of *vital powers* upon the solids, and fourthly, a *sound mind*, influencing and *giving motion and direction to the various faculties* with which we are endowed; and that *health* depends upon such a harmony and equilibrium of the matter and powers of the system as is requisite for the due performance of its physical functions. Hence, therefore, it is very evident how the principles presently examined must contribute to its support: they act and re-act perpetually upon each other. The *fluids* are the source of and stimuli to the *solids;* the solids again are calculated by the *vital powers* to experience the influence of their stimuli, and to re-act upon them. And in reference to the ultimate union of the mind with the body, the influence is far more extensive than is usually imagined; for that of the will is not confined within the narrow limits of those actions designated voluntary; and the mind is influenced by the affections of the body in many other ways than by the perception of *sense*, properly so called, i. e. the *external* senses.(e) These divisions are not fanciful, but of the utmost importance to be observed by the anatomist and studied by the physician; for diseases, injuries, and their remedies must be considered with reference as well to the component parts as to all the functions which they affect, and are to be classed and treated accordingly.(f)

II. The Component Materials, Organs, Functions, &c.

II. The Component Materials, Organs, Functions, &c.

We are now to examine more particularly the *Component Materials* of the human frame. All physiologists agree that the most obvious and preferable general division of the material of the entire frame, is into *flu-*

(c) 3 Bost. Preface.
(d) 3 Dr. Gregory's Economy of Nature, 417.
(e) 1 Ell. Blum. 4th edit. 50. Bost. Phy. Introd. 1 and 13, 14.
(f) Ell. Blum. 2, 3. Good's Study of Medicine, per tot.

CHAP. II. II. THE COMPONENT MATERIALS, &c.

They are Fluids or Solids.

ids and *solids*.(*g*) Indeed the whole material world has been properly divided into solids and fluids; these being the only essentially different states of matter we are able to observe. From one of these states to the other, matter appears to be continually passing, but with these restrictions, that no species of matter can assume a solid form, without having first been in a fluid state; nor can any *change* take place in a solid till it be first formed into or suspended in a fluid.(*h*) The living animal body is obedient to these general laws, for *all solid and animal matter has first been fluid*, and having passed into this solid form, becomes a recipient for other fluids, out of or by which the solids may themselves be renovated and increased.(*i*) It has, however, been remarked, that the terms fluid and solid, as applied to the components of the body, are rather relative than positive; for there is scarcely any part so solid which may not by desiccation, or by mechanical compression, be rendered still more compact, and most of what have been called animal fluids contain different species of solid matter imperfectly dissolved, or merely in a state of mechanical diffusion.(*k*) Dr. Bostock, considering the *solids* as being the most durable part of the fabric, and as forming the organs necessary to prepare the fluids, and to apply them when prepared to their different uses, treats *them* as the *first* objects of attention, but admits that upon a more minute examination, we may find the *fluids* to be of no less importance in our economy, as either by the intervention of external agents, or by the action of their components upon each other, they are in most cases the media through which those operations are effected which are essential to life.(*l*) Others consider the *fluids before* the solids, because the latter are formed from and renovated by the former;(*m*) and Dr. Hunter, after observing that there appears to be a sympathetic intercourse between the solid and the fluid parts of an animal designed by nature for their mutual support, and that in disease, when the machine cannot be furnished in the common way, the solids of the body supply the defects, and the person becomes lean, concludes that from this, the fluids would appear to be *more an object of attention* in the machine than even the solids;(*n*) and on these accounts the latter arrangement seems preferable.

First, The Fluids. (*o*)

Dr. Hunter observes that the fluid part of an animal body in its natural state has but *one* appearance, which is that of blood.(*p*) The Fluids, however, are of *three descriptions*, *first the crude*, or incomplete components

1. Chyle.

of blood, called the *chyle*, formed from the food after it has been digested in the stomach and has been passed from thence into the duodenum, the superior part of the small intestines, and the other matters *absorbed* on

2. Blood.

the surface and in other parts of the frame. *Secondly*, the *blood* itself, or central mass, which constantly flows, as it were, in a double circulation from the heart through the lungs, and back to the heart, and then through the same into the *aorta* and other *arteries*, to the extreme parts of the frame, and then back through the veins into the heart again, in perpetual circulation during life; and the *gluten* (sometimes called *fibrin*, and sometimes *lymph*,) being the most nutritious part of the blood, and which is the basis of every solid part possessing life, and constitutes no less than *nine-tenths* of the solids of the whole frame, and their membranes, liga-

(*g*) Hunter on Blood; Ell. Blum. 4th edit. 1. 2, 50; 1 Bost. Ph. 15; 1 Dungl. Phy. 21.

(*h*) As to the fluids in general, see Ell. Blum. 1, &c.; 1 Dungl. Phy. 26; Jack. Prin. Med. 80

(*i*) Hunter on Blood.

(*k*) 1 Bost. Ph. 16.

(*l*) 1 Bost. Ph. 16, 17.

(*m*) Ell. Blum. 4th edit. 1, 2, 50; Brouss. Phy. 39; see also supra Hunter on Blood.

(*n*) Hunter on Blood.

(*o*) See in general Ell. Blum. 1, &c.; Jack. Prin. Med. 80.

(*p*) Hunter on Blood.

ments, and tendons, all of which consist of this part of the blood.(*q*) *Thirdly*, certain *secretions* from the blood, which are either intended for certain useful purposes in the economy, as the saliva, mucus, gastric juice, pancreatic juice, and bile; or are *inert* and *excrementitious*, as the liquid urine, or the more solid fæces. Some of these may be permanently liquid, like the bile, or solid, as the osseous. Each of these will be particularly considered when we separately examine the different parts of the frame and their functions. It may suffice here to notice that *blood* is the chief and primary fluid, and the vehicle of those successions of renovating oxygenous and carbonaceous particles that cease with life only, the nourisher of the frame, the source of almost every other fluid, that *into* which the crude fluid, called the chyle, is converted, and *from* which all the secretions are derived, and which, with the few exceptions of some ex-sanguineous parts,(*r*) is universally diffused through the system in various proportions according to the nature of each part; abundantly in the muscles; still more so in certain viscera, as in the spleen, placenta, and uterus during utero gestation; but very sparingly in the tendons and cartilages. The *blood*, when renovated in passing by the air vesicles of the lungs, and thereby conveying away the injurious carbon acquired in the general circulation, passes to the heart and distributes the fresh oxygen it has received in the lungs throughout the body, thus giving rise by the change to *animal heat*.(*s*)

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3. Secretions.

This *blood* is composed of a watery fluid or *serum*, which is gelatinous, and contains soda and other alkalies,—and cruor or crassamentum, containing fibrine or lymph;—colouring matter and some iron,—the former of which is glutinous, and termed *plastic*, because it affords the chief materials from which the muscles (vulgarly called flesh) are produced.(*t*) This repairs wounds and lacerations, and even fractures of bones, and fills up the area of large blood vessels when divided, and thereby sometimes spontaneously stops hæmorrhage; and it supplies the materials of the solids originally, and ever afterwards their nourishment.(*u*)

The Fluids greatly preponderate in weight over the solids, but vary according to the age, sex, and constitution, and hence have perhaps arisen the unsatisfactory disputes respecting the precise degrees of difference. Authors have singularly varied in their account of the weight of the *entire blood* in the human frame, as from eight to one hundred pounds, (although the whole frame ordinarily does not weigh more than one hundred and fifty pounds.) Blumenbach contends that *ten pounds* is about the real weight of the blood,(*x*) but others more correctly have considered it in relation to the body, as about one to five, or about *thirty pounds* weight, considering the entire weight of the whole frame to be about one hundred and fifty pounds.(*y*) A mummy, with all its viscera and muscles perfectly dried, has weighed only seven pounds and a half, when the living human body usually weighs from one hundred and thirty to one hundred and sixty.(*z*) Chaussier obtained what has been considered by some a fair approximation, by subjecting a body, previously weighed, to destructive distillation, and the result of which was, that the entire fluids were found to be to the solids as *nine* to *one*.(*a*)

(*q*) 1 Dunglis. Phy. 27.

(*r*) Such as the epidermis, (layer of the skin,) the arachnoid, the amnion, the vitreous substance of the teeth, and the body of the crystalline lens in the eye, &c.

(*s*) 2 Dunglis. Phy. 182 to 194; Brouss. Phy. 289.

(*t*) 1 Bost. Ph. 89.

(*u*) Ell. Blum. 4th edit. 6 to 22.

(*x*) 2 Dunglis. Phy. 117.

(*y*) Ell. Blum. 11, note; and 2 Good's Stud. Med. 20; 1 Dunglis. Phy. 27.

(*z*) Ell. Blum. 2, note B.

(*a*) Quain's El. 1st edit. 30; 2d edit. 22.

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Secondly, The *Solids*.

The *Solids* of the human frame, as well as of all animals, are derived from the fluids.(*b*) Although composed principally of *one species of matter*, yet they admit of great variety in their appearance.(*c*) They differ infinitely in their *degrees of cohesion*, from the soft and almost pulpy medulla of the brain, to the vitreous substance of the corona of the teeth.(*d*)

The principal varieties of solids, considered in relation to their *form and structure*, are *externally* the *integuments* (which include the *skin*, *hair*, and *nails*,) and *internally* the *bones*, with the *ligaments* and *cartilages*, and of *joints*, technically termed *articulations;* the *muscles* with their *tendons;* the membranes or cellular tissue (which muscles and cellular tissue with the intermixed nerves are vulgarly called *Flesh;*) and all the various kinds of *sacs* and vessels, whether arteries, veins, capillary vessels, lacteals, ducts, absorbent and secernent vessels, nerves, and the whole cerebral matter.

If we arrange the solids of the body with regard to their *chemical composition*, and to the *uses* which they serve in the animal economy, we may place them under *five divisions*, namely, 1, the *osseous* matter or bones; 2, the *membranous* or cellular tissue; 3, the *muscular;* 4, the adipose or *fat*, and 5, the *cerebral* or brain; and we may say in general terms, that the comparative degrees of their solidity or softness are in that order.(*e*)

The component parts of the solids are of several kinds, varying in description and quantities in different parts. Besides the *gelatinous* and *glutinous* parts of the solids, *earth* enters more or less into their composition, and is principally *lime* united with *phosphoric* acid, and whence it is commonly termed *phosphate of lime*. The bones possess this in the greatest abundance, particularly in advanced age.(*f*) The texture of the greater part of the solids consist of *very minute globules*, disposed together in *fibres* more or less parallel and continuous throughout the frame, as in the bones, muscles, tendons, ligaments, aponeuroses,(*f*) and in certain membranes, as the dura mater, &c. In other parts no fibres can be discovered, but the texture is peculiar, and has been termed *parenchyma*, and differs in various viscera, especially those which secrete, as in the liver and kidneys.

Cellular Tissue, or Membrane.

In all these structures, whether fibrous or parenchymatous, there is interwoven what is properly termed *membrane* or *cellular membrane*, or of late more commonly called *cellular tissue*, (from its capacity to contain fluids in its minute cells,) which is quite distinct from the *muscles* and other parts which it *surrounds*, though vulgarly confounded and included with them under the general term *flesh*.(*g*) It is sometimes called *mucous web*, (though improperly so, because this structure neither secretes mucus nor consists of it.) (*h*) Indeed, the variety of names has not a little tended to perplex the student.(*i*) This is amongst the most important and remarkable constituents of the body, and is subject to numerous *particular* disorders, especially inflammation.(*k*) It has been described to be a net-work of a very fine membranous substance, and it is important to know that it is universally diffused over every part of the body; it not only separates various parts, as the skin from the muscles and the muscles

(*b*) Ell. Blum. 4th edit. 23; 1 Horn. Anat. Intro. xx.

(*c*) Hunter on Blood.

(*d*) See note (*b*) supra.

(*e*) 1 Bost. 16, 17.

(*f*) Ell. Blum. 4th edit. 23; 1 Horn. Anat. 75. *Aponeuroses* resemble fibrous membranes, and the term *aponeurosis* means an expanded fibrous lamella.

(*g*) Ell. Blum. 4th edit. 26; 1 Bost. Ph. 18; and see 1 Horn. Anat. 339, as to *cellular substance;* 1 Dungl. 24, 29; Jackn. Prin. Med. 19.

(*h*) Ell. Blum. 24, 26, note A.

(*i*) See in general, Copl. Med. Dic. tit. *Cellular Tissue*.

(*k*) Ell. Blum. 4th edit. 26, note A.; and see 1 Bell. Anat. 396, as to *cellular membrane;* Jackn. Prin. Med. 20.

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from each other, but there is no minute subdivision of even a single muscle which does not exhibit cellular membrane between its fibres.(*l*) It serves for separation between the muscles and other parts, and to the blood and other vessels and nerves for support, and to every part it acts as the common medium of connexion.(*m*) It is originally derived from the lymph of the blood. Besides these utilities, it receives several kinds of fluids, the serous halitus, more commonly called exhalation, which moistens and lubricates every part.(*n*) Even at the risk of tautology, it is expedient here to state the observations of some of the ablest physiologists of the present day upon the subject of *cellular tissue.*

Dr. Edwards' account of *Cellular Tissue.*

Dr. Edwards has recently, in his observations on the elementary structure of the body, stated the result of microscopical observations, and concludes that the *cellular substance* consists of *cylinders*, resolved into *rows of globules*, all of the same size, (*d'une excessive petitesse,*) namely, $\frac{1}{300}$th part of a millimetre, or about $\frac{1}{7500}$th part of an inch in diameter, and which rows of globules are separated from each other, and lie in various directions, *crossing and interlacing*, some of them being straight, others bent, and some twisted, forming imperfect strata, which are connected with each other by a kind of irregular net-work; and the serous as well as mucous membranes are in this respect precisely the same. The *muscular fibre* is composed of the like globules of the same size, but differing in this respect, that they are all composed of *straight* lines of globules. *Tendons* and the *aponeuroses*, and the parts of the *skin*, are also composed of the same sized globules, formed into lines, but *differing* in the direction or parallelism of the lines. The middle coat of *arteries* is also composed of the same kind of globules, all in the same direction, but resembling *tissu fibreux*. So the *nerves* and nervous matter are composed of lines of globules of the same size, but holding an intermediate place between membranes and muscles as to the regularity of their disposition, and having a fatty matter interspersed between the rows of globules.(*o*) And hence he concludes, that whatever difference may be impressed on various parts, they are nevertheless all composed of the *same sized minute globules*, though differently disposed.(*p*) It is proper, however, to observe that Meckel has denied the existence of any *cells*.

Dr. Bostock's view of the same.

Dr. Bostock, in his excellent comprehensive treatise on physiology, arranges the consideration of *membrane* or *cellular tissue* under three heads: 1. The extent and structure of membrane; 2. The properties of membrane, physical and chemical; and, 3. The different species of membrane.(*q*) Under the *first* head, he states that it is the most simple in its structure of any of the organized parts of the body; it is the most extensively diffused, and exists in the greatest proportion. The coverings, not only of the body at large, but of each of its individual parts, both internal and external, are principally composed of membrane, and it lines all the cavities in which the different organs are situated; it constitutes the main bulk of the *bones* and determines their figure; the earthy matter, upon which their strength and hardness depend, being deposited in a tissue of *membranous cells*. Membrane also enters into the structure of *muscles*, not only affording them an external sheath, in which they are each of

(*l*) 1 Horn. Anat. 340.
(*m*) 1 Bost. 19.
(*n*) Ell. Blum. 4th edit. 23 to 27.
(*o*) Extract from 3 Bost. 273 to 277; but see variations in extract from M. Dutrochet's Elementary Structure of the Body, 3 Bost. Ph. 277; and post, 24, note (*z*,) as to the globules being a 13000th part of an inch, not a 7500th.
(*p*) Phil. Trans. for 1821, p. 20, 9 vol. 390; id. p. 348.
(*q*) 1 Bost. 15 to 74.

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them enclosed, but the same matter is also interposed between their fibres, separating them into bundles, to which it in like manner affords a distinct covering, and these into still smaller bundles, until it appears at length to envelop each individual fibre. It also composes very nearly the whole bulk of the *tendons* by which the muscles are attached to the bones; also of the *ligaments* and of the *cartilages*. Membrane also enters very largely into the composition of the *hair*, the *nails*, and other similar parts connected with the surface.(*s*) It likewise composes what is *properly* called the *cellular texture*, being a series of cells or interstices, which extends over a great portion of the body, fills up its intervals, and serves to unite the different parts to each other. Membranous matter is the chief ingredient in the *glands*, as well those belonging to the absorbent system as to the secernent. The *brain* is also enveloped in a covering of membrane; and it is *probable* that the *nerves* are composed of a series of fibres enclosed in membranous sheaths, analogous to those of the muscles.(*t*) The *pouches* or *sacs* which are formed in different parts of the body, such as the *stomach* and the *bladder*, are almost entirely composed of membrane; and what, perhaps, must be regarded as the most important of all the purposes which it serves, this substance composes the principal part of the *tubes* or *vessels*, such as the *arteries* and *veins*, with which the animal body is so plentifully furnished.(*u*) Membrane (vulgarly confounded with the muscles and nerves and termed *flesh*) exceeds in quantity all the *other solids* of the body taken together, and it enters, as a principal ingredient, into almost every part of the animal frame excepting the enamel of the teeth,(*x*) and Dr. Bostock insists that, were it possible to remove the earth from the bones, the muscular fibre, the nervous matter, and the fat from the soft parts, to empty the vessels, and to carry off the fluids generally, the size and figure of the body would remain nearly unchanged. Membrane may therefore be considered the connecting medium between the different parts of the body by which they are held together, the basis to which they are all attached, and the mould in which the particles of the other kinds of matter are deposited.(*y*) With respect to the *structure* of membrane, it is composed of a vast assemblage of lines or fibres, in their state of ultimate division, too small to be perceived by the eye, and it is stated at about $\frac{1}{13000}$th of an inch in diameter,(*z*) but which, by the union of a sufficient number of them, are formed either into larger visible fibres or into plates, according to the structure of the parts in which they are situated, and termed, by Haller and others, though Dr. Bostock thinks not entirely correctly so, *cellular web*, and it has uninterrupted continuity all over the body.(*a*)

Secondly.—With respect to the *physical properties* of membrane, Dr. Bostock states them to be *cohesion*, *flexibility*, *extensibility*, and *elasticity*, (the latter of which Blumenbach terms *contractility*, differing, however, from the moving power of muscles,) properties of the greatest importance in a system like that of the living body, in which great *strength* is necessary, together with *lightness* and a capacity for *free motion*, and where the parts are perpetually varying in their bulk and relative position.(*b*)

Insensibility of

The better opinion seems to be, that simple membrane is *insensible* in its *healthy* and natural state, but that it is liable to *inflammation*, and

(*s*) 1 Bost. 18.

(*t*) It will be observed that, as respects the nerves, Dr. Edwards speaks in the affirmative more positively, *ante* 23; 3 Bost. 273 to 277.

(*u*) 1 Bost. 18.

(*x*) Id.; Blum. Phy. 22; Hatchet, Phi. Trans. for 1799, p. 328.

(*y*) 1 Bost. 19.

(*z*) According to Dr. Edwards, about *double* that size, *ante* 23.

(*a*) Haller, El. Phy. lib. 1, s. 2; 1 Bost. 20.

(*b*) 1 Bost. 25.

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membrane, and the reason why pain is felt when it is inflamed.

that it then, sometimes, becomes severely painful.(*c*) This is attributed to the enlargement of the bulk of the part affected by the inflammation, and the pain is generally in proportion to the difficulty with which the part admits of this extension. It has been observed that a high degree of inflammation may exist in loose cellular texture and we may be scarcely sensible of its existence, while the inflammation of the periosteum of the smallest bone, as a tooth when in its socket, or of the sclerotic coat of the eye, or of the tense membrane about the finger nail, will be almost intolerable. In these cases, even if the inflamed part be without nervous filaments, which give it sensibility, still it will be found that there are some branches of nerves immediately contiguous to the inflamed part, which in consequence of the enlargement, extension, and firmness of all the neighbouring parts, are pressed upon and irritated, while the blood vessels connected with them are in a state of plethora; it is a general law of the animal economy that no cause is more powerful in producing pain than a certain degree of pressure upon a nerve when its sensibility is augmented by an unusual determination of blood.(*d*)

With respect to the *chemical properties* of membrane or its *chemical composition*, and the effect of *chemical re-agents* upon it, Dr. Bostock observes, that the ancient doctrine, that membrane consisted of simple fibres, and that the fibre itself is composed of earthy particles cemented by gluten, is exploded,(*e*) and that the present doctrine is, that the basis of membranous matter is a substance which, in its *chemical properties*, is identical with the *albumen* of the egg when in a state of coagulation. *Albumen* naturally exists in the form of an adhesive fluid, miscible in water, but when subjected to a temperature of about 165,(*f*) it experiences a remarkable change in its physical properties; by the operation of heat it is converted into a solid, which is no longer capable of being dissolved in water; and if, after coagulation, it be gradually exposed to a higher temperature, it is reduced to a firm semi-transparent body, very similar to some of the more compact varieties of membrane.(*g*) But though albumen appears to be the essential part of membrane, that which gives it its general form and determines its peculiar texture, yet it probably always contains animal *jelly* or *gelatine*, and, in some cases, even much more copiously than the albumen itself.(*h*)

Another substance is *animal mucus;* this is not properly soluble in water, nor does it possess the property of gelatinization, and it differs from jelly in many of its chemical relations. Animal mucus appears to be nearly related to albumen.(*i*)

A considerable proportion of both the bulk and weight of membrane, as well as of all the other soft parts, consist of *water*, and it has been supposed by many eminent physiologists, that upon the relative quantity of this water and the solid matter depend many of the morbid changes of the body, as well as the natural varieties in the constitution and temperament of different individuals; and Dr. Bostock observes, that there are some facts connected with pathology and the practice of medicine, which would lead us to conceive that the elasticity, and, perhaps, even the density of some of the external parts of the body, may be influenced by being exposed to warmth and moisture.(*k*)

(*c*) See the various descriptions of inflammation of cellular tissue, Jackson, Prin. Med. 20; Brouss. Phy. 480.

(*d*) 1 Bost. Ph. 29, 30; Blum. Ph. 210; Jackson, Prin. Med. 20.

(*e*) 1 Bost. 34, 35.

(*f*) The temperature of the human frame is only about 96 or 98 Far. As to albumen, see Dr. Turner's El. Chemis. 534.

(*g*) 1 Bost. 37.

(*h*) Id. As to gelatine, see Dr. Turner's El. Chemis. 536.

(*i*) 1 Bost. 37.

(*k*) Id.

CHAP. II. II. The Component Materials, &c.

With respect to the *ultimate chemical elements* of which membrane is composed, like other animal substances, it consists essentially of *oxygen, hydrogen, carbon,* and *nitrogen* or *azote*,(*l*) and some iron and earth and saline matters in small quantities.(*m*)

The particles of membrane, as well as those which compose any other solid, are held together by their *attraction* for each other, not by any connecting medium.(*n*)

Thirdly.—With regard to the *different species* of membrane, Dr. Bostock describes them as, first, *cellular texture;*(*o*) and, secondly, *membranes*, especially so denominated, and which consist of their semi-transparent sheets or plates, which generally form the coat or covering of some other parts, and which differ from the cellular texture in the *greater continuity* of their structure, and are either mucous or serous or fibrous membranes.(*p*)

Dr. Quain on Cellular Tissue, and generally on the composition of the human frame.

Dr. Quain, in his detailed practical work on anatomy, gives a description of the *different materials* of which the whole frame is composed, and the following is the substance.(*q*) Certain *simple substances* are found to exist, not indeed separately, but *variously combined* in animal compounds; namely, *azote*, (also denominated nitrogen,) (*r*) *carbon, hydrogen,* and *oxygen*, which are the chief ingredients. To these are added some others, but in small proportions, such as *phosphorus, sulphur, iron, soda, potass,* and *lime*. Some salts, as the phosphate of lime, are found in considerable quantity, whilst others, such as the muriates of soda and potass, are sparingly diffused through a few only of the animal fluids.(*s*) The soft parts are made up of azote, carbon, hydrogen, and oxygen; the hard parts, especially the bones, of the lime and phosphorus. The *proximate animal compounds* formed from these are not very numerous. The following enumeration includes all that are sufficiently well characterized and of general occurrence; namely, *gelatine, albumen, fibrine, mucus, picromel, urea, osmazome, resin, sugar, oils,* and *acids*. The identity of the ultimate constituents of these substances will at once appear from the following tabular view, which it is unnecessary to extend beyond the first three.(*t*)

	Carbon.	Hydrogen.	Oxygen.	Azote.
Gelatine or Jelly consists of	47.88	27.20	27.20	17.00
Albumen	52.883	7.540	23.872	15.705
Fibrine	53.360	7.021	19.685	19.934 (*u*)

Gelatine, or *animal jelly*, is an abundant ingredient, not only in the fluids, but also in the solid parts of the body, as is evident from the fact that by boiling, it can be extracted from skin, membrane, ligament, cartilage and bone. It is inodorous and tasteless, dries into glue, and is soluble in warm water, in acids, or alkalies, and becomes solid again on cooling. The solution, on cooling, forms a tremulous mass, and if the aqueous part be dissipated by heat, the remainder becomes brittle, and breaks with vitreous fracture; this is named animal glue. Gelatine is

(*l*) 1 Bost. 38. Probably the power in living membrane of resisting putrefaction is owing to the *small proportion of azote* which it contains; Quain's El. 2d edit. 27.

(*m*) Dr. Turner's El. Chemis. 532, *ante*, 14.

(*n*) 1 Bost. 34. As to attraction, see *ante*, 13, 14; and 1 Arnott, El. Phy. 56, &c.

(*o*) 1 Bost. 42 to 52; and see Quain's El. 2d edit. 23.

(*p*) Id. 52 to 104. See also Jackson, Prin. Med. 18, 19.

(*q*) Quain's El. 1st edit. 28 to 34; 2d edit. 21; the statements in the latter differ but little from the former.

(*r*) Dr. Turner's El. Chemis. 154 to 174, where see full observations on nitrogen.

(*s*) 2d edit. 21.

(*t*) Quain, 1st edit. 28, 29; 2d edit. 21; see the Tables in Elliotson, Blum. 4th edit. 18, 19; 1 Bost. Phy. 39, differ in some respect from that in Quain's El. 29.

(*u*) See table El. Blum. 18, 19; Quain, 28, 29, 2d edit. 21; 1 Bost. Phy. 39; Dr. Turner's El. Chemis. 534.

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soluble in pure liquid alkalies, and is not precipitated from them by acids; this latter property distinguishes it from albumen, fibrine, and other animal products, and points out the method of separating it from them; its most active precipitant is tannin, with which it forms an insoluble compound.(*x*)

Albumen, next to gelatine, is the most abundant constituent of animal substances. It is found in the blood, in several secreted fluids, such as chyle and synovia, and forms a principal basis *of some solids*, of cellular membrane, skin, and glands. Its appearance is that of a viscid transparent fluid, without taste or smell, which may be coagulated by the action of heat and of alcohol.(*y*)

Fibrine forms the basis of muscular structure, and exists in muscles only, besides the blood, and is indeed their chief constituent, giving them form, and rendering them fibrous, and this, by ablution with water, may be obtained free from all the more soluble parts, except some albumen, which adheres to it. It is insoluble in water or acids; but is completely dissolved by the caustic fixed alkalies. Fibrine, when pure, is destitute of taste or smell, of a pale colour, elastic, and divisible into filaments. It is obtained in considerable quantity from the crassamentum of blood, and may be recognised also in chyle.(*z*)

Mucus is the viscid fluid which lubricates the mouth, nose, œsophagus, alimentary canal, and all the tubes and ducts which convey excrementitious fluids, or which open into the *primæ viæ*, the uriniferous or genital tubes. Besides forming an ingredient in several healthy secretions, such as saliva and synovia, it exists in some fluids, particularly in that effused in dropsies. Mucus consists of albumen and muriate of soda, or of albumen with pure soda. The residuum, after evaporation, is transparent, and found to be soluble in acids, but insoluble in water.(*a*)

The proximate constituents of the *solid* parts of the body, as obtained by what may be termed anatomical analysis, have been variously arranged by different anatomists. Haller contended for the existence of three elementary tissues, each composed of fibres distinguishable from those of the others by certain essential and characteristic properties, namely, first, *cellular tissue;* secondly, *muscular fibre;* and, thirdly, *nervous substance.* The two latter cannot be considered as elements in the strict acceptation of the term; for when properly examined, they are found to consist of two constituents, an animal matter composed of cellular tissue, the areolæ of which are filled with fibrine, the material of muscular fibre, or neurine, forming nervous substance. The Cellular Tissue, according to its mode of aggregation, forms fibres or lamellæ, which are so disposed as to constitute cells or areolæ. This element, variously modified and combined, may be said to form the component texture into which the greater number of the structures of the body may be resolved; and when within its texture are deposited fibrine or neurine; muscular fibre, or nervous fibre, are the results; but the circumstances which determine the production of the one or the other cannot as yet be assigned.(*b*)

Adopting this division of the anatomical elements, the *different textures* of the body, according to Dr. Quain, may be arranged in the following order:—

(*x*) See as to jelly, 1 Bost. 37 to 41; Ell. Blum. 19, no.; Dr. Turner, El. Chem. 534.

(*y*) See farther, as to *Albumen*, 1 Bost. 37; 1 Dunglison, Phy. 15; Am. Cyclop. Prac. Med. tit. *Albumen;* Dr. Turner, El. Chem. 534.

(*z*) As to fibrine, see farther, Ell. Blum. 119; Dr. Turner, El. Chem. 533.

(*a*) 1 Dunglison, Phy. 16, 17; see farther, 1 Bost. Phy. 50.

(*b*) Edwards, Memoire sur la Structure elementaire des principaux tissues organiques de l'Homme, Paris, 1823; 1 Dunglison, Phy. 29 to 33.

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First, *The cellular tissue*, or web,(*c*) or *membrane*.(*d*) This is the element by far the most generally diffused, and which enters more or less into the composition of all the organs of the body. It exceeds in quantity all the other solids of the body taken together. It has been variously denominated. It is made up of pale, elastic, and extremely fine filaments, interwoven in different ways, so as to form areolæ, or spaces, of variable size and figure, and calculated to contain such fluids as may be deposited in them. It possesses what may be termed the hygrometric property, by which it is enabled to absorb a portion of any fluids into which it may happen to be immersed, an effect which probably is produced by the imbibition of capillary attraction. It is now generally admitted that this membranous matter is continuous all over the body, and serves the purpose of connecting the different parts together,(*e*)

When condensed or compressed, the cellular tissue forms the cutis, or true skin, which invests the exterior of the body, and is endowed with the power of secreting and depositing upon its surface a concrete lamella (epidermis) which serves to modify the effect of external impressions.

The tegumentary membrane is not confined to the mere external part of the body; it is prolonged into the interior, where it serves a corresponding purpose. From the lips and nares, or nostrils, it extends along the whole length of the alimentary canal, as well as into the different follicles and excretory ducts which open into it. The larynx, trachea, bronchi, and air-cells of the lungs, are lined in the same way by a mucous membrane, and as the whole forms a continuous surface, it has been named by Bichât the "*gastro pulmonary* mucous membrane." A similar mucous surface may be traced from the orifice of the meatus urinarius, along the urethra, bladder, and ureters, to their termination in the calyces or infundibula of the kidney, also into the vasa deferentia, vesiculæ seminales, and tubular structure of the testes in males; and in the female along the vagina, uterus, and Fallopian tubes, on which account the whole has been denominated by some the *genito urinary mucous* membrane.

When disposed in the form of dense compact fibres of various lengths, the cellular tissue constitutes the basis of the various fasciæ, aponeuroses, fibrous bands, ligaments, and tendons, observable throughout the body.

The cellular tissue, thus condensed into the lamellar form, assumes the form of sacs, or bags, lining the articulating ends of the bones, entering into the formations of the joints constituting the serous synovial membranes. All cellular tissue is permeable to the exhalents. The leading anatomical character of serous membranes is, that they form loose or shut sacs, admitting neither an interruption to their continuity, nor perforation of their surface, but are always moistened either by a fine halitus, or vapour, which, when condensed, resembles the serum of the blood, or by a thin fluid, (synovia,) intended to lubricate articulating surfaces.

By another mode of aggregation, the cellular tissue is formed into *fibres*, which, by being coiled into tubes, constitute the different sorts of vessels, named *arteries*, *veins*, and *absorbents*. It should, however, be observed, that this position rests solely on the fact, that fibrine, the essential constituent of muscle, cannot be proved by chemical analysis to exist in the tunics of any of the vessels. Bichât contends that arteries are irritable, contractile, and muscular; others, that they are merely elastic, their middle coat being composed of a peculiar texture, (*tissue jaune, tissue elastique*,) resolvable ultimately into cellular tissue.

Secondly, *The muscular fibre* is the next general constituent of organized structure, and is characterized by what has been termed *irritability*,

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(*c*) See 1 Bell, Anat. 396, as to the *cellular substance;* Jackson, Prin. Med. 19.

(*d*) 1 Bost. 19, &c.

(*e*) Ibid. 17.

or sometimes *contractility*, which may be considered as its distinguishing property. In warm-blooded animals its colour is red; in others, it is pale or white; but in all its forms it is usually denominated the *flesh*.(*f*) The fibres are always found collected into *fasiculi*, and these again into bundles, *muscles*, the bond of union being cellular tissue, which is interposed between them. These are the active agents in locomotion, and in all the various actions which animals perform. The muscular fibre presents some modifications which deserve notice, referrible not only to its situation and mode of arrangement, but also to the nature of the stimulant it is intended to obey.

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When subjected altogether to the control of the will, and placed beneath the external tegument, it constitutes what Bichât termed the *muscular system of animal life.*

When arranged in the tubular form, and disposed around the internal tegument or mucous membrane, it constitutes the *muscular system of organic life*, which is removed from the direct influence of the will, its appropriate stimulus being such extraneous substances as are introduced for the purpose of nutrition. In the alimentary canal we find this mode of arrangement of the muscular fibre exemplified.

The two preceding forms being placed, one beneath the external, the other the internal tegument, there is a third, and distinguished from them by being stimulated to action only by a fluid, (the blood,) which is endowed with properties so nearly analogous to those of the living solids, that Mr. Hunter and some other physiologists have asserted its vitality. The heart furnishes an example.

Thirdly, *The nervous fibre* is the third constituent. This maintains an intimate relation with the others, and produces, or at all events *conveys* to the muscles, their immediate excitant, which has been termed nervous fluid, nervous influence, &c. In one mode of arrangement it forms chords (*nerves*) through the texture of organs, of such extreme minuteness as, it is said, not to exceed in diameter the thirty-two thousand four hundredth part of a hair,(*g*) but ramified. In another it is disposed in masses (cerebrum, cerebellum, and medulla Spinalis,) with which the nerves are connected; so that the latter serve the purpose of *chordæ internunciæ* between the different organs of the body and the common centre of nervous influence, the *brain*. (*h*)

Dr. Copland's view of the Cellular Tissue.

Dr. Copland, in his excellent Dictionary of Practical Medicine, gives a full account of *cellular tissue* and its diseases, and the appropriate remedies.(*i*) The student, anxious to extend his knowledge upon the composition of cellular tissue, or any other part of the human frame, should examine Dr. Turner's Elements of Chemistry. The above outline will suffice for the general reader.

Of Organization and the combination of these materials in *Organs*, *Apparatus*, and *Functions*.

All the anatomical constituents, elements, or ingredients thus enumerated, are variously modified and combined into distinct parts, technically called *Organs*, (*organon*, or material instrument,) by which an action is performed and effect produced. When *several* organs are combined for a joint purpose, the aggregate is sometimes technically called

(*f*) It will be observed, that in very few anatomical works is the term flesh ever once mentioned. But Dr. Bostock says, "Muscles constitute what are called the *flesh* of animals." 1 Bost. 105.

(*g*) 3 Gregory, 280.

(*h*) Dunglison, Phy. 41 to 64.

(*i*) Title Cellular Tissue, 298.

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an Apparatus, and when a great many organs or apparatus are so disposed as to produce one grand effect, the whole constitute what is termed a *Function*, and which consist, in the human frame, principally of the functions of respiration, circulation, digestion, absorption, secretion, and the functions of the nervous system.

Of Organization.

Organization, in its most extensive acceptation, may be regarded as nearly synonymous with the word *arrangement*, signifying that the parts of the organized body are placed according to some specific structure, visible to the eye.(*j*) It is said to be doubtful, whether the term can, with propriety ever be applied to any *fluid*, and on the other hand, it is equally a question whether any of the solids are not organized.(*k*)

But besides this kind of physical *organization*, the word is employed by physiologists in a more restricted, though at the same time in a more correct sense, when it is applied to a *system*, composed of a number of individual parts, possessing each of them appropriate powers and functions, but all conducive to the existence and preservation of the whole. An animal body is thus said to be organized, or to consist of a number of *Organs* or *instruments*.(*l*)

Of Organs.

The constituents of fluids and solids we have enumerated, variously modified and combined, are found to enter into the composition of certain *parts*, each of which is marked by a *particular* conformation, and intended for a special purpose; these are called *Organs*, a term (οργανον, instrumentum,) used to express the material *instrument* by which an action is to be executed or a function performed; for instance, the organ of voice, the organ of respiration.(*m*) Some organs are distinguished from others by being termed *vital* organs, as essential to life, such as the *Heart*, the *Lungs*, and the *Brain*, and which maintain a very close degree of affinity, and if one cease to act, the others also instantly cease, and life is extinct.(*n*)

Speaking of organs, Beclard observes,(*o*) that whilst conducting the examination of an organ, or when giving what may be termed its anatomical history, the anatomist should consider his subject as divisible into the following heads, and should treat each of them *seriatim et singulatim*:—1st, Its form and outline; its disposition, as being symmetrical or irregular: 2d, Its situation in reference to contiguous parts, as well as regards the entire body: 3d, The direction of its great diameter, which may be parallel, oblique, or perpendicular, to the axis of the body: 4th, Its size: 5th, Its physical properties, viz. its degree of density, cohesion, elasticity, colour, &c.: 6th, The fluids or humours which it contains or secretes: 7th, The properties it manifests during life: 8th, Its vital action, and the connexion of that action with others: 9th, The varieties dependent on age and sex, or individual peculiarities: 10th, The morbid changes.

Enumeration of the organs.

When hereafter examining the different functions, we shall have occasion to consider each organ in particular, and it may, therefore, here suffice merely to enumerate them. The organs are, 1st, The *Integuments*: 2d, The Bones: 3d, The Joints: 4th, Cartilages: 5th, Muscles: 6th, Tendons: 7th, Ligaments: 8th, Blood vessels: 9th, Lymphatics or

(*j*) 1 Bost. Ph. 31, 32.
(*k*) Id. 32.
(*l*) Id. 32.
(*m*) 1 Dunglison, Phy. 26, Broussais, 37, and Jackson, Prin. Med. 15, &c.
(*n*) 2 Good, passim, &c.
(*o*) Beclard, Anatomie Génerále, 132; and see Jackson, Prin. Med. 15, &c.

Lacteals: 10th, Glands: 11th, Various other viscera and organs, especially in the Thorax and Abdomen: 12th, The Nerves: and, 13th, The organs of External Sense.

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1st, The *Integuments* constitute the *external* covering, namely, the true skin, and the hair and nails.

2d. *Bones* are hard substances, which form the solid basis of the body, or the skeleton.

3d. The *Joints* are moveable or fixed, and either enable the bones to move without separation, or form the connexion between the flat bones, as in the case of the sutures in the skull.

4th. *Cartilages* are firm, smooth, elastic bodies, which cover the ends of the bones; but perhaps this statement of them as distinct organs may be considered as at least unmedical.

5th. *Muscles* are contractile organs, which are attached to bones, and perform the motions of the body.

6th. *Tendons* are the cords, by means of which muscles are attached to bones.

7th. *Ligaments* are strong fibres or membranes, which connect bones to each other.

8th. *Blood vessels* are membranous flexible tubes, either arteries or their Capillary terminations or Veins, which convey the blood from and back to the heart.

9th. *Lymphatics* or *lacteals* are those tubes which perform *absorption.*

10th. *Glands* are the organic masses destined for the purposes of *secretion,* or of effecting some unknown change in absorbed fluids traversing them.

11th. Organs in the thorax and abdomen, as the lungs, heart, stomach, liver, spleen, pancreas, kidneys, and the intestines.

12th. *Nerves* are white cords connected with the brain or Spinal Marrow, and are the instruments of *sensation* and *voluntary motion.*(*p*)

Of an *Apparatus.*

An *assemblage* of *several* organs, contributing to a common function, is termed *Apparatus,* namely, the Lachrymal apparatus, the Digestive apparatus; and the *result* which follows a certain action, or is produced by an organ or an apparatus, is termed *Function.*(*q*)

Of the different *Functions.*

The several *Functions* of the human living frame have been differently arranged and divided, but most usually they have been classed under—*first,* those which are *vital,* and *secondly,* those which are termed *animal* or *sensitive:* but as all these are more or less conducive, if not essential, to the healthy state of each other, and of the whole, it seems to be of little importance how they are arranged.(*r*)

The *Vital* Functions.

First, The functions termed *Vital,* have been so called and classed, because their uninterrupted and complete performance is indispensable to *Life.* Of these, some are more important than others, though all are essential. Thus *Respiration* and the *Circulation* of the blood are the principal functions primarily to be considered, because neither can be suspended, even for a very few minutes, without the immediate extinction of life; *respiration,* although generally treated of after the *circulation,* may be properly considered as *most* essential to existence, since unless by that process the blood be exposed, through the lungs, to the influence of the atmosphere, and thereby renovated, the circulation of blood would instantly cease.(*s*) *Circulation* has also justly been considered as the *next main*

(*p*) See American Cyclop. Prac. Med. tit. *Anatomy;* and 1 Dunglison, Phy. 21, &c.

(*q*) 1 Dunglison, Phy. 26.

(*r*) Jackson, Prin. Med. 124.

(*s*) 1 Bost. 258; Mr. Brodie, Phil. Tra. for 1811, p. 36, et seq.; 2 Bost. 253. It is true, that it is there contended, that *respiration* is *subordinate* in importance to the *circulation;* but why? because if the blood

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spring of all the rest, and that from which they derive their origin and is essential to the well-being of the whole.(*t*)

A *second* order are also absolutely necessary for our *continued* existence (although they have been treated as subordinate, because they are exercised only at *certain periods*, and not so incessantly as respiration and circulation, although they in general quickly succeed each other,) either when circumstances admit of their action, or if we regard their final cause when there is a demand for them in order to supply the wants of the system; these are the three functions of *Digestion*, *Absorption*, and *Secretion*. By the renovating function of *Digestion* and its consequences, the *aliment* taken into the stomach experiences a series of changes in its constitution and properties by the intervention of certain secreted fluids, such as the gastric juice and others hereafter considered, and which convert it into the substance called *chyle*; and which seems to be the immediate source of *new blood*, and the consequent cause of *nutrition;* whilst by the function of *Absorption* (or sucking in or taking up) the nutritious particles are carried from the digestive organs and intermixed with the blood, and become purified in the lungs, and afford materials for the formation of all the solids and fluids which compose the human frame; and, on the other hand, the function of *Secretion* (synonymous to *separation*) (*u*) affords the means by which certain parts of the blood are separated from the mass, either to serve some useful purpose, as the formation of the gastric juice, bile, &c., or to occasion the removal of some substance or fluid that is superfluous or injurious, as urine and excrement.(*x*) Of all these the *Heart* has been truly considered the central and principal organ.(*y*)

The *Animal* Functions.

Under the second description of functions, namely, those termed *Animal* or *Sensitive*, are classed the functions by which take place the communications of the *Mind* with the body, through the intervention of the *brain* and *nerves*, especially the *external senses* and *voluntary muscular motion*, which may or may not be partially defective without the loss of life. The *Brain* is considered the central organ of these.(*z*)

What organs are symmetrical or not.

The *organs* of the *vital* or *organic functions* are, except in a very few instances, *single* and not double, or situated with their centres in the median line, nor are possessed of symmetrical halves, as, for instance, the heart, stomach, liver. There are, indeed, two kidneys, but they continually differ in size, figure, and situation, and the two lungs are very dissimilar: whereas, the organs of the *animal functions* are usually *double* and correspondent; there being on each side of the median line of the body either two distinct organs, as the eyes, ears, extremities, or two correspondent halves, as is the case with the brain, spinal marrow, nose, tongue, &c.(*a*)

Objections to the Distinctions taken between Vital and Animal Functions.

It has, however, been objected, that neither this classification nor the nomenclature of the several functions is correct, for that *all* the functions may be strictly called *animal*, and that the animal functions are also strictly entitled to the appellation of *vital*, for not only are they directly essential to the support of life, but they are likewise most characteristic of its presence.(*b*)

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could undergo exposure to the atmosphere by any other means, respiration might be dispensed with. 1 Bost. 258; and per Mr. Brodie, Phil. Tran. for 1811, p. 36, &c. But whilst the human frame is constructed as it is, respiration *must* continue to be as it is, the *most* important function.

(*t*) 1 Bost. 258; 2 Id. 253.

(*u*) 2 Bost. 247.

(*x*) Id. 253.

(*y*) 1 Bost. 258; Mr. Brodie, Phil. Tran. A. D. 1831, p. 36, et seq.

(*z*) El. Blum. 52, 53, 55; 1 Bost. 193, 258.

(*a*) Quain's El. 55.

(*b*) 1 Bost. 253. It will be observed, however, that in another page the

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The different functions (whether or not, as supposed by some, they depend upon *contractility*,) such as respiration, circulation and digestion, have certainly a *necessary connexion with each other*. The *circulation* could not be carried on unless *digestion* produced the new materials of which the blood is composed; *respiration* must cease unless the heart propel the blood through the lungs; and *digestion* can only be performed by the *circulation* of the blood being conveyed to the minute arteries of the stomach, and there forming the gastric juice; whilst the Nervous System, influencing every organ and part, unites in one connected whole, the various functions of the animal frame. The *nerves* pervade every part, and give to the whole set of organs and all the functions a necessary vital dependence upon each other, so as to bestow upon the animal the feeling of individuality, and to connect all its operations without any visible change in its structure and composition.(*c*)

The numerous individual organs which make up the human body, although various in structure and office, are all intimately connected and mutually dependent. They are merely subordinate parts of one great machine; and they all concur, each in its own way, in producing one general result—*the life of the individual;* all the leading functions or phenomena are calculated to give a character of unity to the organization and living actions of our frame. There is a common source of nutrition for the whole body, a single centre of circulation, the *Heart;* a common source of sensation and volition, and of nervous energy of every kind, the *Brain*. The nervous organs are not only intimately connected by the share which they severally take in executing associated and mutually dependent functions, but they act and react on each other often very powerfully, by those mysterious, or, at least, hitherto unknown influences which we call sympathies. As the animal machine, although complicated in structure, is single; and as its living motions, although numerous and intricate, form one individual series; so a similar connexion runs through those *changes* of structure and functions which constitute disease; hence, there is one *anatomy* and *physiology*, and there can be only one *pathology*.(*d*)

How particular organs and functions may be more peculiarly affected by circumstances, as by the passions, disease, or injury.

The effects of the *Passions* and of *Diseases* and *Injuries* upon particular organs and functions, will be more fully considered in the *second part* of this work. But we may here observe, generally, that they are much influenced by *habit*, for even *poisons* may gradually become comparatively innoxious; they are still more affected by mental *passions;* thus, *vexation* greatly disturbs the stomach and diminishes its power of digestion; and *fear* augments the quantity of urine,(*e*) and the *pulse* becomes irregular, throbbing violently, or being nearly suspended, according to the degree of emotion or of the mental feeling immediately connected with it, and mental distress will even occasion change in the colour of the hair.(*f*) With respect to the *vital* organs and their functions, diseases affecting them are much more extensively felt than in other organs, and are more rapid and more fatal. Thus, if the heart, the lungs, or the brain, be inflamed, whether primarily or secondarily, as by sympathy, the stomach is peculiarly influenced, from the essential impor-

same learned author admits that a person may *live* with an impaired nervous or muscular power, but like *an automaton*. 1 Bost. 207. There seems, therefore, ground for the distinction between the *nervous* system and the *vital* organs.

(c) 1 Bost. 206 to 207.

(*d*) Per Lawrence, cited S. Coop. Dict. Prac. Surg. 322.

(*e*) Broussais, Phy. 206 to 226. Jackson Prin. Med. 253.

(*f*) Cogan's Treatise on the Passions, part 2, ch. 3, p. 278; 3 Bost. 203 to 208; Conversat. Animal Economy, 30, 31.

CHAP. II. II. THE COMPONENT MATERIALS, &c.

tance of these organs to life, as all the vital organs, or those essential to life, maintain a very close degree of affinity, and the disease originating in any of these has, in consequence, a more violent effect upon the constitution than the same quantity of inflammation would have, if it were *not* in a *vital* part, or in one with which the *vital* parts do not sympathize.(g)

General Division of the Human Frame, into the Head, Neck, Trunk, and Extremities, and the contents of each.

Even upon the most superficial view of the living human frame, an obvious division at once presents itself, namely, into Head and Neck, Trunk, and Upper and Lower extremities.

The *Head* includes the hair, scalp, pericranium, or membrane surrounding the skull, the cranium or skull itself, which covers and secures the brain and organs of sense; the brain itself, both cerebrum and cerebellum, and the medulla oblongata, prolonged through the spinal canal, under the name of *Medulla Spinalis*, from which arise all the nerves distributed to the muscles of the trunk and to the extremities. The Head also includes the nose, the ears, the teeth, the mouth, the uvula, soft palate, the tongue, the salivary glands, and the organs of deglutition. Near the root of the tongue is the *Larynx*, being the opening of the trachea or windpipe, communicating the air with the lungs, and the epiglottis and organs of the voice; and the *Pharynx*, being the opening into the œsophagus or gullet, which also commences in the head and communicates with and passes food and drink into the stomach.

The *Neck* includes all the communications with the trunk; namely, in front, the trachea or windpipe passing into the thorax or chest, and immediately behind the same, the œsophagus or gullet, and the jugular and other veins, with arteries communicating with the head, passing in front of the seven cervical vertebræ, namely, at the top, and connected with the head, the atlas, and next, the dentata, and the five other vertebræ of the neck, being parts of the entire spinal column.

The *Trunk* is divided into two principal cavities, the thorax or chest, and the abdomen or belly.

The *Thorax* (commonly called breast, and the upper part chest,) is that part which lies between the neck and the abdomen or belly, and is bounded above and in front by the clavicles, and behind by the scapulæ and dorsal spine, encircled by the ribs (costæ) with the *sternum*, or breast bone and the cartilages of the ribs, and containing the organs of respiration and circulation; namely, of the *former* (*respiration*) the bronchial tubes, terminating in the air cells of the lungs; the right and left lungs themselves, with their several blood vessels and covering of pleura, separated in the centre of the thorax by the *Mediastinum*. The lungs rest upon and are influenced in respiration by the *Diaphragm*, (from the Greek δια, "through," and φραγμα, "a fence,") which is a muscular partition or fence between the chest and abdomen, and is the chief agent of inspiration. The organs of Circulation, namely, the Heart, inclining rather to the left side of the sternum, and divided in itself into auricles and ventricles; and the aorta and other arteries and veins communicating with every part of the frame, and being the vessels through which the blood circulates, and surrounded with the pericardium, or surrounding sac of the heart, rests at its base on the diaphragm, and communicates through the pulmonary arteries with the lungs, and propels the blood through the same, to be there renovated by atmospheric influence, through the thin pervious skin-like division, separating the blood in the pulmonary vessels from the atmo-

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(g) See fully 2 Good, 278; and Broussais, Pathol. 57 to 72.

sphere; containing also the thoracic duct, through which the chyle and other secretions are passed towards and finally proceed into the right auricle of the heart.

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The lower part of the trunk is divided into the *Abdomen* (vulgarly termed belly) and the *Pelvis*. The *first* is bounded by the diaphragm above, and is surrounded by the abdominal muscles; the *second*, the *Pelvis*, is a bony basin composed of the two ossa innominata laterally, and the sacrum and os coccygis behind. In the *Abdomen* are the organs of *Digestion*, namely, the Stomach, small and large Intestines, forming the Intestinal Canal; and the organs subservient to Digestion, namely, the Liver and Gall Bladder, the Spleen and Pancreas, and the Kidneys and Ureters. In the Alimentary Canal, the food is digested by means of the gastric juice in the stomach, and by the biliary and pancreatic juices; and the nutritious qualities are transferred and passed through various absorbent vessels into the thoracic duct, and after passing through the same, are mixed with the venous blood and passed into the right auricle of the heart, and thence through the lungs, and thereby becomes perfect new blood; whilst the *residue* of such food is passed downward into the inferior intestinal canal, and carried off as excrement. The *Kidneys* are destined to the *secretion of urine*, which is transmitted from them by the two ureters to the *urinary bladder*, which is placed in the bony basin or pelvis, and from which it is propelled through the canal of the penis or urethra; and to the penis is appended the scrotum, being the bag containing the testicles, and divided in the middle by the *Septum Scroti*.

The *two Superior* or *Upper Extremities* are respectively divided into the *shoulder*, which comprises the *claviele*, commonly called the collar bone, resembling an italic *S*, and the two scapulæ; secondly, the *arm*, extending between the shoulder and elbow joint; thirdly, the forearm, which lies between the elbow and the wrist, or commencement of the hand, and consists of two bones, the ulna and the radius, extending from the elbow joint to that of the wrist; and, fourthly, the hand, which again is divided into three parts, the carpus, metacarpus, and the phalanges, or four fingers and thumb, with their respective joints, nails, &c.

The two *Inferior* or *Lower Extremities* are divided into, *first*, the *thigh*, which extends from the pelvis and ischiatic notch, which is part thereof, to the knee joint; *secondly*, the *leg*, which comprises the tibia and the fibula, being the two long bones between the knee joint and the ankle, and the patella or rotula, in front of the *knee joint;* and, *thirdly*, the *foot*, comprising the tarsus or ankle, the metatarsus being the middle part of the foot, between the former and the toes, and the phalanges or five toes with their joints.

Symmetrical structure, or central division of corresponding parts into two lateral halves.(*h*)

But there is still a more important division in most parts of the human frame, from a knowledge of which great practical utility results; namely, that the composition is *symmetrical*, being made up of *two lateral halves*, united along the middle line, or corresponding in their respective compositions; so that an anatomical and physiological knowledge of one half or part, extends also to the other; and if we have sufficiently informed ourselves of the structure of one half or one part, and of the diseases or injuries affecting the same, we, in general, necessarily know all that belongs to the other, and for that reason it has been considered, in the explanatory plates and references given in the subsequent parts of this work, to refer only to one half or one side of the frame. Thus the head and trunk, in their composition, are symmetrical, being made up of two lateral halves united along the middle line by a suture, or raphè, the traces of which are

(*h*) See farther as to the progress of growth, post, 38.

CHAP. II. II. The Component Materials, &c.

more or less perceptible in different parts.(*i*) On each side of the skull there is a similar bone, called *os parietale*, with an *os temporalis*, one eye and one ear, and this symmetry is also closely maintained in the upper and lower extremities; it is also observable internally as well as externally, and these are the necessary results of the mode in which the body and its different organs were, in the first place, developed in the fœtus and childhood. Thus the *falx cerebri*, dividing the brain in the centre from the front to the back of the head, descends from the middle of the arch of the skull, and beneath the same is the corpus callosum, forming a connecting medium between the cerebral hemispheres, and from which projects the septum lucidum, which bears to the internal cavities of the brain the same relation that the falx does to that of the cranium. So the division of the nasal cavity is marked out by the septum narium, and that of the mouth by the frena of the tongue and lips, as well as by the uvula. The like central division in the front and in the thorax is indicated by the *sternum* and *mediastinum*, and by the *septum* between the ventricles and auricles of the heart;(*k*) and the spinal column and lateral ribs, and the sacrum, having on each side an os innominatum, mark the division in the neck and trunk at the *back*. In the abdomen also there is the like division manifest in the infant whilst in the uterus, though the only traces that exist in the adult are the falciform processes, extending from the umbilicus, the one upwards with the remains of the umbilical vein, the other downwards with that of the urachus; in the genital organs the line is distinctly marked by the septum of the corpora cavernosa, and in the scrotum and perinæum by the raphè.

The *Nervous system* also is symmetrical in the strictest sense, for it consists of two lateral halves, which being disposed similarly on each side of the central line, resemble one another in every particular. Thus the brain is divided into two hemispheres, each presenting on its inferior surface three lobes; the cerebellum is also divided into two lobes; and the medulla oblongata into two lateral halves, each consisting of three fasciculi, or bundles of fibres, the division being established by two grooves or sulci, one on its anterior, the other on its posterior aspect, situated exactly in the median line. These sulci, by being continued along the whole length of the medulla spinalis, divide it also into symmetrical portions. This symmetrical arrangement extends to the *nerves* so long as they retain the form of distinct cords; but when, at their peripheral termination they become expanded into and blended with the minute texture of the different organs which they supply, their mode of distribution eludes our research. We can, however, infer that their filaments interlace one with another so as to form a net-work, by which a complete and free communication is established between them. Again, when we examine the *central* parts, we find that each lateral half is connected with the other by certain transverse bands disposed along the middle line, and which are termed *commissures;* on this union and connexion between the different parts of the nervous system, by which they become intimately blended at their periphery, as well as towards the centre, the individuality of the animal essentially depends.(*l*)

From this, in general, equal division or distribution of similar bones, muscles, cellular tissue, nerves, and parts, and the certainty or probability of each half resembling the other, it follows, that with a very few exceptions, a knowledge of the several bones and some organs and parts upon one side, and of the injuries which affect them, and the appropriate reme-

(*i*) 1 Bost. 183; 3 id. 299; El. Blum. 55; and Park, Inq., &c. 35 to 37.

(*k*) 1 Bost. 183; 2 Horner, Anat. 146.

(*l*) 2 Horner, Anat. 327; Jackson, Prin. Med. 29.

dies, will equally apply to the bones and organs of the other side, excepting that for the purpose of prehension in the hands and expansion of the feet,(*m*) the bones and muscles are framed and turned in opposite directions.(*n*) Hence also it is that one side of the frame may be paralyzed and the other not.

But this is not universally so as respects the *viscera under* the surface; thus the lung on one side of the thorax is larger than on the other, and the heart is more on the left side, and the liver and other viscera of the abdomen are not by any means equally distributed in each half of the frame. We shall find that many of the nerves, of which there are usually pairs, actually *cross* from one side to the other.

DIVISIONS INTO REGIONS.

In order to assist in ascertaining the exact local situations and state of a particular organ or part that is supposed to be diseased or injured, so as to apply appropriate remedies, it has long been the usage of medical practitioners to divide many external parts of the human frame, and especially the thorax or chest, and the abdomen, into certain parts, technically called *Regions*, by certain arbitrary and ideal lines and cross lines constituting compartments and divisions; and by long practice and observation these have been rendered so exact and certain, that it is considered that any able physician or surgeon may thereby so accurately know what particular organ, or part of an organ, is under any particular point on the surface, as to be able with a stiletto, or other small pointed instrument, immediately to perforate and touch it without the least deviation, and also to discover, by inspection or sound, the state of inflammation or of other disease or injury.(*o*) It has been observed, that by a proper examination of parts of the surface in these regions, the state of certain diseases or injuries may be well ascertained, more especially in the thorax and abdomen. This mode of discovery is technically termed *Exploration* (from the verb *exploro*, to examine.) In two very valuable modern publications, these regions, especially as regards the chest and abdomen, have been explicitly defined, and the use of such exploration clearly and practically shown; but it is to be regretted that there is still considerable discrepancy amongst the writers upon the subject.(*p*) Mr. Bell has ridiculed, as we have seen, the extension of these fanciful or ideal subdivisions of *Regions* to *parts* not capable of, or at least not requiring, such arrangement, observing what must be the surprise of any well educated young man when he reads in those books which he must study, of the *Regions* of the *elbow*, or *thumb*, or *forefinger*;(*q*) and if an anatomist understands such things with difficulty, how distressing must they be to the student? But we nevertheless find the terms still practically continued and extended in very learned works, to *every minute* part of the frame, especially as regards the muscles,(*r*) and not confined to the tho-

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(*m*) 3 Par. & Fon. 33. 10 Harg. State Trials, 29.

(*n*) By observing this law of nature, murder by another person, instead of felo de se, has been detected, as by the discovery of the impression of a bloody left hand upon the *left arm* of the deceased. So the murderer Patch was convicted, partly by the proof that the loaded pistol must have been fired by a left handed person, and that Patch was left handed.

(*o*) See 3 Bell, Anat. 255; 3 Good, 201 to 207; S. Cooper, Dict. tit. Auscultation, and tit. Sounding, Amer. Cyclop. Prac. Med. tit. Abdomen, and id. tit. Auscultation; 1 Dungl. 435 to 437.

(*p*) See plate in the excellent article by Dr. Forbes, tit. Abdomen, Cyclop. Prac. Med. 2; and 3 Good, 201.

(*q*) 2 Bell, Anat. Introd. xxiv. xxv. ante, 10.

(*r*) See Quain, El. 2d edit. Table of Contents, xxiii. to xxv., and pages in context, 239 to 385.

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rax and abdomen, but extended to the epicranial, palpebral, nasal, maxillary, auricular, orbital and cervical regions of the head and neck, and so on downward in every part of the frame, and notwithstanding Mr. Bell's observations, we have still repeated the external, internal, and middle *palmar regions* of the *hand*. Hence, even a practitioner in the law should be acquainted with these regions so that he may be enabled duly to examine a medical witness. The practical application of the knowledge of regions will hereafter be more fully considered when we describe the various modes of discovering and ascertaining disorders and injuries, and plates will then be given showing the regions as described by Dr. Forbes and other able physiologists.(*s*) But by examining some of the references it will be seen that the learned do not altogether agree.

Physiognomists divide the *face* into three ideal divisions and term them regions; the upper part being that of the intellectual life, the middle the moral, and the lower part of the animal life; and these are supposed to be analogous to the head, chest, and abdomen, and are respectively in the notions of physiognomists the seat of three corresponding classes of faculties.(*t*) Whilst the *Phrenologists*, more properly cranioscopists, divide the entire skull into *five regions*.(*u*) The utility, if any, of these latter divisions, will be better considered hereafter when examining the *head* and its parts; they are here merely mentioned to show the entire outline of the different divisions.

Progress of growth from the circumference to the centre.

It is here important to notice two laws of organized nature, termed by M. Serres Zoognie, which not only regulate the *original formation* of the organs, or different parts, but also in case of loss or injury, as of fractured bones or muscles, the manner in which they are *reproduced*. M. Serres states, that these laws are two in number, and are to be denominated the laws of symmetry, and that of *conjugaison;* the first of these designated as "le principe du double developpement des organes," the second, as "le principe de leur reunion."(*v*) Unorganized bodies, such as crystals, commence with a central nucleus, and are enlarged by attraction and the deposition of layers on its surface, and, therefore, grow from the centre to the circumference. But contrary to the general supposition, it is otherwise in organized bodies, which increase and *enlarge from the circumference to the centre*, and not by any law of attraction, and the outward form is as it were sketched concurrently with the production of the inner parts, and, indeed, is completed before many of them have made much progress in their development;(*x*) whilst, on the contrary, diseases grow, or have a tendency from the centre to the surface.(*y*) Each organ of the animal function is in the first instance double, its parts being placed laterally with regard to one another; but as the process of nutrition advances, they gradually thicken and enlarge, and approach and unite, so as to form organs, usually termed single, from their appearance on examination after their growth has been completed.(*z*) The process of ossification, for instance, proceeds from the circumference towards the centre. Thus the lateral parts of the cranial bones are formed first, and their extension proceeds from the sides, beginning at the prominent parts

(*s*) See the plate Cyclop. Prac. Med. 2, 3, and see description of the Regions of the abdomen, 3 Bell, Anat. 255; Horner, Anat. 4—5.

(*t*) 3 Bost. Phy. 220.

(*u*) Spurzheim.

(*v*) Serres, Anatomie Comparée, du cerveau dans les quatre Classes des Animaux Vertebrés; and see extracts, 3 Bost. 297 to 303.

(*x*) 1 Dunglison, Phy. 6.

(*y*) See instances and exceptions, S. Coop. Dict. tit. Ulceration.

(*z*) Id. ibid. and El. Blum; 53; 3 Bost. 297, centre to the surface.

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of the parietes and frontal bones, and then extends to the central line.(*z*) Each vertebra of the spinal column, and, therefore, the whole pillar itself, even including the sacrum, is composed of two parts, which finally become, as it were, soldered together along the median line. In considering the progress of ossification, M. Serres observes, that if we watch the gradual formation of the bones we shall perceive that the *external* parts are first visible, and that the *interior* and *central* parts are composed of productions from these, and that it is in consequence of this progress of ossification that the double development of the single parts which compose the centre of the skeleton is effected, and hence arises *the law of symmetry*, by which, with a few exceptions, the two sides correspond with each other; and as respects the law of conjugaison he points out its operation in the formation of the various cavities, holes and canals which are found in the bones, and which he supposes to be produced by a *union* of what were *originally* separate parts, and he concludes, that by the application of these principles, what we may consider as the mechanical process by which the solid frame-work of the body is progressively developed may be explained, and the *relation* detected which its component parts bear to each other.(*a*)

This principle prevails in all cases and in all parts of the entire structure,(*b*) whether the structure consists of a simple tube, as a blood vessel, or a muscle, or a nerve. The course of the intestinal canal is at first marked out by two *flat bands* running along its entire length; these unite in front, so as to form a groove, the margins of which finally arch in and complete the tube. In this way the Trachea or wind-pipe, larynx, œsophagus and aorta are formed. The same principle obtains also in the *Muscular System*, the lateral parts being produced before those at the middle line. The *Nervous System* in its development obeys the same law, and may be said to *begin* in its formation and growth where it has hitherto been thought to *terminate*, and *vice versa*.(*c*)

It is stated by several authors, that also in *Reproductions* of parts destroyed by laceration or ulceration, the renovation is first on the margins of the skin, and then the chasm is gradually filled up from those margins towards the centre, and this is certainly so when an ulcer is in a state of healing.(*d*)

It has been observed that these facts claim in an especial manner the anatomist's attention; they point out the marked line of distinction which exists between *organized* and *unorganized* bodies; the latter being universally admitted to be produced in the first instance by an aggregation of particles of matter regulated by the laws of chemical attraction, and subsequently increased by a deposition of similar particles round the central nucleus, and the development and increase proceeds in a course precisely the reverse of that in *organized* matter, where we have seen it begins at the circumference and gradually extends to the centre, and which must evidently be regulated by laws differing altogether from those which direct the formation of masses of inert matter.(*e*)

The appearance of monsters, and erroneously supposed hermaphrodites or other mal-formed children, and even a hare lip, or fissured palate, has been ascertained to be attributable to some irregularity in the progress

(*z*) [This is not strictly correct, as the commencement and progress of ossification vary in the different bones. 1 Horn. Anat. 68 to 71.]

(*a*) M. Serres, Anatomie Comparée du Cerveau dans les quatre Classes des Animaux Vertebrés; and see 3 Bost. 297, 299.

(*b*) 3 Bost. 299.

(*c*) 3 Bost. 300; Quain's El. 2d edit. 19, more fully.

(*d*) S. Coop. Dict. tit. Ulceration.

(*e*) 3 Bost. 299; Quain's El. 2d edit. 16, 88.

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of growth from the circumference to the centre, and a want of proper proportions and union between the lateral parts.(*f*)

Consequence of imperfection in an organ or part.

It has been observed, that in the *animal functions* a harmony of action in every organ, or in each half of the organ, is indispensable to perfection when both organs or sides act together, and that if such harmony do not occur, it is better for one organ or one half to act alone.(*g*) This certainly appears true as respects the eye and ear, and even the brain. But it certainly does not hold good in the actions of the voluntary muscles, nor in the operation of the brain or spinal marrow in willing those actions. From the duplicity of the organs it also happens that one side may cease to act without detriment to the functions of the other. While in the vital or organic functions no harmony of action is possible, and the derangement of any one part of an organ generally affects the whole; as an obstruction in the colon, disturbs the functions of all the alimentary canal. And, at least, much of the comfort of life altogether depends upon an harmonious co-operation of the whole of the organs as well as the functions.(*h*)

III. THE ESSENTIAL PROPERTIES AND VITAL POWERS, &c.(*i*)

III. Essential Properties, and Vital Powers, &c.

We have now to consider the effect produced upon the aggregate of all the foregoing materials when thus formed into organs and functions, by the *Vital* and other *Properties and Powers* with which the living frame is endowed.

First, Life defined, and the power of resisting putrefaction considered.

Here the *first* question is, *What is Life?* or, *In what consist vitality and the power of resisting putrefaction* or *decomposition?* This has been generally termed the *vital principle*, but, as shown by Dr. Bostock, that term has been used without any definitive or appropriate signification, and seems rather calculated to mislead and to induce an erroneous supposition that it is some unknown *independent material agent*, than to elucidate.(*k*) By the term *Life* or *Vitality* is generally meant the power of organized matter to preserve its particles in *such* chemical relations as to prevent *other* chemical relations from inducing disorganization, to increase or decrease by internal appropriation and separation, to produce peculiar matters for its own purposes, to preserve in some measure a temperature distinct from that of the surrounding medium,(*l*) to move certain parts of itself sensibly (as muscles) or insensibly as the capillaries independently of mere impulse, attraction, or repulsion.(*m*) What is it in the human frame when living that prevents the decomposition and putridity of the materials which we have just considered, and which we know immediately ensue after death? The answer has usually been, it is the *Vital power;* but until of late, no philosophical definition of what that power is, has been given. Life is nothing more than the preservation of the body, which is composed of materials naturally corruptible, but without the occurrence of corruption. It is the opposite of putridity. Vitality is that power which, during life, opposes the chemical affinities which would otherwise induce immediate

(*f*) Quain's El. 25; Geoffroy St. Hilaire, Philosophie Anatomique, vol. 2; Amer. Cyclop. Prac. Med. tit. *Acephalous.*

(*g*) El. Blum. 55, 56.

(*h*) El. Blum. 55, 56; 4 Good, 227; 3 Bost. 176; Jackson, Prin. Med. 313.

(*i*) See general divisions of the subject, ante, 13.

(*k*) 2 Bost. 148 to 152.

(*l*) El. Blum. 61; 2 Bost. 192.

(*m*) Thus the internal *Temperature* of man is usually about 96 or 98 degrees, and which is also the degree of heat of the blood at the centre, or under the armpit, and termed *blood heat*, whilst (at least in England) at the same time the *external* atmosphere is usually from 50 to 70, and universally *under* the temperature of man, 2 Bost. 192, &c. As to *Animal Heat* and *Temperature*, see post. Chap. on Respiration.

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putrefaction.(*l*) The power of the living muscle so far exceeds the force of gravity, that it will readily raise the same weight which, if the muscle were dead, would break it asunder.(*m*)

But the foregoing observations afford no satisfactory answer to the *question*, In what does the *Vital power consist?* We may safely *answer negatively*, that it is *not*, as has been supposed by some, an unknown independent material agent; but that *it is* to be attributed *principally* to the *several* consequences of *respiration*, and to the perpetual *animal heat* and *changes* occasioned by continued fresh inspiration and expiration, which introduce new wholesome materials, and carry off from the blood those which are noxious, and occasion incessant motion and change in every part of the frame, and excite the muscles to contractility and perpetual motion, thereby excluding *stagnation*, and its usual incident putridity.(*n*) We say *principally*, because, according to the conception which we are led to entertain of the structure and power of the living body, it is clear that *every* action which it performs, produces *some useful* purpose in its economy, and is essential to the *perfect* existence and well-being of the whole. But there are some *principal* functions so indispensably essential, that a suspension of their exercise, even for *five minutes*, would be fatal, and hence they naturally claim *principal* and *primary* consideration. Thus in particular it is established, that of all the constituents of the body, the *Blood*, and especially its *red globules*, are the most subject to decomposition, and it is accordingly on this that the air is conceived more immediately to act in the process of respiration, by the removal of superfluous carbon, and introducing fresh oxygen, and thereby carrying off the noxious parts, and introducing a perpetual renewal of wholesome qualities, and occasioning the circulation of renovated blood, and also those secretions and excretions which remove the effete and noxious matter. This is one of the principal preventions of decomposition and corruption, and the principal cause of vitality.(*o*)

It has been usually considered, that there are *distinct orders* of the vital powers, according to the variety of the phenomena by which they are manifested. These are threefold, 1st, *Organic formation* and increase; 2dly, *Motion* in the parts when formed; 3dly, *Sensation*, from the motion of certain similar parts.(*p*) The two specific powers that distinguish living from dead matter, are *spontaneous motion* and *sensation;* the first is confined entirely to the muscles, while the latter is equally confined to the brain and nerves. When a nerve is acted upon in such a manner as that its appropriate power is excited, motion is not necessarily produced, nor any other visible change, but the animal feels; on the other hand, there are many cases in which motion is produced, that is unattended with sensation; of this kind are most of the minute operations that compose the internal functions (as the abdomen,) of which, in a state of health, we are perfectly unconscious, and which are only known to us by their effects. These two powers, therefore, motion and sensation, although in a great number of instances they are connected together, being reciprocally the cause of each other, are not however necessarily connected, for either of them may exist separately, and when they are connected, it is not in any regular proportion. We conclude, therefore, that it is the office of the *Nervous System* to produce sensation; but with respect to the way or mode in which this is accomplished, or the succession of changes by

(*l*) El. Blum. 28, n. (*b*) cites Stahl and J. Junker, as to *putrefaction*, and what contributes towards or retards its progress; see also Dr. Turner, El. Chem. 578.

(*m*) El. Blum. 281; 1 Horn. Anat. 381.

(*n*) 2 Bost. 148 to 152; Jackson's Prin. Med. 98, &c.; and post, 46, 47.

(*o*) 2 Bost. 148 to 152; as to *azote*, ante, 26, note (*l*;) and Quain's El. 2d edit. 27.

(*p*) El. Blum. 29, 30; Jackson's Prin. Med. 11, &c.

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which it is immediately preceded, we find its knowledge not as yet to have been ascertained,(*q*) though of late it has, with great probability of accuracy, been ascribed to *electricity occasioned by the contact of the nerves with the muscles.*(*r*)

Treating of the uses of the *Nervous System*, and of *Sensitiveness* and *Contractility*, Dr. Bostock seems to admit, that they are not essential to mere vitality, because, he says, that without them man would be a mere automaton without homogeniety and destitute of consciousness, from which it would be inferred, that, though sensation and contractility may be indispensable to *perfection*, yet that *life* might continue without them.(*s*)

Certain peculiar powers or properties of vitality.

There are certain peculiar and extraordinary powers and properties incident to vitality, which should here be noticed. The *first* requisite involved in the name and notion of an *organized* body, is a *determinate form*, designed for certain ends. That species, therefore, of the vital powers is most general, which produces the genital and nutritive fluids, and prepares them for organic nature, and which have been denominated by Blumenbach the *Nisus Formativus*, because it is the source of all generation, nutrition, and reproduction,(*t*) and by which power, lacerated, or fractured parts are reproduced.(*u*)

The perpetual change of parts and formation of new, and power of restoring lacerated parts or broken bones.

No point in physiology is better settled than that, although the body remains apparently the same, yet its component parts, however solid, are subject to perpetual mutation.(*x*) The component particles of all the structures, even of bone itself, undergo a slow but constant change, and after a temporary sojourn, some parts are taken away and carried back again into the circulating mass, to make way for other new parts to be deposited in their place. The absorbent vessels (principally the *lymphatics*) effect this purpose, and are subsidiary to the process of nutrition and growth;(*y*) in other words, the particles of which the body is composed have a tendency to change; the old ones are perpetually removed, while fresh matter is continually deposited in their place.(*z*) As long as life lasts, the fluids are subjected to a constant internal motion, in which we can trace evidence of an uninterrupted separation of old particles, and a correspondent admission of new ones; and though the form of the body remains the same, its component parts are subject to perpetual mutation. These changes necessarily imply that the fluid parts are constantly being converted into solid structures, to maintain their growth and nutrition, and again that the particles which had for some time formed part of the solids, are taken up by the absorbent vessels and carried back into the current of the circulation, to make way for the new matter about to be deposited in their stead.(*a*)

(*q*) 1 Bost. 192, &c.; and see post as to the *Muscles* and causes of contraction.

(*r*) See post, 44, 45; and 3 Bost. 281. MM. Prevost and Dumas on Muscular Contraction, there extracted; see, also, 1 Dunglison, Phy. 311, &c.; and 1 Horner, Anat. 381.

(*s*) 1 Bost. 207.

(*t*) El. Blum. 29, 62. By this power we know that the claws and parts of lobsters and crabs are reproduced, and parts of worms, when separated, will reunite. 3 Bost. 53.

(*u*) See 1 Bost. 99; post, as to bones; 3 Bost. 271.

(*x*) Quain's Elem. Introduc. 18; 2d edit. 20, 21; 1 Bost. 101, 102; 2 Bost. 152; id. 99, 423; see post, under the absorbent function, as to the office of the lymphatics.

(*y*) Id. ibid.; and see 5 Good, 168, 176; El. Blum. 382, 383; 2 Bell's Anat. 336 to 343; Cooper, Dict. tit. Absorption; Amer. Cyclop. Prac. Med. tit. Absorption. But note, it is considered that the *brain*, the spinal chord, and the organs of *sense*, undergo less of this exchange of particles than other parts. 2 Bost. 431, note.

(*z*) Crawford on Animal Heat, 150; 2 Bost. 99.

(*a*) 2 Dunglison, 165, &c.

This renovating power extends to the *bones* as well as to every other part;(*b*) and it has been observed, that we have reason to suppose, that, every portion of bone, like every other organized part, is connected both with the arterial and the absorbent systems, and that, in process of time, each particle is removed, and fresh ones deposited in their place. This gradual exchange of old for new matter, is proved by the phenomena which attend the growth of bone. A solid organized body cannot grow by the distension of its parts, or by the accretion of new matter to its external surface, but by the gradual remodelling of the whole. If the *secreting* vessels be supposed to act more powerfully than the *absorbents*, the new matter is either conveyed more rapidly or in greater quantity than the old matter is removed, so that the bulk of the whole is ultimately increased, and yet the operation is effected so gradually, that the general form of the bone, and the relation of its different parts to each other, are not materially altered.(*c*) Hence it has been observed, that a bone itself exhibits very unequivocal marks of *vitality*.(*d*)

This renovating power also extends to the *Nerves*, which are not only repaired but even reproduced; and after a nerve has been *completely divided*, and its functions totally suspended, it has been known gradually to resume its power, and the ends were found to be connected by the formation of a new substance.(*e*)

Dr. Roget has written a beautiful article upon *Age*, in which he has ably illustrated this doctrine, and stated, that doubts may very reasonably be entertained as to the identity of any part of the body, at different epochs of its existence. A period of seven or eight years was assigned by the ancients as the time required for this *entire change of all the materials of the system;* but Dr. Roget observes, that modern researches, which show us the much more speedy reparation of injured parts, and the rapid renewal of the substance of bones *that have been tinged by madder* given to animals with their food, render it extremely probable that a complete renovation takes place in a much shorter period.(*f*)

This constant motion and *renewal* of new materials, partly composed of or influenced by the powerful antiputrescent *gastric juice* associated with the animal heat, unquestionably tend to prevent the decomposition and putridity that would otherwise ensue, and contributes to the duration of vitality.(*g*)

Self Adjustment.

Self adjustment is also an important feature in the animal economy, and one which materially affects its operations and regulates its motions, which have been characterized by the term *Self Adjustment*.(*h*) Exposed as the body is at all times to a variety of external agents, differing from each other both in their direct and their indirect effect, it was necessary that there should be some kind of corresponding change in the machine, to prevent the irregularities that might otherwise arise in its action. Now, we shall find, that the different vital functions are so adapted to each other, that their respective defects or excesses are compensated by the extraordinary action of some other function, and which is the necessary result of the previous irregularity. It was from observing a number of examples of this kind, that a pathological hypothesis was formed, which has long been a favourite doctrine of the schools of medicine, according to which all these trains of action are referred to the

(*b*) 1 Bost. 101 to 105.
(*c*) 1 Bost. 101, 105, 259, 260.
(*d*) Id. ibid.; Convers. Animal Econ. 124.
(*e*) 1 Bost. 360.
(*f*) Cyclop. Med. Prac. tit. Age, 35; Amer. Cyclop. Prac. Med. tit. *Ages*.
(*g*) Ante, 40, 41; post, 46, 47.
(*h*) 2 Bost. 147.

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operation of a specific principle, which has been named the *vis medicatrix naturæ.* but upon which Dr. Bostock has judiciously observed, that there is no foundation for this mode of reasoning, as these trains of action can be referred to no one physical principle, and only agree in their final cause. They resemble each other only in exhibiting examples of the admirable order which pervades all parts of the universe, and which we observe as well in the inanimate as in the animated parts of the universe.(*i*)

Reaction.

Reaction. There is also another peculiar operation confined to the living body, and which tends to preserve the machine in its proper order, and to regulate its motion, which has been styled *Reaction.* This more nearly approaches to what may be regarded as a specific principle, and may, perhaps, be considered as a mode of self-adjustment, which operates in all cases upon the same substances, and by the intervention of the same functions. If the action of a vital part be by any cause diminished, provided the defect be within certain limits only, the diminution of action becomes the immediate cause of an increase of power in the part by which it is enabled to overcome the obstacle, and restore the balance of the system. This capacity of reaction appears to reside as well in the contractile as in the sensitive parts, and is one of the most efficient means which is employed by the Physician for restoring the functions to their state of healthy action, when this has, by any means, become deranged.(*k*)

Secondly, The power of Motion and Contractility.

Secondly, One of the principal vital powers is, as we have seen, *Motion* in parts already formed, and which have been divided into *common,* affecting every part of membrane throughout the frame, and *proper,* which affects only particular organs for the purpose of peculiar and anomalous motions. The motions affecting the membranes of the whole frame are *contractility* or *irritability.* Some have supposed that mere *contractility* is characterized by a simple and not very perceptible effort of the membrane to contract upon its contents, especially upon its source of moisture, the serous vapour, and to propel this into the lymphatic system. *Irritability* (more properly *muscular contractility*) is a condition peculiar to the *muscles,* and it is marked by an oscillatory or tremulous motion distinguished from simple contraction, both by occurring far more easily on the application of any strong stimulus, and by being attended with a much more considerable contraction.(*l*) The *contractility* of *membrane* is the chief cause of strength, health, and beauty, since upon it depends the vital elasticity and fulness, and indeed the tone of parts, for, by its means, the membrane, to mention one, only, of its functions, absorbs during health, the serous fluid, like a sponge, and propels it into the lymphatic vessels. In disease, on the contrary, having lost its tone, it is filled with water, giving rise to œdema, or watery effusion. Hence, after death, even in young subjects, full of juices, the back, loins, and buttocks, having for some time lost their vital tone, are, if the body be horizontally placed on the back, depressed and flattened by the superincumbent weight, and therefore this appearance may be regarded in cases otherwise doubtful, as one of the indisputable signs of death.(*m*) The various internal motions, contractions, and elongations of the membrane also contribute, of themselves, to resist decomposition and putridity.

(*i*) 3 Bost. 145, 146.
(*k*) 3 Bost. 145, 146; see also Jackson, Prin. Med. 604, 605.
(*l*) 2 Dunglison, 502 to 505.
(*m*) El. Blum. 4 edit. 27 to 37, and see 1 Bell's Anat. chap. ix. of the Muscular Power, 378; Jackson, Prin. Med. 266.

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What is the cause of muscular contractility. Semble, electricity by the contact of the nerves and muscles.

But the precise cause or causes of muscular contraction appear as yet unascertained, at least with any satisfactory degree of certainty. Dr. Bostock observes, that two distinct questions here present themselves: *first,* what is the efficient cause of the contraction of the fibre, or by what physical cause is it produced? and, secondly, what is the cause of contractility, or that property of the fibre which produces contraction? That learned physiologist remarks, that both these questions are highly interesting, but that they unfortunately are both of them of very difficult solution. (*n*) Many physiologists of the first eminence have, of late, endeavoured to account for the cause of contractility, by insisting that it is attributable to the *natural attraction* of the fibres to each other; others call it the *attraction of life*, and others term it as an attraction depending upon the operation of the vital principle. But Dr. Bostock shows that though we admit the truth that during life there exists such attraction, yet that it affords no explanation of the *cause* of contractility; and he concludes that, in the present state of our knowledge, contractility ought to be regarded as the *unknown* cause of *known* effects, as a quality attached to a peculiar species of matter possessed of properties peculiar to itself, and which we are not able to refer to any general principle. (*o*) Of late we have seen that the contractility of the muscles has been ascribed by some to *electricity*, occasioned by the nerves coming in contact with the muscles, which causes contraction, and which again is controlled by the will, and there seems to be strong ground to expect that farther experiments may establish this position. (*p*)

Thirdly, Sensation, Sensitiveness or Sensibility.

The *third* vital power is *Sensation* or *Sensibility*, or, more properly, *Sensitiveness*. This, it is laid down, is peculiar to the *nervous medulla* communication from the *sensorium*. It bears the title of *vis nervæ*, and is the cause of *perception* in the *mind* when irritation (and, consequently, contractility) is excited in parts to which it is distributed. (*q*) Sir Everard Home has considered that the brain is composed of small *globules* connected together by a peculiar gelatinous substance, which he conceives constitute a very important part in the animal economy, and he even insists *that there can be no doubt that the communication of sensation and volition more or less depends upon* it, and he even regards it as the very essence of life. (*r*) Dr. Bostock observes, that, with respect to the relation which the different parts bear to each other, it has been generally supposed that the *brain* is the centre of the *Nervous System*, or is that part to which all the others are subservient, and that the *Nerves* receive *impressions* from *external* objects, and *transmit* these impressions to the *Brain*, where they become sensible to the *Mind*, constituting *Perceptions;* and that view of the subject is, in the main, correct, although the experiments and discoveries of the modern anatomists have led to some modification; but that all questions respecting the action of the *Nervous System* are involved in much obscurity, and which, in some measure, attaches to the nature of the subject. (*s*) The present doctrine is, that, however essential sensation may be to the *Perfection of Man*, yet that the *Nervous System* is not *necessary* for the *mere* continuance of animal life, though it is indispensable as regards the functions of *Organic Life*, namely, respiration, circulation, digestion, &c. (*t*)

(*n*) 1 Bost. 125.

(*o*) 1 Bost. 132 to 135.

(*p*) Prevost and Dumas's Hypothesis of Muscular Contraction, and see 3 Bost. 281; and see 1 Bost. 167, as to *Electricity* being the cause of contractility, ante, 42, note (*r*,) and post, as to the *Muscles;* see also Dr. Dunglison, Human Physiology, 1, page 313 to 316; and Jackson, Prin. Med. 117.

(*q*) El. Blum. 30; 1 Bost. 192.

(*r*) Cited in 1 Bost. 187.

(*s*) 1 Bost. 193, 194.

(*t*) 1 Bost. 268, note; 195, note.

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Most of these modes of vital energy, though necessarily distinguished into *orders*, are intimately *connected*, the membrane forming the basis of so many organs, and the seat of their contractibility is interwowen also with the irritable muscular fibres and the sensible nerves.

Combined view of all these vital and other powers.

Vitality exists as well in the fluids as in the solids, or at least in the *Blood*, though the incorruptibility of the latter during life might be attributable to the perpetual changes which it undergoes, especially in respiration.(u) Indeed, it has been truly observed by a most able commentator, that Harvey's doctrine of the *life* of the *Blood* is the best established doctrine of modern physiology.(x)

As these changes during life necessarily imply that the fluid parts are constantly being converted into solid structures to maintain their growth and nutrition, and, again, that the particles which had for some time formed part of the solids, are taken up by the absorbent vessels and carried back into the current of the circulation, to make way for the new matter about to be deposited in their stead, it follows that the ultimate constituents of the solids and fluids are identical, else this ceaseless conversion of the one into the other could not take place, the only difference between them being as to their mode of composition or aggregation.(y)

It seems, therefore, to be considered, that the *vital power* of resisting putrefaction is *principally* attributable to respiration, and the circulation of the blood and incessant motion of the parts, which prevent stagnation and inertness, which are the preliminaries to putrefaction; and, according to the experiments of Mr. Brodie, Dr. Philip, and the opinion of Soemmering, Dr. Bostock, and others, the nervous system is not necessary to the mere continuance of animal life, though without its due exercise, man would be a mere automaton.(z) It is, however, admitted by the ablest writers, that, beyond this truth, *the essential nature of life* is still an impenetrable mystery, and no more a subject for philosophical inquiry than the essential nature of Attraction or of its counteractor, Heat; but that life never originates, but began at the creation, and is communicated to assimilated matter, and propagated from parent to offspring.(a)

According to Mr. Lawrence, organized differs from unorganized matter merely by the addition of certain *properties* which are called *vital*, as *sensibility*, (more properly sensitiveness,) and *irritability*, (more properly contractility.) Masses of matter, endowed with these *properties*, become organs, and systems of organs constitute an animal frame, and execute distinct sets of *Purposes* or *Functions*. *Life* is the *assemblage* of *all* the *functions*, and the *general result* of their exercise.(b) Some authors have therefore indulged in fanciful illustrations; thus, the human frame has been compared to a *musical instrument* (as a barrel organ,) possessing a systematic arrangement of parts played upon by peculiar powers, and executing particular pieces or purposes; life is the *music* produced by the general assemblage or result of the harmonious action. So long as either the vital or the mechanical instrument is duly wound up by a regular supply of food, or of the winch, so long the music will continue; but both are worn out by their own actions, and when the machine will no

(u) El. Blum. 31, 61, 62; 2 Dunglison, Phy. 52, 507.

(x) See note of Mr. C. Bell, 1 Bell's Anat. 511, in which he denies the doubt as to the vitality of the blood, in 1 Bell, 518, 519; see also 2 Good, 42.

(y) 1 Bost. 101 to 105, every part of the body is probably removed in process of time, particle by particle, in a manner precisely the reverse of that in which it was formed, and this process can only be effected by the absorbent system. Ante, 42, 44.

(z) 1 Bost. 268, note.

(a) El. Blum. 4th edit. 64, 65, and 510; 1 Bost. 192, 194.

(b) Lawrence, Introduction to Comparative Anatomy and Physiology, 120.

longer work, the life has the same close as the music.(*c*) Akenside, when speaking of seventy years as the ordinary duration of the life of man, adopts the same comparative idea of a musical instrument, observing, "Strange that a harp of thousand strings should keep in tune so long." There are other instances of similar illustration, but as they do not lead to any advantageous practical result, we think it inexpedient to enumerate them. The imaginations of the most sensible writers have induced them frequently to introduce similar fanciful illustrations; thus, in a recent valuable work, the author, not content with fully describing the parts of the *human ear*, insists, that it resembles a *splendid edifice with portals, ante chamber, and presence chamber*, with numerous servants, valets, and secretaries, progressively ushering in, or introducing the visiters (*sounds*,) but without attempting to draw from such illustrations any anatomical or philosophical result.(*d*)

Dr. Bostock, after stating the various doctrines and opinions upon *Vitality*, thus concludes: "I conceive that the present state of our knowledge does not admit of our giving a satisfactory answer to the question in what it consists, but, that, so far as we are able to understand it, I think it is *very evident*, that it depends upon *no single cause or principle*, but upon the *conjoined operation of many actions*, which, together, constitute life, or by the operation of which the living differs from the dead animal. The regular supply of fresh material, as furnished by the Digestive organs,(*e*) and the removal of various secretions and excretions, and *lastly*, the *abstraction by the lungs* of the superfluous carbon and water, effects which depend upon the united agency, of both chemical, mechanical, and vital actions, are among the various causes which probably all contribute to the ultimate object."(*f*)

Fourthly, The Mental Faculties.

Fourthly, The *Terrestrial* or *Animal Mind, or, in other words, the Mental Faculties or intellectual principle*, forms, as we have seen, the fourth principal division, and is, perhaps, the most interesting but most difficult of the whole.(*g*) The mind is intimately connected with the body, and develops, by exercise and education, various kinds of mental faculties. The sensibility of the nerves, mentioned among the vital powers, constitutes the medium which propagates the impressions of stimuli upon sensible parts, and especially upon the organs of external sense, (namely, of sight, hearing, smelling, taste, and touch,) to the sensorial portion of the brain in such a manner that they are *perceived* by the mind. The mental or *intellectual faculties* are, *perception, attention, memory, comparison, imagination, abstraction, reason*, and *judgment*, and the full combination of these constitute the entire *Intellectual Faculty*.(*h*) Besides these, there is another order relating to *Appetency*, and which *consists* of *desires* and *aversions*, and the faculty which *selects* out of many desires and aversions, and can at pleasure determine to perform functions of the body for certain purposes, and is denominated *volition*.

Dr. Bostock observes, that, although the *intellectual* function is a less direct object of physiology than the three prior requisites of the perfect living system, yet many of them are so closely connected with physical changes of the body, as to require some degree of notice in a system which professes to give a complete view of the animal economy. These, although intimately, and, as it would appear, necessarily connected with the nervous system, are, at the same time, so different in their phenomena and their characters from any of the properties of matter, that he con-

(*c*) 4 Good, 38.
(*d*) See Quain, El. Introd. 2d ed. 5, 6.
(*e*) Including that powerful anti-putrescent, the *gastric juice*, and the pancreatic juice and bile.
(*f*) 2 Bost. 152.
(*g*) El. Blum. 40 to 50, 65 to 80; 4 Good, 32 to 47; 1 Dungl. 230 to 281; see division, ante, 13.
(*h*) 4 Good, 42, &c.; Jackson, Prin. Med. 177, &c.

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ceives we are warranted in the conclusion that they originate from an essentially different source, and are of an essentially different nature. Whatever hypothesis, however, we may adopt upon the subject, it is obvious, that they possess the power of acting upon matter, and that they exercise a very extensive influence over the animal body, and as far as this influence extends, it is necessary, in a treatise on Physiology and Pathology, to investigate its nature and to trace its effects. Among these intellectual operations, which possess a decided action upon the corporeal frame, we must place the *Passions*, and, in the same class, we may regard that compound of mental and physical influences, from which results what we call *Temperament* and *Character*.(*i*) We hence proceed to functions of a more purely *intellectual* kind, which, as they recede from the corporeal and advance towards the *mental part* of our frame, are less within our province, and belong more to the *moralist* or the *metaphysician*,(*k*) but which, in connexion with the melancholy disease, *Insanity*, are parts of physical inquiry.

The *Brain* is now generally allowed to be the organ of the *Mind*, and the powers of the latter have been generally supposed to depend upon its dimension and construction.(*l*) Farther, the ablest divines and metaphysical writers agree that every sentiment and propensity is given us for a good purpose, and that it is only when one or more is excessive, or defective, or too much or too little excited, by external circumstances, or by disease, that error occurs.(*m*) This is a mere outline of the mental faculties, which, with their influence on the fluids, the solids, and the vital powers, and consequently on health and happiness, will be more fully considered. We may, however, be allowed here to observe, that physiologists and pathologists, because they have not been able to *prove* to their own satisfaction, the essential cause of the intellectual *mental* faculties in connexion with the perceptible organs of external sense, appear to have too much neglected the investigation of the subject, with a view to ascertain how far, by mental exercise or other pathological means, these faculties may be improved, or how alleviated, or cured, in various branches of mental aberration. It is admitted, that *delirium* may arise from actual disease of the *brain*, but it has been supposed that insanity is not at least to be discovered to be attributable to any such cause; but when we know the innumerable sufferings of the mind, connected with bodily defects, or attributable to external causes, which may be mitigated by kindness or by medicine, it becomes a distinct system of pathology, applicable to mental sufferings, and is a subject of most interesting inquiry.(*n*)

But our law seems, like our physicians, to have shunned inquiry into these subjects, as if beyond any useful attainment, or, at least, as being incapable of just regulations, and therefore the law has not afforded any adequate punishment even for death, occasioned by the torments of the *mind*, inflicted by cruelty, or some other malevolent means: thus, to occasion immediate death, or the most violent mental suffering, by *sudden* alarm, is not punishable as murder, unless accompanied with some *external violence*, constituting *an assault in law*, or a libel, or a conspiracy; and the frightening to death by the semblance of a ghost, is merely a misdemeanour, and the verbally inventing a story exciting the agonizing feeling of jealousy, seems to be wholly dispunishable. Should the law continue thus deficient?(*o*)

(*i*) As to temperaments, see conclusion of this chapter, 48, &c.

(*k*) 1 Bost. 262, 263.

(*l*) El. Blum. 49, 65; 1 Dungl. Phy. 232, &c.

(*m*) Id.

(*n*) See post, chapter on the Nervous Function; and Jackson, Prin. Med. 235.

(*o*) See considerations upon this subject, post, in the chapter on the Nervous Function.

IV. OF TEMPERAMENTS.

Of Temperaments.

Before we close this chapter, professing to explain what relates *generally* to the *whole* human frame, it will be proper, concisely, to consider the subject of *temperaments* or particular *characters*, which, as Dr. Bostock observes, equally affect every part, *corporeal* as well as *mental*, and therefore are properly to be noticed here.(*o*) It is believed by all Physiologists that *different distinguishing temperaments* do certainly sometimes exist, and strongly characterize different individuals, though all are alike composed of the same materials, and endowed with the same functions, and corporeal as well as mental powers.

Temperament defined.

A *Temperament* is defined to be a *peculiar* state of the system, depending on the relation between its different capacities and functions, by which it acquires a *peculiar tendency or predisposition* to certain actions;(*p*) or, according to Blumenbach, an aptitude of the living solid in each individual to be affected by stimuli, especially the mental; and again, of the mental stimuli to be excited with greater or less facility.(*q*)

The Tonic is the perfect temperament.

Dr. Bostock observes that the *tonic temperament* is perhaps to be regarded as the *perfect state* of the human frame, because in it the different powers are the most nicely balanced, and where we have the greatest capacity for action, combined with the greatest strength of resistance. The body, in that state of temperament, is usually spare but hardy, capable of long continued exertion, rather than any peculiar degree of physical strength, while the mind is firm and ardent, and exhibits that happy combination of genius and industry, which gives rise to the best directed efforts of human intellect.(*r*)

The deviations.

From this perfect state there are sometimes such disproportions or *deviations* in the different powers, as to constitute positive *disease;* whilst, in some persons, there are only *smaller* disproportions compatible with continuing *health,* but yet observable and occasionally developed by certain actions.

The ancients, and amongst others Hippocrates, erroneously attributed these solely to the *fluids*, and described four peculiar temperaments, *hot*, *cold*, *moist*, and *dry*, and these were supposed to give the specific characters to the four ingredients of which the *blood* was thought to be composed; and hence were derived the names of the *Sanguine*, the *Phlegmatic*, the *Choleric*, and the *Melancholic temperaments*, as indicating a *disproportion* or *excess* of each of those substances, and to these were afterwards added a fifth, the *Nervous temperament;* and although the ancient notion, that these temperaments were entirely attributable to the fluids, has long been refuted, yet the division of the Temperaments themselves is still continued. Dr. Bostock adopts them and adds a fifth, or Nervous temperament; and Blumenbach, observing upon the division of the ancients, says, although it was built by Galen upon an absurd foundation, derived from an imaginary depravation of the elements of the blood, it appears, if made to stand alone, both natural and intelligible;(*s*) and farther, that predisposing and occasional causes of the diversity of temperaments are very numerous, that is *hereditary* tendency, habit of body, climate, diet, religion, mode

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(*o*) 3 Bost. 247; and El. Blum. 51 to 54. fully. N. B. TEMPERAMENT is distinguishable from *Temperature*, which will be considered at the conclusion of the Chapter, upon the circulation; see post, and see 2 Bost. 192; 1 Dungl. Phy. 236.

(*p*) 3 Bost. 243.

(*q*) El. Blum. s. 78, p. 51.

(*r*) 3 Bost. 246.

(*s*) El. Blum. s. 79, p. 51, 52.

CHAP. II. IV. TEMPERAMENTS.

of life and luxury,(*t*) whilst Dr. Bostock observes, that the different states of the entire systen may be conceived to depend partly upon a difference in the original conformation of the body, and partly upon a difference in its powers and functions.(*u*)

Enumeration of deviations.

The five temperaments of Sanguineous, Phlegmatic, Choleric, Melancholic and Nervous, are to be considered as deviations from the full healthy temperament which we have seen is the *Tonic*.

Sanguineous.

The *sanguineous* or *sanguine* temperament is *excited* most readily, but slightly. This, it is said, depends chiefly upon the organization of the body, and the nature of its composition. In this temperament the vessels are capacious, and the solids distensible, the proportion of the fluids is larger, and all the actions which depend especially upon chemical changes seem to proceed with an *unusual* degree of facility. There is, therefore, much activity, but the strength is soon exhausted, while the functions are all disposed to excessive action, and are liable to be deranged from slight causes, and consequently, this is not a perfect state.(*x*) Dr. Elliotson observes, that this temperament is denoted by a full habit and rather soft fibre, a delicate skin, with large veins, a fresh complexion, often red or yellow, and occasionally darkish hair, great sensibility, a quick pulse, free secretion, and a cheerful disposition.(*y*)

Phlegmatic.

The *Phlegmatic temperament* is *excited* most slowly of all, and indeed with difficulty.(*z*) It is characterized by a lax and weak habit, a pale smooth skin, generally destitute of hair, or having very light hair upon the head, a slow weak pulse, small blood vessels, languid secretions, and dulness of mind and feeling, and consequently this is not perfect.(*a*)

Choleric.

The *Choleric* temperament is *excited* readily and violently; it lies between the Sanguineous and the Melancholic temperaments. It is marked by a softer fibre, a more irritable habit, a less dark and hairy skin, a more florid countenance, a quicker and stronger pulse, and a more irritable mind than the melancholic. This, also, is not perfect.(*b*)

Melancholic.

The *Melancholic* temperament is excited slowly, but is more permanent. It is denoted often by a spare habit, firm fibre, dark hairy skin, black hair and eyes, and a dark complexion; a slow pulse, little sensibility, sparing secretions, and a gloomy cast of character; great perseverance in all pursuits, and constancy of passion, but still not perfect.(*c*) The cheerfulness of the Sanguineous temperament, and the gloom and constancy of the Melancholic, are, however, subject to great exceptions, as they depend entirely upon the development of certain parts of the brain.(*d*)

Nervous.

The *Nervous* temperament obviously owes its peculiarities principally to the sensibility of the nerves exciting in an undue proportion the contractility of the muscles, and consequently prevents a perfect state.(*e*)

How these deviations may be modified.

Dr. Bostock observes, that few individuals are affected by these deviations or characteristics in an *extreme* degree; and that, even where they have been the most strongly marked by nature, yet education, climate, habits, and many other causes, may modify them in various ways; and that they are also capable of being combined together, by which imme-

(*t*) El. Blum. 52.
(*u*) 3 Bost. 246; 2 Dungl. Phy. 448.
(*x*) El. Blum. 79, 51; 3 Bost. 246.
(*y*) Dr. Elliotson, n. A. id. 53.
(*z*) El. Blum. s. 79, p. 51; 2 Dungl. Phy. 448.
(*a*) Dr. Elliotson, n. A. id. 54.
(*b*) El. Blum. s. 71, p. 51; 2 Dungl. Phy. 447.
(*c*) Id. s. 79, p. 51, 53; 2 Dungl. Phy. 447.
(*d*) Id. s. 54; where see further as to the temperaments.
(*e*) 3 Bost. 246; 2 Dungl. Phy. 448.

diate shades or variations are produced; so that it is often difficult to determine under which temperament many individuals, as we see them in society, ought to be classed; but that, nevertheless, such distinguishing temperaments do in fact exist.(*f*)

CHAP. II. IV. TEMPERAMENTS.

Effect of deviation on medical operations.

As regards *Physiology* and *Pathology*, and the applications of medicines and remedies, it is well known that the different temperaments become most important objects of study and attention, in consequence of their powerful and counteracting influence against remedial proceedings in disease and injury.

Legal effects.

In *Law*, although any deviation in temperament, as a Choleric disposition, is not directly recognised or admitted as affording any legal defence for violent injury, yet practically, with a jury, the proof of such a predisposition on the part of an offender may have considerable effect; and if a person, aware of such a predisposition, should purposely irritate the subject, and thereby excite him in sudden wrath to give a fatal blow, a jury might make allowance, and either acquit, or find the prisoner guilty only of manslaughter: whilst, if the offender had notoriously been of a different temperament, perhaps the conviction would have been capital. It is true that we ought to struggle and endeavour to counteract and control such a predisposition, but sometimes the greatest anxiety to prevent its effects will not succeed, and as the predisposition may be inherent, allowance should be made in certain circumstances. The party influenced by a choleric temperament is not guilty of such *voluntary* deviation from strict propriety of conduct; he is not like a drunkard, "*voluntarius dæmon:*" hence, therefore, a knowledge of this subject is important for the study of all who may be concerned in the administration of justice.(*g*)

The subjects of descriptive anatomy.

Descriptive anatomy includes several compartments, which are variously termed, according to their derivation from the Greek, and the subjects of which they treat, and they are usually arranged in the following order,(*h*) namely:

OSTEOLOGY (οστεον, a bone, and λογος, a discourse or description,) comprises the description of the structure, form, and uses of the osseous system and its different parts.

SYNDESMOLOGY (συνδεσμος, a ligament, and λογος,) or the description of the ligaments and other structures which serve as the means of connexion between bones, and constitute their articulations or joints.

MYOLOGY (from μυων, a muscle, and λογος,) the description of the muscles, the active agents in the different motions and actions of the body.

ANGIOLOGY (from αγγειον, a vessel, and λογος,) or ANGIOGRAPHY, the description of the vessels which convey the circulating fluids.

(*f*) 3 Bost. 247.

(*g*) Strong provocation, as pulling a man by the nose, and his killing the aggressor, may reduce the offence from murder to *manslaughter*, *Rex* v. ——, Kelw. 135; 4 Bla. Com. 191. So libels on the character of a deceased person with intent to excite his relatives to commit a breach of the peace, are indictable, because the law recognises that the provocation may be too powerful to be overcome, see *Rex* v. *Topham*, 1 Term Rep. 126, and Dr. Johnson's observations in Boswell's Life of Johnson, vol. 2. *Juries* will certainly make great allowances for the influence of passion upon a *choleric* man. See this subject considered in a legal view, post, in the chapter on the Nervous Functions.

(*h*) Quain's El. 2d edit. 94.

ANDENOLOGY (from αδην, a gland, and λογος,) the description of the glands and absorbent vessels.

SPLANCHNOLOGY (from σπλαγχνον, a *viscus*, and λογος,) the description of the viscera situated in the large cavities, and which minister to the more important functions.

NEUROLOGY (νευρον, a nerve, and λογος,) includes the description of the brain, nerves, and organs of sense.

Enumeration of the functions.

The FUNCTIONS, which we shall now proceed separately to consider, are usually arranged in the following order:—

1. Motion or Locomotion.
2. Respiration.
3. Circulation.
4. Digestion.
5. Absorption.
6. Secretion.
7. Nervous Function.
8. Generation and distinction of the Sexes.

Plate I

Drawn by J Perry

Engraved by J Drayt

Drawn by J Perry

Engraved by J. Drayton

CHAPTER III.

OF THE SKELETON AND BONES, JOINTS, CARTILAGES, LIGAMENTS, SYNOVIAL MEMBRANES, MUSCLES AND TENDONS, AND THE NERVES, BEING THE ORGANS OF THE FUNCTION OF LOCOMOTION.

CHAP. III. Of the Skeleton and Bones, Joints, Muscles, Tendons, &c.

Authors on anatomy and physiology in general, commence their observations by separately considering the *Skeleton* and *Bones*, next the *Joints*, termed articulations, and then the *Muscles* with their *Tendons*, all these being concerned in supporting the entire frame, and producing, when influenced by the nerves, what (although not usual, and, perhaps, somewhat unmedical,) we will term the *Function* of *Motion*, or *Locomotion*. In this chapter, we will, for a clear understanding of the subjects, consider each of these organs or parts separately, and then for practical purposes take a combined view of the whole, because, in every operation, whether of reducing a fracture or dislocation, or otherwise, the surgeon must be well informed, not only of the structure of every part, but also of the conjoint operation of every bone, joint, ligament, muscle, tendon, or nerve, for very generally he has to overcome the local counteracting contraction or force, of numerous muscles, and must take especial care not to injure any essential nerve.

Section I.—Of the Skeleton and Bones.

Sect. I. Of the Skeleton and Bones.

Before we proceed to consider the details of this subject, it has been deemed expedient to assist the reader by introducing two plates of the skeleton, the one anterior or frontal, the other posterior, with *numbers* applicable to each bone; and the following table contains *corresponding numbers* and the *names* of each bone in explanation of those plates. These present to the view the names of most of the principal bones. The whole number in the Human Frame is 245, besides some very small bones; namely, in the head, sixty-seven, including the thirty-two teeth; in the trunk, fifty-four; in the upper extremities, sixty-four; and in the lower extremities, sixty bones.(*a*)

(*a*) See the very useful tables of Bones, Joints and Ligaments, Muscles, Brain, Nerves, &c., arranged for Students, and published by Messrs. Burgess and Hill, A. D. 1830, and which every Student is advised to purchase; see also two plates; p. 54, 55, and post, 68.

TABLE OF BONES IN EXPLANATION OF PLATES I. AND II.

PLATE I.—FRONT VIEW.

Head.

1. Frontal Bone, or Os Frontis.
2. Parietal.
3. Temporal.
4. Sphenoid.
5. Occipital (see Plate II.)

Face.

6. Malar, or Cheek bone.
7. Superior Maxillary.
8. Inferior Maxillary.

Neck.

9. Atlas.
10. Dentata.
11. Five other Cervical Vertebræ.

Trunk.

12. Twelve Dorsal Vertebræ.
13. Five Lumbar Vertebræ.
14. Sternum, or Breast bone.
15. Seven True Ribs.
16. Five False Ribs.

Upper Extremity.

17. Clavicle, or Collar bone.
18. Scapula, or blade bone.
19. Humerus, or Shoulder bone.
20. Radius.
21. Ulna.
22. Carpus, or Wrist.
23. Five Metacarpal bones.
24. Fourteen Phalanges.

25. *Pelvis.*

26. Sacrum.
27. Os Coccygis.
28. Os Innominatum, divided into three, namely:
29. Ilium, or Flank bone, and
30. Ischium, and
31. Pubis.

Lower Extremity.

32. Femur, or Thigh bone.
33. Patella, or Knee pan.
34. Tibia.
35. Fibula.
36. Tarsus, or Ankle.
37. Os Calcis, or Heel bone.
38. The Foot divided into
39. Five Metatarsal bones.
40. Fourteen Phalanges or Toes.

PLATE II.—BACK VIEW.

Head.

1. Frontal Bone.
2. Parietal bones.
3. Temporal.
5. Occipital.

Face.

8. Inferior Maxillary.

Neck.

9. Atlas.
10. Dentata.
11. Five other Cervical Vertebræ.

Trunk.

12. Twelve Dorsal Vertebræ.
13. Five Lumbar Vertebræ.

Upper Extremity.

17. Clavicles.
18. Scapulæ, or Blade bones, two.
19. Humerus.
20. Radius.
21. Ulna.
22. Carpus, or Wrist.
23. Metacarpus.
24. Fourteen Phalanges, or Finger bones.

25. *Pelvis.*

26. Sacrum.
27. Os Coccygis.
28. Os Innominatum, divided into
29. Ilium, or Flank bone, and
30. Ischium, and
31. Pubis.

Lower Extremity.

32. Femur, or Thigh hone.
33. Patella.
34. Tibia.
35. Fibula.
36. Tarsus, or Ankle.
37. Os Calcis, or Heel bone.
38. Foot, divided into the
39. Metatarsus, and
40. Phalanges, or Bones of the Toes.

DIVISION OF THE SUBJECTS OF SECTION I.(a)

First. Of the Skeleton and Bones in general, in connexion with the Joints, Muscles, and Tendons.
Secondly. Importance of Knowledge to Lawyers and Medical Practitioners.
Thirdly. General utility of Bones.
Fourthly. Form and several kinds.
1. Long Bones.
2. Short round Bones.
3. Flat Bones.
4. Mixed Bones.
Fifthly. Structure and component materials of Bones.
Gelatine.
Cartilage.
Marrow.
Other oily matter.
Arteries and Veins.
Absorbents and Secernents.
Nerves.
Sixthly. Vitality of Bones.
Seventhly. Periosteum, of.
Eighthly. Progress of Ossification.
Ninthly. Of Defects and Diseases of Bones.
Tenthly. Of Injuries to Bones.
Eleventhly. Of the Number and Names of the several Bones, and description of some in particular.

First, Of the Skeleton and Bones in general, in connexion with their Joints, and the Muscles and Tendons.

The *Human Skeleton* is so associated with ideas of death and loss of friends, that, to most persons, it is an object of horror, or of melancholy reflection; but upon due examination and reflection, we shall find that the so admirable adaptation of all the parts to their purposes, and of parts which, being purely mechanical, are perfectly understood, render it, independently of all professional considerations, an object of the deepest philosophic interest. Such mechanism, it has been observed, reveals, by intelligible signs, the hand of the Creator—and man may be said sublimely to commune with his Maker when he contemplates and understands the structure aright.(b)

In a *general* view of the skeleton we must remark the nice adaptation of all the parts to each other, to effect the intended purpose, and to the strains and supports which they have respectively to bear; as 1st, in the *size* of the spinal vertebræ increasing from above downwards, and the bones of the legs being larger than those of the arms. 2d. The objects of *strength* and *lightness* combined; as by the hollowness of the long bones,—their angular form,—their increased thickness and flexures in particular places, where great strain has to be borne,—the enlargement of the extremities for the purposes of forming joints, and to which the muscles are attached, lengthening the lever by which these act. 3d. We have to remark the nature and strength of material in different parts, so admirably adapted to the purposes which the parts serve; there is bone, for instance, in one place, incased in enamel, the latter of which is nearly as hard as iron, and having the form of *Teeth*, with the office of chewing and tearing all kinds of matter used as food. In the *cranium*, again, bone is softer, but tough and resisting. In the middle of *long bones* the bone is compact and little bulky, *to leave room for the swelling of the muscles* lying around it, while, at either end, with the same quantity of matter, it is large and spongy, in order to give a broad surface for articulation;

(a) The study of the Bones is termed *Osteology*, from the Greek οστεον, a *bone*, and λογος, a discourse. The works to be read, relating to Bones and Joints, are referred to in Cooper's Dict. titles, *Bone* and *Necrosis*. The celebrated modern treatises of Sir A. Cooper on Fractures and Dislocations, and of Mr. Brodie on Diseases of Joints, and Mr. Abernethy's third Physiological Lecture on Bones and Joints, must be read; see also Copeland's Diseases of the Spine; Wilson on Bones and Joints; Bell, Anat. vol. 1, p. 1 to 206; 1 Horner, Anat. 49 to 265; 1 Bost. Ph. 75 to 104; 1 Dunglison, Phy. 289 to 294; 1 Gibson, Surgery, 282 to 389; and Park's Inquiry, 14, 15, where bones in general, and each bone in particular are fully considered. As to the *differences* between the *Male* and *Female* Skeleton and Bones, see Par. & Fonb. 74 to 83; id. 311; 1 Horner, Anat. 106.

(b) 1 Arnott, El. Phys. &c. 431, &c.

CHAP. III. Sect. I. Skeleton and Bones.

and in the *Spine* the bodies of the vertebræ, each of which rests on an elastic bed of intervertebral substance, are light and spongy, while their articulating surfaces and processes are very hard.

In the *Joints* we see the tough, elastic, smooth substance, called *cartilage*, covering the ends of the bones, defending, and, as it were, padding them, and preventing friction. In infants we find all the bones soft, or gristly, and therefore calculated to bear with impunity the falls and blows incident to their age: and we see certain parts, where elasticity is necessary or useful, remaining cartilage or gristle for life, as at the anterior extremity of the ribs. About the joints we have to remark the *Ligaments* which bind the bones together, possessing a tenacity scarcely equalled in any other known substance: and we see that the *Muscular fibres*, whose contractions move the bones and thereby the body,—because they would have rendered the limbs clumsy even to deformity had they all passed over the joints to the parts which they have to pull,—attach themselves at convenient distances, to strong cords called *Tendons;* by means of which, they make their effort effective at any distance. These Tendons are remarkable for the great strength to be found in their apparently slender forms, and for the lubricated smoothness of their surfaces.(*c*)

The Skeleton.

The *Skeleton* (from σκελετὸν or σκελλω, to *dry*) is the fundamental part of the living fabric in man as well as animals, inasmuch as it gives *form, solidity, support,* and means of *tenacity* to the whole, and constitutes the substratum to which the other parts are applied. The *Skeleton* serves to *extend* and *support* the muscles and other parts which would otherwise naturally fall together in one compressed mass. But this again is constituted of various parts, which, during life, and even for a considerable time after death, are connected by *Joints* and *Ligaments;* for otherwise, as in the case of that defect (sometimes improperly termed *disease* of the bones) *Anchylosis*,(*d*) and constituting a *soldering union of the joints*, would be in one continuous mass, and would be incapable of locomotion. And these several parts are admirably constructed in different lengths and dimensions, so as to admit of various degrees of motion between the parts.

Bones, then, with their ligamentous connexions, constitute together the *passive*, whilst the *muscles*, influenced by the nerves, are the *active* instruments of locomotion.(*e*) The *number* of these bones vary in the different ages of life, being gradually reduced by the process of ossification, as in the instance of the sternum, or breast bone, which, in the infant, is in three pieces, united only by *cartilage*, but which in manhood become *one* entire bone. In manhood the principal bones are 197, though, by enumerating certain smaller bones, they may amount to 260; and this number is made up by similar bones on each side of the head, as the two ossa parietalia and the two ossa temporum, and other parts, which we have seen are very generally symmetrical.(*f*) The foregoing frontal and posterior views of the Skeleton present to the eye a view of only the *principal* bones, with numeral references, giving the technical and popular names of each. A full account of some of the bones will presently be given.

Secondly, Import-

A knowledge of the appearance, situation and structure of the skeleton, and of each bone, is peculiarly essential to every surgeon, and to all con-

(*c*) See farther, 1 Arnott. El. Phys. 438.

(*d*) From ανα an absence of, and κυλος juice—or as others, though it should seem incorrectly, derive it from αγχυλος crooked; see Cooper's Surg. Dict. tit. *Anchylosis*. Anchylosis is the union of two opposed surfaces when the intervening cartilage has been absorbed. It is not strictly a *disease*, but a *healthy* result of previous disease, for it proves the bone itself to be healthy, or it would not unite. 2 Gibson, Surg. 51.

(*e*) 1 Dunglison, Phy. 282, &c.

(*f*) Ante, 35.

CHAP. III. SECT. I. SKELETON AND BONES.

cerned in judicial inquiries, as exemplified in the case of Bowerman, who was charged with the murder of his child, by perforating its skull with an awl, and which was considered as established by discovering a hole in the skull, on one side, near the ear, and about three years after the death, supposed to have been made by a sharp instrument that occasioned the death; and upon which a coroner's inquest was about to find a verdict of murder, had not an intelligent surgeon proved, that such hole was an ordinary and natural aperture usually to be found, and designed by nature, for the passage of a vein, and which testimony saved the supposed criminal's life.(*g*) So in cases of doubt respecting the sex of the skeleton of a person supposed to have been murdered, the proof of the peculiar structure of the *female pelvis* might remove all difficulty.(*h*) So the progress and dimensions of the bones in the *fœtus* would also tend to fix with greater certainty whether at the time criminal means were used to cause miscarriage, the mother had *quickened*, so as to subject the party to capital punishment under the absurd, but still existing law.(*i*) And the very frequent actions against surgeons for the unskilful treatment of a fractured or dislocated bone, establish the great importance on their part, of acquiring a *very minute* knowledge of every bone and joint, and their connected muscles and tendons, and of their ordinary injuries and proper remedies. Sir A. Cooper, in his admirable work on Dislocations and Fractures, forcibly illustrates the disastrous consequences to professional character from the too frequent inability of even some practising *surgeons* correctly to pronounce whether or not a bone has been dislocated or fractured, and which incompetency is usually attributable to their ignorance of all the particulars of the natural state, and of the varying appearances constituting deviation from such natural state in cases of injuries. So a barrister can scarcely with skill examine professional witnesses upon such a subject unless he has himself acquired at least a general knowledge of the structure of the skeleton, bones and muscles.(*k*)

ance of the knowledge of Bones to Lawyers as well as the Medical Profession.

Thirdly, General Utility of Bones.

The bones, with their joints and ligaments, serve to extend, support, defend, and place in various moveable positions the muscles, or flesh, and other soft parts of the human frame, which would otherwise, from their natural gravity, fall into one compressed mass. The *Bones* have been termed the *Levers*, and the *muscles* and *tendons* the *pulleys* or *cords* of the living frame.(*l*) The bones enable us, with the assistance of the muscles and tendons, and influenced by the *nerves* and mental volition, to exercise the power of locomotion. They are generally hard and inflexible bodies, without contractility, and very little subject to decay,(*m*) they are considered as comparatively the most permanent and unchangeable parts

(*g*) See *Bowerman's* case, 3 Paris & Fonb. 80, post.

(*h*) *Aran's* case, 3 Paris & Fonb. 77, 311, 314, post.

(*i*) See 9 G. 4, c. 31, s. 13; Amer. Cy. Prac. Med. tit. Ages; Smith, For. Med. 312 to 316; 1 Paris & Fonb. 239, 339; and see post, as to quickening. The quickening is between the fourth and fifth month, and at six months the skeleton of the fœtus is usually about *twelve inches long*, and *the spine five;* and certain other bones are formed after the *fifth* month.

(*k*) Amongst others, he states an anecdote of a malevolent countryman having consulted Sir A. Cooper on the state of his shoulder joint, and being assured it was dislocated, contrary to the report of his country surgeon, and being advised it was too late to attempt a reduction, he vowed vengeance, and indulged his malice by exhibiting his deformity round the country, and declaring that Mr. —— might be a good apothecary, but he was no surgeon, and thereby the latter was materially injured, although in his general practice of a surgeon and apothecary, he was eminently skiful. See also ante, 15, 16, as to the necessity for being well informed of the healthy and natural state of the human frame. Ryan, Med. Jur. 91.

(*l*) 1 Dunglison, Phy. 329, &c.; 1 Bost. Ph. 75.

(*m*) Bost. Ph. 75.

CHAP. III. Sect. I. Skeleton and Bones.

of the body, and remain undecomposed even for centuries.(*n*) But even these vary in their consistency and structure at different ages.—Like the muscles, they are nourished by the fluids, and even material parts destroyed by a fracture or disease are renewed by the process of ossification,(*o*) and small particles are constantly removed, and new materials deposited in their stead.

Fourthly, Form, and several sorts of bones.

Bones, with regard to their *form* and *size* are very various. They are either *long*, or irregularly *round* figured, short, broad and *flat*, or mixed,(*p*) and they have accordingly been arranged into *classes*, namely, the long round bones, the broad flat bones, and the short bones—approaching more or less to the square form; to the first class belong the bones of the upper and lower extremities; to the second class those of the skull; and to the third the vertebræ. These three kinds of bones differ not merely in their shape, but in the more essential points of the mode of their growth and their mechanical structure. They are also distinguished by the uses which they serve in the animal economy. The long bones are more immediately adapted for the purposes of motion, either enabling us to shift our position from place to place, constituting what is termed locomotion, or to act upon other bodies that are contiguous to us, as is especially the case with our hands and arms. The flat bones obviously serve for the protection of the soft parts; while the third class of bones are usually found in those organs where it was necessary to unite in the same part a considerable degree of strength with the capacity of free motion.(*q*)

Long Bones.

The *long* or *cylindrical* bones belong in general to the parts intended for locomotion; each long bone presents a body or middle, and two extremities; the shaft or body in the centre is round and cylindrical in some, prismatic or three-sided in others, but somewhat bent or twisted on its axis, so that the direction of its upper end does not correspond with that of the lower end. The external part is an osseous shell, with cancelli projecting inwards. The internal canal is circular, and is intended not merely to lodge and protect the medulla or narrow, but it greatly contributes to the strength of the bone upon the general well-known principle, that if there be two cylinders containing the same quantity of matter, and of the same weight, and one be solid and the other hollow, the power of resistance of the latter is greater than that of the former, owing to its greater diameter.(*r*) We observe the same principle in the composition of the hollow bones of birds, and even in their quills; and the application of this certain principle, as regards hollow bones, has led to the adoption of hollow masts of ships, and hollow tubes of metal, which are stronger than the same quantity of metal as a solid rod, because its substance, standing farther from the centre, resists bending with a longer lever; hence, pillars of cast iron are generally made hollow that they may have strength, with as little metal as possible.(*s*) By this conformation these bones, without being increased in weight, afford a more expanded surface for the attachment of muscles or flesh, and require an adequate degree of lightness, together with sufficient superficial extent, which are important requisites in what may be considered the passive organs of locomotion. Some of these long bones, especially the tibia, are peculiarly subject to *mortification*,(*t*) perhaps, because they are farther from the heart than the femur. When

(*n*) 1 Bell, Anat. 2; 1 Horner, Anat. 56; 1 Bost. Ph. 75.

(*o*) Ante, 42, 43; and post.

(*p*) 1 Dunglison, Phy. 289; 1 Horner, Anat. 51; 1 Bost. 76.

(*q*) 1 Bost. 76; 1 Dunglison, Phy. 289.

(*r*) This is a doctrine applicable *to all* cylinders, 1 Horner, Anat. 54; 1 Dunglison, Phy. 290; 1 Bost. 84; 1 Arnott, El. Phys. 435.

(*s*) 1 Arnott, El. Phys. 434, 435.

(*t*) See 2 Gibson, Surg. 9 to 37, on Diseases of Bones.

fractured, these long bones quickly reunite by callus, in a manner hereafter explained, when fractures will be considered.(*u*)

The Short Round Bones.

The *short irregularly round figured bones* are usually situated in parts in which solidity and firmness are required to be combined with freedom of motion, as in the carpus, tarsus and vertebral column. Their external conformation is necessarily influenced and determined by that of the parts into whose composition they enter, and as they are intended to co-operate in certain common functions, they present a number of articulating surfaces, prominences and depressions suited to their mode of adaptation and mutual connexion. These, in general, consist of a spongy structure, incased in their osseous shell, and of which also the extremities of all the long cylindrical bones consist.(*x*) These bones, or parts of bones, are peculiarly liable to *caries or ulceration*, but not to *necrosis* or mortification, nor to *exfoliation*. The caries in these bones is to be treated differently, according to the nature of the ulceration.(*y*) *Dislocations* of these spongy bones rarely occur; and if in the upper part of the spinal column, as in the atlas or dentata, they are commonly combined with fracture, and are almost inevitably fatal. Their fracture is usually transverse, and they seldom reunite by osseous union: but, as it is said, generally by ligamentous union; and some contend that they reunite by cartilaginous reunion;(*z*) but according to the better opinion, that is an error, because *cartilage* is never *reproduced*.

The Flat Bones.

The *third* class, or *flat bones*, are principally those in the cranium or skull.(*a*) These are dense and compact, and usually consist of two tables, one under the other, and the exterior of which is thicker, the interior more dense, and denominated the *vitreous table*, and between them there is an intermediate spongy substance termed *Diploe*.(*b*) They present two surfaces, one convex and the other concave, which conformation, by giving them an arched form, increases their power of resistance, and affords additional security to the organs they enclose. The bones of the pelvis also come under this denomination.(*c*)

The Mixed Bones.

The *fourth*, or *mixed* description of *bones*, are so irregular in their form, as not to be properly classible under either of the other heads. Most of these are situated along the median line, as the Sphenoid and Ethmoid bones.(*d*)

Surfaces, eminences and depressions.

The *surfaces* of bones in general have *eminences* and *depressions;* the former constructed for numerous purposes and uses, as for articulation, or for insertion of the tendons, or adapted to the form of the surrounding muscles;(*e*) as in and near the centre of the humerus the bone is small, and the surface adapted to make room for and receive the swell or belly of the muscle, when the fore or lower part of the arm is raised to the head.

Fifthly, Structure and composition of Bones.

The general opinion amongst modern anatomists respecting the *structure of bone* and its porosity, and the manner in which its membranous

(*u*) 1 Gibson. Surg. 311.

(*x*) 1 Horn. Anat. 54, 55; 1 Dung Phy. 290.

(*y*) 2 Gibson, Surg. 14, 15.

(*z*) Liz. 116, 117. How to treat a fracture of these bones, see Sir A. Cooper on Dislocations, and 1 Gibson Surg. 295.

(*a*) 1 Horn. Anat. 163; as to these, see post, Head and Brains, and as to the *Diseases* more particularly affecting them, 2 Gibson, Surg. 9 to 32, &c.

(*b*) 1 Horn. Anat. 163, &c.

(*c*) 1 Arnott, El. Phys. 433.

(*d*) Quain's El. 39, id. 2d edit. 39. The occipital is also there instanced, but that bone is not a good instance, for it in every respect corresponds with the other cranial bones.

(*e*) 1 Horn. Anat. 51; 1 Bost Phy. 13, 1 Dungl. Phy. 290.

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part is arranged, is, that, like the soft solid, it is essentially composed of *fibrous laminæ or plates*, which are so connected together as to form by their intersection a series of cells analogous to those of the cellular texture or tissue, and in which the earthly particles are deposited.(*f*)

The *composition* of bone is made up of several elements, namely, a cellular base, or simple membrane (before described,) in the areolæ of which is deposited a peculiar earthy salt.(*g*) The principal constituents are gelatine, cartilage, and phosphate of lime; the gelatine and cartilage constitute the *animal* property, and the phosphate of lime the *earthy*.(*h*) These constituents may be separated, so that each may be examined by itself. Bone, shell, cartilage and membrane, in their nascent state, are all the same substance, and originate from the *coagulable lymph of the blood*, which gives forth *gelatine*, and produces bone by secretion, though it does not contain albumen;(*i*) *membrane* is *gelatine*, with a small proportion of albumen, to give it a certain degree of firmness; *cartilage* is membrane, with a larger proportion of albumen, to give it a still greater degree of firmness; and shell and bone are cartilage, hardened and rendered solid by the insertion of lime into their interior; in the case of shell, the lime being intermixed with a small proportion of phosphoric, and a much larger proportion of carbonic acid, and in the case of bone, with a small proportion of carbonic, and a much larger of phosphoric acid.(*k*) Healthy bone should, it is said, contain more than half of the earthy matter, and if not, it will be too flexible.(*l*)

The two following are stated to be the results of experiments and analysis.(*m*)

Fourcroy and Vauquelin.

Animal matter	51.0
Phosphate of Lime . . .	37.7
Carbonate of Lime . . .	10.0
Phosphate of Magnesia . .	1.3
	100

Berzelius.

Cartilage	32.17
Blood Vessels	1.13
Fluate of lime	2.0
Phosphate of Lime . . .	51.09
Carbonate of Lime . . .	11.30
Phosphate of Magnesia . .	1.16
Soda, Muriate of Soda and Water	1.20
	100

The general results of these analyses serve to show that the fibrillæ, into which bone may be divided by maceration, consist of a *cellular tissue*, containing in its areolæ a quantity of earthy salts. It is hence obvious, that if the earthy and the animal parts of bone do not bear a proper relation to each other, the bone must be improperly tempered and unadapted to its office; and that if the earthy or calcareous part be deficient, its substance must be too soft and yielding, and tend to produce that defect or disease called *Parostia Flexilis* or *Mollities ossium*, or too great flexibility of bone; and that if, on the other hand, the animal part be deficient, or the calcareous part in excess, it must lose its cohesive

(*f*) 1 Bost. Ph. 84; 1 Horn. Anat. 52.
(*g*) See 1 Bost. 85; 1 Horn. Anat. 55. Quain's El.
(*h*) 1 Bost. Ph. 85; 1 Horn. Anat. 55.
(*i*) Id. ibid. and ante, 20, 21.
(*k*) 1 Bost. 85 to 88, &c.; 5 Good, 218, 1 Horn. Anat. 55, 267; 1 Dungl. Phy. 291. Jackson, Prin. Med. 268; 1 Bell's Anat. 526; 3 Paris & Fonb. 76.
(*l*) 5 Good, 220.
(*m*) See a description of the process to analyze, 1 Bell's Anat. 526; Quain's El. 44.

power, become brittle and apt to break, and produce that defect or disease called *Parostia fragilis* or *Fragilitas ossium*.(*n*)

The knowledge of these defects leads to a peculiar treatment of each with respect to *diet* and *other remedial measures*;(*o*) and though it is said that the earthy property of lime is supplied and continued without regard to the nature of the food, or of the soil or country where the party resides;(*p*) yet, when the bone is too brittle, an unhealthy condition of the osseous system is thereby indicated, for which sea air, tonics, with the use of acids and a generous diet, are recommended;(*q*) and when, on the other hand, the bones are too *flexible*, perfect quiet, with a plain unirritating but somewhat generous diet, and tonic medicines, are recommended.(*r*)

Gelatine and cartilage defined.

Gelatine, we have seen, is a gluey matter, being the *lymph* of the blood.(*s*) *Cartilage* is the silvery white semi-transparent but dense and solid substance, which *covers* the *articular ends* of bones, entering into the formation of joints in the fresh state, and which would otherwise rub against each other, or it is *interposed between bones*, as between the vertebræ and ribs, and which, as man advances in age, gradually become in a degree ossified, but which still exist in the hardest bones, and constitute their basis, and from which the gelatine and phosphate of lime may be removed; and this substance is provided with nerves, arteries, veins, and lymphatics. But it has been considered, that in joints, the cartilaginous surface does not secrete any synovial fluid;(*t*) and we have seen, that it is the general opinion that cartilage is never reproduced.(*u*) In adult age, the earthy portion or phosphate of lime preponderates, and the bones are of a whiter colour, and they are then more brittle, and when fractured, unite more slowly than in youth.(*x*)

Marrow.

Medulla or *marrow* is found even in the most solid portions of bone. It serves to moisten the bones, and thereby gives them strength.(*y*) This does not begin to be secreted until after birth. The constituent principles of marrow are found to be the same as other fat sustances, namely, oil, water, and sebacic acid.(*z*) In infancy, being interspersed with numerous blood vessels, it appears like a *red jelly*, afterwards, towards maturity, as the blood vessels therein decrease, it appears *yellow*, and in old age is of a *deep yellow* colour, and of a thicker consistence. It is more solid and yellow in males than in females.(*a*) In consumptive diseases, the medulla is absorbed by the lymphatics, but is soon deposited again if the constitution resume its healthy functions; it does not appear to be subject to *idiopathic* diseases, but is only changed when the bones are affected at the same time.(*b*)

Other oily matter in bones.

Besides the marrow which occupies the central cavities of some of the larger bones, the pores and cancelli of the bone itself contain a kind of *oily matter*, which has been thought to differ from marrow merely in being more fluid.(*c*) It is conjectured, that the marrow and the oil of bones serve the same purposes in the animal economy with the other oily secretions.(*d*)

Bones, in their most perfect state, possess but very few *blood vessels*,

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(*n*) 5 Good, 218, 219; 2 Gibson, Surg. 32, 34.

(*o*) Id. 223, &c.

(*p*) Id. 235.

(*q*) Id. 219.

(*r*) Id. 223.

(*s*) Ante, 26, 27; 1 Dunglison, Phy. 15.

(*t*) 2 Dunglison, Phy. 209; 3 Par. & Fonb. 76; 1 Horner, Anat. 279; see post, as to cartilage.

(*u*) Ante, 59.

(*x*) 3 Paris, 73, 76; 5 Good, 218, 219; Amer. Cyclop. Prac. Med. tit. *Ages*.

(*y*) 1 Horner, Anat. 65; 2 Dunglison, Phy. 209; but see 1 Bost. 88.

(*z*) 1 Bost. 86; 2 Dunglison, Phy. 209.

(*a*) Id. ibid.; and see 2 Par. & Fonb. 21, 24.

(*b*) 1 Horner, Anat. 67.

(*c*) 1 Bost. 87.

(*d*) Id. 88.

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Arteries and veins in bones.

compared with other parts of the human frame. They are, however, supplied with arteries and veins (*f*) for their growth and nourishment.(*g*) The bones, in infancy, are formed by the arteries, and modified partly by the periosteum and partly by their elaboration through the gelatinous and cartilaginous substances:(*h*) but as they advance gradually towards completion, the vessels which enter their structure become obliterated, and the bones become more and more dependent on the periosteum for osseous nutrition.(*i*)

Absorbent and secernent vessels in bones.

It has been observed, that no *absorbent* or *secreting vessels* have been *discovered* in the bones, but that it is certain that they contain them from other effects, namely, the gradual removal of old particles and deposite of new, which it is known take place, and which can be attributed to no other cause, as in the instance of bones of animals fed upon madder root, which become thereby coloured.(*k*)

Whether there are *nerves* in bones.

It has been said, that when bone is in its most perfect state (that is, when most ossified,) it does not seem that any *nerves are sent to them*, and that bones are consequently devoid of *sensibility;*(*l*) others state, that although they have but *little* sensibility, still they possess *some* feeling.(*m*) It is generally admitted, that when bones are the seat of *disease*, they become exquisitely painful, and this is accounted for on the ground that the sensation arises, not from any nerves actually *sent to* the bone itself, but from their increased bulk (attributable to their inflamed state,) and their unnatural or unhealthy firmness of texture distending and pressing upon the nerves, which are distributed upon the contiguous parts; and this we have seen takes place with respect to diseased membranes of all descriptions.(*n*)

Sixthly, Vitality of bones.

Dr Bostock inclines to think, that every part of the bone is possessed of *vitality*, and that even the phosphate of lime, while forming a part of an organized body, is alive, because the bone is so generally.(*o*)

Seventhly, Of the Periosteum of bones.

The bones are *invested* or surrounded throughout (except at their articulating or joining extremities) with a vascular membrane called the *Periosteum* (from περι about, οστεον the bone,) and of which some contend there is an *external* and an *internal* periosteum;(*p*) but the latter has been disputed.(*p*) The internal periosteum of the long bones in particular, it is insisted, is concerned in the reproduction of bone after necrosis or mortification.(*q*) In the latter part of life, when the blood vessels in the bone have become obliterated, the periosteum affords osseous and appropriate nutrition to the bones,(*r*) and it has been considered as the exclusive organ of ossification.(*s*) The periosteum also gives attachment to tendons, ligaments and muscles.(*t*)

Eighthly, Progress of ossification and reproduction of bone or callus.

Of all the systems of organs, the *osseous* is that which in the ordinary course of nature arrives *latest* at its full period of development and perfection, the progress of ossification not being fully completed in all the different parts of the skeleton until about the sixteenth or eighteenth

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(*f*) [The author is in error, as the blood vessels of bones, though small, are very numerous, see 1 Horner, Anat. 61, 62.]

(*g*) Broussais, Phy. 228; 1 Bost. 101.

(*h*) The formation also, like all other secretions, is influenced by the *nerves*.

(*i*) 1 Horner, Anat. 73.

(*k*) 1 Bost. 101; 1 Horner, Anat. 63.

(*l*) 1 Bost. 101; [See on this subject, Beclard, Anat. Gen. who states that nerves have been traced into them.]

(*m*) Liz. 113 to 116.

(*n*) 1 Bost. 102; Broussais, Phy. 485; Jackson, Prin. Med. 273.

(*o*) 1 Bost. 103; and see post, 64, 65.

(*p*) 1 Horner, Anat. 63; 1 Dunglison, Phy. 292; 1 Bell, Anat. 27, 28, 399 to 401.

(*q*) 1 Horner, Anat. 67.

(*r*) Liz. 116; Coop. Dict. tit. Fracture.

(*s*) Coop. Dict. tit. Fracture.

(*t*) 1 Horner, Anat. 63.

year,(*u*) and sometimes even later.(*x*) The progress of the growth of bone in the *fœtus* being practically of very considerable importance, as well surgically as in numerous judicial inquiries, will be hereafter more particularly considered.(*y*) It may here suffice to state that the ossific process runs though three distinct states or conditions, namely, the mucous, next cartilaginous, and finally that of solid bone.(*z*) Though these succeed each other regularly, it would be a mistake to suppose that the mucus becomes hardened into a cartilage, or the latter solidified into bone, by any process similar to transformation. The change is gradual, coinciding, in some measure, with an alteration in the mode of nutrition in the part, in consequence of which bone is from time to time deposited in place of cartilage.(*a*) Like other parts of the human frame, bones ossify and increase from the external circumference towards the centre, and not from the centre towards the surface,(*b*) though we have seen that there are exceptions, especially in the cranial bones.(*c*)

The progress of ossification in cases of *fracture* and diseases of the bone, will be more properly considered when we examine the treatment of *fractures* and *dislocations*.(*d*)

The power which the constitution possesses of repairing bones when accidentally injured, is, perhaps, more wonderful in its operation than that which originally produced them, as it exhibits, in a remarkable manner, that mutual adjustment of the different corporeal actions, and the adaptation of it to fortuitous circumstances, which distinguish the living animal machine from all mechanical contrivances. Not only do we find that if a bone be completely divided, the fractured ends are quickly cemented together and rendered as firm as before the injury; but even after a considerable portion of the bone has been removed, a new portion is actually *generated* to supply the deficiency.(*e*)

It is now generally understood, that the process by which bone is *repaired*, is very similar to that by which it was originally produced; the arteries of the divided bone throw out a soft matter called *lymph* or *coagulated albumen;* this becomes gradually converted into cartilage, or rather, perhaps, is replaced by it after being itself previously absorbed. The earth of bone is then deposited in this cartilage, and the cartilage itself is then gradually removed by the absorbents: but the immediate cause by which this change is effected seems unknown.(*f*)

Like all other organized parts, we have reason to suppose that every portion of bone is connected with both the arterial and the absorbent system, and that in process of time each particle is removed and fresh ones deposited in their place.(*g*)

Ninth, Defects and diseases in bone. (*h*)

Bones are subject to various *defects* and *diseases*. The defects are, *misossification*, which is of two descriptions, namely, 1st, *parostia fragilis* or

(*u*) Amer. Cyclop. Prac. Med. tit. *Ages*, 260.

(*x*) 1 Horner, Anat. 72, &c., 3 Par & Fonbl. 75, 76; and see 3 Bost. 264.

(*y*) Post, Chapter on the Distinction of Sexes, &c.

(*z*) 1 Horner, Anat, 68; 1 Bost. 95, 96.

(*a*) 1 Horner, Anat. 69; 3 Par. & Fonbl. 75, 76.

(*b*) 1 Horner, Anat. 69, 70; but see ante, 38, 39.

(*c*) Ante, 38, 39.

(*d*) See Sir A. Cooper on Dislocations and Fractures; Coop. Surg. Dict. tit. Callus, 282; and tit, Fractures, 498 to 502; and post, of *Fractures;* 1 Gibson, Surg. 282.

(*e*) 1 Bost. 99; and see ante, 42, 43, as to the continual renewal of parts; and see the peculiarity that in *some* pregnant women callus will not form until after their delivery, and will then proceed regularly; 5 Good, 10; post, 66, note.(*r*) 1 Horner, Anat. 75.

(*f*) 1 Bost. 99, 100; 1 Horner, Anat. 75.

(*g*) 1 Bost. 99 to 104; ante, 42; and supra, note (*d*,) (*e*).

(*h*) It will be observed, that in the context, the phrases adopted by Dr. Good in

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too great *brittleness*,(*i*) or, 2d, *parostia flexilis* or *mollities ossium*, being too great *flexibility*,(*k*) or, 3d, bones may be changed into a fleshy substance called *osteo sarcoma*, (from οστεον and σαρξ flesh) and which always originates in the periosteum.(*l*) So there may be *contortions* of bone,(*m*) which is either *cyrtosis rhachia*, vulgarly called *rickets*, and chiefly affecting children,(*n*) or *cyrtosis cretinismus* or cretinism, also constituting a contortion of bone, and usually combined with mental imbecility.(*o*)

A *third* defect or disease is termed *anchylosis*, or a junction of the joints, as if they were soldered together, and destroying the power of locomotion.(*p*)

Fourthly, is a local defective ossification in some of the vertebræ, and a fluid swelling, most commonly situated over the lower lumbar vertebræ, called *spina bifida*.(*q*) This is merely *defective union* of the two ossific centres, forming the spinous process of each vertebræ.

A *fifth* irregularity is *osthexia* or *osthexy*, from the Greek οστεον and εθος, "*a bony habit*," and which is an undue ossification of the soft parts, and when they become indurated by a superfluous secretion and deposite of ossific matter.(*r*) In this disease, the earthy property is *too* abundantly generated and not sufficiently carried off; whereas in the parostia flexilis it was too deficiently supplied.(*s*) This is of two descriptions, namely, *first*, *osthexia infarciens*, which are calculous concretions of ossific matter, deposited in nodules in the organs of, and formed in the kidneys and bladder, and sometimes in the substance of the brain, or in the lungs, and in the substance of the breast, &c., and which sometimes occur in the decline of life;(*t*) *secondly*, *osthexia implexia* or ossific matter, deposited in concentric layers in the tunics of vessels, rendering them rigid and unimpressible, as an ossification of the *aorta* or other large arteries.(*u*) The arteries of almost any part of the body may deposite bony matter, however soft and flexible may be the structure in which they ramify. We have bony deposite in the kidneys, in the fibrous membrane of the brain, or even in substance in the tendons, and very generally in the arteries of old persons, rendering them rigid and incompressible.

The *diseases* of the bones are either *general*, which may affect *all*, or *peculiar* and confined to *some* bones. When bones are labouring under disease they exhibit very unequivocal marks of *vitality;* being subject to affections which are precisely similar to the inflammation, swelling, and suppuration of soft parts, making allowance for the difference of their mechanical structure. And although healthy bone is insensible, yet in some of its diseased states it becomes exquisitely painful; and in this case

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his excellent comprehensive work, in describing the *diseases* of bone, have been adopted; but it is fit to intimate to the student that some of these are now objected to by some eminent surgeons as not strictly professional. The *diseases* of bone, as distinguishable from *defects*, are in general similar to those of *soft parts*. *Inflammation*, terminating either in abscess, ulceration, or caries, in *necrosis* or mortification, or *deposite of bone*, called *thickening*, when in the walls or medulla, or *exostosis* or growth from the surface, fragilitas osseum, mollities osseum, rachitis, each of which may be congenital, the latter generally so. Osteo sarcoma is a growth from bone, partly bony, partly of a hard, whitish, firm, flesh-like substance, or rather like gristle.

(*i*) 5 Good, 218; 2 Gibson, Surg. 34; Coop. Surg. Dict. tit. Fragilitas Ossium, p. 540.

(*k*) 5 Good, 219; 2 Gib. Surg. 32; Coop. Surg. Dict. tit. Mollities Ossium.

(*l*) Coop. Surg. Dict. tit. Osteo Sarcoma; 2 Gibson, Surg. 25.

(*m*) 5 Good, 224; 2 Gibson, Surg. 35.

(*n*) 5 Good, 224, &c.; Coop. Surg. Dict. tit. Rachitis; and tit. Rickets see the *remedy*, 5 Good, 229; andas to the vertebral column; 1 Arnott, 425.

(*o*) 5 Good, 232.

(*p*) Ante, 56, n. (*d*;) Liz. 127; Coop. Surg. Dict. tit. Anchylosis.

(*q*) 5 Good, 273; Coop. Surg. Dict. tit. Spina Bifida.

(*r*) 5 Good, 234.

(*s*) Id. ibid.; and supra.

(*t*) 5 Good, 235.

(*u*) Id. 236.

it may, we have seen, be presumed that the sensation arises not from any nerves actually sent to the bone itself, but from its increased bulk and firm texture distending the nerves that are distributed upon the contiguous parts, as takes place with respect to dense membranes of all descriptions.(*x*) Should the health of the patient thus affected, suffer by the combined effects of the disease and long confinement, it may be desirable to bring the disease to a crisis by artificial means, namely, that of cutting down on the bone and sawing away the diseased or dead portion.

The same general observations with respect to the nature of their *Diseases*, will apply to the bones as to the cartilages and the tendons.(*y*) They are principally *caries, necrosis, exostosis;* and when the bone is inflamed, the action terminates either in resolution, exfoliation, necrosis, or caries.(*z*)

Caries.

Caries is ulceration of bone, and this ulceration is found to vary or to present different types in precisely the same manner as the soft parts; namely, there is healthy ulcer, and healthy caries, indolent ulcer and indolent caries, &c.(*a*) This more frequently affects the spongy bones, such as the vertebræ. When it affects the body of one of the vertebræ, or one of the bones of the carpus or tarsus, it generally also affects the contiguous one. The TREATMENT, if it be a healthy description of caries, is that of simple dressing; when indolent, stimulating dressing and slight pressure by bandage; when irritable, anodyne fomentations and poultices; (*b*) when inflammation has subsided, and no other means exist of procuring a healthy termination to the disease, then amputation may become necessary.(*c*)

Necrosis.

Necrosis is a *mortification* of bone, and this more frequently attacks the long cylindrical dense bones, and especially the Tibia,(*d*) and which bones we have seen are seldom affected by caries. It never affects the ribs, although their structure resembles the other bones subject to that disease.(*e*) In the TREATMENT, the dead bone is to be left as long as the health of the patient will permit, for the purpose of being either exfoliated or absorbed.(*f*)

New formed parts, such as callus, readily admits of being absorbed, and hence, when formerly there have been broken bones, ulcers will, sometimes, destroy the callus of old fractures.(*g*)

Exostosis.

EXOSTOSIS has been defined by one of the ablest anatomists and surgeons of the present time to be a disease of bone consisting of the heaping up of new spongy ossific matter from the surface of apparently healthy bone. These tumours sometimes acquire an enormous size, and on examination appear like large fungous growth of bone, destroying all trace of the form of the bone from which they grew. The same disease in the horse is called a *splint*.(*h*)

(*x*) Ante, 25.
(*y*) 1 Bost. 102, and post.
(*z*) 2 Gibson, Surg. 9 to 40; 1 Bost. 102.
(*a*) 3 Good, 348; Cooper's Surg. Dict. tit. Antrum; tit. Caries; and tit. Vertebræ.
(*b*) Id. Ibid. 2 Gibson, Surg. 11.
(*c*) 2 Gibson, Surg. 12.
(*d*) 2 Gibson, Surg. 18; 3 Good, 345; 5 Good, 220; Cooper's Surg. Dict. tit. Necrosis, and tit. Spina Ventosa.
(*e*) Lizars, 13.
(*f*) 2 Gibson, Surg. 18; and see numerous authors referred to in Coop. Dict. tit. Necrosis.
(*g*) See Coop. Dict. tit. Ulcers.
(*h*) See also the definition in 5 Good, 215; Coop, Dict. tit. Exostosis; 2 Gibson, Surg. 20 to 22.

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Spina Ventosa.

Spina Ventosa (a term nearly obsolete among medical writers,) is a disease of the long bones, attended with a formation of matter in, and absorption of the medullary cavity, and thinning with extension of the walls. It is occasionally confounded with a somewhat similar change in the bone which occurs in white swelling.(*i*)

6. Injuries to Bones.

The injuries to *Bones* are principally *fractures*, and those to *Joints* are usually *dislocations;*(*k*) but they are not unfrequently composed of both. *Fracture* is the actual separation of one part of a bone from the other, whilst *Dislocation* obviously signifies the separation of the parts composing a joint.(*l*) The *Vertebræ*, and the bones of the carpus and tarsus, and other irregularly round figured bones, which consist of a spongy structure, incased in a thin osseous shell, are, on account of their situation, seldom dislocated, they being so strongly connected by muscles and ligaments;(*m*) but they may be fractured, and are usually so transversely.(*m*) If the Atlas, or either of the cervical vertebræ be dislocated, it usually instantly occasions generally paralysis and death.(*n*) The *Sternum*, or the breast bone, also, is never dislocated, but is subject to fracture.(*o*) The Ribs are particularly liable to a splintering or comminuted fracture.(*p*) The *Vertebræ*, and other bones first referred to, seldom unite by osseous junction, but generally by cartilaginous or ligamentous union, or by both.(*q*) The dense bones when fractured form a strong bond of union, and their torn vessels pour out a superabundance of bony matter.(*q*) But the subject of fractures and dislocations and their treatment will be more properly considered hereafter. It is a remarkable, but well established fact, that all the powers are frequently so devoted and applied in the support of the growing fœtus that a broken bone in a *pregnant woman* will sometimes not, during her pregnancy, secrete any callus, and consequently will not unite till after child-birth,(*r*) but this result is by no means universal.

7. The Number and Names of Bones in particular. (*s*)

The *number* of bones differ according to the age at which the enumeration is taken; for at maturity and subsequently, many bones, apparently several, are so joined by ossification as to become one. The whole skeleton is supposed to contain 245 bones, or according to Dr. Bostock, 260 bones,(*t*) or, omitting the mere small accessory bones, then only 197 bones,(*u*) namely, the *head, face and tongue and larynx* sixty-seven, including the thirty-two teeth; the *trunk*, containing the spinal column, thorax and pelvis, fifty-four. Each *upper extremity*, consisting of the shoulder, arm, forearm,

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(*i*) See also the definition in 2 Gibson, Surg. 22; 3 Good, 350; Coop. Dict. tit. Spina Ventosa; and tit. Exostosis.

(*k*) Some of the most celebrated authors speak rather vaguely of *Dislocations*. A dislocation can only be an injury to a *joint*, and not to the *bone* itself, and it is an injury only to *that part* of the joint most distant from the trunk. There is no such accident as dislocation of the *hip*, though the most eminent surgeons speak of it. It is a dislocation of the *femur* from the acetabulum. Both when united form the joint. Perhaps the proper definition of the term Dislocation is, *the displacement of the parts composing a joint.*

(*l*) See authors referred to in Coop. Dict. tit. Dislocation and Fracture.

(*m*) 1 Gibson, Surg. 355.

(*n*) 3 Paris, 51, 52.

(*o*) Id. 1 Gibson, Surg. 301; and Coop. Dict. tit. Dislocation.

(*p*) 1 Gibson, Surg. 298.

(*q*) 1 Lizars, 117; Coop. Dict. tit. Dislocation, and tit. Callus.

(*r*) 5 Good, 10.

(*s*) I have taken some of the following descriptions from Bell on Anatomy, Dr. Quain's El. 2d edit.; Dr. Arnott, El. Phys. and some from a skeleton before me; but principally from Dr. Arnott, who so clearly explains every subject on which he attempts to observe.

(*t*) 1 Bost. 76; Soemmering, Corp. Hum. Tab. ff. 12; Boyer's Anatomie, tom. 1, p. 12; Monro's Outlines, vol. 1, 12; 1 Horner, Anat. 50, &c.

(*u*) 1 Horner, Anat. 50—57.

hand, fingers and thumb, thirty-two; and each *lower extremity*, containing the thigh, leg, foot and toes, thirty bones. Thus, in the Head, the Cranium contains sixteen bones, eight being of the head, and eight of the ear; the face, forty-six bones, including the thirty-two teeth.(*v*) In the trunk, the spine contains twenty-four bones or vertebræ, the first nearest the head, called the Atlas, which supports the head; the second vertebra, termed the axis, because it is the pivot on which the head turns, or *dentata,* from its tooth-like process, by which it is fixed by ligaments to the base of the skull;(*x*) the thorax, twenty-six bones, namely, the two parts of the sternum or breast-bone (united in one at manhood,) and the twenty-four costæ or ribs; the pelvis, where the real spine terminates, and of which the hip bones form the sides, four bones, namely, the os sacrum (which is a spongy bone, like the vertebræ,) the os coccygis, and the two ossa innominata.(*y*) In the *upper extremity* the projection of each shoulder is formed by two bones, each upper arm contains one bone, each forearm two bones, and each hand twenty-seven bones, namely, each wrist eight bones, five metacarpal bones, and the fingers and thumb fourteen bones. In the *lower extremity* each thigh contains one bone, the *femur;* each leg three bones, namely, the *Tibia*, *fibula*, and *patella;* and each foot twenty-six bones.

But besides the above 245 bones, there are some other small bones, namely, the ossa Sesamoidea, which vary in size and number in different persons, and are usually situated at the roots of the thumb and great toe, and the ossa triquetra, or wormiana, which are small bones, varying in size and number, and occasionally found in the line of the sutures in some skulls.

The following tables and maps of the skeleton give the number, names and situation of each bone.

(*v*) It is part of the duty of a surgeon in the army to examine the teeth, for bad teeth, or loss of them, *disqualifies* a soldier from biting off the end of the cartridge, G. Smith, 441.

(*x*) 1 Horner, Anat. 83.

(*y*) As to a distorted Pelvis, see 1 Paris, 272, 274; Dewees, Midwif. 28.

TABLE OF THE BONES.(z)

- **SKELETON, 245 BONES.**
  - Head, 67 Bones,
    - Cranium, 16 Bones, viz. Head 8, Ears 8,
      - 1 Os Frontis
      - 2 Ossa Parietalia
      - 1 Occipitis
      - 2 Ossa Temporum, containing
        - 2 Mallei
        - 2 Inci
        - 2 Ossa Orbicularia
        - 2 Stapides
      - 1 Os Ethmoides
      - 1 Os Spænoides
    - Face, 46 Bones, viz. 6 Pairs, 2 Single Bones, 32 Teeth,
      - 2 Ossa Maxillaria Superiora
      - 2 Ossa Nasalia
      - 2 Ossa Lachrymalia
      - 2 Ossa Malarum
      - 2 Ossa Palatina
      - 2 Ossa Turbinata Inferiora
      - 1 Os Vomer
      - 1 Os Maxillare Inferius
      - 32 Dentes or Teeth, consisting of
        - 8 Incisores
        - 4 Cuspidati or Canini
        - 8 Bicuspides
        - 12 Molares
    - Tongue and Larynx, 5 Bones,
      - 1 Os Hyoides
      - 1 Thyroid bone
      - 1 Cricoid
      - 2 Arytenoid
  - Trunk, 54 Bones,
    - Spine, 24 Bones, - -
      - 24 Vertebræ, consisting of
        - 7 Cervical
        - 12 Dorsal
        - 5 Lumbar
    - Thorax, 26 Bones, - -
      - 2 Bones of the Sternum
      - 24 Costæ or Ribs, consisting on each side of -
        - 7 True
        - 5 False
    - Pelvis, 4 Bones, - -
      - 2 Ossa Innominata, each divided into - - - - - -
        - 1 Os Ilium
        - 1 Os Ischium
        - 1 Os Pubis
      - 1 Os Sacrum, 1 Os Coccygis — False Spine
  - Upper Extremity, 64 Bones,
    - Shoulders, 4 Bones, -
      - 2 Claviculæ
      - 2 Scapulæ
    - Arms, 2 Bones, - - -
      - 2 Os Humeri
    - Forearms, 4 Bones, -
      - 2 Ulnæ
      - 2 Radii
    - Hands, 54 Bones, - -
      - 16 Bones of the Carpi or Wrists
        - 2 Ossa Navicularia or Scaphoidea
        - 2 Ossa Lunaria
        - 2 Ossa Cuneiformia
        - 2 Ossa Pisiformia
        - 2 Ossa Trapezia
        - 2 Ossa Trapezoidea
        - 2 Ossa Magna
        - 2 Ossa Unciformia
      - 10 Bones of the Metacarpi
      - 28 Bones of the Phalanges or Fingers
  - Lower Extremity, 60 Bones,
    - Thighs, 2 Bones, - -
      - 2 Ossa Femorum
    - Legs, 6 Bones, - - -
      - 2 Tibiæ
      - 2 Fibulæ
      - 2 Patellæ or Rotulæ
    - Feet, 52 Bones, - - -
      - 14 Bones of the Tarsi or Insteps
        - 2 Astragali
        - 2 Ossa Calcium
        - 2 Ossa Cuboidea
        - 2 Ossa Naviculari or Scaphoides
        - 6 Ossa Cuneformia
          - 2 Internal
          - 2 Middle
          - 2 External
      - 10 Bones of the Metatarsi
      - 28 Phalanges of the Toes.

(z) See the two Plates of the Skeleton, and most of the principal Bones, with their names, ante, 54, 55.

Each bone is treated of separately in the different works on anatomy, as in Bell's Anatomy, 1 vol. page 1 to 203; [Horner's Special Anatomy, vol. 1, page 77 to 265;] in Quain's Elements, 36 to 143, and 237, id. second edition, 95 to 195. In these works a very particular view of each bone with the attachments of Muscles and Ligaments to each, is very fully and separately considered. In examining the Head, Nerves and Nervous System, we shall hereafter consider the bones of the head more particularly.

CHAP. III. SECT. I. SKELETON AND BONES.

Particular Bones.

The bones of the Cranium.

The *Cranium* or *Skull*, is described by Dr. Arnott as an instance of the arched form answering the purpose of giving strength.(*z*) The brain in its nature is so tender and susceptible of injury, that slight local pressure disturbs its action. Hence a solid covering like the skull was required, with those parts made stronger and thicker which are most exposed to injury. An architectural dome is constructed to resist one kind of force only, always acting in one direction, namely, that of gravity; and therefore its stength increases regularly towards the bottom, where the weight and horizontal force of the whole are to be resisted; but in the skull, as in a barrel-formed egg-shell, the mere tenacity of the substance is many times greater than sufficient to resist gravity, and therefore the form and securities are calculated to resist forces of other kinds operating in all directions.

In the early fœtal state, that which afterwards becomes the strong bony case of the brain, exists only as a tough flexible membrane. Ossification commences in this membrane long before birth, at a certain number of points, from which it spreads from the centre of each in the manner already stated,(*a*) and the portions of the skull formed around these points soon acquire the appearance of so many scales or shells applied on the surface of the brain, and held together by the remaining membrane not yet ossified. They afterwards become firmly fixed together, by projections of bone from each other, shooting in among similar projections of the adjoining ones, until all mutually cohere by perfect dove-tailed joints. These joints are called the *Sutures* of the cranium, and are visible after the skin has been removed, to extreme old age, and indeed for centuries after death. Through early childhood the cranium remains to a certain degree yielding and elastic, causing the falls and blows, so frequent during the lessons of walking, &c., to be borne with comparative impunity. The mature skull consists of two *layers* or *tables*, with a soft *diploe* between them; the outer table being very tough, with its parts dove-tailed into each other, while the inner table is harder and more brittle, and hence called *vitreous*,) with its edges merely lying in contact.

A very severe partial blow on the skull generally fractures and *depresses* the part, as a pistol bullet would; while one less severe, but with more extended contact, being slowly resisted by the arched form, often injures the skull by what is correspondent to the *horizontal thrust*, in a bridge, and causes a crack *at a distance* from the place struck—generally half way round to the opposite side. The French, in speaking of this effect, use the term *contre coup*. Sometimes in a fall with the head foremost, the skull would escape injury, but for the trunk which falls upon it and drives the end of the spine against or even through its base.(*b*)

Lower Jaw.

In the *Lower Jaw* we have to remark the greater mechanical advantage or lever power with which the muscles act, than in other parts of the

(*z*) 1 Arn. El. Ph. 422.

(*a*) Ante, 39, note (*z*) 1 Horn. Anat. 187.

(*b*) 1 Arnott's El. Ph. 423; 2 Gibson, Surg. 124.

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body. The temporal and masseter muscles pull almost *directly*, or at right angles to the line of the jaw, while in most other cases, as in that of the *deltoid muscle* lifting the arm, the muscles act very *obliquely*, and with power diminished in proportion to the obliquity of their attachment to the bone they are destined to move. An object placed between the back teeth is compressed with the whole direct power of the strong muscles of the jaw. Hence the human jaw can crush a body which offers great resistance.

The Teeth

The *Teeth* rank high amongst those parts of the animal body, which appear almost as if they were the results of distinct miraculous agencies; so difficult is it to suppose a few simple laws of life capable of producing the variety of form and fitness which they exhibit. They constitute a beautiful set of chisels and wedges, so arranged as to be most efficient for cutting, and tearing, and grinding the food, while their exterior enamel is so hard, that few substances in nature can make an impression upon it. In early states of society, teeth were used for many purposes for which steel is now used. It seems, however, as if the laws of life, astonishing to human intellect as they are, had still been inadequate to cause teeth, cased in their hard and polished enamel, to grow as the softer bones grow; and hence has arisen a provision more extraordinary still. A set of *small* teeth appear soon after birth, and serve the child until six or seven years of age; these then fall out, and as the jaws rapidly extend in dimensions, the second *Dentition*, as it is termed, commences, and these earlier small teeth are replaced by larger ones, and which usually, with care, endure for life; the number of the latter, however, being completed only when the individual is full grown, by the four teeth, called wisdom teeth, from their usually not appearing till maturity, fill up the then more spacious jaw. The general care of the teeth is of the utmost consequence to the health, comfort, and appearance of all, and considering the pain and the defects in speech, as well as appearance that may ensue from neglect of the teeth, the subject deserves the particular consideration of all parents and individuals, especially at the age of second dentition.(*c*)

The Spine.

The *Spine*, or *Back Bone*, in its structure has as much of beautiful and varied mechanism as any part of our wonderful frame. It is the central pillar of support, and the great connecting chain of all the other parts; and has at the same time, the office of containing within itself, and of protecting from external injury, a prolongation of the brain, called the *spinal marrow*, more important to animal life than the greater part of the brain itself. It has united in it the apparent incompatibilities of great elasticity, great flexibility in all directions, and great strength both to support a load, and to defend its important contents, as will be perceived on examining its elasticity and flexibility.

As respects *Elasticity*, the head rests on the elastic column of the spine as softly as the body of a carriage rests upon its springs, for between each two of the twenty-four vertebræ, or distinct bones of which the spine consists, there is a soft elastic *intervertebral substance* about half as bulky as a vertebra itself, and which yields readily to any sudden jar, The spine is waved, or bent like an italic *ſ*, as is perceived on viewing it sideways or in profile, and on this account, also, it yields to any sudden pressure operating against either end. The bending might seem a defect in a column intended to support weight, but the disposition of

(*c*) See observations in 1 Horn Anat. 505, &c., and the very sensible and instructive Treatise on Teeth by Nicholles, Surgeon Dentist, A. D. 1833.

the muscles around is such as to leave all the elasticity of that form, and a roomy thorax without any diminution of strength.

As respects *Flexibility*, the spine has been compared to a chain, because it consists of many distinct pieces, (twenty-four.) They are in contact by smoothly lubricated surfaces, which allow of a degree of motion in all directions, and a little motion comparatively between each two adjoining pieces necessarily becomes a great extent of motion in the whole line.

The *strength of the spine* as a whole, is shown in the fact of a man easily carrying upon his head or back, a weight heavier than himself, and the strength of each separate vertebra surrounding the spinal marrow is evident in its being a double arch or strong irregular ring. The spine increases in size towards its lower end in the justest proportion, as it has more weight to bear. The articulating surfaces of the spine are so many, and so exactly fitted to each other, and are connected by such number and strength of ligaments, that the combination of pieces becomes in reference to motion a much stronger column than a single bone of the same size would be.

Considering the great number of parts forming the spine, and their nice mutual adaptations, it might be expected that injuries and diseases of the structure would be very frequent. The reverse, however, under natural circumstances, is true; so that while almost innumerable works have been published on the diseases of almost every other part of the body, comparatively few works of authority have been written on spine affections; and what have appeared are of very recent date. One reason is, that whatever regards health and disease, is now much more completely analyzed than formerly; but Dr. Arnott correctly suggests, that another and the chief reason is, that from a change in modern times introduced into the system of management and dress of young ladies, a considerable proportion of them have grown to womanhood with weakened and crooked spines. The subject merits and will receive farther consideration in the second part of this work.

The Ribs.

The *Ribs.*—Attached to the twelve vertebræ of the back are the ribs, or bony stretchers of the cavity of the chest, constituting a structure which, as observed by Dr. Arnott, solves in the most perfect manner the difficult mechanical problem of making a cavity with a solid exterior which shall yet be capable of dilating and contracting itself. Each pair of corresponding ribs may be considered as constituting a hoop, which hangs obliquely down from the place of attachment behind, so that when the forepart of all the hoop is lifted by the muscles, the cavity of the chest is enlarged.

We have to remark the double connexion of the rib behind, first to the bodies of two adjoining vertebræ, and then to a process or projection from the lower vertebræ of the two, thus effecting a very steady joint, and yet leaving the necessary freedom of motion; and we observe the forepart of the rib to be joined to the *sternum,* or *breast bone,* by flexible cartilage, which allows the degree of motion required there without the complexity of a joint, and admirably guards, by its elasticity, against the effects of sudden blows or shocks.

The muscles which have their origin on the ribs, and their insertion into the bones of the arm, afford an example, worth remembering, of action and reaction being equal and contrary. When the ribs are fixed, these muscles move the arm; and when the arm is fixed, as by resting on a chair or other object, they with equal force move the ribs. The latter occurrence is seen in fits of asthma and dyspnoea, or difficulties of breathing.

Consideration of the Bones of

Some bones of the *Upper extremity* being most frequently the subjects of Dislocations and Fractures, and the subjects of actions against surgeons for supposed negligence in reducing or treating them, appear here to de-

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the Upper Extremity, and especially the Scapula, or shoulder blade, the Clavicle, or collarbone, and the Humerus, and shoulder joint, in connexion with Dislocations or Fractures, and actions against Surgeons for negligence.

The two Scapulæ. (d)

mand more particular consideration. These are principally the two Scapulæ or shoulder blades, the two Clavicles or collar bones, and the two Humeri or arm bones, and their two joints, with their several muscles; but as these are symmetrical, the description of one side will suffice for the other.

Each Scapula (from the Latin, and vulgarly called Shoulder Blade,) is placed upon the upper and back part of the thorax, and extends behind the second to the seventh true rib, and with its principal muscles attached, moves externally over those ribs, and forms the posterior part of the shoulder. It is rather irregularly triangular, being, near its inferior angle, of about the width of one inch, and gradually increasing upwards to four or five inches, and indeed at its largest and highest upper projection it is, from its inner to its outward edge, nearly six inches wide.(e) It lies nearly flat on the back, but it is rather concave internally, and in its centre is about one line, or the twelfth of an inch in thickness, whilst round its outward edge it is about the thickness of a quarter of an inch. Towards the top externally it has from its inner edge to its external upper extremity a ridge projecting of about an inch, and which terminates in a bony projection, resembling the smaller bones of the horn of a stag, and it has inward a similar but smaller projection, and which superiorly appears to form an upper projection to a small very shallow cavity in the centre, and at the top of the external, rather projecting edge of the scapula called major, and which cavity being termed the *glenoid cavity*, constitutes the small cavity in which the *joint* of the shoulder bone rotates or moves. The two projections over this cavity, from their form and appearance, might be termed the antlers of the scapula. They are considered as assisting in protecting and preventing dislocation. From the shallowness of this cavity it can scarcely be termed a socket, whilst on the other hand such shallowness is essential for the facility and rotatory motions of the shoulder joint in every direction. The external surface of the scapula is divided into the supra and infra spinatus fossæ, the inner surface is called *subscapular*. In order to increase the range of motion in the greatest possible degree, not only the joint of the humerus rolls in almost every direction in or rather upon this cavity, but also the scapula itself slides about upon the convex exterior of the chest, having its motion only limited in certain directions by its connexion through the clavicle with the sternum. This scapula, or shoulder blade, is an illustration of the mechanical rules for combining great lightness with strength. It has the strength of the arch, from being a little concave interiorly, and

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(d) I have been favoured with the following description of the scapula by one of the ablest anatomists of the present time. It has three costæ, or sides; a superior, or short; an anterior, or inferior; and a base directed towards that of the opposite side, and parallel to the spinal column. At the junction of the superior and the inferior sides, the bone is hollowed out into a small cavity, to receive the head of the humerus or upper arm; this is called the *glenoid cavity*, and is of an oval shape, presenting a hollow very slight, in proportion to the size of the head of the bone which articulates with it. From the upper and inner side of the glenoid cavity, and at the external extremity of the superior costa, a process of bone projects in an arched form towards the joint. It is about an inch in length, and is named the Coracoid process, as supposed from its resemblance to the beak of a crow. From the dorsum or posterior surface of the bone, at the distance of one-third from the upper costa, there extends from its base outwards a ridge increasing in height as it advances, and which terminates in a long projecting process, forming a sort of arch over the shoulder joint, and curved forwards towards the coracoid process; this is the *acromion*, or most prominent point of the shoulder, and from which a strong ligament extends inwards to the coracoid process, for the protection of the joint. By the projection of the spine two fossæ are formed; the superior is called the supra spinatus, the inferior, the inferior spinatus fossa. The anterior surface which lies on the ribs is called the subscapular fossa. To this bone are attached nearly all the muscles which move the humerus in its socket.

(e) See Plate II. No. 18, ante, p. 54.

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its substance is chiefly collected in its borders and spines, or edges, as they are termed, with their plates between.

The Humerus and shoulder joint.

The *Humerus*, or bone of the upper arm, is the largest bone of the upper extremity, and extends from the scapula to the bones of the forearm, with each of which it is articulated or jointed at the elbow. Its direction is vertical, with an inclination inwards towards the lower end. Long and irregularly cylindrical in form, the humerus is divided into a body or shaft and two extremities, and has ridges to give it strength. We shall here only speak of its upper or scapular end, where there is a large hemispherical eminence covered with cartilage on its posterior and inner surface, and by which it articulates with the glenoid cavity of the scapula, which we have already considered, and with which it articulates by a strong ligament, and this is called the *head* of the humerus, and which round head turns in the cavity of each shoulder bone in every direction. In consequence of such shallowness, the humerus is peculiarly subject to dislocation from the cup-shaped cavity in which it partially rests.

The Clavicles or collar bones. (*f*)

From each side, at the top of the sternum or breast bone, and connected on each side thereof by strong ligaments, are the two *collar bones*, technically called *clavicles*, (from *Clavis*, a key, which correctly designates their utility *in locking or securing together* the several bones of the scapula and humerus on each side to the sternum, though some insist that it is termed clavis because its form is supposed to resemble that of an ancient key,) and which extends from the sternum on each side to the shoulder, and over the shoulder joint. The external or scapular extremity of each clavicle is inclined a little backward and upward, and articulates with the *acromion* of the scapula by a narrow surface, which is covered with cartilage. This is frequently incorrectly described in plates of the skeleton as curving *upwards*. It is true that in its correct description it resembles an italic *f*, but it only resembles that letter when reversed, as thus  Looking from above and perpendicularly downwards on the chest, the clavicles project or curve forwards on each side of the sternum, like a bow, and thereby give space, and then as they approach near the arm they curve backwards, and they do not project much upwards, as has been represented in the plates, taken even from Albinus. The plates No. 1 and 2, ante, 54, correctly describe the scapula, clavicle, shoulder bone and joint. Each clavicle is nearly six inches long, and round in the centre, and not half an inch diameter, and is as thick again at each extremity as in the middle. Sir A. Cooper, in his invaluable Treatise on Dislocations and Fractures, describes an interesting case of a young woman whose clavicle or collar bone had, by dislocation or fracture, been depressed to such a degree, as dangerously to press upon and impede the use of the œsopha-

(*f*) The following description of the Clavicles is also from a most able Anatomist. "The Clavicle is a bone about six inches in length, extending horizontally outwards between the upper part of the sternum, or breast bone, and the acromion process of the scapula, with both of which it is articulated. Its greater extremity, or sternal end, is received into a very superficial cavity in the upper angle of the sternum,—its outer end is flattened horizontally, and is fixed by strong ligaments to a corresponding surface, observed on the extremity of the acromion. Thus a *bony* arch is formed over the shoulder joint, which serves the double purpose of affording protection to the joint, and of giving attachment to the large muscle of the shoulder, or Deltoid. The clavicle is curved like an italic *f*; its sternal curve being directed forwards for the purpose of allowing a space for the large vessels of the chest to emerge from that cavity; its acromial end curved backward, in order that it should form no obstacle to the elevation of the arm in that direction, and afford a somewhat longer attachment for the deltoid muscle. Many important muscles are connected to it, destined to move the upper extremity, and it serves the additional office of a *pivot* or *radius*, on which that extremity performs its various evolutions without coming in contact with the body. As to the difference between the male and female clavicle, see 3 Paris & Fonbl. 79.

gus; but she was relieved, and her life saved by a surgeon opening the chest, and sawing off the part of the bone that pressed on the œsophagus.

Dislocation of Shoulder Joint.

Notwithstanding all the securities to the shoulder joint which we have described, yet in the infinite variety of twists, falls and accidents to which men are liable, the joint is frequently *dislocated*, that is, the rounded head of the humerus, or arm bone, slips from its socket into the axilla or armpit, or in some other direction, and instant lameness is the consequence.

Arms, shoulder.

The bones of the arms, considered as levers, have the muscles which move them attached very near to the fulcra or axis of motion, and very obliquely, so that the muscles, by a comparatively slight contraction, move the distant extremity of the bones, through a space proportionate to the length of the bone, and thus they are required to be of great power. It has been calculated, that the muscles of the shoulder joint in the exertion of raising a man upon the hand, pull with a force of two thousand pounds.

Elbow.

The elbow joint is a well formed joint, but although, compared with the shoulder joint, strongly secured, it is nevertheless frequently dislocated, and this without fracture of the bones composing it.

Fore arm.

The fore arm consists of two bones, with a strong membrane between them. Its great breadth from this structure, affords abundant space for the origin of the many muscles which go to move the hand and fingers, and the very peculiar mode of connexion of the two bones, gives man the most useful faculty of turning the hand round into what are called the positions of pronation and supination, exemplified in the action of twisting, or of turning a corkscrew or gimlet.

The wrist.

The wrist. The many small bones forming the wrist, have a happy effect of deadening, in regard to the parts above, the shocks or blows which the hand sometimes receives.

The wrist and annular ligament.

The *annular ligament* is a strong band passing round the joint, and confining all the tendons which pass from the muscles above to the fingers. It answers the purpose of so many fixed pulleys for directing the tendons, and without it they would all, on action, start out like bow strings.

Hand and finger.

The human hand, and particularly the fingers, are so admirable, from their numerous mechanical and sensitive capabilities, that amongst the ancients an opinion at one time prevailed, that man's superior reason depended on his possessing such an instructer and such a servant. Perhaps no instance of the astonishing facility and rapidity of movement and execution can be referred to than that of any celebrated performer on any musical instrument, especially the pianoforte or the violin.

The pelvis.

The *Pelvis* or *basin* is a strong irregular ring of bone, on the upper edge of which the spine rests, and to the sides of which the legs are attached, and forms the centre of the skeleton. A broad bone was wanted here to connect the central column of the spine with the lateral columns of the legs, and a circle was the lightest and strongest that could be devised. If we should attempt still farther to conceive how the circle could be modified, so as to fit it for the spine to rest upon, for the thighs to roll in, for muscles to arise from, both above and below, for the person to be able to sit, &c., we should find, on inspection, that all these objects are admirably accomplished in the most perfect manner. In the pelvis, too, there are the thyroid and the ischiatic notches, furnishing subordinate instances of contrivance to save material and weight; they are merely deficiencies of bone, where solidity could have given no additional strength. The broad ring of the pelvis protects most securely the important organs placed within it; namely, the bladder and organs of generation, &c.

The hip joint exhibits the perfection of the ball and socket articulation. It allows the *leg* to move round in a circle, as well as to have the great range of backward and forward motion exhibited in the action of walking. When we see the elastic, tough, smooth, cartilage, which lines the deep socket of this joint, and the similar glistening covering of the ball or head of the thigh bone, and the lubricating synovia poured into the cavity by appropriate secretories, and the strong ligaments giving strength all around, we feel how far the most perfect of man's work falls short of the mechanism exhibited in nature.

The hip joint.

The thigh bone is remarkable for its two projections near the top, called *trochanters*, to which the moving muscles are fixed, and which lengthen considerably the lever by which the muscles work. The shaft of the bone is not straight, but has a considerable forward curvature. Short-sightedness might suppose this a weakness, the bone being a pillar to support a weight, but the bend gives it, in reality, the strength of the arch to bear the action of the mass of muscles called vasti, which lies and swells upon its fore part.

The thigh bone.

The knee is a hinge joint of complicated structure, claiming the most attentive study of the surgeon. The opposed surfaces of the bones composing it are flat and shallow, and therefore the joint has little strength from form, but it derives security from the numerous and singularly strong ligaments which surround it. The line of the leg, even in the most perfect shapes, bends inwards a little at the knee, requiring the support of the ligaments, and in many persons it bends very much, but the inclination does not increase with age. The legs of many weakly in-kneed children become straight by exercise alone. This inclination at the middle joint of the leg, by throwing a certain strain on the ligaments, gives, in such actions as jumping, running, &c., an increase of elasticity to the limb.

The knees.

In the knee there is a singular provision of loose cartilages between the ends of the bones. They have been sometimes called *friction cartilages*, from a supposed relation, in use, to friction wheels, but their real effect seems to be to accommodate, in the different positions of the joint, the surfaces of the rubbing bones to each other.

The knee joint is supplied with two lateral ligaments, preventing lateral motion in the extended position, *two* internal ligaments, which cross each other from the anterior to the posterior part of the articulation, and which restrain the extremes of flexion and extension; they are called the *crucial* ligaments. *Two* moveable cartilaginous sockets, which change their form for the purpose of adaptation to the varying form of the articulating end of the thigh bone, whether in one or the other position of the knee. The front exposed surface of the joint, in its bent state, is protected by the *knee pan* or *patella*, on which we kneel, and which serves the additional purpose of giving attachment to the powerful muscles which extend the leg. (*g*)

The knee joint.

The great muscles on the fore part of the thigh are contracted into a tendon a little above the knee, over and in front of which the tendon has to pass to reach the top of the leg, where its attachment is. The part of the tendon over the joint becomes bony, and forms the *patella or knee pan*, often called the pulley of the knee. This peculiarity enables the muscles to act more advantageously, by increasing the distance of the rope from the centre of motion. The patella is moreover a sort of shield or protection to the fore part of this important joint. (*h*)

The patella or knee pan.

(*g*) See the plates and the description of diseases in the knee joint, in Mr. Brodie's Treatise on the Diseases of the Joints, 2d edit.

(*h*) 1 Arnott, El. Ph. 434.

CHAP. III. SECT. I. SKELETON AND BONES.

Leg below.

The leg, below the knee, like the fore arm already described, has two bones, the tibia and fibula; they offer spacious surfaces of origin for the numerous muscles required for the feet, and they form a compound pillar of greater strength than the same quantity of bone, as one shaft, would have had. The individual bones also are angular instead of round; hence deriving greater power to resist blows, &c.

The ankle joint.

The ankle joint is a perfect hinge of great strength: there is an annular ligament by which the tendons passing to the foot and toes are kept in their places: there is a *posterior* as well as an anterior ligament, and *three* tendons pass under it behind the malleolus internus.

The tendon Achilles.

The heel, by projecting so far backwards, is a lever for those strong muscles to act by, which form the calf of the leg, and terminate in the tendon Achilles. The muscles, by drawing at it, lift the body in the actions of standing on the toes, walking, dancing, &c. In the foot of the negro, the heel is so long, as in European estimation to appear ugly, and its great length rendering the effort of smaller muscles sufficient for the various purposes: the calf of the negro's leg is smaller and higher than that of other races of men.

Arch of foot.

It has been observed,(*i*) that the arch of the foot is to be noticed as another of the many provisions for saving the body from shocks, by the elasticity of the support; and that the heel and the ball of the toes are the two extremes of the elastic arch, and the leg rests between them.(*j*) In fact, the elasticity of the foot depends not on one, but its *double* arch, one from the heel forwards, the other from side to side, at the *distal* extremities of the metatarsal bones. By this structure, not only does the foot acquire elasticity, but it is capable of being *organized;* for had it been placed flat on the ground, the function, as well of the blood vessels as of the nerves, would have been arrested.

It has been remarked, that in a graceful human step the heel is always raised before the foot is lifted from the ground, and the weight of the body, supported by the muscles of the calf of the leg, rests for the time on the fore part of the foot and toes. There is at that time a bending of the foot in a certain degree: but where strong wooden shoes have been used, or any shoe so stiff that it will not yield and allow this bending of the foot, the heel is not raised at all until the whole foot rises with it, so that the muscles of the calf are scarcely used, and in consequence soon dwindle in size, and almost disappear. (*j*)

(*i*) 1 Arnott, El. Phys. 437.

(*j*) 1 Arnott, El. Phys. 435. See also 1 Dungl. Phy. 340 to 359 on attitudes.

SECTION II.—OF SYNDESMOLOGY,(*k*) OR THE DESCRIPTION OF THE LIGAMENTS AND THE STRUCTURE OF JOINTS IN GENERAL.

First, Of the different descriptions of joints.
- 1. Diarthrosis or moveable.
  - 1. Enarthrosis, or ball and socket.
  - 2. Ginglimus, or hinge-like.
  - 3. Planiform.
- 2. Symphisis, or union by cartilage, as in vertebræ.
- 3. Synarthrosis, or immoveable joints, as
  - 1. Sutures.
  - 2. Harmony.
  - 3. Gomphosis.

Second, Of Cartilages.
Third, Of synovial membranes, and the bursæ mucosæ.
Fourth, Of ligaments.
Fifth, Of disease of joints.
Sixth, Of injuries to joints and dislocations.
Seventh, References to enumeration of all the particular joints.

It is obvious, that unless the various bones were connected by some means with each other, the different parts of the entire skeleton would have no adequate tenacity, and that on the other hand, if the parts should be, as it were, soldered together, the whole frame would be rigid and incapable of locomotion; hence there is a connexion between each part adapted for the purposes of each. The *connecting* media are strictly only *ligaments*, though fibro cartilage and fibrous membrane, variously arranged and disposed, sometimes allow a free and extended range in different directions.

The connexion of bones with each other at *Joints* by *Ligaments*, is technically termed *Articulation* (derived from the Latin *articulo*, to join, or the Greek αρθροω, to articulate,) (*l*) and is of three classes or descriptions, viz. *first*, what is technically termed *Diarthrosis*, or moveable articulation, as by *enarthrosis* or ball and socket, having motion in all directions, as the hip joint, in which the globular head of the femur is received into the cotyloid or cup-shaped cavity. *Ginglimus*, where bones mutually receive each other and admit of a hinge-like motion, as in the elbow joint and knee joint; and *Planiform*, as where plain surfaces are opposed to each other, having little motion, as some of the bones of the wrist or metacarpus, instep or metatarsus, fibula and tibia, &c. (*m*)

Secondly, *Symphisis*, or a union by cartilage, as in the vertebræ, symphisis pubis, &c., and

Thirdly, *Synarthrosis*, or immoveable *connexion* or junction, which is of three descriptions, viz. *Suture*, where the bony fibres of the edge of one bone intermingle with those of the opposite bone, forming an irregular serrated line, as in the cranium; and which, when broken, has *irregular cracks*, as in glass and ice; secondly, *Harmony*, having only a line of union, without the serrated appearance; and thirdly, *Gomphosis*, where one bone is received into another, as the teeth into the alveoli or sockets.

All the bones before enumerated are united by some *Ligament* of a particular construction. Some joints are loose and free, capable of easy

(*k*) From συνδεσμος, a ligament, and λογος, a discourse or description of ligaments. For the works to be read, see Sir A. Cooper's and Brodie's works, and other references in Cooper's Dict. titles Anchylosis; Bursæ Muscosæ; Dislocation; Joints; 1 Bell's Anatomy, 405 to 445; 2 Good, 452 to 495; 1 Horner, Anat. 273, &c. In Lizars, *Ligaments* are considered conjointly with the Muscles applicable to each bone; Lizars, parts iv. v. vi. page 1 to 219.

(*l*) 2 Good, 452; 1 Bost. 78, 79.

(*m*) 1 Dungl. Phy. 292, 293.

CHAP. III. SECT. II. JOINTS, &c. motion, but weak in proportion, and liable to be displaced; such is the joint of the shoulder, which rolls in every direction, whilst other rolling joints are more limited in their motion, and are better secured with ligaments of peculiar strength; such is the joint of the hip, where the structure is of great strength. Hinge joints are incapable of circular motion or circumduction. (*n*)

In the *Ball* and *Socket joint*, the moveable end is furnished with a *round head*, which plays in a corresponding hollow in the fixed bone, while in the hinge both ends are furnished with processes and depressions, which are mutually adapted to each other. The hip joint is an example of the first, and the elbow of the second species of articulation. It is obvious that the first admits of a rotatory motion in all directions, while the second is capable of being moved only in two directions. (*o*)

Cartilages. Whenever two bones are destined to move on each other, their opposed surfaces are covered with the beautifully white, smooth, and very elastic substance called *cartilage*, which owes its *elasticity* to the peculiar arrangement of its fibres. It is composed of innumerable minute pillars, standing up perpendicularly from the bony surface below, resembling velvet. It is always lined by synovial membrane when it enters into the composition of a joint. Although the general form of the articulation may be observed in the solid body of the bone itself, yet in most cases *cartilage* materially contributes to the accurate completion of these parts, and the whole extent of the surface of the *articulating* ends is always covered with this substance, the nature and appearance of which, and its silvery white, or rather of pale appearance, we have already stated. Many obvious advantages arise from this construction: the smoothness of the cartilage, as well as its elastic nature, admits of a more easy motion than could have existed if the two hard substances had been in immediate contact, while at the same time the parts are less liable to injury from violent concussion than if they had possessed a more rigid texture. (*p*)

Cartilages form the basis of many parts of the body, supplying the place of bone, and they all cover the ends of the bones, and assist in the formation of the joints. (*q*) It has been said, that they in many respects nearly resemble *ligaments*, although they differ from them in some important particulars. (*r*) It is not easy to perceive any fibrous texture in cartilage; on the contrary, their obvious appearance is that of a uniformly dense membranous matter, not extensible, but highly elastic. Their use is principally to cover the ends of the bones, especially about the joints, where, for the purpose of motion, a smooth and firm surface is required, and in many parts they supply the place of bone, where strength is necessary, together with a degree of flexibility, as about the thorax and the trachea. They are described by the most correct anatomists as being without visible vessels or nerves. They appear to consist principally of albumen, with little, if any, jelly and mucus. It is said, that a portion of earthy matter is always found in them, which Dr. Davy estimates $\frac{1}{200}$ of their weight, but Mr. Hatchett does not consider it as essential to their constitution. Cartilages appear to hold a kind of intermediate place between membrane and bone. (*s*)

(*n*) 1 Dungl. Phy. 293.

(*o*) Id. 1 Bost. 79.

(*p*) Id.

(*q*) 1 Bost. 18; see further as to cartilage, id. 91 to 100; and ante, 31, 60, 61, and 1 Horner, Anat. 267; 3 Paris, 76; and Dr. W. Hunter on Structure of Cartilage, Phil. Trans. vol. 42, post, 79, n. (*x*.)

(*r*) But the most able anatomists insist that cartilage *never* resembles ligament, although it occasionally appears in a mixed or degenerate form, and is called *fibro cartilage*, 1 Horn. Anat. 272.

(*s*) 1 Bost. 54. 55.

It has been stated, that the fibrous membranes, the tendons, and the cartilages, possess neither blood vessel nor nerves: that they are not furnished with any organs, that we *can detect*, for the purpose either of secretion or absorption, and that they do not exhibit any of the appropriate powers of vitality, being neither contractile nor sensitive. (*t*) But although we are not able *to discover* any absorbent apparatus in tendons or cartilage, yet it is said that there is sufficient proof of their existence. (*u*)

Of Synovial Membranes and Bursæ Mucosæ. (*x*)

In order to facilitate motion by diminishing friction, the joints are enclosed in membranous bags, filled with a dense lubricating fluid, called *Synovia*, which is always interposed between the moveable extremities. Besides the structures of joints themselves, there are *Synovial* sacs, called Bursæ Mucosæ, situated about the joints, particularly of the extremities; they are placed between parts exposed to much friction, and are intended for the same purposes as the synovial membranes of joints, viz. to *secrete Synovia*, which lubricates their contiguous surfaces; and their structure and anatomical arrangement are quite similar to such membranes, both being shut sacs. These parts are filled with an oily kind of fluid, the use of which is to lubricate the surfaces, upon which the tendons play, on their passing over the joints. In the healthy state, this fluid is very small in quantity, but occasionally such an accumulation takes place, that very considerable swellings are the consequence. (*y*) *Bursæ* vary considerably in size as well as form, some being oval or circular, others elongated, so as to form sheaths, which enclose tendons; thus, where tendons are retained in situ by fibrous sheaths, the contiguous surfaces are invested by a bursal membrane, ex. gr. the different flexor and extensor tendons in both extremities; also, where a muscle has to slide over a bony prominence, as where the gluteus maximus passes over the great trochanter a bursa is interposed, or where processes of bone play on fibrous structures, as between the acromion and the capsule of the shoulder joint. These instances will suffice to point out the operation

(*t*) 1 Bost. 54.

(*u*) Id. 55.

(*x*) See in general as to synovial membrane relating to bones and mucous bursæ, 1 Horner, Anat. 277; 1 Bell's Anat. 397; Munro's description of the Bursæ Mucosæ; Brodie on Joints, chap. 9; Quain's El. 190; Coop. Surg. Dict. tit. Bursæ Mucosæ; and 1 Bost. 79; Mr. Brodie, in his valuable work, p. 8, thus observes, "The synovial membranes of the joints have not been well described by the majority of the old, nor even of modern, anatomists. A sufficiently accurate account of them, however, has been published by Dr. W. Hunter, in a communication to the Royal Society, on the structure of Cartilage, published in the 42d volume of the Philosophical Transactions, and since then by M. Bichat, in his Traité des Membranes; and to these authors I may refer those of my readers who wish to see their anatomy more fully explained. At present it is sufficient for me to observe, that the office of the synovial membrane of a joint, is to secrete the synovia, by which the joint is lubricated; that it lines the ligaments, by which the bones are held together, covers the bones themselves for a small extent, taking the place of the periosteum; and that from thence it passes over the cartilaginous surfaces and the inter-articular fat. Where it adheres to the bones and soft parts, it very much resembles the peritonæum in its structure, and possesses considerable vascularity; but where it is reflected over the cartilages, it is thin and readily torn; its existence, however, even here, Mr. Brodie observes, may be distinctly demonstrated by a careful dissection.* The synovial membrane of a joint forms a bag having no external opening, in this respect resembling the peritonæum, pleura, and the pericardium, which it also resembles in its functions, and to which it bears some analogy in its diseases." Brodie's Diseases of Joints, 8, 9, 2d edit.

(*y*) Coop. Dict. tit. Bursæ Mucosæ, 1 Bost. 79.

* See also 1 Horner, Anat. 277.

CHAP. III. SECT. II. JOINTS, &c.

of the general principle which determines the formation of *Synovial* or *Mucous bursæ*.(z) The bursæ mucosæ are liable to peculiar diseases.(a)

Ligaments.

To complete the mechanism of the joints, they are provided with a suitable apparatus of *ligaments*, which serve to keep the bones in their relative situations, and to regulate the motions of the joints, so as to prevent their displacement, except under circumstances of extraordinary violence.(b)

By the *Ligaments* the bones and other solid parts are connected to each other.(c) These, in their texture, nearly resemble *tendons;* they are like them, compact, strong, and flexible bodies, but they are generally more dense in their consistence, and their fibrous texture is generally less distinctly marked. They have no nerves, but they have a few blood vessels distributed to them, and they appear to possess somewhat more connexion with the vital powers of the system. Their use is sufficiently expressed by their name; they are principally employed in connecting the bones with each other, particularly about the articulations. In their *chemical composition*, tendons and ligaments nearly resemble the more compact membranes; their basis appears to be coagulated albumen, united to different proportions of jelly and mucus; they contain no earth, and only a minute quantity of saline matter.(d)

Diseases of the joints. (e)

The joints and the bursæ mucosæ are liable to various *Diseases*, such as inflammation, which may end in absorption of the cartilages, in the secretion of matter, or ulceration of the synovial membrane, to gout, rheumatism, dropsy, the formation of loose cartilages, collection of blood and scrofulous disease of the bones composing the joints,(f) all of which will be noticed hereafter.

Injuries to joints.

The *Injuries* to joints are *Dislocations*, fractures, and wounds, extending into them, which will hereafter be fully considered.(g)

Of each joint in particular.

The enumeration of the particular joints and ligaments, from the head to the lower extremity, would follow the same order as that observed in the arrangement of the bones themselves. These are distinctly pointed out in the recently published tables of joints and ligaments, with their names,(h) and are fully considered by most of the anatomical writers,(i) and must be examined by the student; but the particular examination of these in this summary would be too extensive an inquiry.

(z) 2 Dungl. Phy. 209; Coop. Dict. title Bursæ Mucosæ.

(a) Brodie on Joints, ch. 9; Coop. Dict. tit. Bursæ Mucosæ, 2 Gibson, Surg. 45.

(b) 1 Bost. 79.

(c) Id. 18.

(d) 1 Bost. 54, 79; and see 1 Arnott's El. Phys. 438.

(e) See in general the works referred to in Coop. Dict. tit. Joints, Diseases of; and Mr. Brodie's in particular; and 2 Gibson 37, to 58.

(f) Coop. Dict.; 2 Good, 452, to 495. *White swellings*, although treated as a disease of the *joint*, is not an affection of a joint, but begins in the *bone* forming it, and *extends* to the joint *consecutively*.

(g) And see Coop. Dict. tit. Joints; 1 Dorsey, Surg. 101, 209 to 280.

(h) And see Tables published by Burgess and Hill.

(i) See 1 Horner, Anat. 280 to 337.

SECTION III.—OF MYOLOGY, OR THE MUSCLES AND TENDONS.(a)

General utility.

However perfect the form of the bones, united or connected by the various joints or ligaments, may be, yet it is obvious that without some other mechanism they would be incapable of freely moving backwards and forwards, and in various other positions, nor would the figure be full or complete; therefore, *Muscles* (in ordinary language termed *flesh*,)(b) have been introduced in connexion with every bone; and as it would be both inconvenient and unsightly were the fleshy muscles themselves to pass over the largest ends of the joints; therefore *Tendons*, as the muscles approach the bone, are interposed and fixed to the ends of the muscles at one end, and at the other into the bone to pull the same.(c) In the *practice* of Surgery, an accurate knowledge of the several numerous muscles, and their actions, is indispensably necessary, because it forms the basis of all the remedial means in the *Reduction* of *Dislocations*, and in the treatment of fractures it determines the proper position of the limb under various circumstances of accident or injury.(d) Many interesting cases are stated by Sir A. Cooper, in his treatise on Fractures and Dislocations, explaining the difficulties which sometimes occur in reducing a dislocation, in consequence of the opposition of the muscles, influenced by the nerves, and one in particular where he succeeded, by suddenly calling the patient's attention to a different position, by which the muscles, previously influenced by the nerves, suddenly relaxed.(e) We must consider the Muscles and Tendons separately. From the works of Provost and Dumas,(f) it is to be collected that the consideration of the former may be properly arranged under *six* heads, namely, *first*, their form and structure; *secondly*, their chemical composition; *thirdly*, their properties; *fourthly*, their uses; *fifthly*, their mechanism; and *sixthly*, their action; to which may be added, *seventhly*, their number and names.

(a) The consideration of muscles is termed *Myology*, from the Greek μυαν, a muscle, and λογον; a discourse or description. See Dr. Elliotson's Blumenbach, 270 to 281; and 1 Bost. 105 to 274; and as to Muscular Power, 1 Dungl. Phy. 282 to 413; and of each muscle in particular, 1 Horn. Anat. 391 to 500; and of Tendons, id. 388; and See Coop. Surg. Dict. tit. Dislocations; Broussais, Physiol. 227 to 247; Jackson, Princ. Med. 74 to 80.

(b) 1 Bost. 105; 1 Dungl. Phy. 282.

(c) 1 Dungl. Phy. 284.

(d) 1 Dorsey, Surg. 209.

(e) Sir A. Cooper on Fractures and Dislocations.

(f) Journal de Physiologie, tom. iii.

CHAP. III. SECT. III. OF MUSCLES.

1st. Form and Structure of muscles.

1. *Their Form and Structure.*—Muscles constitute what is usually called the *flesh* of animals, and is now considered to be synonymous, though formerly a distinction was made between what was styled the *flesh* or membranous part and the *fibrous* part, regarding only the latter as the proper organ of motion; but that distinction is now treated as erroneous.(*g*) In their usual form, Muscles are composed of masses of small fibres (upon the contraction of which muscular motion depends,) lying parallel to each other, intermixed with a quantity of membranous matter, and constituting a structure visible to the eye without a microscope. These fibres are disposed in small bundles, called *lacerti* or *facieuli*, each of which is also enclosed in a sheath of cellular membrane, and these bundles are divisible into still smaller bundles, apparently without any limit, and though it is a disputed point, the better opinion seems to be, that the fibres are continuous.(*h*) The fibre is represented by many authors to be *straight* whilst at rest, but as exhibiting a *wrinkled* or waved appearance or *zigzag* course, as thus  (or, as the French say, "Se flechissent tout a coup *en zigzag* et presentent un grand nombre des ondulations regulieres."(*i*) When under contraction, the ends approximate each other;(*k*) but some physiologists observe, that there is reason to doubt whether this be its natural state, and whether it may not depend upon the condition in which it is found when it is examined after death, and detached from the neighbouring parts.(*l*) In most muscles, *the centre* is the thickest part, and appears to contain more fibres, and is called the *belly*,(*m*) and it gradually diminishes in size to the extremities, one or both of which usually terminate in a membranous structure, which is either a *tendon* or an expanded membrane, called an *aponeurosis*, according to the situation of the muscle, and its connexion with the neighbouring organs. There are considerable interstices between the muscles, which are occupied by *fat* and *cellular membrane*, and in these intervals a safe lodgement is afforded for the trunks of the blood vessels and nerves. Most of the large muscles are situated near the surface, covering the bone and filling up the spaces between them, so as to produce the general form and outline of the body.(*n*) Anatomists, in dissecting the muscles, generally divide them in the order of their position, or in that of their actions.(*o*) Sir A. Carlisle describes the ultimate fibre or filament as "a *solid cylinder*, the covering of which is a reticular membrane, and the contained part a pulpy substance, regularly granulated and of very little cohesive power when dead," and that the extreme branches of the blood vessels and nerves are seen ramifying on the surface of the membrane, enclosing the pulp.(*p*) Dr. Edwards and M. Dutrochet, from their microscopical examination of the elementary structure of the body, conclude that *muscular fibre* is like the *membranous fibre*, composed of infinitely small globules of $\frac{1}{300}$ths of a millimetre in diameter.(*q*)

Arteries, capillary vessels, veins, and nerves in muscles.

Muscles (with the exception in some of the viscera) are more plentifully supplied with *Arteries* than any other parts of the body; these are distributed amongst the fibres in numerous branches, which continue to subdivide with so much minuteness as at length to become no longer

(*g*) Steno de Musc. Obs. Specimen in Manget Bib. An. tom. 2, p. 518.
(*h*) 1 Bost. 106; id. 17, 18; ante, 30, 31.
(*i*) 3 Bost. 282.
(*k*) El. Blum. 278, 279; 1 Bost. 108, &c.; 1 Dungl. Phy. 308, &c.
(*l*) 1 Bost. 106.
(*m*) 1 Bost. 106.
(*n*) See small plate, post, 88, exhibiting the Biceps muscle between the shoulder and the forearm, in the act of contracting to raise the hand.
(*o*) Horn. Anat. 391 to 500.
(*p*) 1 Bost. 112.
(*q*) Ante, 23; 3 Bost. 271 to 280; see also 1 Dungl. Phy. 29, 30.

visible.(r) The *Capillary Vessels* form a complete vascular net-work, the contents of which are gradually discharged into the veins, which become larger and larger, until the blood at length arrives at the main trunks. The veins that belong to the muscles are remarkable for the number of *valves* which they contain.(s) Numerous *Nerves* are sent to the muscles, especially those which are under the control of the will. The nerves that belong to the voluntary muscles, proceed almost exclusively from the brain itself, or from the spinal cord; whereas the muscular coats of the viscera are for the most part supplied immediately from the ganglia of the sympathetic.(t) These nerves influence the muscles, but are not, as has been supposed, of the same substance as the muscle.(u) The nerves which are distributed to muscles, convey to them two distinct functions, one of *motion*, the other of *sensation*, which they derive from their double origins, whether from the spinal marrow or the brain. Each root arises partly from the anterior, and partly from the posterior surface or pillar of the spinal chord, or from the same pillars expanded into the brain. Motion is derived from the *anterior*, sensation from the *posterior* roots; and as these two sets of filaments do not necessarily concur in the same affection, it is obvious that the muscles of a limb, or of the whole body, may be thrown into the most violent agitation, or the firmest rigidity, without much or perhaps any degree of painful emotion or increased sensibility: and we can hence readily account for the little complaint of pain that is made by patients upon this subject on their being freed from a severe paroxysm of tetanus, convulsion fits, or hysterics.(x) The effect of the nerves upon locomotion will be more properly considered when the nervous function is examined.(y)

Muscles divided into those voluntary or involuntary.

The muscles of the body may be divided into two grand classes, *voluntary* or animal, and *involuntary* or automatic.(z) In the former we meet with some that are peculiarly remarkable for strength and continuity of contraction, as the greater part of the round muscles; and others as remarkable for mobility, among which we may place most of the long muscles. Continuity of exertion is generally less evident in the voluntary than in the involuntary muscles, of which last some organs, as the heart, continue their efforts, through life, without intermission, though all of them relax or remit occasionally or periodically; for this greater permanency and regularity of action, they are indebted to the peculiar provision which has been made for their supply of nervous power; for while the voluntary muscles are furnished in a direct line from the sensorium, the involuntary muscles are dependent chiefly on the intermediate or ganglionic system, and are more remotely connected with the sensorium.(a) Others arrange these two classes, as, first, the *proper muscles;* and, secondly, the *muscular coats.*(b) The *first* (*proper* muscles) are always designed to produce the *motion* of some part of the body, by altering its relative position. But in regard to the *second*, which exist principally in the viscera of the abdomen, and in the muscular coats of vessels, the fibres which appear in these, essentially resemble those of the proper muscles, and are attached to membranous expansions, composing what have been called muscular coats. These coats are connected with the hollow cavities that exist in different parts of the body, in the form either of pouches or cylinders, and are destined for the transmission or lodgement of various bodies of a soft or fluid consistence, and

(r) 1 Bost. 107; 1 Horner, Anat. 379.
(s) Id. 107; 1 Horner, Anat. 173.
(t) Id.
(u) Id. 117.
(x) 4 Good, 228.
(y) Id. 17, 18.
(z) 1 Bost. 249; post, as to nerves, and connexion between the muscular and nervous systems. 1 Horner, Anat. 385.
(a) 4 Good, 226; 1 Bost. 250.
(b) 1 Bost. 116.

CHAP. III. SECT. III. OF MUSCLES.

which propel their contents by means of the contraction and extension of these fibres, such as the stomach, intestines, arteries, &c. The mechanical structure of these muscular coats is considerably different from that of the proper muscles; for the fibres are much shorter, and instead of lying parallel, as is always the case with the proper muscles, they seem to be interlaced or twisted together, and sometimes anastomose or bifurcate. The fibres of these muscular coats do not exhibit that division into lacerti or bundles, nor have they the regular belly or tapering extremities of the others. Their immediate attachments are also different, not, as proper muscles, by tendons of fibrous membrane, but the coats are attached to membranes that exhibit less of the fibrous and more of the cellular texture.(*c*) These muscular coats also are not influenced directly by nerves from the brain, but from the ganglia, and their action is entirely involuntary.(*d*) The nerves influencing the proper muscles of motion, are much more numerously distributed than in any other structures of the body, so that it was remarked by Haller, that the nerves which go to the thumb are more in quantity than those which supply the whole substance of the liver.(*e*)

Again, these *voluntary* muscles are of two descriptions as to their operation. Thus, in almost every part of the body there will be found a muscle *to contract* or pull one way, and what is termed an *antagonist* muscle, to pull back and restore the muscle to its previous position;(*f*) for muscles seldom act singly, and two or more usually are so placed in the frame as to execute movements apparently simple. Those which act together, are called *associates;* and when one group habitually reverses the action of another, they are called *antagonists.* Thus, the muscles seen on the forearm, and which, by several tendons or white cords, are prolonged through the palm of the hand to the bones of the fingers, curve or bend the joints of the latter, and are, therefore, named *flexors*, whilst those of the back part straighten or extend them, and are called *extensors.*(*g*)

2dly. The chemical composition of muscles.

2dly. *With respect to the Chemical Composition of Muscle.*—Muscle is essential fibrine, but contains also albumen, gelatine or jelly, fat, salts, &c. and a peculiar substance termed osmazome.(*h*) They abound in azote more than other animal parts,(*i*) and the departure from this principle, from its combination with hydrogen and carbon, that exists during health, entirely converts them under particular morbid affections and after death, into an adipocerous substance, somewhat resembling soap or spermaceti.(*i*) The muscles are distinguished from other similar parts, chiefly by two characteristic features, the one derived from their *structure*, the other from their singular *vital powers*.(*i*) Their fleshy structure is formed of the moving fibres *sui generis*, and of a faint red colour, and every muscle may be resolved into fibrous bands; these into bundles of fibres or *fasiculi;* and these again into very fine fleshy fibres and fibrils; (*k*) every muscle possesses a covering of cellular membrane, which is so interwoven with its substance as to surround the bands, the bundles, and even each particular fibre and fibril.(*k*)

Every part of the muscles is amply supplied with *blood vessels, arteries,* and *veins* and *nervous* threads. The latter appear to unite intimately with the muscular fibres: the former are so interwoven with the fibres, that the whole muscle is red, and acquires its own paleness only

(*c*) 1 Bost. 116.
(*d*) Id. 117.
(*e*) Id. 107; see also 1 Dungl. Phy. 52, &c.
(*f*) Id. 151; 1 Dungl. Phy. 332, &c.
(*g*) 1 Horn. Anat. 447, &c. p. 1 and 2; 1 Bost. 151.
(*h*) 1 Dungl. Phy. 287; 1 Bost. 120 to 125.
(*i*) 1 Bost. 121; El. Blum. 277.
(*k*) Id. ibid.; 1 Bost. 106, 118.

by being washed.(*l*) The apparatus of *nerves*, which is sent to the muscles, is very considerable, and especially to those which are under the control of the will, being greater in proportion to their size than to any other part of the body, except in those relating to the organs of the senses.

The other exclusive character of muscles is their *irritability*, bestowed upon all muscular parts, but varying in degree, and which power is an original endowment of the Creator, imparted in a way of which we as yet know but little.(*m*) This irritability is the power of contracting upon the application of a stimulus, and ceases only with life.(*n*)

3dly. The properties of muscles.

3dly. The *Properties* of *Muscle* have been arranged as *physical* and *vital*. The first, comprehending those which are connected with its mechanical form, its structure, and its obvious external characters; the second, comprising its powers, as forming part of a living organized body.(*o*)

As to the first, the *physical* properties, it seems clear that the muscular fibre possesses all the properties that belong to simple membrane (before considered,) (*p*) although in different degrees. It is less *cohesive* than membrane, but more *flexible;* it is highly *extensible*, and perhaps *elastic*.(*q*)

The *vital* properties of muscles are those which pre-eminently distinguish this part of the frame from simple membrane and the rest of the frame. This consists in what has been termed its *irritability*, or, as Dr. Bostock observes, more properly to be termed *contractility*.(*r*) This is defined to be that power, which the muscular fibre possesses, of *diminishing* its length, or of *contracting* and *shortening* itself.(*s*) The nature of muscular *contractility*, or the relations which it bears to the other powers of nature, has been much discussed and disputed.(*t*) It has been supposed to be exclusively attached to the muscular fibres, and to differ materially from those of nervous sensibility,(*u*) and to be perfectly distinguishable from elasticity; and it has been observed, that one of the most remarkable circumstances respecting contractility, is, that in all muscular action, however powerful the stimulant that is applied, still, after some time, the effect ceases, and the muscles become relaxed,(*v*) the muscles that have been contracted, become what is termed exhausted, and some time is necessary to elapse before they are again capable of being stimulated or excited into action.(*x*) The phenomena which attend upon the *relaxation* of a muscle, are precisely the reverse of those of its contraction; the *belly* becomes soft, its swelling subsides, and the wrinkles disappear from its surface; the force of contraction no longer existing, the ends, not being drawn together, recede, and the whole resumes its natural quiescent state. *Relaxation* is not a mere passive effect, but, on the contrary, when parts have been displaced by contraction, there is a necessity for some absolute power to bring them back to their former situation. This power is, in most cases, that of the *antagonist muscles;* and it will be found that the muscular system is so arranged, that, in most parts of the body, one muscle or set of muscles has another muscle or set of muscles, which act in precisely a contrary direction, and is intended to produce precisely the opposite effect; one

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(*l*) El. Blum. 271; 1 Bost. 117; ante, 82, 83; 1 Dungl. Phy. 285.

(*m*) El. Blum. 217; 1 Dungl. Phy. 312, &c.; as to muscular power, 4 Good, 223, &c.; attributed of late to electricity, occasioned by the contact of the nerves with the muscles; ante, 42, n. (*r*,) and 44, 45; post, 87, n. (*g*.)

(*n*) El. Blum. 279.

(*o*) 1 Bost. 125.

(*p*) Ante, 22 to 29.

(*q*) 1 Bost. 126.

(*r*) 1 Bost. 129; 4 Good, 223.

(*s*) 1 Bost. 130.

(*t*) 4 Good, 223.

(*u*) 1 Bost. 141, 142; but see post, 87, n. (*g*,) and ante, 42, 44, 45.

(*v*) Cullen's Instit. § 108.

(*x*) 1 Bost. 135.

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muscle raises the arm, another depresses it; and when either muscle has been in action, it generally happens that the opposing muscle then acts and produces the contrary effect.(y) However, besides the antagonist muscles, another contracting force, which is often useful in replacing parts, is *elasticity*,(y) as in the structure of the chest. Another means by which muscles are replaced after contraction, is the force of gravity, which frequently occurs in the motions of the extremities.(z)

But what are the *stimulants* or causes of contractility? It has been long supposed, that one general stimulant or cause is, that every body in existence is a stimulant to the muscular fibre, because, independently of any other quality, the *mere contact* of a material substance produces this effect. But the stimulants or causes are arranged more comprehensively under three heads, viz. 1, Mechanical; 2, Chemical; and 3d, Vital; (or according to Blumenbach, *mental*,) and are either exciting or depressing.(a)

1. *Mechanical* impulses of all kinds, beginning with the slightest *touch* that is capable of being perceived, and proceeding to a degree of violence short of that which absolutely destroys the texture of the part, are of the first class.

2. A great variety of chemical substances, that have few properties in common, as alcohol acids, alkalies, metallic salts, and many vegetable acids, are of the second class.

3. In the third class may be placed those agents that seem to operate immediately upon the *vital* powers, without producing any apparent physical change in the part, as the *electric fluid*, and particularly that modification of it which constitutes *galvanism*. Independent of any *external* agents, the muscles are thrown into the strongest contractions by a variety of *nervous affections*, which arise from internal causes, and above all, from the act of *volition*. By a process, which will probably always remain inexplicable, we no sooner *will* the motion of any muscle than it *obeys* the summons with promptness and accuracy.(b) In general, the contraction and relaxation of the muscles is entirely regulated by the will, through the nerves. Thus we know that if we wish, or in other words *will*, to give a severe blow, the muscles of the right arm are accordingly immediately contracted, and the arm propelled in order to perfect the intent; and we know how suddenly that wish or will may be interrupted or stopped short and changed by a contrary wish or will, putting in motion the antagonist muscles at the very instant the blow was about to be perfected, and the force is stopped or withdrawn. It should seem, therefore, that although the muscles possess the contractile power, yet that the exercise of it is attributable entirely to the nervous system, in the manner presently explained.(c) In another place it is observed, that the mere act of volition, like all the other mental faculties, is directly connected with the brain, while the exercise of volition requires the co-operation of the brain, nerves, and muscles; and whatever volition is conceived in the mind, it cannot be carried into effect unless the nerve and the muscle be in a sound state.(e)

The most recent supposition as to the cause of the contraction and motion of the muscles, has been suggested by the experiments and ob-

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(y) Bost. 136; 1 Dungl. Phy. 310.

(z) 1 Bost. 137.

(a) El. Blum. s. 52, 53, p. 33; and of late it is supposed, that the contraction of the muscles is attributable to *electricity*, occasioned by the nerves coming in *contact* with the muscle. See quotations, 3 Bost. 281; and Dungl. Phy. 313; ante, 42, n. (r,) 44, 45; and infra, 87.

(b) 1 Bost. 138; El. Blum. 43; and more particularly, 3 Bost. 194 to 202.

(c) And see 1 Dungl. Phy. 309, &c.

(d) 3 Bost. 193, 195.

(e) See the observations and authorities collected in 3 Bost. 193 to 202.

servations of MM. Prevost and Dumas,(*g*) and supported by a degree of approbation on the part of Dr. Edwards, Dr. Bostock(*h*) and Dr. Quain,(*i*) though the latter observes, that the researches are far from conclusive. The supposition is, that the *contraction of muscles is attributable to electricity, occasioned by the nerves, influenced by the will, coming in contact with the muscles.*(*l*) It is admitted, that in this mode of viewing the subject, the muscle itself appears to be passive, and the nerves alone active.(*m*)

A living muscle, when thrown into action, has been supposed to increase in absolute weight, in density, and in power of resistance;(*n*) but the increase in weight or density has been disputed.(*o*) It can raise a weight, which, when dead, would crush it to atoms. By this, a horse can draw, with ease, three times his own weight; and in smaller animals, the muscular power is even greater in proportion; and it is said, that a flea can draw from seventy to eighty times its own weight.(*p*) The muscles undergo a change in their state, as age advances, partly in consequence of the change in the state of the membrane, which enters so largely into their composition, and finally, in consequence of the alteration of the fibres themselves: they become generally less contractile, while those that serve for the voluntary motions are less under the control of the will, or less able to execute its commands. In some instances, parts that were originally muscular become tendinous, the muscular fibres being gradually absorbed, and tendinous matter deposited in their room. In some cases the muscular or soft parts become rigid, from the quantity of bony matter deposited in them.(*q*)

4thly. The use of muscles.

4th. *The Use of Muscles.*—The muscles constitute the cords or ropes, as bones are the levers of the living frame.(*r*) The general use of the muscles is sufficiently obvious; they are the great organs of motion, both of that by which the body is moved from place to place, constituting *locomotion;* that by which each of its separate parts is moved when we act upon the contiguous bodies in our intercourse with the external world; and that by which many of the various minute actions are performed, which are essential to the exercise of the vital functions. In short, muscular motion seems to be concerned in almost every operation that is produced either by the system at large or by its individual parts.(*s*)

5thly. The *mechanism* of muscles.

5th. *Mechanism of Muscles.*—We have just observed that the bones are the levers of the body, and the muscles the cords which pull them. In considering the mechanism of muscles we must bear in mind that their action consists essentially in the approximation of their extremities, in consequence of the shortening of their fibres, and that the immediate effect of this is to move any body to which the ends are attached.(*t*) The fixed points of the body from which motion commences, or against which the muscles react when they begin their contractions, are generally the *bones*, and the motions are performed by the intervention of *joints.* Considering, therefore, the bones as being acted upon by the muscles after the manner of levers, the part where the muscle or tendon is inserted into the bone will represent *the power*, the joint *the fulcrum*, and the part that is moved constitute *the weight.* Writers on mechanics have divided levers into three

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(*g*) Journal de Physiologie, tom. iii.
(*h*) 3 Bost. 281.
(*i*) Quain's Anatomical Plates, 3.
(*l*) MM. Prevost and Dumas, Journal de Physiologie, tom. iii: and see extract and observations, 3 Bost. 281; and Quain's Anatomical Plates, page 3. See 1 Dungl. Phy. 313, &c.
(*m*) Quain's Anatomical Plates, 3.
(*n*) 4 Good, 224.
(*o*) 1 Bost. 130 to 132.
(*p*) El. Blum. 279.
(*q*) 3 Bost. 264, 265.
(*r*) 4 Good, 224; 1 Bell's Anat. 394 to 399; 1 Bost. 143.
(*s*) 1 Bost. 143.
(*t*) Id. 146.

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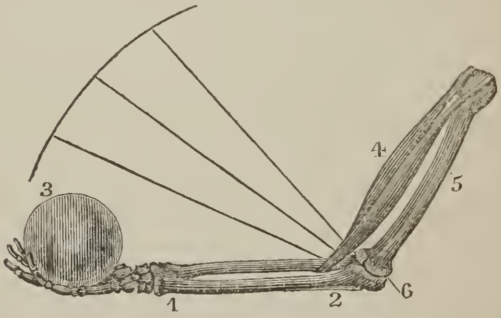
kinds, according to the relative position of their three essential parts, the weight, the power, and the fulcrum. Those of the first kind have the fulcrum in the centre, in those of the second kind the weight is in the centre; *while in the third, the power is in the centre;* the bones are of this last description, in which the *power* is placed between the fulcrum and the weight. The motion of the forearm may be taken as an example of the effect of muscular contraction, and the manner in which it is produced. When we wish to raise a weight by bending the elbow joint, it is effected by a muscle below the shoulder, which has tendons inserted into the top of the bone of the forearm near the elbow.(*u*) Let Nos. 1 and 2 represent the forearm; No. 3, the weight to be raised; No. 4, the Biceps muscle, arising from the shoulder, with its tendon inserted into the forearm below the elbow; No. 5, the upper arm small in the middle and large at the extremities; and No. 6, the elbow joint, being the fulcrum, thus:



By the *contraction* of the Biceps muscle, 4, to a small extent, the bending the joint, 6, is occasioned, and the weight is carried up to a height proportionate to the length of the forearm, or in other words, the hand forms a part of the circumference of a circle of which the elbow is the centre. This consideration of the manner in which the muscle acts, shows that the mechanism of the animal body is calculated to produce a great loss of absolute power, but such power is thus sacrificed to afford *increased velocity* and *symmetry of form*, which, if the muscle were otherwise placed, would be clumsy and awkward.(*x*)

6thly. The action of muscles.

6th. *Their Action explained.*—The *cause of* the contraction of *muscles* seems to be imperfectly known.(*y*) Dr. Bostock, on Physiology, concludes his valuable observations on the subject, by stating, that in the present state of our knowledge, *contractility* ought to be regarded as the unknown cause of known effect, a quality attached to a particular species of matter possessed of properties peculiar to itself, and which we are not able to refer to any general principle.(*z*) But MM. Prevost and Dumas have, as we have seen, recently attributed muscular contraction to electricity, and by the nerves coming in contact with the muscles.(*a*) And Dr. Edwards, remarking upon this hypothesis, himself concludes, "d'ou il paraitrait resulter que les contractions sont dues à l'electricité produite par le contact du nerf et du muscle."(*b*)

The action of muscles never intermits, and is only diminished in the sleeping state; though where the sleep is profound and lethargic, the

(*u*) Winslow, sect. 3, art. 5; and Mem. Acad. pour, 1720; 1 Bost. 147.

(*x*) 1 Bost. 147 to 157; 1 Dunglison, Phy. 324 to 340.

(*y*) 1 Bost. 157 to 174.

(*z*) 1 Bost. 174; 4 Good, 223.

(*a*) See ante, 87, and extracts, 3 Bost. 281 to 288, and Quain, Anat. Plates, p. 3.

(*b*) See extract, 3 Bost. 284.

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diminution amounts to almost a cessation, except in the involuntary organs. When muscles are not exercised the *vis insita* is very slightly exerted, but we can still trace its influence by the position which the limbs assume, and discover the strength of the antagonizing muscles,(*c*) and in disease, especially in children, the observance of the muscles during sleep will assist in discovering the state of tone.(*d*)

7thly. The connexion between the muscular and nervous systems.

In considering the nervous system, we shall examine the connexion between the muscular and nervous system.(*e*) To every muscle there are two distinct sets of nerves, the one to excite and give the muscles their power of motion, the other perceptive nerves, appropriated to the sensitive faculty of such muscles, and to communicate the sensation to the mind.(*f*) Prevost, Dumas and Dr. Edwards appear to attribute muscular motion to the effect of *electricity*, occasioned by the contact of the nerves and muscle.(*g*)

II. Of Tendons and Aponeurosis.

In order to promote the symmetry of form and the facility of motion, we find that in many cases the flesh of the muscle itself is not inserted directly into the bone which is to be moved, one or both of the ends terminating in membrane, which, according to the situation or use of the part, is either converted into a strong cord constituting a *Tendon*, or is spread out into a membranous expansion technically called an *Aponeurosis* (from *απο* and *νευρον*.) (*h*)

The tendons are the continuation of the interstitial cellular membrane of the muscle, and may be unravelled into a web.(*i*) But tendons, as distinguishable from muscles, have been supposed by some to be dead and unorganized, and have no visible nerves, and are insensible and not contractile,(*k*) and they possess very few if any blood vessels; and no vessels have been discovered in them for the purpose of secretion or absorption: but the better opinion is, that tendons have an absorbent apparatus.(*l*) Indeed if they have not, or if, as supposed, they be unorganized, how could a ruptured tendon reunite and again become useful, as certainly in some cases occur, in case of the rupture of the Tendo Achilles.(*m*) In their *chemical composition* tendons nearly resemble the most compact membranes; their basis appears to be a coagulated albumen, united to different proportions of jelly and mucus. They contain no earth, and only a small quantity of saline matter.(*n*) The principal use of tendons is to connect the muscles with the bones, and serve as cords or ropes to transmit the action of the muscles to a distant point, and in doing this their operation appears to be entirely mechanical.(*o*) Unless the muscle is directly connected with a bone, tendons are seldom found, and, therefore, there are no tendons attached to the muscles of organic life.(*p*)

III. Of the

Muscles and tendons are subject to several *diseases*, particularly rheu-

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(*c*) 4 Good, 225.
(*d*) 4 Good, 226. The student should here read 4 Good, 223 to 226.
(*e*) Post, and see 1 Bost. 232 to 252; 4 Good, 223.
(*f*) See Mr. Bell's observations in Phil. Trans. for A. D. 1826, p. 163, & 1 Dungl. Phy. 53, and post.
(*g*) 3 Bost. 281; ante, 82 to 88.
(*h*) 1 Bost. 146; 1 Horn. Anat. 388.
(*i*) Bell's Anat. 399; 1 Bost. 20.
(*k*) 1 Bell's Anat. 398; 1 Horn. Anat. 388; 1 Bost. 54.
(*l*) 1 Bost. 53.
(*m*) See S. Coop. Surg. Dict. tit. Tendon; 1 Horn. Anat. 389.
(*n*) 1 Bost. 54.
(*o*) Id.
(*p*) 1 Bell's Anat. 398.

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matism, spasms or tumors, each of which will hereafter be fully considered, with their remedies.(*q*)

diseases of the muscles and tendons.

In cases of sudden death from lightning or electricity, or a blow upon the stomach, or the bite of some venomous animals, or from some acrid vegetable poison, as laurel-water, or from exercise, or violent mental emotion, occasioning sudden extinction of life, the muscles will be found in a state of relaxation, and to have lost their susceptibility to contractility by any stimuli, and the blood will be non-coagulable; circumstances important to be attended to when there is any supposition of criminal death,(*r*) whilst it is the opinion of some pathologists that the force of muscular contraction through the system generally is increased in inflammatory fever.(*s*)

IV. Of the *Injuries* to muscles and tendons.

Muscles and tendons are also liable to various *Injuries*, as ruptures and wounds,(*t*) which it will be more proper to consider in a subsequent chapter. Ruptures even of the Tendon Achilles are capable of reunion by relaxation and care.(*u*) When a muscle has been divided across by a deep wound or cut, the union which may result is always incomplete as regards the muscular fibres. The *muscle* may be said to unite as a whole, but the *muscular* fibres *not*. The union takes place between the cellular tissue investing the opposite surfaces, and the union presents a firm line of fibro-cellular material, at which the muscular fibres of each half terminate. But the injurious consequences of deep transverse cuts across muscles may be long if not permanently felt in reducing or retarding the power of the limb, and in that view it may frequently be important in judicial inquiry to be able to enumerate and establish in each case all the probable consequences of such an injury, so as justly to increase the measure of compensation for the injury.(*v*)

V. The number, names, and description of each muscle and tendon.

The *enumeration* of the particular *muscles*, from the cranium to the lower extremity of the human frame, would follow the same order as that observed in the arrangement of the bones, and the joints and ligaments.(*w*) The muscular fibres of the neck, back and loins, those on which all the complicated movements of the *vertebral column* depend, compose more than 300 distinct muscles in the whole;(*x*) and it is said that the entire human body, possesses about 450 muscles or upwards, but varying in number in different individuals: it is thus furnished with a double advantage, namely, an extreme agility of motion in particular parts, and throughout the whole a surprising degree of strength and endurance of labour.(*y*)

The muscles have been generally arranged and examined in the order of their several layers, of which there are four on the back, and elsewhere usually two; and of these are considered, first, those most external, and then

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(*q*) As to *Rheumatism*, see Good, 452; to 466; *Spasms*, 4 Good, 223 to 347; *Twitchings*, 4 Good, 323; Coop. Dict. tit. Paralysis. As to the remedy by *Acupuncture* for Rheumatism, see that title, American Cyclop. Med Prac. and 2 Good, 465..

(*r*) 1 Bost. 354, 355; Hunter on Blood, 26.

(*s*) 1 Bost. 358.

(*t*) Coop. Dict. tit. Tendons, and tit. Wounds; 4 Good, 223; El. Blum. 278.

(*u*) See several instances, and the proper treatment, in the authorities referred to in S. Coop. Surg. Dict. tit. Tendons, 1 Horn. Anat. 389.

(*v*) See a useful practical article, S. Coop. Surg. Dict. tit. Wounds.

(*w*) See 1 Bell, 207 to 393, 394 to 406; 1 Horn. Anat. 391 to 500.

(*x*) 4 Good, 233.

(*y*) El. Blum. 277; 1 Dungl. Phy. 329.

successively the under layers, until the bones are exposed.(*z*) It has been justly observed, that their present nomenclature is very perplexing, and not uniform upon the same principle; for sometimes the name is taken from their situation, at others, from their action and use, and sometimes *from their order of dissection*.(*a*) Very useful Tables of all the muscles, showing their names, action and use, have been recently published,(*b*) and the student must study the observations of Dr. Quain, in connexion with his explanatory plates.(*c*)

SECTION IV.—OF NEUROLOGY,(*d*) OR THE NERVES.

The utility of the nerves in stimulating and influencing the muscles to motion.

The bones with their joints, and the muscles and tendons, though *capable* of motion, would be inactive, unless excited and stimulated by the *Nerves*. These communicate sensation from the different parts of the body to the sensorium, and other nerves excite the motion of the muscular fibres;(*e*) but as they form parts of what is termed *the nervous system*, they will be more properly and particularly considered hereafter.

It may suffice here to observe, that with respect to the relations which the different parts bear to each other, the *Brain* is the *centre* of the *nervous system*, or that part to which all the others are subservient, and that some *Nerves receive* impressions from external objects, and *transmit* such impressions to the brain, where they become sensible to the mind, constituting perceptions, which is *one* mode in which the nervous system operates.(*f*) The *second* mode in which the nervous system operates is by its *reaction* on some of the organs of the body, an operation which, with respect to the succession of events, is the *reverse* of that just noticed. Of the actions of this description one of the most importance to our existence, and the most frequently exercised, is the faculty of *voluntary motion* of the muscles. Here the affection originates in the brain, in which some change takes place; this is transmitted down the nerve into the muscle, where an effect is produced on the fibre, which causes it to contract, and in this as in the former case, all the three stages are equally essential.(*g*) It will here suffice to notice that the *nerves*, as they appear to the eye in every part of the frame when dissected, are white cords, flat, round or irregular, bound up in firm membranes, and blood vessels accompanying them; and each nerve consists of many fibrils, and the cellular texture and blood vessels are interwoven with such fibrils.(*h*)

(*z*) See 1 Horn. Anat. 391 to 500.

(*a*) Quain's El. 2d edit. and Quain's Anatomical Plates, p. 1.

(*b*) Quain's El. 2d edit. 383, 385, and Burgess and Hill's Tables.

(*c*) A. D. 1833, in course of publication by Taylor, bookseller, Gower-street.

(*d*) Neurology, from νευρον, a nerve, and λογος, includes properly the description o the nerves, brain, and organs of sense. As to the nerves in general, 1 Bost. 179, and post; 1 Dungl. Phy. 41 to 64.

(*e*) Jackson, Princ. Med. 127, &c.; 4 Good, 4.

(*f*) 1 Bost. 175, and post.

(*g*) 1 Bost. 232.

(*h*) 1 Bell, Anat. 365; 2 Horn. Anat. 327, &c.

CHAPTER IV.

OF THE FUNCTION OF RESPIRATION, AND INCIDENTALLY OF VOICE, SPEECH, AND OTHER SOUNDS, AND THE SEVERAL EFFECTS OF RESPIRATION.(*a*)

CHAP. IV.
SECT. I.
RESPIRATION.

General view of the function of respiration.

PERHAPS, of all the organs and functions, those of *Respiration* should most excite our admiration, as well in respect of their structure as their durability, notwithstanding their very delicate structure and incessant employment. The *Lungs* are composed of exceedingly delicate and small air cells, and the pulmonary blood vessels from the right ventricle of the heart, containing the dark blood, pass by and around these air cells; and the atmospheric air, containing oxygen and renovating principles, is inhaled in rapid succession into such air cells, and absorbed through the delicate membrane of such cells into the blood, in those vessels, whilst, through the same media, the carbon and other noxious particles of the blood acquired in the course of circulation, escape and are carried off from the system; and although it must be admitted that a great proportion of mankind, especially in England, die from disease of the *lungs*, yet it is astonishing that so delicate a membrane should be capable of enduring and performing its office during even protracted life. We are here to consider, in detail, all the organs and functions of *Respiration*, and incidentally, the organs and functions of *voice and speech*, and various other sounds.(*b*)

Respiration (a compound of the Latin *re* again, and *spiro* or *spiritus*,) (*c*) commonly called *breathing*, consists of the drawing into, *inhaling*, or technically called *inspiring*, atmospheric air into the lungs, and then forcing out, *expelling*, or technically *expiring*, from the lungs the air therein, whilst at the same time the blood is transmitted through a set of vessels, so situated in the lungs as to enable the air to act upon it, and to

(*a*) In general, the circulation of the blood has been treated as the principal vital function, and therefore first considered; and respiration, or, as some term it, the *amospherization* of such blood, has been treated as a subordinate function; 2 Bost. 1; but in respect of its indispensable utilities, as well directly as remotely, we have in this work given respiration precedence.

(*b*) See in general as to *respiration, voice*, and *speech*, El. Blum. 110 to 153; 1 Good, 338 to 361; 1 Bost. 1 to 246; Jackson, Princ. Med. 403 to 455; 2 Dungl. Phy. 66 to 115.

(*c*) 2 Par. and Fonb. 11.

produce that change in its nature and properties which fits it for the support of life.(*d*) These operations are directly, immediately, and obviously subservient to two important purposes; the first, and principal, that of carrying off from the blood a *gas*, recrementory and deleterious to life, and introducing, in lieu, one or more gases indispensable to animal existence; and the other, that of furnishing us with *speech*, or the means of vocal communication and interchanging our ideas. To these are to be added some minor consequences, which will be presently considered.(*e*) More remotely, and less obviously, respiration is the main occasion of *contractility* or motion, animal heat, and antiputrescence, and consequently the continuance of life,(*f*) and prevents the decomposition of the body, which would otherwise ensue,(*g*) We will first consider the *Organs* of *Respiration* and *Speech*, in their natural order; and secondly, the *Functions* of *Respiration, Voice, &c.* The following is a concise table of the organs and functions of respiration, speech, and voice.

I. ORGANS.
- 1. Nostrils.
- 2. Mouth.
- 3. Os Hyoides.
- 4. Larynx.
- 5. Glottis and Epiglottis.
- 6. Pomum Adami.
- 7. The Trachea.
- 8. The Thorax.
  - 1. Its boundaries.
  - 2. A description of the Cavity and Parts contained.
    - 1. Spinal Vertebræ.
    - 2. Scapulæ.
    - 3. Ribs.
    - 4. Clavicles and Sternum.
    - 5. Diaphragm.
    - 6. The anterior and posterior Mediastinum.
- 9. Bronchi.
- 10. Lungs, and Blood Vessels.
- 11. The Muscles and Nerves.
- 12. Pleuræ.

II. FUNCTIONS.
- 1. Respiration.
- 2. Voice, Speech, Singing.
- 3. Other Sounds.

Nostrils.

The nose and *nostrils* being principally concerned in the *sense* of smelling, will be hereafter more particularly considered when examining that sense, as part of the Nervous Function. It may suffice here to observe, that the nostrils are considerably concerned in the respiratory function, and in speaking and singing, for through them and into the posterior fauces the air is inhaled and expelled and carried through the *glottis* into the trachea.(*h*) One communication of the air is through the nostrils, the floor of which forms the roof of the mouth, and at the extremity of which is attached the soft palate, and thence into the upper part of the throat,(*i*) and through these, probes or tubes may be introduced into the throat;(*i*) and if there be obstruction or wound in the mouth or trachea, glottis, or epiglottis, or of the œsophagus, so as to render it expedient to introduce food or medicine through the mouth, it may be communicated through a flexible elastic gum catheter passed through one of the nostrils into the *œsophagus*,(*k*) and, perhaps, this expedient might be resorted to in case of a locked jaw;(*l*) and it has been supposed, that an elastic gum catheter might be introduced advantageously through the nostril into the trachea, in order to facilitate respiration.(*m*) On the other hand, if there be obstruction in the nostrils,

(*d*) 2 Bost. 1.

(*e*) 1 Good, 339.

(*f*) 2 Bost. 126, 127.

(*g*) Id.

(*h*) 3 Bell, 194; 1 Good, 339, 340.

(*i*) Lizars, part i, p. 58, 59.

(*k*) Coop. Dict. tit. Throat; and tit. Œsophagotomy, and see a case fully stated, Coop. Dict. tit. Epiglottis.

(*l*) Coop. Dict. tit. Tetanus, *sed quære*, as deglutition could not be supplied, and at most *liquid* aliment could be introduced.

(*m*) Coop. Dict. tit. Bronchotomy. But it is admitted, that this has not as yet been attempted by an English surgeon; id. ibid. And a very experienced anatomist has objected that the introduction of a catheter through the *glottis* would be *impossible*, because the irritability of the membrane is too great to admit even the

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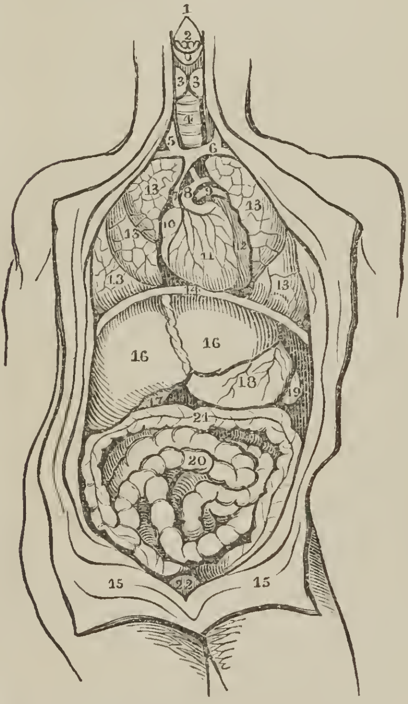
then the patient may breath alone through the mouth.(*n*) On the other hand, the smallest particle of food is in general prevented from entering the nostrils or Eustachian tubes, by means of the soft palate, which, as well as the *uvula*, is extended by muscles of its own, and closes those openings during the operation of swallowing.(*o*) The nostrils and parts communicating with the throat are frequently subject to the most calamitous diseases.(*p*)

Mouth. In regularly tracing the organs of respiration and voice, from the external atmosphere to the innermost cells of the lungs, we should begin with the two orifices, namely, the *mouth* and the *nostrils*, through which the air is inspired and expired. But with respect to the *mouth*, as its various parts are more actively concerned in mastication and deglutition, we will consider them as parts of the Alimentary Canal, and connected with the Function of Digestion.

We will, therefore, now consider the upper parts of the air tube, which commences in the fauces, and descends through the neck, in front of the œsophagus, into the thorax, and is the only tube which carries the air into the lungs, and is wholly distinct from the œsophagus, which lies behind the same.(*q*.)



1. Os Hyoides.
2. Epiglottis.
3. Two lobes of thyroid gland.
4. Trachea.
5. Internal jugular veins.
6. Subclavian veins.
7. Superior cava.
8. Aorta.
9. Pulmonary artery.
10. Right auricle of heart.
11. Right ventricle do.
12. Left ventricle do.
13. Lungs.
14. Diaphragm.
15. Abdominal muscles.
16. Liver.
17. Gall-bladder.
18. Stomach.
19. Spleen.
20. Small intestines.
21. Colon.
22. Bladder.

Os hyoides. At the root or posterior extremity of the tongue, lies a bone, which, from its resemblance to the Greek Ů or letter Υ, is called the *os hyoides* or *hyoid* bone,(*r*) and which may be felt between the chin and the thyroid cartilage. It is complete in the front and sides, but deficient posteriorly,

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smallest drop of water. See Dorsey, Surg. 413.

(*n*) Lizars, part ix. p. 56.

(*o*) 1 Dungl. Phy. 473.

(*p*) 2 Gibson, Surg. 213, &c.

(*q*) 2 Dungl. Phy. 69.

(*r*) In Greek there is no H, and the Υ aspirated is sounded in English as Hy.

where it terminates in being connected to the *pharynx* (which will be considered hereafter as part of the alimentary canal.) (*s*)

Larynx.

The superior extremity of the trachea is furnished with a number of cartilages of a peculiar form, which constitute the *larynx*. The larynx commences about an inch below the hyoid bone, to which it is connected by strong ligaments, and it forms a part of the tube through which the air passes into the lungs. It is composed of five moveable cartilages, or rather bones, namely, the thyroid and cricoid, and the two arytenoid cartilages, and the epiglottis. The thyroid cartilage, supposed to have been so named from its resemblance to an ancient shield, is formed of two square pieces of bone united along the front, and diverging backwards: at the upper part of their junction, in front, is a slit-like projection, more apparent in males, called the pomum Adami, and vulgarly attributed to Adam's eating the forbidden fruit.(*t*) Below the thyroid is the cricoid cartilage, bearing a strong resemblance to a real ring, the broad part of which is turned backwards, and filling up a part of the vacancy in the back of the thyroid, to the lower edge of which it is united by ligaments. On the upper edge of the cricoid cartilage are placed behind, two triangular pieces of cartilage called the arytenoid, which are moveable on the cricoid, and from the bases of which there proceed forwards the two chordæ vocales: these are two ligamentous chords, placed somewhat parallel to each other, and which have between them the fissure called the *glottis*. The voice is produced by the air vibrating upon these chords, and if the air be forcibly propelled from the lungs through the glottis, according to the varying form and size of the aperture, caused by the muscles moving the arytenoid cartilages, the different vocal sounds will be produced. The muscles of the glottis are under the control of the will; and an individual, by his voluntary effort, operating through the medium of these muscles, can produce all the vocal or musical sounds or tones of which the voice is susceptible, though such sounds are modulated, some by the larynx, others by the tongue, or in the mouth, teeth, lips, or the cavities of the nostrils.(*u*)

Glottis and epiglottis.

The part of the larynx most concerned in producing the voice, is considered to be the glottis or narrow opening of the wind pipe, and over this aperture lies one of the cartilages, the epiglottis, which closes it in the act of swallowing, so as to direct the food to the œsophagus, and prevent it escaping down the wind pipe, though it has been observed, that the glottis, when sound, may be sufficiently closed and protected, independently of the epiglottis.(*x*) It is clearly ascertained, that in fact the air expired from the lungs, and striking properly upon the margin of the glottis, becomes sonorous.(*y*) The larynx is contracted and dilated by the powers of the muscles and the elasticity of its cartilaginous structure, and is covered internally with a very sensible vascular and mucous membrane, which is a prolongation of the membrane of the mouth.

Speech, Voice, &c.

Speech (the gift of which so eminently distinguishes the human species from all other animals,) depends upon another series of actions connected with the muscles of the *tongue and lips*, which, although they are distinct from those that are concerned in the formation of the *voice*, are like them, connected with the respiration, as articulate sounds necessa-

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(*s*) 1 Horn. Anat. 190; where the os hyoides is fully described.

(*t*) 1 Good, 340; Amer. Cyclop. Prac. Med. tit. Asphyxia.

(*u*) See the explanatory plate of the organs of respiration, ante, 94. See also an account of the larynx, El. Blum. 139, 144; 2 Horn. Anat. 121; 1 Good, 339 to 347; Amer. Cyclop. Prac. Med. tit. Asphyxia; and see Albinus, tab. 11, figs. 44, 48; and tab. 12, figs. 1, 7.

(*x*) 1 Dungl. Phy. 360, &c.

(*y*) Jackson, Princ. Med. 287; 1 Good, 341, and Brous. Phy. 285.

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rily depend upon the emission of air from the lungs. Besides the cartilages and muscles that compose the larynx, there are several ligaments which serve to connect the various parts.(*z*)

The chordæ vocales.

The *chordæ vocales* are the two long edges of the *rima glottidis* (from *rima*, a chink or fissure, and *glottis.*) The form of the *glottis*, composed of three distinct cartilages, resembles that of a small box, with a minute aperture or *rima* (chink or fissure,) nearly an inch, or ten or eleven *lines* in length, and two lines or one-sixth of an inch in breadth at its greatest diameter, *resembling the reed in the clarionet*,(*a*) but capable of enlargement or diminution. The margins or edges of the chink, which constitute the glottis, are formed by two thin ligamentous chords, which extend forwards from the *base* of two triangular and moveable cartilages to their attachment in front, which is fixed. These are called the *chordæ vocales*, and the diameter of the aperture between them varies according to the actions of the muscle, which are attached for that purpose to the arytenoid cartilages; and the voice is the sound of the air propelled through and striking against the sides of the glottis or fissure between the chordæ vocales, somewhat as in a clarionet. Speech and singing are the modification of the voice into distinct articulations, by the glottis itself, or in the cavity of the mouth, or of the nostrils.(*b*)

Whistling.

The *tongue* also assists in articulation, though it is said that there are instances of distinct articulation after it has been lost.(*c*) *Whistling* has been incorrectly supposed to be performed in the larynx and completed by the coartation of the lips, so as to serve as an embouchure to the column of air expelled through the larynx and mouth, and that the varieties of intonation entirely depend on the alteration of the tongue, and on the corresponding motion of the larynx; namely, that for the higher sounds in whistling, the tongue is brought forwards and the larynx is raised, and for the lower sounds, that the tongue recedes and the larynx is depressed;(*g*) but this supposition is incorrect as regards the larynx being concerned in the action, for whistling is a musical sound, produced wholly by the lips, modified by the cheeks and tongue. The lungs supply the air, and the larynx nothing more than as a part of the tube through which such air passes.

It has been conjectured, that when persons are drowned, the *glottis* almost immediately closes, so as to prevent much water from escaping into the lungs, and that consequently death proceeds from the want of inspiration, and not from suffocation by water.(*h*) Besides other disorders, the larynx, glottis, and epiglottis are liable to a dangerous inflammation, sometimes excited by too much exertion of the organs in singing, or public speaking, called *Empresma Laryngitis*, or *Cynanche Laryngea*, and differing in some respects from croup, and requiring *immediate* care, and sometimes even the operation of Bronchotomy or Tracheotomy.(*i*)

Injury to the os hyoides, &c.

If the os hyoides, glottis, or epiglottis, be injured or destroyed by gunshot or other wound, the patient may be fed by means of an elastic gum *catheter* being passed through one of the nostrils,(*k*) and even the power of voice, and speech, and deglutition may, it has been supposed, be continued, though in a very diminished degree.(*l*)

(*z*) 2 Bost. 169.

(*a*) A *line* is a measure adopted on the continent; and one line is the twelfth part of an inch.

(*b*) 1 Dungl. Phy. 363; and see as to ventriloquism, 1 Good, 345 to 347; and see El. Blum. 139 to 153, with the notes, containing some interesting observations on the *voice* and *singing;* Tuson's Dissector, 117; and see 2 Bost, 170, note.

(*c*) El. Blum. 141, 146; 1 Good, 370, *sed quære;* 1 Dungl. Phy. 382.

(*g*) 1 Dungl. Phy. 366, &c.

(*h*) 1 Par. & Fonb. 35 to 37; El. Blum. 136, in note (*a;*) Cyclop. tit. Asphyxia.

(*i*) 1 Good, 310; see those titles in Coop. Surg. Dict., and Amer. Cyclop. Prac. Med.

(*k*) Coop. Dict. tit. Epiglottis.

(*l*) Id. and El. Blum. 318, n. (*c*.)

Change of voice at puberty.

At the age of puberty, which commences about fourteen in males, and twelve in females, the voice becomes fuller, deeper, and more sonorous;(*m*) and Richerand, Good and others, have clearly shown that this change of voice depends upon the *Larynx* and *Glottis* undergoing an increase in capacity; the former observes, that at the time of puberty the aperture of the glottis augments in the proportion of five to ten in the course of twelve months, that its extent is in fact doubled both in length and breadth, but that these changes are less marked in women, whose glottis only enlarges in the proportion of five to seven.(*n*)

Trachea. Throat, or windpipe itself.(*o*)

The *Trachea*, or windpipe itself, sometimes called aspera arteria,(*p*) (of which we have thus seen the Larynx is considered the uppermost part, and commences in the *fauces*,) is a long cylindrical tube, composed of cartilaginous rings, each forming about three-fourths of a circle, which is defective behind, united together by elastic membrane, extending down the neck, and nearly in front of the œsophagus (though that tube somewhat inclines to the left side) (*q*) from the *Hyoid* bone at the root of the tongue to the second or third dorsal vertebra in the thorax, where it branches off(*r*) into the two bronchial tubes, through which the air passes freely into each corresponding lung.(*s*)

Thyroid Gland.

The Trachea then passes downwards, as before observed, to the second or third dorsal vertebra, where it divides into the bronchi. It is placed between the great vessels of the neck, and covered partly by the *thyroid gland* and its veins,(*t*) also by the *sterno hyoid* and *sterno thyroid* muscles, and crossed by the left vena innominata, the arteria innominata, and the arch of the aorta.(*u*) We shall hereafter, in describing glands in general, necessarily consider the structure of this gland; it may here suffice to state, that the thyroid gland is a body composed of two somewhat oval portions, united at their superior end by a small transverse slip, which lies across the trachea. The size varies exceedingly, its average being about an inch and a half. Its use is unknown: no ducts are traced either to or from it, but it receives a large supply of blood, and few nerves. Its enlarged state is called *Bronchocele*.

The Trachea continued.

The Trachea itself is composed of fibro cartilaginous rings, varying from sixteen to twenty in number, and united together by an elastic membrane, and furnished with muscular fibres. Elastic fibrous lamellæ form the circumference of the tube, and serve to connect the cartilaginous ring, which seem as if developed in its interior, and also to complete the circuit posteriorly, where these rings are deficient. Interior to these is situated the mucous lining, continuous superiorly with that of the larynx, and ultimately prolonged through the bronchial ramification. Where the

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(*m*) 1 Paris & Fonb. 185; 5 Good, 8; see more particularly on puberty, post.

(*n*) Elements of Physiology, translated from the French of Richerand, by R. Kerrison, London, p. 438; 1 Paris & Fonb. 185, note.(*a*)

(*o*) *Trachea* is probably from τραχυς, Latin, *asper*, and from thence the word *aspirate*. The term *Throat* is derived from the Greek word θροεω, to speak. The *Pharynx* derives its name from φαρυγξ, Latin *guttur*, and from thence the word guttural sound, Coop. Dict. Pharyngotomy. The term *Throat* has been properly defined to be only the *forepart* of the neck or windpipe, though it is commonly used to describe all the contents of the neck, and to comprehend parts of the œsophagus, and arteries and veins; at least the term *wounds of the Throat* comprises injuries to all those organs, see Coop. Dict. tit. Throat. So the term *sore throat* imports disease of the tonsils, or pharynx or œsophagus, 2 Good, 302.

(*p*) 2 Horner, Anat. 132.

(*q*) 2 Horner, Anat. 132; 2 Bost. 3.

(*r*) 2 Dungl. Phy. 64, 69; 1 Bell, 561; Broussais, Phy. 279.

(*s*) 1 Good, 339.

(*t*) As to the *Thyroid Gland*, see Coop. Dict. Thyroid Gland, and *Bronchocele;* 5 Good, 207; 2 Horner, Anat. 136.

(*u*) 2 Horner, Anat. 132; and 1 Bell, 561.

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cartilaginous rings are deficient, the mucous membrane is supported by some longitudinal fibres, and beneath it are a series of muscular fibres, resembling those of the intestinal canal. These are disposed transversely, so as to connect the extremities of the cartilaginous rings.(*x*)

If foreign substances, obstructing respiration, have escaped into the trachea, or into the adjoining œsophagus, it may become essential promptly to perform the operation of *Bronchotomy*, more properly, with reference to the *place* of operation, termed *Tracheotomy*, when performed in the trachea, and derived from the Greek τραχεια, the windpipe, and τεμνω, to cut, and which is the operation of cutting an opening into the windpipe for various surgical purposes:(*y*) and when performed in the œsophagus, is termed *Œsophagotomy*.

The Thorax.(*z*)

At the termination of the neck, and nearly where the Bronchi commence, the trachea enters the *thorax* (from θοραξ, or Latin *pectus*,) which we may remember constitutes the upper division of the trunk, and is that cavity which extends widely from shoulder to shoulder at the top, and is bounded by and principally influenced by the *Diaphragm* at the bottom, which separates the cavity of the thorax from that of the abdomen.

The thorax is *protected* posteriorly by a part of the spinal column, on the sides by the ribs, and in front by the sternum, and is bounded at the bottom by the *Diaphragm*, which will be presently described. This cavity, by the contraction principally of the diaphragm, and by the influence of the intercostal muscles (*i. e.* the muscles intervening between the ribs,) is capable of considerable enlargement, followed by corresponding contraction, and which operations are constantly repeated during life, when inhaling and exhaling air into and from the lungs. In this cavity are placed the central and most important organs of life, viz., the *Heart*, being the principal organ of circulation, and the *Lungs*, the principal organ of respiration; and it is well adapted for securing them from injury, for it is protected from external injuries by the vertebræ, and twenty-four bones, or ribs of the thorax, by the clavicles at top, the scapulæ behind, and the sternum or breast bone immediately in the centre in front. It *contains* part of the trachea, the bronchi, the lungs and pleura, blood vessels and nerves, the heart, with its blood vessels and pericardium, with the separation or mediastinum, and through it pass downwards the Œsophagus, conveying the food into the stomach, and extending upwards the thoracic duct and the main veins from the abdomen. It was formerly supposed that there was actually a quantity of air in the cavity of the thorax between the pleuræ, but this notion has long been exploded, and on the contrary the layers of the pleura, *i. e.* the pleura pulmonalis and costalis, are in immediate contact.(*a*)

The diaphragm.

The *Diaphragm* (from the Greek διαφραγμα, δια, between, and φραγμα, a fence,) (*b*) vulgarly called the midriff, principally regulates the size of the cavity of the thorax.(*c*) It is the base or floor of the thorax, in form somewhat resembling a small dome or roof, to the abdomen, the centre of which is tendinous, and is fixed immoveably to the spine, and upon which the heart lies. The sides are muscular, convex above, concave below, and each supporting the corresponding lung. Thus, by the contraction of the sides of the diaphragm, the lateral parts of the chest are enlarged, the muscle becomes horizontal, and the lungs are filled with

(*x*) 2 Bost. 3; 2 Horner, Anat. 133; see full description of muscles of windpipe, 2 Horner, Anat. 134.

(*y*) Coop. Dict. tit Bronchotomy, and Tracheotomy.

(*z*) As to the *Thorax* in general, see Ell. Blum. 112; 1 Horner, Anat. 110 to 125; 2 Bost. 5, 6.

(*a*) See authorities, 2 Bost. 4, note.

(*b*) Ante, 34.

(*c*) 2 Bost. 5; 1 Horner, Anat. 423.

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air, the heart remaining stationary. This constitutes the act of inspiration. It is a very firm, stable, and strong muscular expansion, possessing great power of contractility, and throughout more or less moveable, for the purpose of respiration. It has been observed, that the beautiful contrivance in the shape of the thorax and the diaphragm, deserves our highest admiration; for by its being thus conical, every degree of motion in the diaphragm produces a greater effect on the capacity of the chest, than could occur were it of any other shape.(*d*) The diaphragm may be termed the moveable base of the thorax.(*e*) In *inspiration*, when the fibres of the diaphragm contract, the muscle descends and becomes an inclined plane, whose direction is downwards and forwards. By these means the abdominal viscera are pressed against the lower and fore part of the walls of the cavity, so that the capacity of the abdomen is diminished in proportion as the thorax is enlarged.(*f*) On the contrary, in *expiration*, the muscles, particularly of the abdomen, return to their state of relaxation, and the diaphragm becomes again conical, and the dimensions of the superior cavity are diminished, and the breath is naturally forced out; and which operation is therefore compared with passive inspiration.(*g*) The œsophagus and the aorta descend, and the thoracic duct, and ascending veins pass upwards through this diaphragm.

Diseases of and injuries to the diaphragm.

The diaphragm may be afflicted by acute rheumatism or inflammation.(*h*) Wounds or injuries to the diaphragm have ever been considered of the most dangerous nature.(*i*)

The Bronchi.

The *bronchi* are two branches from or division of the trachea, and in which it terminates nearly at the level of the second or third dorsal vertebra;(*k*) these incline obliquely downwards towards the lungs; the *right* one having to supply the larger lung (the heart occupying a part of the left side) is larger but shorter than the other: it inclines outwards almost horizontally, and enters the right lung on a level with the fourth dorsal vertebra. The *left* bronchus is less in diameter, having to supply the smaller lung, but is longer than the right, inclines more longitudinally downwards to reach the lung. Each bronchus, at its entrance into the lungs, divides into two branches, one being intended for each lobe. The lower branch of the right lobe also subdivides, or rather gives off a branch to its middle lobe: each bronchial ramification again resolves itself into two tubes of smaller size, and so, by means of this binary division, continued through five or six successive stages of decrease, a series of tubes is formed, increasing in number as they decrease in size, until finally, each becoming capillary or hair-like, terminates in a minute cul de sac or air vesicle, the aggregate of which constitutes the proper cellular structure of the lungs.(*l*)

The bronchi and their primary ramifications are of the same structure as the trachea,(*m*) but the rings are found gradually to lose their circular form, and to degenerate into lamellæ of irregular shape, placed in different parts of the circumference of the canal, at the several points of subdivision; however they are still somewhat annular, so as to keep their orifices open.(*n*) The sensibility of the bronchiæ or smaller subdivisions, and the existence of their nerves, appear in asthma and otherwise.(*o*)

(*d*) El. Blum. 112, 122; 2 Bost. 3 to 13.

(*e*) Id, ibid.; and see further, Dr. G. Smith, 279; 2 Dungl. Phy. 67; 1 Bell, 555; 2 Horner, Anat. 426.

(*f*) Jackson, Princ. Med. 407.

(*g*) Jackson Princ. Med. 407.

(*h*) 2 Good, 341.

(*i*) G. Smith, 279; 2 Beck, Med. Jur. 113.

(*k*) It would seem from the terms "Bronchocele" and "Bronchotomy," that operations performed even in the larynx and trachea derive their names from the bronchi. See those titles, Coop. Dict.

(*l*) El. Blum. 11, 117, 118; 2 Dungl. Phy. 69; 2 Horn. Anat. 132; 1 Bell, 563; 2 Bost. 13, 14.

(*m*) As to which, see ante, 97.

(*n*) 2 Horn. Anat. 132.

(*o*) 2 Bell, 507, note (1.)

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The lungs themselves.(*p*)

The *Lungs* (*q*) (vulgarly called the *lights*) constitute the principal organ of *respiration*. They are two bodies of highly elastic spongy texture,(*r*) suspended within the cavity of the thorax or chest by the tubes of the windpipe and large blood vessels, and rest upon the diaphragm, and extend at their summit to a little above the first rib. (*s*) They are so light as to swim in water,(*t*) though if respiration has never taken place, as in the case of a child dead before it is expelled from the uterus, the lungs being collapsed, sink when placed in water.(*u*) There are two lungs, having no communication with each other, or indeed any but through the bronchi, namely, the right and left lung, whose aggregate bulk in various individuals materially vary in size. The right is divided into three *lobes*, and the left into two lobes;(*x*) sometimes these, according to their situation, are called the anterior or the posterior lobe. They occupy the lateral parts of the cavity of the thorax, which they completely fill.(*y*) Each lung is of a conical figure; the *external surface* of the lung, smooth and convex in its general outline, corresponds with the arch of the ribs. The *internal* is compressed, and rests on the side of the heart against the *mediastinum* (from the Latin,) and which is a process or septum or division of the pleuræ, so called because it is situate between the two lungs,(*z*) and the centre division passing perpendicularly through the thorax from the sternum to the back bone, and retains the heart to the left side,(*a*) and at its middle third, the bronchi and vessels enter its substance, forming, by their aggregate, what is termed the root of the lung. The perpendicular depth of the *left* lung is greater than that of the right, as the corresponding part of the diaphragm does not ascend so high. Its inner border also receives the heart and its pericardium.(*b*) The capacity of the lungs of an adult, during a strong inspiration, is said to be about 120 cubic inches, but is capable of being inflated to a still larger extent.(*c*)

Mediastinum.

Internal construction of lungs.

We have described how the bronchi terminate in air cells, which constitute the lungs. The lungs are light, elastic, sponge-like organs, composed of numerous *delicate membranous air cells*, and forming what is termed a lobulus, interspersed with air tubes and muscular fibres, arranged longitudinally and transversely, and small arteries.(*d*) A number of air vesicles, connected together by cellular texture, form what are termed *lobules;* a number of these lobules compose *lobes*, and the aggregate of these lobes constitute the lungs. (*e*) The substance of the lungs is lobular, the larger lobes dividing into smaller, and the subdivision being continued through an almost infinite series, till the ultimate lobules terminate in very minute vesicles, in which the capillary extremities of the bronchi terminate. (*f*)

It has been observed, that whatever may be the varying opinions respecting the form of the vesicles or the connexion which there is between the air cells and the blood vessels, "*we know that the parts are so arranged as to enable the air and the blood to act upon each other, by the*

(*p*) As to the lungs in general, see El. Blum. 110 to 139; 2 Horn. Anat. 140; 1 Good, 347; and as to the dissection of lungs, see 3 Par. & Fonb. 53; 2 id. 394.

(*q*) Latin *pulmones*, and hence the diseases are termed *pulmonary;* Greek, *πνευμων*.

(*r*) 2 Dungl. Phy. 68; 2 Bost. 4.

(*s*) El. Blum. 110; Brouss. Phy. 278; 1 Bell, 566.

(*t*) 2 Horn. Anat. 144, 145.

(*u*) This has been considered as one of the tests of infanticide; see post.

(*x*) Smith, 377; Brouss. Phy. 279; 3 Par. & Fonb. 113; 1 Bell, 561; but Dr. Gordon Smith, 377, objects to the term *lobes*.

(*y*) 2 Bost. 4; 2 Dungl. Phy. 68.

(*z*) 1 Good, 347; 1 Bell, 555; 2 Horn. Anat. 146; also 2 Dungl. Phy. 71.

(*a*) 1 Bell, 555; 2 Horn. Anat. 146.

(*b*) 2 Horn. Anat. 141.

(*c*) El. Blum. 111; but see post, where it has been supposed to be even considerably more; *sed quære*.

(*d*) 2 Dungl. Phy. 68 to 71; 1 Bell, 563; 2 Horn. Anat. 142; El. Blum. 111.

(*e*) 2 Bost 4.

(*f*) 1 Good, 347; 2 Bost. 4.

blood being divided into a great number of small portions, and thus expose as large a surface as possible, and by being separated from the air merely by the interposition of a very delicate membrane."(*g*)

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There is this peculiarity in the structure of the lungs, that contrary to the general rule in the rest of the body, they contain more arteries than veins. Their degree of fleshy consistency and solidity, although compressible, is attributable to the many vessels which carry blood through them, and the firm texture of the membrane necessary to support them.(*h*) These air cells are smaller in infants than in adults, and less in adults than in persons of advanced age.(*i*)

It is supposed, that the lungs are separate groups of cells, which are connected together, while these groups are themselves distinct.(*k*) The dimensions of each air cell vary: it has been said, although erroneously, that they are usually in an adult somewhat less than two lines or two twelfth parts of an inch in diameter:(*l*) but there must have been some error in this supposition, for the size of the air cells is so small as never to have been seen even by the most powerful lens. The size of the cells may be modified by disease, and in persons who have coughed much, shortly before death, are generally larger, even to the extent of two lines.(*m*) But the structure as well as the size of the air cells appears to rest on conjecture.(*n*)

The several contents of the lungs, bronchi, arteries, &c.

The anatomical constituents of each lung are, 1, the bronchi and their ramifications; 2, the pulmonary artery and its ramifications, and terminating in capillaries surrounding the air cells, and the four pulmonary veins; 3, the bronchial arteries and veins; 4, the lymphatics; 5, the nerves of the pulmonary plexus, formed by the par vagum.(*o*) These are surrounded by a quantity of *cellular tissue*, which forms a connecting medium between them, as before mentioned.(*p*)

The pulmonary artery and its exhalations

The *pulmonary artery* and its minute branches, including its smallest capillaries, are considered to form the most essential part of the respiratory organs, or that to which all the rest are subservient, carrying the blood into the lungs, and through what is termed the rete mirabile Malpighi (from the name of the anatomist who first attempted to describe the same,) to be there aërated, and thereby renovated, or, as Dr. G. Smith called it, atmospherizated, and after which, the thereby renovated blood is collected in and carried through the four pulmonary veins to the *left* auricle of the heart, to commence its new or repeated circulatiou through the aorta and other arteries, and the rest of the frame.(*q*) Such blood in the pulmonary artery and its branches is, however, still retained in its proper blood vessels, and it is only through the vessels coming in *contiguity* or propinquity with the air, through the extremely delicate thin sides of the air cells, and through the exquisitely fine membranes of the blood vessels, that it is supposed the blood is thus renovated.(*r*) There is thus a double partition between the blood and the air, and, were it otherwise, the lungs themselves would be flooded and choked with blood, and respiration would be destroyed.(*r*) The coat of the ves-

(*g*) Cuvier, Lec. Anat. Comp. vol. iv. 298; and 2 Bost. 15. A common observer would scarcely understand or believe how, for *seventy years*, through so delicate a membrane, air can so rapidly pass and repass, and why so thin a membrane should not rapidly decay, or by thickening become impervious; but probably this delicate membrane is perpetually renovated in its particles, like every other part of the human frame.

(*h*) Bell, 560, 561.

(*i*) 1 Good, 348.

(*k*) 2 Bost. 14; 2 Horn. Anat. 142.

(*l*) 1 Good, 348.

(*m*) Id.

(*n*) 2 Bost. 15, 16.

(*o*) 2 Dungl. Phy. 68.

(*p*) 2 Dungl. Phy. 70; 1 Good, 348.

(*q*) 2 Bost. 4.

(*r*) El. Blum. 111, 133, and 16, n, (G;) 1 Good, 352; 2 Bost. 15; Cuvier, Lect. Anat. Comp. vol. iv. 298.

CHAP. IV. Sect. I. Respiration.

sels, or of the partition, has been supposed to be as scarcely equal to one thousandth part of an inch in thickness.(*s*) But, as regards the composition of the arteries and veins passing through the lungs, it more properly belongs to the chapter in which the organs and vessels of *circulation* will be considered.

Exhalation from the pulmonary artery.

It is established, that, from the pulmonary artery and its branches, there is an *exhalation* which most essentially conduces to preserve the due temperature of the body: this is an aqueous *vapour*, which will presently be particularly described.(*t*)

Colour of lungs.

The *colour* of the lungs in the adult, is a bluish gray, and in old age, purple or livid, with dark spots.(*u*)

Size and weight of the lungs.

The lungs vary much in *size* and *weight* at different ages and in different adults. In children who have not breathed, they are, in general, with respect to the whole weight of the body, in the variable proportions as 1 to 55, or 1 to 76; but after respiration has taken place, in the proportion as 1 to 28, or 1 to 33.(*x*) It should seem, that, after the first respiration, they are about double their previous weight,(*y*) and, hence, this is, as will be hereafter considered, one of the tests whether or not a child has been born alive. Before respiration, it has been said, that, the lungs of a mature fœtus generally weigh about two ounces, but afterwards four ounces.(*z*) The medium weight of the lungs, containing blood and air, of a healthy man, is about four pounds; when the air is removed, it bears a proportion to the whole *weight* of 1 to 35. The lungs of the male are larger than those of the female,(*a*) Whilst others say, that the lungs do not weigh a pound and a half;(*b*) though, in consumption, the lungs, from the deposition of new matter, have weighed not less than five or six pounds, which, it is insisted, is nearly four times their ordinary weight.(*b*) It is singular, that there should be such variations of opinion on a matter of fact, which, it might be supposed, is capable of demonstration.

Motion of the lungs. Muscles, &c.

There is a *contractile*, and even an *irritable* power in the lungs.(*c*) The moving powers of the lungs consist in the bones and cartilages and muscles; by which they are connected to the ribs and sternum or breast bone;(*d*) but still more by the diaphragm, which principally gives effect to inspiration and expiration by its rising and falling.(*e*)

Nerves.

But to excite these moving powers to action, the phrenic *nerves* and *par vagum*, and sympathetic nerves in particular, are influenced by the will from the brain, and if these or the brain cease to act, the power of motion and respiration will also cease.(*f*) From experiments, it has been ascertained, that, the *par vagum nerve* (synonymous to the eighth pair of nerves) is mainly concerned in respiration, and that, if divided, respiration will cease, and, consequently, life.(*g*) But, it is said, that although the par vagum and the great sympathetic nerves pass through the diaphragm, yet they are not, as supposed, subjected to such a mate-

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(*s*) El. Blum. 111.

(*t*) Post, 104, 105, tit. *Expiration;* El. Blum. 135, 138; 2 Bost. 49 to 98; 3 Bost. 326; 2 Dungl. Phy. 99.

(*u*) 1 Bell, 560, 561; 2 Horner, Anat. 144.

(*x*) Cloquet's Anatomy, by Knox; see 3 Par. 117; but see G. Smith, 358, where it is said, that, *before* respiration, it is 1 to 70, and afterwards, 2 to 70; also, 1 Beck, 226.

(*y*) G. Smith, 360, 361; Beck, ibid.

(*z*) Id.; *sed quære* if not much heavier. 1 Beck, 253.

(*a*) Meckel's Anatomy, by Jourdan and Breschet, vol. iii. 521.

(*b*) 3 Good, 197.

(*c*) 2 Quain, El. 573.

(*d*) 1 Good, 349; 1 Bell, 566; El. Blum. 118, 119; 2 Dungl. Phy. 80.

(*e*) Ibid. 81.

(*f*) 1 Good, 352; 2 Paris & Fonb. 19 21; 2 Dungl. Anat. 107.

(*g*) 2 Bost. 129 to 134; and see Dr. Philip on the Lungs, as observed upon in 3 Bost. 327 to 328.

CHAP. III. Sect. I. Respiration.

rial pressure in respiration, so as to occasion any material effect upon such nerves in that respect. (*h*) Mr. Brodie, and some other eminent physiologists, contend, that, *animal heat* principally depends on the *nervous influence*, whilst Dr. Bostock attributes the same principally to the effect of oxygen combining with carbon in the lungs, thereby causing *combustion*, and creating and diffusing animal heat, and insists that such heat is very little attributable to the nervous functions: (*i*) whilst others insist that there is no such particular combustion in the lungs, but animal heat is generated in all parts of the frame.

The Pleuræ.

The cavity of the thorax is lined with the serous membrane called Pleura, and the lungs are also invested and protected by a duplicature of the same membrane. These, with reference to the different parts they invest, are termed *pleura pulmonalis*, from its lining the lungs themselves, or *pleura costalis*, where it lines the ribs or thorax, or *pleura diaphragmatica*, when upon the diaphragm. (*k*) These are thin semi-transparent membranes. Each lung is invested by the above serous *lamella* derived from the pleura, its interior is lined by a prolongation of mucous membrane, and the intervening structures form by their aggregate what is called the *Parenchyma* (from παρεγχυμα, meaning the spongy or pithy part) of the organ. (*l*) The two cavities of the pleuræ are completely distinct from each other, and have no communication whatever. (*m*) It is now the opinion, that, in the healthy state, there is not any quantity of air in the cavity of the thorax between the pleura, but that the whole thorax is at all times completely filled, though capable of expansion in respiration to a considerable extent. (*u*)

Diseases of the Pleuræ.

The pleura is subject to a peculiar disorder called *pleuralgia*, without fever or inflammation, but which occasions an acute pain in the side, which will be hereafter considered, and may be affected with acute rheumatic inflammation. (*p*) To these must be added *Pleurisy*, which is inflammation, and attended with fever. (*q*) It is said to be extremely rare to see the pleura of both sides simultaneously attacked with violent inflammation and abundant effusion, and when such a case does occur, it is almost always speedily fatal. (*r*)

Section II.—The principal direct Functions and Consequences of Respiration, and Modes in which performed.

Enumeration of the principal more *direct* functions, and operation of the lungs in

The *principal function* of the lungs is *Respiration*, which it is generally believed introduces fresh oxygen into the *blood*, conveys away the *superfluous noxious carbon* (carbonic acid) from the blood, *renovates its qualities*, bestows *heat*, *stimulates* the system, endows us with the power of *speech* and of *singing*, and feeds the sense of *smelling*, or at least considerably contributes to the perfection of that sense. (*s*)

Antecedently to birth, the lungs are of small comparative importance to the function of life and growth, and hence no more blood seems in the

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(*h*) 2 Bost. 34. But see Jackson, Prin. Med. 413, 416, as to the *respiratory nerves*.

(*i*) 2 Bost. 195 to 229.

(*k*) El. Blum. 117; 2 Horn. Anat. 145; 2 Dungl. Phy. 71; 1 Bell, 555, 516, 565, 566; Brous. Phy. 281.

(*l*) Jack. Prin. Med. 413; see objections to the term Parenchyma, 5 Good, 193.

(*m*) Coop. Dict. Paracentesis.

(*n*) Ante, 98; 2 Bost. 8, 9, 10.

(*o*) 1 Good, 459.

(*p*) 2 Good, 461.

(*q*) 2 Good, 336.

(*r*) Id. 337.

(*s*) 3 Bell, 239; 1 Bell, 560, 561; 2 Paris & Fonb. 17; 3 Paris & Fonb. 53; 2 Good, 126; Ell. Blum. 9, note 382; 1 Bost. 386. It is generally said to *afford* the sense of smelling, but this is incorrect; it may *feed* or *assist*, but can hardly be said to *afford* it.

CHAP. IV. SECT. II. RESPIRATION.

Respiration; the changes in the air, and also in the blood, and what effects the operation produces *collateral* to its principal objects in renovating the blood.

fœtal state to circulate through them than is necessary for their *own* development and health. The florid or decarbonated blood, instead of being received from the lungs of the pulmonary veins, is during gestation received from the *placenta* by the venæ cavæ, and passes for the most part at once into the general circulation, as before birth the fœtus does not breathe whilst still in the uterus.(*t*) But from the moment the infant is exposed to the atmospheric air, and sometimes even before complete birth, as soon as the head is without the vagina, the air rushes in, and the process of *respiration* commences.(*u*) But still before a separate and complete independent circulation has taken place, the child cannot, it has been supposed, be said to have been *born*, so as to subject the party who, by a wound or injury occasioned death, to be indited for murder or manslaughter.(*x*)

Respiration defined.

Respiration (from the Latin) consists of two acts, *inspiration*, or inhaling or drawing in the atmospheric air, and *expiration*, or the act of throwing the air back again, after it has acomplished the purpose of nature. We have seen that the moving powers of the lungs consist in the bones, the cartilages and muscles, by which they are encircled and influenced by the nerves.(*y*) For man, in common with all warm-blooded animals, cannot long retain the inspired air, but is compelled to discharge it, and take in a fresh supply of this *pabulum* of life, as *fresh air* has always been denominated. The ancients regarded the aliment as threefold, namely, victuals, drink and air, and the latter has even been considered *vital*, because we cannot dispense with it without danger to life.(*z*)

Inspiration.

In *Inspiration* the air enters the lungs by *suction;* the motion of the thorax produces that suction, or in other words the operation of the weight of the air permitted to take effect by the tendency to a vacuum which the rising of the sides of the thorax produces, and the pressure of the atmosphere then causes the air to descend into the bronchial cells.(*a*) When excited to *inspiration* the diaphragm sinks from *instinctive sympathy* towards the viscera beneath, and the chest becomes deepened, and the ribs rise by the agency of the intercostal muscles, and the chest becomes elevated: consequently the entire cavity of the thorax is considerably enlarged, and into the dilated vacuum thus produced, the *external* air rushes forcibly through the nostrils or mouth into the trachea, and thence through the bronchial tubes into the lungs, and the lungs may be inflated to the full stretch of their elasticity, and as the lungs have become greatly expanded, the pulmonary artery and its branches become dilated, and thus relieved, can receive from the right ventricle and auricle a greater quantity of blood to be exposed to the atmospheric air, and thereby the heart becomes liberated from a load which would still incumber it if the lungs continued compressed and unexpanded.(*b*) The passage of the air into the cells may be distinctly heard by applying the ear to the corresponding part of the chest, or by the Stethoscope, and is called by Laennec the respiratory murmur.(*c*) It is universally agreed, that the blood is *drawn* towards the heart during *inspiration.*(*d*) The effect of the circulation will be demonstrated when considering the action and beating of the heart.(*e*)

Expiration.

The process of *Expiration* then follows. The muscular contraction of

(*t*) 1 Good, 349; 2 Bost. 28.
(*u*) 1 Good, 349; 3 Paris & Fonb. 113; 1 Beck, Med. Jur. 236; El. Blum. 116; 2 Bost. 31.
(*x*) *Rex* v. *Poulton*, 5 Car. and P. 329; but see *Rex* v. *Senior*, 1 Mood. 346; and see more fully post.
(*y*) Ante, 102; 1 Good, 349, 350.
(*z*) El. Blum. 113 to 115.
(*a*) 1 Bell, 566; 2 Dungl. Phy. 80.
(*b*) 1 Good, 349; 1 Bell, 566; El. Blum. 113; Jackson, Princ. Med. 408.
(*c*) 2 Dungl. Phy. 87.
(*d*) Id. 94.
(*e*) And Broussais, Phy. 282, &c.

the diaphragm and intercostals having ceased, is succeeded by a *short* relaxation or pause,(*f*) during which the renovation of the blood is completed, the elasticity of the cartilages of the ribs and texture of the lungs, occasionally aided by the muscles of the belly and loins, and the rising up of the diaphragm, in a conic form, reduces the chest to its former dimensions, and as the capacity of the lungs is thus diminished, *some* of the air in them is expelled into and through the mouth or nostrils. In a little while the *contraction* of the diaphragm and intercostals is again *renewed*, and is again followed by *relaxation*, and the alternate actions of inspiration and expiration continue with life.(*g*) But the elasticity and muscularity of the lungs are not sufficiently great to expel the *whole* of their air in expiration, and consequently they always remain in a small degree of distention,(*h*) and if, as supposed by some, after a full inspiration the lungs contain about 120 cubic inches of air, then, as each expiration only carries off about fourteen inches, it would follow that upwards of 100 inches are *generally* in the lungs, though exchanged for part of the fourteen inches inspired.

It has been supposed that during *expiration* the great venous trunks of the heart, neck, chest, abdomen, and the four upper and lower extremities, swell from the blood, either being obstructed or retrograding(*i*) and that the passage of the blood through the pulmonary vessels is *impeded* by *expiration*, and a sense of anxiety is thus produced, and that this unpleasant sensation acts as a stimulus upon the nerves of the lungs and parts connected with them, which excites the energy of the sentient principle, and this, by causing the contractions of the diaphragm, enlarges the chest, and removes the painful feeling, by occasioning inspiration, which, having been completed, the muscles then cease to act, in consequence of the stimulus no longer existing.(*k*) But Dr. Bostock has considered this notion to be questionable, and that the precise causes of successive inspiration and expiration have not been satisfactorily ascertained,(*l*) though he says that we may conclude, that ordinary respiration depends upon a cause which, in some way, that we are not able to explain, acts upon the diaphragm, so as to produce its contraction.(*m*)

The mere suspension of respiration impedes the circulation through the heart, by causing obstruction in the lungs, and, consequently, inspiration, by giving free passage to the blood through those organs, will accelerate its course through the veins.(*n*)

Use of expiration.

The following are the words of Harvey. "It would appear that the use of expiration is to *purify* and *ventilate* the blood, by separating from it the noxious and fuliginous vapours."(*o*)

Entire quantity of air *sup-*

We have seen that it is essential to the proper construction of hospitals, as well as of apartments in which a crowd of persons may be in the habit of assembling, to inquire what quantity of atmospheric

(*f*) Copland, Dict. Prac. Med. tit. Chest. The blood is changing at every inspiration, of which there are about twenty in a minute, and few people can suspend inspiration for sixty seconds, or one minute.

(*g*) 1 Good, 349; 1 Bell, 566; El. Blum. 113; 2 Bost. 6, 7; 2 Dungl. Phy. 84.

(*h*) Ibid. 85; Jackson, Princ. Med. 418.

(*i*) Jackson, Princ. Med. 424. If a portion of the cranium be accidentally removed, then an alternate elevation and depression of the brain is visible, but not, as supposed, corresponding with the action of the lungs, but immediately with that of the heart; *sed vide* 2 Bost. 42, 43.

(*k*) Whytt on Vital Motions; and 2 Bost. 33, 34.

(*l*) 2 Bost. 35, 36.

(*m*) Id. 37.

(*n*) Jackson, Prin. Med. 424.

(*o*) El. Blum. 138. It has been supposed that the ordinary quantity of aqueous vapour emitted by the lungs, trachea and mouth, may be about twenty ounces in twenty-four hours, whilst others state it to be only half-a-pound in that time. This is purely theoretical.

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posed to be in the lungs immediately after inspiration, and before expiration, and the rapidity of its consumption.

air is usually consumed by each individual, and hence, the following observations will not be altogether useless.

It has been supposed even by some of the ablest modern authors upon physiology, that the lungs in their natural or quiescent state contain no less than 290 *cubic* or *solid* inches of air, to which, adding forty inches, supposed (but incorrectly so) to be inhaled at each ordinary inspiration, then the aggregate would be the enormous quantity of 330 cubic inches in the distended state of the lungs; and that, about one-eighth of the whole of the air of the lungs (or forty cubic inches,) is changed by each act of respiration, and that rather more than three-eighths can be expelled by a forcible expiration, and that supposing each act of respiration to occupy three seconds, or the twentieth part of a minute, a quantity of air rather more than two and three-quarter times the whole contents of the lungs will be expelled in a minute, or about 4000 times their bulk in twenty-four hours. The quantity of air during this period would be 1,152,000 cubic inches, or about 666½ cubic feet.(*p*) But can this be considered otherwise than an *overcharged* view of the compass of the thorax and of each operation?(*q*)

Quickness of Respiration and Expiration.

It does not appear to be agreed what is the extent or average *quickness* of the repetition of inspiration and expiration. The average rate of inspiration, in the healthy state of repose, is said by Dr. Bostock and some others, to be from seventeen to *twenty times* in a minute,(*r*) while the average velocity of the pulse may be reckoned at eighty; and that consequently the heart contracts three or four times during the completion of each movement of respiration.(*r*) But Laennec and Mr. S. Cooper and Dr. Good say, that the breathing may be considered natural when the number of inspirations in the state of repose is from twelve to fifteen in a minute;(*s*) and Blumenbach observes, that the alternations of inspiration and expiration occur, in an adult at rest, about fourteen times in a minute, or once to about five pulsations of the heart.(*t*)

But the *quickness* of the return of inspiration may be influenced and accelerated or retarded by the *will* and by habit, as is evinced by the pearl divers, who, by practice, can remain a considerable time under water, during which, of course, there can be no repetition of expiration and inspiration.(*u*) The utmost time during which inspiration can be suspended, is however much disputed. Instances are stated of such pearl divers remaining half an hour under water.(*x*) But Dr. Paris, relying on the observations of Mr. Brodie, insists, that, unless in some cases of asphyxia (suspended animation) it is extremely doubtful whether, under the most favourable circumstances, the heart ever continues to pulsate for so long a time as *five minutes* after the lungs have ceased to perform their office, though instances have occurred of persons, by habit, acquiring the power of abstaining from inspiration longer than others, and of persons being restored after having been under water for a longer time.(*y*)

(*p*) 2 Bost. 27; 2 Dungl. Phy. 85.

(*q*) Post, note. If instead of forty cubic inches, only ten of such inches be so inhaled at each time, which is, probably, nearer the truth, then, of course, according to the above calculation, only one-fourth of the aggregate of each operation will be produced, and which appears nearer to the fact.

(*r*) 1 Mayo's Outlines, 87; 2 Bost. 17, 44; 1 Good, 352, 353; 2 Dungl. Phy. 87, &c.; see 2 Bost. 16 to 27, for the several opinions upon this subject.

(*s*) Laennec on Diseases of the Chest, and on Mediate Auscultation, translated by Dr. Forbes, p. 13; 1 Good, 353.

(*t*) El. Blum. 113; but see id. 134, where it is considered as probably *twenty*.

(*u*) 1 Good, 350; 2 Dungl. Phy. 87.

(*x*) Id.; but see post.

(*y*) See 2 Par. and Fonb. 10, 11, 33, 34; and 3 id. index, tit. Respiration; El. Blum. 136, 137, and see notes; and id. 302, n. (*c*;) Amer. Cyclop. Med. tit. Asphyxia; 2 Bost. 143, note and post, *Drowning*.

Quantity of air inspired and expired each time,

As the *quickness* of the repetition of inspiration is disputed, so is also the exact, or even average *quantity of fresh air* inhaled at each inspiration. Sir Humphrey Davy contends that 13 cubic inches of air are in every inhalation taken in, and about $12\frac{3}{4}$ alternately thrown out. (*z*) Dr. Goodwin calculated the inspired air at 12 cubic inches, and the expired at 14, *being a difference produced by expansion from the heat of the lungs,* and which, it has been observed, does not essentially vary from the estimate of Sir Humphrey Davy, and he calculated the residuary air in the lungs, immediately after expiration, at 109 cubic inches, which, upon inspiration, was increased to 123 cubic inches, the average quantity of air contained in the lungs immediately after a complete ordinary respiration. (*a*) Mr. Abernethy fixed the measure at 12, and Delametherie at a still smaller quantity. (*b*) Mr. Ellis has stated, that the *diminution* in the bulk of respired air, calculated by Dr. Bostock to be on the average about $\frac{1}{80}$th of its bulk, may be accounted for by a union of the carbon of the blood with the oxygen in the air cells, and the formation of aqueous vapour by the disengagement of the caloric from the oxygen of the atmospheric air; (*c*) but other authors contend, that the quantities inhaled and expired are greater. Dr. Elliotson observes, that the common quantity of air taken in at each inspiration is about 16 and a half cubic inches, and that the quantity remaining after death in the lungs of a stout adult man, is about 100 cubic inches, according to Allen and Pepys; whilst Dr. Bostock, agreeing with Dr. Menzies and many others, and having all the above authorities before him, still considers that 40 cubic inches is the average inspiration, and thinks that 160 or 170 remain in the lungs after ordinary expiration, which never empties these organs. (*d*) These discrepancies show that there is at present no certainty upon this part of the subject. The quantity of air inhaled in a single act of inspiration, however, is certainly found to vary in persons of different sized chests, but the aggregate inhaled in a given period does not essentially differ, since those who inhale most at a time, make the fewest inspirations in a minute. (*e*)

It has been observed, that in good health, and perfect quiet, with an open chest, few persons perhaps are found to breathe more frequently than about twenty times in a minute, and that the quantity inhaled and exhaled, at a temperature of 55 of Fahrenheit, is estimated at from 26 to 32 cubic inches each time, which, however, by the heat of the lungs, and saturation by moisture, become 40 or 41 cubic inches in the chest itself. Taking then 20 cubic inches as the ordinary quantity of external air inhaled and exhaled, and these to be repeated about twenty times in a minute, it will follow, that a full grown person respires 24,000 cubic inches in an hour, or the enormous quantity of 576,000 cubic inches in the course of a day, a total equal to about 39 hogsheads. (*f*)

(*z*) 1 Good, 352, 358; 2 Bost. 17.

(*a*) 1 Good, 358; 2 Dungl. Phy. 85.

(*b*) 2 Bost. 19.

(*c*) Ellis's Inquiry into the Changes induced on Atmospheric Air, sect. 83, p. 99; and sect. 107, p. 132; 1 Good, 355.

(*d*) 2 Bost. 19, n. It seems very questionable whether much more than *eight cubic or solid inches* of air are usually inhaled at a time; but Dr. Bostock (vol. ii. 61,) treats an experiment as clearly inaccurate in other respects, because the party only appeared to have $16\frac{1}{2}$ cubic inches respiration in a minute.

(*e*) 1 Good, 358

(*f*) 1 Good, 358; but see experiments, 2 Bost. 60 to 62. In many calculations, whether as regards the capacity for air in the thorax, or the utmost quantity of air therein at any instant; and as to the quantities of air inhaled and expired at a time, there must have been some singular error in the experiments. It is admitted, that the cavity of the thorax is completely filled with the lungs, pleuræ, and heart, and great vessels, ante, 98. Where then is the space in which 200 or 300 cubic or square inches *of air,* are, as supposed, to be contained? And when is it that we are sensible of such a *rush* of air

CHAP. IV. Sect. II. Respiration.

Direct effects of respiration on the *Blood.* (g)

The principal function of the lungs, by respiration, is the CHANGE IN THE BLOOD thereby effected; *all agree*, since Harvey's discovery, that the blood proceeds from the *right* auricle and *ventricle* of the heart, through the pulmonary artery into its various ramifications which pass through the lungs, and that the same is at first of a deep purple hue, *incumbered* with carbon and other *noxious* ingredients, and that it is then *deprived* of those qualities which are incompatible with nutritious secretion and the preservation of of the nervous influence, and the maintenance of the vigorous action of every part and organ, or that it is *immature* and unassimilated to the nature of the system it is about to support, in consequence of its new materials having been received from the thoracic duct, and which that vessel has derived from the lymphatics, and that after having been *materially influenced* in certain respects by the air in the lungs (and especially freed from the superabundance of carbon with which it had become loaded) it returns *from* the lungs, spirited with newness of life, perfect in its elaboration, more readily disposed to coagulate, and the dead purple hue transformed into a bright scarlet. All physiologists *also now agree* that this change in the appearance and condition of the blood, *is in consequence of its being acted upon by the inspired air.* But it is still disputed, *how precisely* it is so acted upon, and what are the *precise changes*, and *how* those changes are effected in the lungs.(*h*) It seems sufficiently established by the researches of modern physiologists, that the purpose of respiration is to expose the portion of the blood which has returned to the heart after it has circulated through the body, and which has acquired, in that course of circulation, the properties of dark or venous blood, and also the new materials for blood, viz. the chyle and other absorbed fluids, to the influence of atmospheric air in the lungs, and that it is the *oxygenous portion* of the air so received in the lungs, that converts this venous blood into florid or arterial blood, that is, into the state in which it is *fitted* for being again circulated through all parts of the body.(*i*) But it is even still disputed, whether the changes produced upon the blood by respiration consist in *the twofold operations of absorption of oxygen and the discharge of carbonic acid*, or simply in the discharge of carbon.(*k*)

Of the atmospheric air, and its effects upon respiration.

The atmospheric air, composed of unequal parts of two aëriform fluids, viz. according to Blumenbch, 79 of azotic gas, and 21 of oxygen gas in 100;(*l*) and according to the experiments of Sir Humphrey Davy, contains, in the 13 cubic inches *inhaled* at each inspiration, 9½ inches of *nitrogen*, three cubic inches and four-tenths of *oxygen*, and one-tenth of a cubic inch of *carbon* or *carbonic acid.* The 12 cubic inches and three quarters of *returned air* gave nine inches and three-tenths *nitrogen*, two cubic inches and two-tenths of oxygen, and one cubic inch and two-tenths

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through the trachea, as even forty cubic inches of air passing *twenty times* in a minute would occasion? Surely mere surface observations upon the dimensions of the thorax, filled as they are by the lungs, and then watching our own quiescent state whilst breathing, will altogether deny the results of these supposed experiments, and establish their total error. A very experienced anatomist of the present day has conjectured, that the lungs contain near 450 cubic inches of *substance* enclosed by the pleura.

(*g*) 2 Bost. 98 to 112. See his general conclusions in last page; Jackson, Princ. Med. 431 to 438.

(*h*) El. Blum. 114, 115; 1 Good, 352; 1 Bell, 542, 547, 548; Ellis's Inquiry into the Changes induced on Atmospheric Air; Brous. Phy. 287.

(*i*) Amer. Cyclop. Prac. Med. tit. Asphyxia.

(*k*) See Dr. Williams's Experiments and Observations on Respiration, vol. ii.; Edin. Med. Chir. Trans. 92; 3 Bost. 326.

(*l*) Jackson, Princ. Med. 427.

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of carbonic acid:(*m*) according to others, if 100 parts of atmospheric air be taken, 27 parts thereof are *oxygen*, considered vital or pure air,(*n*) 72 other parts are *nitrogen* or azotic air (and which by itself would be fatal to animal life,(*o*) and the remaining 1 part is *carbon* or *carbonic acid* or *fixed* air; and it is supposed, that of the 27 parts, only 17 are affected by the respiration.(*p*) Of the 100 parts, the 27 only consist of pure air, the rest will support vegetable, but is not fit to maintain flame or animal life.(*q*) Some authors say, that each person's ordinary consumption is from 1300 or 1400 cubic inches of oxygen in an hour, but that if he is actively engaged, especially in raising weights, the consumption is more than doubled, viz. at the rate of 3200 in the hour: hence, the expediency of the utmost quiet and composure, when the space we breathe in is very limited.(*r*) It has been observed, that a gallon of air will become unfit for respiration in a little more than a minute, and that a man cannot live more than an hour in five cubic feet of air; and that in calculations for the arrangement of an hospital, each individual should be allowed a space of 600 cubic feet, below which it will be found impossible to maintain, for any considerable time, the requisite purity of the air;(*s*) (but it seems now agreed, that by far the most important change which the blood experiences by respiration, at least so far as *quantity* of effect is concerned, consists in the *removal* of a portion *of its carbon*,(*t*) and which removal is greatly increased in each expiration in the state of acute fever.) (*u*)

Dr. Bostock thus states the result of the various experiments and opinions; *first*, air which has been respired, loses a part of its oxygen, the quantity varies considerably, not only in the different kinds of animals of the same species, but even in the same animal at different times, according to the operation of certain external agents, and of certain states of the constitution and functions. Upon an average, he concludes, that we may assume that a man, under ordinary circumstances, consumes about 45,000 cubic inches, or nearly 15,500 grains of oxygen, in twenty-four hours; *secondly*, a quantity of *carbonic* acid is *produced*, the amount of which varies very much according to circumstances, both external and internal; its quantity depends, to a certain extent, upon the quantity of oxygen consumed. In consequence of the variations which take place in the amount of the carbonic acid produced, it appears almost impossible to fix upon any number which may indicate the average quantity; but it may be stated to be somewhere about 40,000 cubic inches in twenty-four hours.

Cause of change in colour.

With respect to the cause of the change in the *colour* of the blood in the lungs, that also is disputed, and seems doubtful, some attribute it to the supply of oxygen, penetrating from the air cells *into* the thin sides of the blood vessels; others to the escape, by the same means, of carbon

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(*m*) 1 Good, 352; as to the quantity of carbonic acid in the frame, see El. Blum. 35.

(*n*) Οξυσ is the Greek term for acid, Turner, El. Chem. 140; and the lungs are the organs for the oxygenation of the blood.

(*o*) But like many other poisons, it may be usefully taken as a medicine in some cases, especially in combination with other particles; 3 Good, 225; 2 Bost. 113 to 121; 2 Dungl. Phy. 109.

(*p*) 2 Dungl. Phy. 86.

(*q*) See further, 2 Bost. 49 to 113; El. Blum. 136, 137; Jackson, Princ. Med. 427.

(*r*) See the advice given to the parties in the Black Hole at Calcutta; to keep exceedingly quiet, so as not to waste the distressingly small compass of atmospheric air, 2 Par. & Fonb. 49 to 55, stating the case of the Black Hole at Calcutta.

(*s*) Ante, 16, 17; 2 Bost. 65, note and authorities there cited.

(*t*) 2 Bost. 65 to 98.

(*u*) 2 Bost. 72, note.

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from the capillaries into the air cells of the lungs, and carried off by expiration; others contend, that the change in the colour is by the passage of caloric from the air cells into the blood vessels.(*x*) But all, as already observed, agree that the colour is changed in the lungs, and that all the perfection of the salubrious qualities of the blood are *there* acquired, and thence passed through the pulmonary *veins* into the *left* auricle of the heart, and that if the alternate actions of inspiration and expiration be suspended, life must cease. Some are of opinion, that the small proportion of iron in the globules of the blood, being exposed to the atmospheric air in the lungs, occasions the red colour.(*y*)

Summary of the several *direct effects* of respiration on the blood.

Dr. Bostock thus states, under the *nine* following *heads*, the results of the different experiments and opinions in *the changes which the blood undergoes by respiration*, but admits, that information upon this subject it still in a very imperfect state.(*z*) The blood, when it leaves the right side of the heart, is of a purple colour; during its passage through the lungs, it is converted into a bright scarlet; and that it afterwards again acquires the purple colour when it arrives at the *venous* part of the circulation: 2, this change, from purple to scarlet, is effected by the oxygen of the atmospheric air, which is received into the vesicles of the lungs: 3, the same change of colour may be produced upon the crassamentum or coagulum of the blood, out of the vessels, by exposing it to atmospheric air, or still more to oxygen, while, on the contrary, scarlet blood is rendered purple by exposure to hydrogen, nitrogen, or carbonic acid: 4, the blood, in passing through the lungs, discharges a quantity of carbon, which is expired, in combination with oxygen, under the form of carbonic acid gas: 5, a quantity of *aqueous* vapour is discharged from the lungs, but this is rather to be considered as the result of secretion or transudation than as a proper effect of respiration: 6, the blood, in passing through the lungs, absorbs a portion of oxygen, and this appears to be more than what is necessary for the formation of the carbonic acid which is discharged: 7, it is probable that the blood, as it passes through the lungs, both absorbs and exhales nitrogen, the proportions which these operations bear to each other being very variable, and depending upon certain states of the system, or upon the operation of external agents: 8, it appears, upon the whole, probable that the atmospheric air is absorbed by the blood in the whole substance, and that certain proportions of each of its ingredients are discharged or retained according to the demands of the system: 9, we have no proof that hydrogen is discharged from the blood:(*a*) to these may be added, 10, the production and continuance, during life, of *animal heat*, so much exceeding the external temperature.(*b*)

Quantity of surrounding natural air essential for life. (*c*)

It should seem that as regards the quantity of natural air and proportion of oxygen therein essential for the support of life, much depends on the temperature of the animal, and that animals enclosed in a given portion of air, die long before the consumption of the whole of the oxygen, and that the fatal effect in this case depends not so much upon the absence of oxygen as upon the presence of the carbonic acid, which is substituted in its place.(*d*)

(*x*) 1 Good, 358 to 361; El. Blum. 133; 2 Bost. 112.

(*y*) 1 Bost. 363 to 375; 2 id. 111, notes; 3 id. 317 to 320; *Blood;* 2 Dungl. Phy. 99, &c.

(*z*) 2 Bost. 112, 113; 3 id. 320 to 329.

(*a*) 2 Bost. 112, 113.

(*b*) Id. 192; 3 Id. 326; and Dr. Williams's Experiments and Observations on Respiration, vol. ii.; Edin. Med. Chir. Trans. 92; and post, 112.

(*c*) 2 Bost. 62; 2 Dungl. Phy. 85.

(*d*) See experiments, 2 Bost. 53, 54; for instance, if a man continue confined

It has been observed, that a gallon of air will become unfit for respiration in a little more than a minute, and that in an arrangement for an hospital each individual should be allowed a space of 600 cubit feet (which we may remember is, according to Dr. Bostock's opinion, about the consumption of air by each individual in twenty-four hours,) below which it will be found impossible to maintain the requisite purity of the air.(*e*) Hence the danger of sleeping in very small rooms, or remaining long in crowded theatres, especially when the apertures for fresh air are limited.(*f*)

Consequences of suspension of respiration.

If respiration be suspended, the blood loses the renovation of those qualities which are essential to the preservation of life.(*g*) This is the cause of death by drowning, and not the suffusion of water into the lungs;(*h*) for the brain in that case suffers from the influx of the dark-coloured venous blood, instead of the ordinary renovated blood;(*i*) and from which cause death will sometimes ensue, though the respiratory organs are afterwards restored to action.(*k*) Hence there are many gases and other aërial poisons, the inspiration of which occasions death, some of them act simply by *excluding* the due quantity of oxygen, while others exert an absolutely deleterious action, in consequence of the specific powers which they possess.(*l*) Oxygen is the only principle which is capable of producing the necessary changes in the blood during its transmission through the lungs, and accordingly, whenever atmospheric air is deprived of this principle, it is no longer capable of supporting life.(*m*) Hence the necessity for endeavouring to reside in pure atmosphere, and to avoid confinement in too small a room, excluding a change of atmospheric air, and of perfect quiet and quiescence of body if so confined.(*n*)

The effect of *oxygen* is also demonstrated by its having been established by Mr. Brodie, that, in some cases of asphyxia (suspended animation,) if oxygen be injected into the lungs through a nostril, as hereafter explained, natural respiration being thereby excited, life may be restored.(*o*) In some diseases and affections, oxygen gas and hydrogen gas may be usefully administered as medicine.(*p*) We shall, hereafter, inquire, when, in cases of suspended animation, the reaction of the heart may be excited by inflating the lungs with proper atmospheric air.(*q*)

The direct effects of respiration.

It has been suggested, that, as the par vagum and great sympathetic nerves pass through the diaphragm, the *nervous functions* were materially influenced by the contraction in respiration; but Dr. Bostock thinks there is no foundation for that supposition,(*r*) though he considers that the pressure of the diaphragm, when contracting pending inspiration, may influence the gall-bladder to evacuate its contents; for, as it has no muscular fibres, it has no means of effecting such evacuation, except what is derived from external pressure.(*s*) Dr. Bostock also considers it not improbable that the compression occasioned by respiration and the alternate motion to which the viscera of the abdomen are thereby subjected, may have the effect of propelling the *chyle* along the lacteals, and the

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in too small a space, he not only consumes too great a quantity of the oxygen therein, but exhales a large quantity of carbonic acid, which becoming intermixed with the residue of the unconsumed atmospheric air, at length destroys life.

(*e*) Ante, 16; 2 Bost. 65; note, and Med. Chir. Trans. vol. vi. p. 115.

(*f*) Ante, 16, 17.

(*g*) 2 Paris & Fonb. 35.

(*h*) 2 Bost. 24; see further post, as to Drowning and its consequences.

(*i*) 2 Paris & Fonb. 35 to 37; El. Blum. 135; 2 Bost. 98 to 113, and the notes; 2 Bost. 141 to 145.

(*k*) 2 Paris & Fonb. 37.

(*l*) See post, as to *Poisons aërial.*

(*m*) 2 Paris & Fonb. 49; Amer. Cyclop. Prac. Med. tit. Asphyxia.

(*n*) 2 Paris & Fonb. 49 to 55.

(*o*) 2 Par. & Fonb. 35 to 37.

(*p*) 3 Good, 225.

(*q*) Post, and 2 Bost. 43, note.

(*r*) 2 Bost. 46.

(*s*) Id. 48; *sed quære.*

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thoracic duct, but he considers that these effects are less powerful than formerly supposed. (*t*)

Contributes to the circulation.

During *inspiration* it is established, that the vena cava is considerably increased in size, and a partial vacuum occasioned, and the expansion of the chest thus attracts the blood, and causes it to fill the great veins, and, consequently, respiration directly assists the due circulation of the blood. (*u*)

SECTION III.—THE MORE REMOTE FUNCTIONS AND CONSEQUENCES OF RESPIRATION.

The more *remote effects of respiration*, namely, 1st, in producing continued *heat* or warmth; 2, in preserving the *contractility*, and several other effects enumerated.

It appears to be agreed amongst physiologists that respiration, besides its *immediate* and *direct* effects which we have considered, has also several *more remote consequences*, and principally, 1st, in producing heat; 2, in preserving the contractility of the muscles; 3, in preventing the decomposition of the body; 4, in promoting the process of sanguification; 5, in the formation of the voice, and the various sounds emitted from the larynx; and 6thly, in the mechanical operations depending upon the motion of the thorax, or upon its connexion with the contiguous viscera. To these, Soemmering adds, that respiration enables us to exercise the sense of *smell*, and the infant to *suck*. (*x*)

First, Respiration produces and continues proper *animal heat*, and regulates the *temperature*. (*y*)

First. As respects animal heat and temperature, Dr. Bostock observes, that the just conclusion from the examination of the various experiments and opinions upon the subject is, that *animal heat* is the immediate effect of respiration, and that the lungs are the apparatus by which the *heat of* the system is evolved, and its *temperature* regulated; and that this is accomplished by the discharge of carbon and water, the *first* (the *heat*) depending upon a chemical combination of the oxygen of the atmosphere, with a portion of carbonaceous matter derived from the blood, during which combination *combustion* takes place, or at least commences, and *heat* is necessarily extricated, (or, in vulgar language, *created;*) the second, (the *cooling*,) from the abstraction of a portion of the heat thus extricated in consequence of the evaporation of water from the surface of the pulmonary cavities; and that hence we obtain the following answers to two most important questions, namely, *first*, by what means is the *uniformity* of the temperature preserved under different circumstances; and *secondly*, how is the body cooled when exposed to temperatures higher than itself; namely, with respect to the first, it is probable that there is a provision in the lungs, by means of the combination of carbon and oxygen, for the production of the greatest quantity of caloric that can at any time be required for the wants of the system; but that when a less evolution of heat is necessary, this is partly effected by a diminution in the quantity of oxygen and carbon combined, but that it is principally brought about by the absorption of heat in consequence of the evaporation of water, a process which is probably at all times going forwards, but which is increased at high temperatures, and so far in proportion to the temperature, that within certain limits, it can prevent the undue accumulation, or carry off the excess of caloric, and prevent the body from acquiring a temperature beyond that which is natural to it. (*z*)

(*t*) Id. 48.
(*u*) 3 Bost. 315.
(*x*) 2 Bost. 126, note; Soemmering Corp. Hum. Fab. tom. 6, ss. 72.
(*y*) As to *Animal heat*, see 2 Dungl. Phy. 190 to 194; the word *Temperature* is here used in a different sense to *Temperaments*, which we have seen constantly and at all *times* vary in different individuals, and which we have already shortly considered, ante, 49, 50.
(*z*) See Dr. Williams's Experiments

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The *heat* created and extricated in the lungs in the course of the circulation through the heart, and the arteries and veins supports the temperature of the system;(*a*) and the result of the most modern experiments establish that "*animal heat* is the result of chemical changes proceeding in the body, and resulting from the functions of respiration and secretion, and a due performance of which functions in that respect is requisite for the healthy and uniform preservation of animal temperature."(*b*)

The ordinary temperature of mankind.

The human *temperature* is less than that of *birds* and of *viviparous* quadrupeds, and averages about 96, 97 or 98 degrees (though the extreme variations run from 87 to 108,) whilst that of birds is from 107 to 108, and that of quadrupeds 100 or 101.(*c*) The surrounding atmosphere is frequently at the same time 40, 50, or even a greater number of degrees colder than the human temperature, so that the heat must be rapidly abstracted from it; but it possesses the power of continually supplying the loss thus occasioned, by the oxygen of the fresh atmosphere which is inspired, combining with a portion of carbonaceous matter derived from the blood, and thereby necessarily producing heat in the manner just explained; and besides this power of *generating heat*, a similar power of producing cold also (as we have just seen) exists.(*d*) The differences to which the *human temperature* is subject in different persons depend *upon age, constitution* and *temperaments*. It is best ascertained by placing the thermometer in the arm-pit. The temperature in infancy (excepting in a newly born child, which is said to be higher,) (*e*) is, upon the average, about 94¼ degrees; and in infants, as well as adults, it gradually increases during the spring, and declines during the autumn. In acute fever it is not increased so much as sensation would induce us to suppose, but it may be raised to 107 degrees, and in local inflammation, it has sometimes been 104 degrees. The same temperature is in health generally preserved alike and at the same degree in the same individual, without regard to the degree of external heat or cold to which the body is exposed, and the blood, and the internal parts in general, at all times, indicate nearly the same degree of heat. But this is not so regular when the *heat* of the atmosphere approaches that of the human frame, as in the case of extreme cold.(*f*) It has been supposed that man could not exist in a temperature greater than his own; but instances of habit enabling persons to endure a temperature as high as 220, 224, 260, or 270 Fahrenheit, for twelve minutes, have been established, though occasioning, even when naked, a profuse perspiration.(*g*)

2dly. The remote effects of

2dly. Due and regular respiration occasions the successive contraction of the heart by the renovated blood flowing into the coronary arteries

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and Observations on Respiration, Edin. Med. Chir. Trans. 92; 2 Bost. 192 to 246; 3 Bost. 326, and references, post, note. But see the qualification in Dr. Stevens on Blood, and Dr. Turner, El. Chemistry.

(*a*) 2 Bost. 203, Crawford's Opinion.

(*b*) Dr. Williams on Respiration, Edin. Med. Chir. Trans. 2 vol. 92, 105; 3 Bost. 326, where also it is maintained that "*artificial respiration*, when properly conducted, prevents the abstraction of heat, which would otherwise take place, while in some cases the temperature would be sensibly increased by the process.

(*c*) 2 Bost. 192 to 195. In taking a warm bath, it is, therefore, usual to have the water at, or rather above blood heat (as it is termed, usually about the ordinary human temperature, namely, 96 to 98 degrees, whilst the atmosphere is much colder,) in order not to repress the cutaneous circulation, and thereby drive the blood to internal organs, and aggravate inflammation by stopping the exhalents of the skin. Cold produces contractility in the arteries.

(*d*) 2 Bost. 192 to 195.

(*e*) Id. 224, note; 2 Dungl. Phy. 182.

(*f*) Id. 230, 231.

(*g*) Id. 229 to 246; 2 Dungl. Phy. 179.

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respiration upon the CONTRACTILITY of the heart and blood vessels, and muscles.

of the heart and muscles.(*h*) This is, however, merely effected by the change of the *blood* whilst passing through the lungs by the operation of respiration from the dark venous state to the arterialized scarlet state, and from the invigorating effect of the latter on the heart and arteries.(*i*) If this operation and effect upon the blood be stopped, the blood passes for a time in its *venous* state, instead of an arterialized renovated state, into the coronary arteries and left ventricle of the heart, and having no contractile power, the circulation soon ceases.(*i*) Cuvier observes, that, as respiration separates carbon and hydrogen from the blood, it will leave in it a greater proportion of nitrogen, and that as respiration maintains the contractility of the system, it is probable that it does so by *leaving* a greater proportion of that body (nitrogen,) in which alone contractility resides.(*k*)

3dly. Remote effect of respiration in *preventing* the *decomposition* of the blood, and eventually of the body.

3dly. It is now an established opinion that one of the more *remote* effects of respiration is to prevent the decomposition of the blood, and eventually that of the body at large. Of all the constituents of the body, the blood, and more especially its red globules, appears to be the part which is most subject to decomposition, and it is accordingly on this that the air is conceived more immediately to act in the process of respiration, and the first step in the spontaneous decomposition of animal matter consists in the loss of a portion of its carbon, which unites with the oxygen of the atmosphere, and forms carbonic acid, as is the case with the air in the lungs. Hence, it seems, that the cause which more immediately operates in preventing the decomposition of the living body, so far, at least, as the chemical nature of the substances is concerned, consists in the abstraction of a part of the carbon of the blood, and that if these particles were not removed from it in the same proportion in which they are deposited, they would produce a tendency to decomposition, which would terminate in complete disorganization.(*l*) To this may be added the effect of respiration upon the circulation in preventing *stagnation*, and the perpetual change of new for old and effete materials, and the discharge or removal of the latter, partly by expiration of superfluous carbon and vapour, or water from the lungs, and partly by various secretions and excretions, all of which are effects which depend upon the united agency of both chemical, mechanical, and vital actions, which are to be accounted for and identified, and are not, as has been supposed, to be attributed to an unknown and inexplicable, independent material agent, termed the vital principle.(*m*)

4thly. Remote effect in completing assimilation.

4thly. It has been supposed, that respiration materially assists in the process of assimilation, namely, that the Crassamentum of the blood is immediately produced from the chyle which enters the vessels just before the blood is exposed to the action of the air in the lungs, and that the conversion of chyle into fibrin is one important office which is served by the lungs. But Dr. Bostock inclines to think that such change is rather attributable to *secretion* than to respiration.(*n*) He admits, however, that the removal of carbon from the blood during its passage through the lungs, will *tend* to bring it into that condition which fits it for the purpose of repairing the necessary waste of the body, and maintaining the various functions in their perfect state.(*n*)

(*h*) Jackson, Prin. Med. 424.

(*i*) 2 Bost. 98 to 113.

(*k*) Cuvier, Leçons, tom. 1, p. 91, 92; see also Young, Lect. vol. 1, p. 739, and other authorities; 2 Dungl. Phy. 105.

(*l*) 2 Bost. 125 to 128; 3 Bost. 326, stating the result of Dr. Williams's experiments and observations, from 2 Edin. Med. Chir. Trans. 116; Jack. Prin. Med. 437.

(*m*) 2 Bost. 125 to 152.

(*n*) Id. 153, 154.

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5thly. Other sounds and acts besides speech, voice, and singing, incident to respiration.

5thly. It may here be proper to mention some other effects produced in part by respiration, besides speech, voice, and singing, already considered. Some to a certain degree instinctive, being directly subservient to some useful purpose in the animal economy, while they are more or less independent of the will, such as sneezing and coughing. There are others, on the contrary, which are entirely under the control of the will, depending upon the contraction of the diaphragm, or the muscles of the chest, which we call into action, and regulate at pleasure, like other voluntary actions, such as sucking and straining. Some of these actions may be regarded as modifications of the voice, being characterized by distinctive sounds essentially connected with their final cause, as laughing and weeping. The mechanical actions connected with respiration, which are enumerated by Haller and Soemmering, are sighing, yawning or gaping, sucking, panting, straining, coughing, sneezing, laughing, weeping or crying, hiccup, and vomiting. (*o*) To which may be added, groaning, snoring, belching. (*p*)

Sighing and groaning.

Sighing consists in a long, full, deep, and protracted inspiration, by which the cavity of the chest is considerably augmented. Its final cause appears to be to promote the passage of the blood through the pulmonary vessels, and to enable the air to act more fully upon it. (*q*) In deep distress, sighing is sometimes followed by *groaning*, which is a sound usually uttered in an expiration after the above-mentioned deep inspiration, (*r*) and to which may be added the habitual noise made by paviours after they have struck the paving-stone, and which they contend prevents any injurious effects from strong expiration. Sighing and straining are considered as completely voluntary, and in these, certain muscles are thrown into contraction in order to accomplish some purpose from a previous knowledge of their effects. (*s*)

Yawning and gaping.

Yawning also consists in a full, slow, and long inspiration, but it differs from sighing in being followed by a slow and full expiration; (*t*) it is also attended by an involuntary opening of the jaws, by which the air has a more free admission to all parts of the chest, rushing into the open fauces and the Eustachian tubes. This is considered as nearest in relation to sighing, though certainly the mental sensation is quite different. It is occasioned by the blood passing through the lungs too slowly, as when the pressure of the air on the body is diminished, as upon very high mountains. The difference between yawning and *gaping* appears to be rather in the extent of the operation, yawning being a deeper and longer inspiration and expiration, with very extended jaws, attended sometimes with noise, whilst in gaping the jaws are not so much extended, nor is it attended with noise, and it resembles a suppressed or controlled yawn. A peculiar feature of gaping is the propensity it excites in others perceiving it also to gape; arising, as some suggest, from the recollection of the pleasure it produced. (*u*) But Dr. Elliotson denies the latter, and asserts that gaping occurs chiefly during fatigue or hunger, when we are but half awake, either before or after sleep, and in ague and hysteria. (*x*)

Sucking.

In *sucking*, the lips are closely applied to the vessel containing the fluid, and by making an inspiration we increase the capacity of the chest, and the air in the mouth and fauces thus becomes rarified, and the pressure of the atmosphere causes a portion of the fluid to enter the mouth. (*y*)

(*o*) Id. 172; 2 Dungl. Phy. 89 to 94.

(*p*) Groaning is the result of the *simple* production of a vocal sound, but continued. Gaping is yawning, presently considered. Snoring is a vibratory action of the soft palate. Belching is merely vomiting, but air simply, and not the contents of the stomach.

(*q*) 2 Bost. 172; 2 Dungl. Phy. 91.

(*r*) El. Blum. 144.

(*s*) 2 Bost. 38.

(*t*) Id. 172; 2 Dungl. Phy. 91.

(*u*) El. Blum. 143, 144; Haller, El. Phys. Book 8, sec. 4, p. 30, 40.

(*x*) El. Blum. 152.

(*y*) 2 Bost. 173. But notwithstanding

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Panting.

Panting consists in a succession of alternate quick and short inspirations and expirations, and thus produces a more frequent renewal of the air in the lungs, in cases where the circulation is unusually rapid, or where, from some obstruction in the chest, we require a more than ordinary rapid supply of fresh air,(z) as when the circulation has been suddenly increased by exercise.

Straining.

In *straining*, the operation commences by a full inspiration and retention of the air in the chest, while at the same time the abdominal muscles are contracted, and not only are the viscera of the abdomen compressed, and incidentally their contents, but also the flow of the blood is retarded, and has a tendency to accumulate in the venous part of the circulation. The act of straining enables us to exercise the greatest degree of muscular power, because the trunk becomes firmly fixed, and serves as the point in which the actions of all the muscles are centred.(a)

Coughing. (b)

Coughing is a quick, violent, and sonorous expiration, following a deep inspiration, and just before the expiration the glottis contracts.(c) It is produced by a quick and forcible action of the diaphragm, by which a large quantity of air is received into the chest: this, by a powerful and rapid contraction of the abdominal muscles, is propelled through the trachea with considerable force, and in this way dislodges mucus or any other extraneous substance which irritates the part. When the irritation is considerable, it is involuntary, although in other cases it is under the control of the will.(d)

Wheezing. (e)

By wheezing is understood that sound which is occasioned by the partial obstruction of air in the bronchial tubes, by a mucous or purulent secretion.(e)

Sneezing. (f)

Sneezing is generally the consequence of an irritation of the mucous or Schneiderian membrane of the nostrils. It is a violent and almost convulsive expiration, preceded by a short and violent inspiration.(g) The chest is here thrown into a state of extraordinary action, from the more quick and violent contraction of the diaphragm, and the operation of various auxiliary muscles, and is considered as quite independent of the will.(h) Sneezing in many respects resembles coughing, but it differs from it in being more violent, and in being involuntary. The irritation is applied to a more sensible part; the inspiration with which it commences is more deep, and the succeeding expirations are more violent, and are directed through the cavities of the nose. The final cause of sneezing is obviously for the purpose of removing an irritation from these passages, and we are able to trace the nervous communications which connect the mucous membrane of the nose with the muscles that are concerned in respiration; but there is still some difficulty in explaining the physical causes of coughing and sneezing, as distinguished from each other.(i) The immediate organ of smell is the mucous membrane called Schnei-

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the high authority of Dr. B. some have considered the explanation of "sucking" to be very different, and that sucking is totally independent of respiration. We can *suck* in air, or other fluid; and expel it equally independently of respiration. Here the agents are the soft palate, tongue, and cheeks. The soft palate closes the mouth *behind*, the lips are closed, and the tongue is depressed with the moveable floor of the mouth; thus, to prevent a vacuum, air rushes through the lips or teeth, &c. &c.

(z) 2 Bost. 173; 2 Dungl. Phy. 93.

(a) Id. 173; 2 Dungl. Phy. 88.

(b) See, as to coughs and their treatment, post. tit. *Diseases*.

(c) El. Blum. 143; 1 Good, 397; 2 Dungl. Phy. 89.

(d) 2 Bost. 173; 2 Dungl. Phy. 89.

(e) 1 Good, 428.

(f) See post, tit. *Smelling*, as being part of the nervous system.

(g) 2 Bost. 173; 2 Dungl. Phy. 89.

(h) 2 Bost. 37; but this also may frequently, by care, be anticipated and prevented.

(i) 2 Bost. 174; id. 37; Mr. C. Bell's observations in Phil. Trans. for 1821, page 398; for 1822, page 284, 287.

derian, from the anatomist who first accurately described it, and which lines the internal parts of the nostrils and the adjacent bones; and this membrane is supplied by the olfactory nerves from the first pair, and which are considered the proper agents of *smell*,(k) while the branches of the fifth pair serve for the general purposes of the nervous influence or sensation. It is upon these latter branches that the irritation is produced which excites sneezing.(l)

Laughing.

Laughing is produced by an inspiration, succeeded by a succession of short, and, as it were, abrupt and imperfect expirations; and if hearty, respiration is interrupted, and actual pain of the sides and diaphragm is felt.(m) Although it may be produced by certain bodily sensations, yet for the most part it depends upon a mental emotion; the theory of laughter, or the connexion which there is between the action and the causes which excite it, is somewhat obscure.(n)

Weeping, crying, or sobbing.

The action of *weeping*, vulgarly called *crying* or *sobbing*, is very similar to that of laughing, although its causes, both corporeal and mental, are very dissimilar. It consists of an inspiration, which is succeeded by a succession of imperfect expirations. Both laughter and weeping are supposed by many physiologists to be confined to the human species; but it has been observed, that we may perceive approaches to them in some of the most intelligent and sagacious animals.(o)

Hiccup.

Hiccup is a sonorous, very short, and almost convulsive inspiration, excited by an unusual irritation of the cardia (the upper orifice of the stomach,) or of the gullet or other neighbouring part.(p) This irritation occasions a quick involuntary convulsive contraction of the diaphragm, occurring at intervals, and affecting the respiration.(p) But Dr. Elliotson has denied that hiccup is produced by irritation of the cardia more than of any other part of the stomach, and suggests, that after the inspiration has proceeded a certain length, the glottis closes and the diaphragm endeavours in vain to contract further, and that this occasions the hiccup.(q)

Vomiting, belching, and retching.

Vomiting is in a degree connected with the respiratory organs, but as it is more connected with the digestive organs, we will consider it under that division of the subject.(r)

Snoring.

Snoring is a deep, sonorous, and, as it were, tremulous inspiration, from the vibration of the *velum palati* during deep sleep with the mouth open.(s)

Section IV.—Of Defects, Diseases, Disorders, and Injuries affecting the Lungs and other Organs of Respiration.(t)

Of malformation of the lungs.

In many works of anatomy it is stated, that sometimes the lungs are originally malconstructed or malformed in themselves, without reference

(k) See post, tit. *Nervous Functions.*
(l) 3 Bost. 131.
(m) El. Blum. 143; 2 Dungl. Phy. 92; 2 Bost. 174.
(n) 2 Bost. 174.
(o) Id.; El. Blum. 144; 2 Bost. 174.
(p) El. Blum. 152; 2 Bost. 174.
(q) El. Blum. 152.
(r) 2 Bost. 174; 1 Dungl. Phy. 518.
(s) El. Blum. 143.
(t) See in general, as to the diseases of the lungs, and remedies, Laennec's Diseases of Chest, edit. by Forbes; S. Coop. Surg. Dict. titles Bronchocele, Bronchotomy; Amer. Cyclop. Prac. Med. tit. Asthma; Dyspnœa and Angina Pectoris; 1 Good, 361 to 462; 2 Id. 302, &c. Pneumonica or Pulmonia (from the Greek πνευμα, and the Latin pulmones, for the lungs;) and *pulmonary disease* has been the general term to describe, as well diseases of the lungs themselves as their membranes, or their motive powers; see 1 Good, 361 to 462; but professionally, distinct names are given to each disease, so as to distinguish each from the other;

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to any pre-existing or subsequent disease.(*u*) And it is certain, that these organs may be larger and more perfect and complete in their development in some individuals than in others, especially where the chest is apparently too flat and compressed; but the cases of actual malformation are rare, as the most eminent anatomists and dissecting surgeons of the present time state, that in all their practice they have not discovered an instance of lungs originally malconstructed.

Diseases of the lungs, &c. in general.

There is no part of the human frame, the *Diseases* of which are more numerous or more uncontrollable than those of the lungs and respiratory organs. We may fairly draw this conclusion, when on looking at the bills of mortality we observe the large proportion of persons dying annually of consumption alone. It has been estimated, that the diseases of these organs yearly occasion the deaths of a fourth part of the population of Europe.(*x*) It will be desirable therefore to give a brief sketch of some of the more important and general diseases of the lungs, and their investing membrane, the pleura.

Peripneumonia or pneumonia.(*y*)

The lungs are subject, like almost every part of the body, to common inflammation or *peripneumonia* (or, according to some authors, *pneumonia*,) which attacks the substance of the lungs, namely, the spongy texture surrounding the air cells, causing pain and difficulty in breathing, and fever. It generally attacks the base of the organ. It may terminate in what is termed *resolution* (*i. e.* by subsiding,) or in common abscess, which, in the substance of the lung, is extremely uncommon, or, what is more frequent, in the vessels pouring out the lymph of the blood, which becoming more organized, consolidates the lung, which then sinks in water: this is technically called *hepatization*, from its resemblance in solidity to liver. So *gangrene* or *mortification* may ensue, which, however, as Laennec says, is not like a similar termination of other inflammation in mortification or gangrene, but is more allied to the same condition of the cellular membrane in carbuncle. There is another state of lung which is the result of compression, from fluid, or other cause, in the cavity of the chest, in which the body of the lung is flattened and its function suspended, till, on removing the compressing cause, the lung gradually distends to its original form and size. This, however, is not a very common consequence. This change in the lung is called, from its flesh-like appearance, *carnification*, which is to be distinguished from hepatization, the latter being the result of disease in the lung itself, the former that of disease around the lung.

Phthisis pulmonalis, or pulmonary consumption.

But the most serious, and by far the most frequent, disease of the lung, and from which the party afflicted rarely recovers, is pulmonary consumption, technically called *phthisis pulmonalis*.(*z*) By the best authors it is considered hereditary; indeed, we have too frequent instances of several members of a family falling victims to it. It attacks all ages and both

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and although the terms used in the context may vary in some respects from prior publications, especially Good's Stud. Med. they have been adopted as being now better understood and used amongst medical men, and therefore appropriate in all *legal* inquiries.

(*u*) 2 Bell's Anat. 68 to 74.

(*x*) Dr. Johnson on Indigestion; Laennec on Diseases of the Chest, edit. by Forbes; 3 Good, 181. Dr. Woolcombe calculates, that in Great Britain, 55,000 die annually of consumptive diseases, and which is greatly attributable to vicissitudes of atmospheric temperature in the climate, with bad ingredients and unhealthy pursuits, and that it generally commences below the rima glottidis, and ordinarily terminates existence within nine months; 3 Good, 181; and as to the treatment thereof, id. 169 to 230; and Dewees, Prac. Phys. 537.

(*y*) See further, 1 Good, 418 to 446; 2 id. 322 to 335; Dewees, Prac. Phys. 445 to 478.

(*z*) See further, as to this disease, there called Marasmus Phthisis, 3 Good, 169 to 230; and Young on Consumptive Diseases; Dewees, Prac. Phys. 499 to 546.

sexes; but persons between the age of puberty and thirty, are most subject to its activity: it appears in the form of very small gray spots or tubercles, interspersed throughout the lung, situated in the spongy texture of the lung, or according to other authorities, in the mucous lining of the air cells themselves. These granules or tubercles probably may remain in a torpid or dormant state for many years, till, on the occurrence of a slight attack of inflammation, they enlarge, become soft, and yellow in colour;(*a*) several unite, and break down in the centre, and burst into the air tubes, a large quantity of matter is coughed up, and a cavity remains in the lung, which is called a *Vomica.* A similar change may take place in various parts of the same lung, or indeed in both; but the root of the lung, or that part at which thé bronchi and pulmonary vessels enter, is almost invariably its seat or commencement. As the disease advances, the blood vessels become included in the destructive process, and streaks of blood mark the fluid coughed up. The quantity of this fluid is sometimes very great; but according to the opinion of Laennec, this is not secreted by the cavity of the abscess, but in a greater degree by the bronchial tubes extending into it. The character of the expectoration varies according to the stage of the disease. In the early stage, it is thin, watery, and like saliva; it afterwards becomes yellow, thick, ropy, and puriform, and streaked with blood.

By the recent important and valuable improvements in this branch of medical knowledge, the state of a diseased lung may be detected with the greatest precision. By the application of the ear to the chest, or by that of the stethoscope (a hollow cylinder of wood, the sides of which are very thick, and hereafter fully described,) every sound is conveyed to the ear of and comprehended by the experienced physician. Among other sounds is a remarkable one, produced to the ear, as if coming direct to it through the walls of the chest, from an abscess in the lung, as though the person spoke from it, and not from the organ of voice: this is technically called *Pectoriloqy*, and is considered an unfailing symptom of a tubercular abscess.

Phthisis is generally ushered in with a dry, short, teasing cough, pain in the side, and frequently occasional spitting of arterial blood, by which the pain is temporarily relieved, and the person for a short period restored to comparative health, provided the loss of blood has not been considerable. On the return of any exciting cause, such as cold or damp weather, or any severe mental emotion, tending to accelerate the circulation, the cough returns, the appetite and strength diminish, the corporeal powers decline, the body wastes, the cough, and its attendant expectoration, increase, the latter undergoing the change above alluded to, and hectic fever, with a constantly rapid pulse, and profuse sweats, leave no hope of recovery. A complete or even partial restoration to health, from this insidious disease, is so uncommon as to be denied by many men of authority and talent; but there are cases on record which lead us to believe that it is not, except in its latest stage, invariably fatal.

Preventives and remedies.

It has been already stated, that *hereditary* tubercles in the lungs are frequently found in young children, and even in the *fœtus in utero*, in their quiescent state. The exciting cause of their advancement to that fatal condition which destroys life, is irregular circulation, the breathing of cold or bleak air, changes of atmospheric temperature, cold partially applied to the body, irregular living, dissipation, &c. The disposition to their increase is to be averted by warm clothing, the selection of a warm, genial, and uniform climate, a regular, but not necessarily a low

(*a*) As to the ordinary colour when in a healthy state, ante, 102.

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diet, and moderate exercise, for the purpose of promoting healthy perspiration. It is a disputed point, whether the morbid state of the lungs in phthisis might be relieved by the respiration of air less oxygenated than that of the atmosphere. Beddoes entertained a favourable opinion of the introduction, but others have disputed its efficacy, and insisted that it would be injurious.(*b*) Of late, the inhaling of steam from hot vinegar and water has been recommended.

Pulmonary catarrh or bronchitis.

Another disease of the lungs is called *Pulmonary Catarrh*, or *Bronchitis.* This is inflammation of the mucous membrane lining the bronchial tubes, to be distinguished from common *catarrh* or *cold* affecting the mucous membrane of the nose and fauces. It may be acute or chronic. In its chronic state, when frequently recurring, and attended with more or less difficulty of breathing, it is called *Asthma;* but (as Laennec says,) is not to be confounded with all diseases, whether of the heart or lungs, causing difficulty of respiration. By long efforts in coughing, by which the lungs are compressed by the agents of expiration, the air cells burst, and a disease is produced, called *Emphysema* of the lungs, and is one consequence of chronic pulmonary catarrh. Previous to the bursting of the air cells, these cavities enlarge, and when the air escapes into the surrounding tissue, the lung always appears morbidly distended with air, it does not collapse, but forces its way through the opening made into the chest, when examined in the dead body. This is the state of the lungs found in broken winded horses.

When termed asthma.(*c*)

When termed emphysema.

Hæmoptysis,

Hæmoptysis (from αιμα, *sanguis*, blood, and πτυω, *spuo*, spit) is expectoration of blood from the lungs. It has been mentioned as a symptom of phthisis or consumption. It may, however, exist independently of any disease in the organ; at all events it frequently continues to recur during many years of life, without the manifestation of any tubercular or other disease. It frequently exists as a symptom of mere obstruction to the circulation on the left side of the heart, which being unable to propel its newly oxygenized blood, the pulmonary capillaries burst, and thus relief is afforded to the circulation. It is a common, though late symptom of disease of the left ventricle of the heart, and on dividing the lung after death, a large portion of its substance *appears* to be converted into blood. This is more properly called *Pulmonary Apoplexy.*

or pulmonary apoplexy.

Dropsy or œdema.

The lungs are liable to *Dropsy* or *Œdema*, which may result from inflammation, or exist in common with a dropsical state of the rest of the cellular membrane of the body.

Cancer.

The lung is also subject to various kinds of malignant diseases, such as *Cancer*, but these are very uncommon.

Pleuritis or pleurisy. (*d*)

The diseases of the *Pleura* or lining membrane of the chest and lungs, are chiefly *inflammation* and its consequences. Inflammation of the pleura is technically called *pleuritis*, or *pleurisy.* Its symptoms are pain in the side, with fever and an accelerated pulse. It may terminate by adhesion or union of the pleura costalis and pleura pulmonalis. In effusion of water, called *Hydrothorax*, the fluid is of a whey-like colour, occasionally more or less purulent: it follows an attack of pleurisy, and by the accumulation of the fluid, gradually compresses the lung of the diseased side. As the fluid increases, it distends the side of the chest, and displaces the heart, which in diseases of the left side may be pressed across to the right side, and its pulsations felt two or three inches to the right

(*b*) See authorities, 2 Bost. 118, 119.

(*c*) As to asthma, in general, see Amer. Cyclop. Prac. Med. tit. Asthma. Dr. Bree on disordered Respiration, 137, 138; 1 Good, 428, &c.

(*d*) As to pleurisy, see G. Smith, 356, 357; 2 Good, 336 to 341; also Dewees, Prac. Phys. 478 to 499.

of the sternum, and forces the diaphragm downwards, and precludes the dilatation of the lung, which assumes the character above described, as carnification of the organ. The person cannot lie on the opposite side, from the weight of the fluid compressing the opposite lung. For this disease the chest may be punctured, and the fluid gradually allowed to flow off as it reaccumulates.

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The operation which is called "*Paracentesis Thoracis*," or, the "operation for empyema," is not generally successful, but its success greatly depends on the change which the pleura has undergone, and the condition of the compressed lung. Much may be hoped from the gradual expansion of the lung during some days after the evacuation of the fluid. The cavity of the pleura may be filled with air called *Pneuma Thorax*, formed by decomposition of the matter contained: it is, however, an uncommon disease. So blood may escape into the cavity from a wound, or from the rupture of a diseased vessel; but this likewise is of very rare occurrence. *Angina Pectoris*, although sometimes considered as an affection of the organs of respiration, yet, as its seat is in the heart or the organized great vessels, will be more properly considered when we examine the organs of circulation.(*f*)

Operation of paracentesis.(*e*)

Pneuma thorax.

Angina pectoris.

Paracentesis or *tapping* of the thorax, may become necessary when the *lungs* or *heart* are oppressed by any kind of *fluid* confined in the cavity of the chest, and the lodgement of which interrupts the performance of the functions of these organs, essential to the support of life, and when no internal medicines can be much depended upon for procuring relief; and this operation may be usefully performed either when water or purulent matter is confined in the chest.(*h*) The safest and most convenient situation for making an opening into the chest, is between the sixth and seventh true ribs on either side, as circumstances may render necessary.(*i*) *Empyema* is a collection of *purulent matter* (as from an abscess) in the cavity of the chest.(*k*) *Emphysema* (signifying a swelling produced by air,) in any part of the cellular substance, arises from *injuries* to the lungs or pleura, as by a fractured rib, by which the vesicles of the lungs are wounded, so that the air escapes from them into the cavity of the thorax. It has also been known to arise from a rupture of the larynx and trachea, or in the air cells of the lungs, produced by a blow or kick, or by violent coughing; and this injury is easily distinguished from œdema or anasarca, by the crepitation which occurs in examining it, or a noise like that arising from compressing a dry bladder, half filled with air.(*l*)

Paracentesis or tapping of the thorax.

Empyema and emphysema.

Bronchocele or Goitre, and in this country, [England,] called *Derbyshire Neck*, is a tumour in the thyroid gland, affecting also the wind pipe, lungs, and, consequently, respiration.(*m*)

Bronchocele or goitre, or Derbyshire neck.

Empresma Laryngitis is an inflammation of the larynx and epiglottis, attended with inflammatory fever, and destroys by suffocation in a day or two.(*n*) The affection, by some called *Cynanche Laryngea*, when seated on the edges of the rima glottidis, so much contracts the opening

Empresma larynitis and cynan-

(*e*) See fully, Coop. Surg. Dict. titles Paracentesis; Empyema. It is said that the safest and most convenient situation is to make the opening into the chest between the sixth and seventh ribs on the proper side; 2 Gibson, Surg. 263. Empyema is a collection of purulent matter, as from an abscess in the cavity of the chest; S. Coop. Surg. Dict. tit. Empyema.

(*f*) Amer. Cyclop. Prac. Med. tit. Angina Pectoris. Brous. Pathol. 293, 294, 417.

(*h*) Coop. Surg. Dict. tit. Paracentesis; and see t'tle Empyema.

(*i*) 2 Gibson, Surg. 263.

(*k*) Id. 1 Gibson, Surg. 137.

(*l*) Id. 5 Good, 294 to 298.

(*m*) See 5 Good, 207; Coop. Surg. Dict. titles Bronchocele and Thyroid Glands.

(*n*) 2 Good, 307.

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che laryngea.

as scarcely to leave the smallest space, and the lungs not being expanded from want of a due admission of atmospheric air, the blood accumulates in them, and the return of blood from the head is more or less impeded. In this situation a timely incision in the trachea would, it is said, save the lives of many, nor is it considered an operation either difficult or dangerous.(*o*)

Empresma bronchlemitis or croup.

Empresma bronchlemmitis or *Croup*, is an inflammation of the *bronchiæ*, in which the breathing is laborious and suffocating, with a short cough, and concrete, bloody or membranous expectoration, with fever or cauma, and extends from the mouth to the lungs themselves.(*p*)

Injuries occasioning asphyxia.

The most dangerous and immediate *Injuries* to the respiratory function, are those producing *Asphyxia*, (suspension of respiration,) and which, if continued for a few minutes, occasions *death*, and during the interval, *suspended animation* is capable of recovery by the employment of proper means. This may be produced by several causes, as by the deprivation of atmospheric air, or affording only air too highly rarified, or by suffocation, as in drowning or by strangulation, or by pressure and prevention of the elevation and depression of the ribs and diaphragm, or by the division of the nerves, &c. These and their remedies will hereafter be considered.(*q*) If asphyxia or suffocation be apprehended from *obstruction* in the trachea, whether from the introduction of an extraneous body or the closing of the passage from disease, the operation of *Bronchotomy*, more properly called Tracheotomy, (or Laryngotomy, when the incision is made in the larynx,) it has been said, affords the only chance of saving life.(*r*) But it is said, that although not hitherto attempted by English surgeons, life might be saved by the introduction of an elastic gum catheter into the trachea from the nose, in order to facilitate respiration.(*s*) Bronchotomy is an operation by which an opening is made into the trachea, whereby air is allowed to enter.(*t*) The term Laryngotomy is applied to the same operation when performed in the larynx itself, which, in that case, is opened between the thyroid and crycoid cartilages; but is rarely resorted to.

Treatment, in introducing fresh oxygenated air by bellows, &c.(*u*)

In cases when, from suffocation, nature requires assistance to restore respiration, a mode of producing artificial respiration has been suggested by Mr. Brodie, namely, by inserting a tube from a common bellows into one of the nostrils, and keeping close the other nostril and mouth, and then blowing the ordinary atmospheric air into the lungs with a proper degree of force, by which the lungs will become sufficiently inflated, and then the air should be suffered to escape from the lungs by the mouth and the other nostril; and when the lungs have thus been emptied, the mouth and other nostril are to be again closed, and the process repeated; and to prevent the passage of the air into the stomach, a proper pressure on the thyroid cartilage is to be made, so as to close the communication between the pharynx and œsophagus. All that is necessary for the operator, is to produce the inspiration,(*x*) but the following precautions are to be observed; 1, the lungs are to be sufficiently, but not too much in-

(*o*) S. Coop. Surg. Dict. tit. Bronchotomy, and ante, 96.

(*p*) 2 Good, 310; Dewees, Prac. 399.

(*q*) Amer. Cyclop. tit. Asphyxia; and Coop. Surg. Dict. tit. Bronchotomy; 2 Bost. 141.

(*r*) Amer. Cyclop. tit. Asphyxia; Coop. Surg. Dict. titles Bronchotomy and Tracheotomy.

(*s*) See fully, Coop. Surg. Dict. title Bronchotomy; but see ante, 93, note (*m*.)

(*t*) S. Coop. Surg. Dict. tit. Bronchotomy; 2 Gibson, Surg. 249.

(*u*) And see same; recommended in case of seeming death by intoxication, 2 Par. & Fonb. 437, n. (*a*); warmth, &c., id. 439.

(*x*) 2 Par. & Fonb. 79, 80, 437, n. (*a*;) and see 2 Bost. 141 to 145; Amer. Cyclop. tit. Asphyxia; and post, fully.

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flated; 2, the inspiration must be repeated sufficiently often, and continuously; 3, the air is to be allowed a free exit from the lungs, so that the same air shall not be transmitted more than once; 4, the method of inflating the lungs must be simple and easy of adoption, for as the interval of time during which the artificial respiration can possibly be of any service, is very limited (not in general exceeding five minutes after the last respiration,) (*y*) it is important to avoid whatever may occasion the least delay.(*z*)

Other injuries, &c.

The proximity of the lungs to the ribs, explains the effect of *fracture* of those bones in producing the tumour called *Emphysema*. The broken end of the rib, piercing the pleura costalis, tears also the pleura pulmonalis, and breaks the surface of the lungs, and opens the bronchial cells, and the injury proceeds and increases.(*a*) Wounds in the diaphragm or thorax in general terminate fatally, though not always so.(*b*)

Pulmonary apoplexy arises from the rupture or bursting of a blood vessel in the lungs, and generally from obstruction to the circulation in the heart.(*c*)

Wounds of and injuries to the *throat* are often attended with considerable danger on account of the great number of important parts which are intersected; but mere cuts of the integuments of the throat and neck are not, generally speaking, dangerous, and do not materially differ from common incised wounds of the skin in any other part of the body.(*d*)

Wounds of the *lungs* are not necessarily fatal, though for the most part extremely dangerous.(*e*) Immediate hæmorrhage may produce suffocation; extravasation into the thorax may also give rise to fatal consequences, and with rapidity; or the foundation of an ulcerative process in the lungs itself may be laid, which will ultimately terminate life. But sometimes a patient may escape with the loss of a lung absorbed in this manner.(*f*)

Of transpiration, evaporation, and transudation.(*g*)

Besides respiration through the lungs, a species of invisible vapour is discharged as well from the lungs as from the surface of the body, through the skin, and called *Transpiration*, and which discharge from the surface of the body is connected with some of the most important operations of the system.(*g*) It has been supposed, that the average quantity of vapour carried off by *cutaneous transpiration* in twenty-four hours, is thirty ounces, while that by respiration, including, as it appears, the pulmonary transpiration, is said to be fifteen ounces.(*h*) But it has been observed, that so far as regards the generation of water in the lungs, the hypothesis is without foundation.(*i*)

(*y*) 2 Par. & Fonb. 33, 34.

(*z*) Id. 80, 81; see farther, id. 86 to 89; and 2 Bost. 141 to 145.

(*a*) 1 Bell, 567 to 569; G. Smith, 278; El. Blum. 123; 1 Gibson, Surg. 137.

(*b*) G. Smith, 279.

(*c*) Coop. Surg. Dict. tit. Pulmonary Apoplexy; see Brous. Pathol. 290.

(*d*) Id. tit. Throat; and id. tit. Wounds; 1 Gibson, Surg. 132.

(*e*) Coop. Surg. Dict. title Gun Shot Wounds; G. Smith 27; El. Blum. 123; 1 Gibson, Surg. 136.

(*f*) G. Smith, 277; 1 Gibson, Surg. 138.

(*g*) 2 Bost. 175 to 190; 2 Dungl. Phy. 211 to 220.

(*h*) Id. 181.

(*i*) Id. 182.

CHAPTER V.

THE FUNCTION OF CIRCULATION; AND, FIRST, OF ITS ORGANS, (NAMELY, THE HEART, ARTERIES, CAPILLARIES, AND VEINS;) SECONDLY, OF THE CIRCULATED FLUID, THE BLOOD ITSELF; AND, THIRDLY, THE MODE OF CIRCULATION.

Section I. The Organs and Parts of the Function of circulation.
- *First.* The Heart.
  - 1. Its External Appearance, Size and Weight.
  - 2. Its Situation and Posture.
  - 3. Its component Parts.
  - 4. The two Auricles and two Ventricles.
  - 5. The Valves of the Ventricles and Aorta and Pulmonary Artery.
  - 6. The Arteries, Veins, and Nerves of the Heart itself.
    - 1. The Coronary Arteries thereof.
    - 2. The Coronary Veins thereof.
    - 3. The Nerves of the Heart.
    - 4. Contractility of the Heart.
    - 5. Action and Beating of the Heart.
    - 6. Rapidity of Circulation through the Heart.
    - 7. Cause of the Action of the Heart.
    - 8. State of Circulation at different Ages.
    - 9. Harvey's discovery of the Double Course of Circulation.
    - 10. Use thereof.
  - 7. Pericardium.
  - 8. Defects and Diseases of the Heart.
  - 9. Rupture, or broken Heart.
  - 10. Injuries to, by Wounds, &c.
- *Secondly.* The Arteries.
  - 1. Description, &c.
  - 2. Diseases.
  - 3. Injuries to.
  - 4. Number and Names of.
- *Thirdly.* The *Capillaries.*
- *Fourthly.* The Veins.
  - And of Pulse-feeling, and Bleeding.
  - 1. Description of Veins.
  - 2. Diseases.
  - 3. Injuries.
  - 4. Number and Names.

Section II. The Blood.

Section III. The *Function of Circulation and its incidents.*

CHAP. V. Sect. I. Circulation.

The Function of Circulation of the Blood stands next to Respiration in importance.(*a*)

We will arrange the subject under several sections, namely, I. The *Organs* and *Parts* concerned in circulation. II. The Blood, and III. The manner in which the Function of Circulation is performed, and its incidents.

Sect. I. The Organs of Circulation in general.

Section I.—The *Organs* and *Parts* concerned in the *Function of Circulation* are principally the Heart, with its Pericardium, and the Arteries, Capillaries and Veins.

The heart.

The *Heart* is the central and principal organ of the function of *Circulation*, and, indeed, the main spring of all the other functions, for if the due

(*a*) Some physiologists even consider this Function superior to, and more important than any other, especially those physiologists who consider that diseases and their remedies are principally connected with the state of the blood, Park's Inquiries, 42 and 335, to the end. But as life cannot continue for five minutes without *Respiration*, and without its perpetually renovating qualities, the blood would not circulate; I have therefore treated respiration as the superior, ante, 92 to 123.

action of the Heart be suspended for five minutes, or even less, all the functions immediately feel the effect and cease to act, and death ensues.(*b*)

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In order that Blood may be properly renovated, and afterwards circulated through the arteries, veins, and capillaries into and throughout every part of the Human Frame, the HEART is placed nearly in the centre of the Trunk, and constitutes the grand mover of the mass of Blood, with a constant unvarying and truly wonderful power to the last moment of existence.(*c*) In the *fœtus* the heart is discernible, and is supposed to be formed before the brain or spinal cord.(*d*)

The external appearance, size and weight of the heart.

On a superficial view the heart appears as if it were *one* entire cone-like figure, but when stripped of the Pericardium and more minutely examined, there are obviously *two parts* and distinct apparatus belonging to each.(*e*) Its external appearance much resembles the heart of a calf, and is about five inches and a half diameter in the upper or widest part, and somewhat resembles the base of a cone reversed.(*f*.)

1. The right Auricle of the Heart.
2. The right Ventricle.
3. The left Auricle.
4. The left Ventricle.
5. The Pulmonary Artery.
6. Its left Branch, afterwards subdividing and passing into the left Lung.
7. The commencement of the right branch of the Pulmonary Artery, afterwards subdividing into
7. 7. 7. Lesser Branches to the right Lobes of the Lungs.
8. 8. The Aorta.
9. The Superior Vena Cava.
10. The Inferior Vena Cava.
11. The Apex of the Heart, formed by the left Ventricle.
12. 12. 12. 12. The four Pulmonary Veins, two from each side of the Lungs, and carrying back the Blood from thence to the left Auricle.
13. 14. 14. Ramifications of the Coronary Arteries of the Heart itself.

Size and weight of the heart.

Anatomists state that there is great difference in the size of the heart in different individuals, even to the variation of double the size, and this without any relative proportion to the general bulk of the body.(*g*) With respect to the *weight* and *size* of the heart, Professor Meckel, in his work on Anatomy, gives the following account:—"The weight of the heart in the male adult is in general about ten ounces, and bears a propor-

(*b*) 1 Bost. 265; Jackson Prin. Med. 457.

(*c*) El. Blum. 85; 1 Bell, Anat. 447; 1 Bost. 268; and see as to the Heart, 2 Horn. Anat. 185 to 198; 2 Dungl. Phy. 117 to 123; Jackson, Prin. Med. 468 to 470; 2 Paris & Fonb. 17, 18; Smith, For. Med. 37, 51, 277.

(*d*) 1 Bost. 267; 2 Horn. Anat. 282.

(*e*) 2 Horn. Anat. 185, 186; 1 Bell, Anat. 449, 454, 496; 2 Dungl. Phy. 117, 118; 2 Good. 3, 4, 5.

(*f*) See representation.

(*g*) 1 Bost. 291.

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tion to the whole body of 1 to 200. Its whole *length*, measured from the space between the auricles, varies between five and six inches; the mean length is five and a half inches, of which four belong to the ventricles, and one and a half to the auricles. The *breadth* of the ventricles united, is three inches at their base, and that of the auricles three and a half inches."(*h*) Laennec, in his work on Diseases of the Chest, thus speaks of the heart:(*i*)—"The heart, comprising the auricles, ought to have a size equal to or a little less, or a very little larger than the fist of the subject. The walls of the left ventricle ought to have a thickness a little more than double that of the walls of the right; they ought not to collapse when an incision is made into the cavity, and the right ventricle is a little larger than the left. Reason indicates, and observation proves, that in a sound and well-built subject the four cavities of the heart, containing each nearly the same quantity of blood, namely; between two and three ounces, so as to equalize the circulation, are within very little equal to each other. But as the walls of the auricles are very thin, and those of the ventricles have much thickness, it results that the auricles form scarcely a third of the total volume of the organ, or half of that of the ventricles."(*k*) But in one of the latest works upon descriptive anatomy, it is observed that Laennec's statement, that the heart is about the same size as the closed hand of the individual, cannot be considered a good standard of comparison, because no part of the entire frame is to liable to be influenced by incidental circumstances as the hand, and it is more accurate to consider its usual weight to be about *ten* ounces, and that in other respects the above description of Meckel is accurate.(*l*) It was formerly a vulgar error that the degree of courage depends on the size of the heart.(*m*) The ancients, and indeed even the most eminent physiologists, erroneously supposed the heart to be the seat of the soul or mind, and that all the attributes of good or bad disposition proceeded from that organ, as good, bad, base, tender, cold-hearted, &c., and hence the innumerable inaccuracies in our English terms continued even in the best dictionaries.(*n*) It is supposed that the heart of old persons, especially of those who are lean, generally diminishes in size and beats more slowly.(*o*)

Situation and posture of the heart.

The *Position* of the heart is singular. It is suspended in its natural position with its base, or largest part upwards, and by the great blood vessels which form the main trunks of the sanguiferous system. It is placed in the left side of the fore part of the thorax, resting upon the diaphragm,(*p*) between the lobes of the lungs, nearly in the centre of the cavity of the thorax, but inclining towards the left, in a line obliquely from the second rib of the right side, to the sixth rib of the left side, and it is on the left side of the *mediastinum* (or the space between the membranes which pass directly across and through the breast from the sternum, or breast bone, to the spine, and which separate and support the cavity of one side of the chest from the other, and separate the two lungs from each other.) It lightly rests upon the *diaphragm* as upon a floor, and by which it is in part supported.(*q*)

The component

The *heart* has been described as a hollow muscle, composed of masses of strong longitudinal fibres, forming an irregular cone, and having an

(*h*) Meckel. vol. ii. 252.

(*i*) Laennec, Traité des Maladies du Cœur.

(*k*) Id. ibid.

(*l*) See 2 Horn. Anat. 185.

(*m*) 1 Bell, Anat. 501. Hence we know that one of our kings, from his courage, was named Richard Cœur de Lion.

(*n*) It is singular that even in such a Dictionary as Walker's, courage is still supposed to be seated in, and depend upon the Heart. Walker's Dict. tit. Heart.

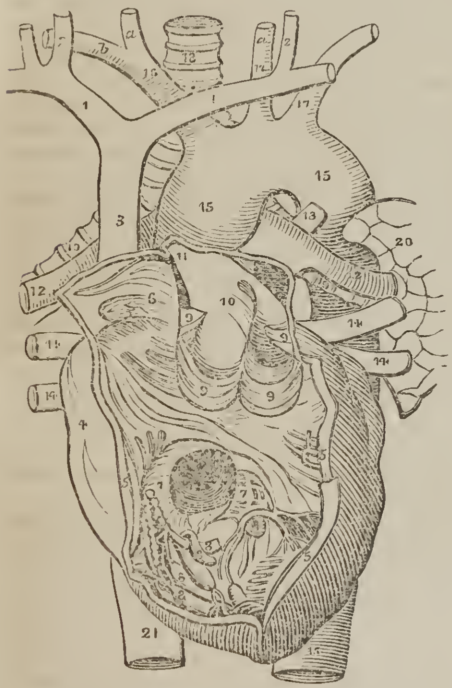
(*o*) Amer. Cyclop. Prac. Med. tit. *Ages*.

(*p*) 1 Bost. 269; 2 Horn. Anat. 185.

(*q*) 1 Bell, 487, 488, 496; 1 Bost. 269; 2 Good, 4; 2 Dungl. Phy. 122; Brous. Phy. 364.

parts of the heart.(*r*)

internal cavity.(*s*) Its texture is peculiarly fleshy, or muscular, dense and compact, and very different from common muscularity. It is composed of fasciculi of fibres more or less oblique, here and there singularly branching out variously and curiously contorted and verticose in their direction, lying upon each other in strata closely interwoven between the cavities, and bound by four somewhat tendinous bands at the basis of the *ventricle*, which thus are supported, and are distinguished from the fibres of the auricles. These fibres arise from a sort of tendinous line, which unites the two auricles to their cavities, and by which the two parts of the heart are joined and united, whereby they mutually strengthen the effect of each other.(*t*) It has been observed, with respect to the muscular fibres of the heart, that both in their form and their mode of connexion with each other, they greatly differ from the ordinary voluntary muscles. Instead of an assemblage of long and comparatively straight fibres, disposed in the form of separate bundles, each of them enclosed in a sheath of cellular substance, and the whole furnished with a coating of the same, the muscular fibres of the heart are disposed in an irregular manner, and they are not divided into distinct parcels, and they have but little cellular substance attached to them.(*u*) The long and straight lacerti of the muscles of voluntary motion are fitted to produce the contraction of those parts in *one* direction only, whereas, the irregular interlacing of the fibres of the heart obviously serves to promote the contraction of this organ *in every* direction, so as to diminish its size in *all* its dimensions. There is no muscular part which is possessed of the same *kind* of action with the heart.(*x*)



1. 1. The two Subclavian Veins or Venæ Innominatæ.
2. 2. The two Internal Jugular Veins.
3. The Superior Cava.
4. 4. The Right Auricle.
5. The Muscular Parietes of the Right Ventricle.
6. A Flap of the Pulmonary Artery, turned back to show the orifice of the Vessel.
7. 7. The Tricuspid Valve, destined to prevent the return of the Blood back into the Auricle, when the Ventricle contracts.
8. 8. The fleshy columns, or Columnæ Carneæ attached to it.
9. 9. 9. The Semilunar Valves of the Pulmonary Artery, one of which has been divided.
10. 11. The Pulmonary Artery opened.
12. 12. Its two Branches passing to each lung.
13. The Ductus Arteriosus,—which conveys the blood from the Pulmonary Artery into the Aorta during

(*r*) See full description of the heart, Bichat's Anat. Dict. tom. iv. p. 87; Boyer, Anat. tom. iv. p. 277; 2 Horn. Anat. 185 to 198.

(*s*) 1 Bost. 268.

(*t*) 1 Bell, Anat. 449, 454, 496; 2 Horn. Anat. 144; 2 Good, 3, 4, 5.

(*u*) Soemmering, Hum. Corp. Fab. tom. v. p. 29; 1 Horn. Anat. 194.

(*x*) 1 Bost. 311.

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Fœtal Life; but which after birth is rapidly diminished in its channel, and finally obliterated.

14. 14. The Four Pulmonary Veins, conveying the Blood from the Lungs on each side to the left Auricle.

15. 15. The Aorta.

16. The Arteria Innominata—a. b. Its division into the right Subclavian and right Carotid.

17. 17. The left Carotid and left Subclavian.

18. The Trachea or Wind Pipe.

19. 19. Its division into the two Bronchia.

20. A portion of the left Lung.

20. The Inferior Cava.

The interior of the heart and its four cavities, viz., two auricles and two ventricles; and of the *pulmonic* and systemic circulation.

We have seen that upon a superficial view there would appear to be only one heart, but that in fact there are two distinct parts with distinct cavities and vessels, and each performing a distinct function and separate circulation of the blood. Physiologists have accordingly divided circulation into the *systemic* and the *pulmonic* circulations, both performed at the same time by different sets of vessels though by one heart, and in the following manner.(y) The *right*, or more properly, *front* part of the heart, has two distinct cavities, called the *right auricle* and *right ventricle;* and the left (or more properly the posterior) part of the heart, has also two distinct cavities, called the left auricle and left ventricle.(z) These respective parts perform *two distinct circulations* of the entire blood; the first being that through the right auricle and ventricle and the lungs, may be termed the *Pulmonic* circulation; and the second, through the(a) left auricle and ventricle, and the whole of the arteries and veins, may be termed the *Aortic* circulation, in respect of the blood first commencing the larger circulation through the Aorta. The dark carbonated or effete blood, which has returned towards the heart through the *veins,* enters the *right auricle* of the heart, and from thence it is poured into the *right ventricle,* and when this ventricle has become distended to a certain extent, its fibres contract, and its cavity being thus considerably diminished, a proportionate quantity of the fluid which it contains is expelled into and through the *Pulmonary Artery* and its branches, into and through the *lungs,* and, after being there renovated or uncarbonized, and oxygenated, or otherwise, there improved by the atmosphere in the manner before and also *hereafter* stated, it is returned in its improved state through the four *pulmonary veins* into the *left* auricle of the heart. This is one complete circulation called the *Pulmonic* or *Lesser Circulation.* From the left *auricle* the thus renovated and scarlet blood is propelled into the *left* ventricle, and thence into the *Aorta,* which is the original and principal artery of the left or posterior part of the heart, and thence through all the arteries and veins, and entirely into and through every part of the frame back again to the *right auricle* of the heart; and this is termed the *Greater Circulation* or *Aortic,* or *systemic* circulation; and then the same double circulations are again and again regularly repeated without deviation during life.

The two auricles and two ventricles.

With respect to the *internal* cavity of the heart, it is lined with the like firm membrane as the outside.(b) The interior of the heart is unequally divided by a strong muscular Septum into *two* distinct cavities called *ventricles,* which have no direct communication with each other. There are also two thin muscular, or almost membranous bags at the base of the

(y) Park's Inquiry, 43.

(z) Dr. Bostock explains why these were *termed right* or *left* auricle or ventricle, though in reference to *mankind* incorrect, viz. that the terms were taken from the positions in *animals* where these organs are so placed, see 1 Bost. 269.

(a) 1 Bost. 270; 2 Dungl. Phy. 117.

(b) Id. 268. [This is an error, the internal surfaces of the heart are lined by a serous membrane, resembling that of the blood vessels.]

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heart called *auricles*, forming in all four separate cells, each of the auricles communicating with its corresponding ventricle; but the auricles, as well as the ventricles, have no direct communication with each other, so that if the cavities of the heart are properly constituted, the blood cannot escape directly from one auricle into the other auricle, or from one ventricle into the other ventricle. Although the auricles may be considered as membranous bodies compared with the ventricles, yet they are furnished with numerous fibres and possess powers of contraction.(*c*)

It is generally supposed that the right auricle is larger than the left, and some contend that its proportion, compared with the left, is about seven to five.(*d*) But it is admitted that the left auricle is considerably stronger than the right, even as one to three.(*e*)

The valves of the ventricles and aorta.

Both the ventricles have *valves* to their respective orifices and to the mouths of the arteries, and which are so constructed, that when the ventricles contract and the blood is forced out, the current is necessarily propelled in the proper direction, and is prevented from returning back to the heart.(*f*) There is a valve or set of valves which, from its figure, as consisting of three principal divisions, has been called *tricuspid*, attached to the passage between the right auricle and ventricle, and so constructed that by the contraction of the ventricle it closes up this orifice, and prevents the blood from returning into the auricle, so that it is necessarily sent forwards into the pulmonary artery, which likewise opens into the right ventricle. The pulmonary artery carries the blood through the lungs, the return of the blood into that artery being prevented by three valves at its commencement, which from their form are called the sigmoid or semilunar, and after it has undergone its appropriate change from the action of the air, it is returned into the left auricle by the pulmonary veins. The like mechanical process occurs in the left side of the heart, for the left ventricle, after it has received from the left auricle a certain quantity of the blood, contracts, and a valve at its mouth, which (from its consisting of two principal divisions) is called the *mitral valve*, prevents the blood from returning into the left auricle, and it is accordingly propelled into the aorta, the great systemic artery; and when the blood has once entered that artery it is prevented from flowing back into the heart by the set of valves called *sigmoid* or *semilunar*, placed at the mouth of the aorta.(*g*) From an enumeration of the mechanism of these valves, it appears that it is impossible for the blood to return from the ventricle into the auricle, because when this fluid endeavours to escape, the first effect is to raise up the valve which was floating upon its surface, and to apply it closely to the passage which leads from the ventricle to the auricle.(*h*)

With respect to the *ventricles*, it has been supposed that the right is larger than the left; but the better opinion is, that they are nearly alike capacious,(*i*) and each of the *ventricles* can hold between two and three ounces of blood, and at each contraction and jet nearly that quantity is propelled into the respective arteries.(*k*) But the left ventricle is considered much stronger than the right,(*l*) and this is accounted for because the right merely has to propel the blood into the lesser circulation; whereas, the left ventricle has to propel it through the larger circulation, which consequently requires more power and force.(*m*)

(*c*) 1 Bost. 269, 270; 2 Dungl. Phy. 121.

(*d*) Haller, El. Ph. vol. iv. 2, 17; 1 Bost. 269, 270.

(*e*) 1 Bost. 284, 285.

(*f*) Id. 273, 274; Jackson, Prin. Med. 468.

(*g*) Id. 274; 2 Horn. Anat. 190, 193; 2 Dungl. Phy. 120, 121.

(*h*) 1 Bost. 274.

(*i*) Id. 284, 285.

(*k*) Lizars, part ii. p. 146; 2 Good, 12; Ell. Blum. 91.

(*l*) 1 Bost. 285; 2 Horn. Anat. 192.

(*m*) Id. 2 Dungl. Phy. 121

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The pulmonary artery, and the aorta and dimensions.

The *pulmonary artery* carrying the blood from the right or anterior ventricle of the heart towards the lungs, and the *aorta* carrying the blood from the left or posterior ventricle of the heart towards every part of the human frame, are nearly of the same *diameters* (namely, nearly that of an inch,) and appear to be so constructed, as to pass equal quantities of blood through each circulation.(*n*)

Internal arteries, veins and nerves of the heart itself.

The heart itself and every part of it is supplied with numerous *arteries and veins* for its stimulation, support and nourishment. The fleshy fibres are supplied with an immense number of blood vessels, which arise from the *coronary* or *cardiac arteries*, and are so infinitely ramified, that the whole structure of the heart has been described as composed of them; but that description must not mislead, for the heart itself is composed chiefly of solid muscle. The stimulus to the contraction of the heart itself is supposed to be the arterialized or renovated blood from its *own coronary arteries*, and not the general mass of blood passing through the left ventricle and auricle, and it has been suggested that the heart itself would, if supplied from its own arteries with proper blood, equally contract and act, whatever might be the fluid of proper temperature and consistency passing through the same.(*o*)

The coronary arteries of the heart itself.

The *Coronary Arteries* spring from the aorta immediately after the renovated blood has passed from the left ventricle into the aorta. These coronary arteries flow into and through all parts of the heart, and are merely designated for the supply of the heart *itself*. The blood in these having merely passed from the lungs through the pulmonary veins, and the left auricle and ventricle, and not having been encumbered by any particles of the frame, is in the highest state of perfection, fully oxygenated and not carbonized, and consequently calculated, as far as blood can in any state exist, to excite all parts of the muscular fibres of the heart itself, and hence it is considered, that as long as oxygenated blood continues to flow from the lungs, the heart is kept in constant perfect action.(*p*)

The coronary veins.

After the blood has, in these coronary arteries and their ramifications, performed this office of exciting the muscular fibres of the heart itself to contract, and perform their office in that respect, such blood having become in a degree effete or carbonized, passes off from the heart through the *Coronary Veins* into the right auricle, where it is mixed with the other blood returned from the Venæ Cavæ.(*p*)

The nerves of the heart.

The heart itself is but scantily supplied with *Nerves;*(*q*) but under certain circumstances, as of passion or mental agony, the action of the heart is greatly influenced by the nervous power.(*r*) Dr. Bostock considers that the heart has but a small share of sensibility, or more properly sensitiveness, and that when it acts in its ordinary manner it produces no sensation, and that it is not under the control of the will, and that the nerves distributed to it are less numerous than those which are sent to other parts containing the same number of muscular fibres, and that both from their origin and texture, they are more analogous to the nerves which supply the muscular coats of the viscera than to those which are distributed over the proper muscles;(*s*) but that one important use which the nerves of the heart serve as well as those of all the other *arterial viseera*, is to indicate to us any injury or disease of the organs of which, as they are removed from our view, we might be unconscious, were not the parts endowed with the faculty of feeling pain.(*t*)

Effect of mental

Almost every motion of the mind influences the action of the heart. Thus by its nerves and the effect of mental emotion, the heart acts more

(*n*) 2 Good, 20; 2 Horn. Anat. 191.
(*o*) 2 Bost. 140.
(*p*) Ibid. 2 Horn. Anat. 195, 196.
(*q*) 1 Bost. 243, 303, &c.; 2 Horn. Anat. 197.
(*r*) 1 Bost. 303.
(*s*) Id. 303.
(*t*) Id. 304.

frequently in joy, more quickly and strongly in anger, more slowly and languidly in grief. Sighing increases the action of the heart and arteries; consequently study or anxiety is injurious in pectoral complaints; and even the external objects of nature, operating on the organs of sense, influence the actions of the heart: thus different scenes in nature produce peculiar effects, placid scenery tranquillizes, wild picturesque scenery quickens them.(*u*) Dr. Bostock has made some valuable observations upon the effect of the nerves in cases of this kind;(*x*) he says, there is another use which may be assigned to the nerves of the heart, although it may belong more to the moral than to the physical part of our frame, namely, that although the heart in its *ordinary* action is independent of the nervous system, yet on certain occasions it is liable to be influenced through it. This is especially the case with respect to *mental emotions*, which frequently produce, or are attended by some change in the state of the circulation, either quickening or retarding the action of the heart, or affecting the quantity of blood propelled by each pulsation. Hence, according to the nature of the emotion, a greater or less quantity of blood will be sent to the surface of the body, and in no part will the effect of this change be more apparent than in the *face*. The countenance, therefore, as indicated by the state of the circulation, becomes the index of mental emotion, and as it is not under the control of the will, it frequently points out what is actually passing in the mind in a manner which can neither be falsified nor concealed, and there are many important effects which are produced upon the various functions, as well contractile as sensitive, by an occasional increase or diminution of the circulation, as indirectly effected by the nerves of the heart.(*y*)

emotions on the heart.

The contractility of the heart.

With respect to the contractility of the heart, one of its *vital* functions and most obvious and characteristic property, is its constant motion, and the readiness with which it obeys the action of various stimulants. The contractility of the muscular fibres of the heart is, indeed, the *main spring* of the animal machine, considering it as an apparatus adapted for the purpose of spontaneous motion; for the *direct office* of the heart and the immediate effect of its contraction, is to *propel the blood* through the *two circulations*, in one of which it undergoes a certain necessary change, while in the other, it is sent, after being changed, to all parts of the body, giving to each of them their specific powers and capacities for action.(*z*) The causes of this contractility, or action of the heart, will be presently considered.(*a*) It is attributable to the renovated blood flowing from the immediate part of the aorta into its own coronary arteries, and it is not at all attributable to the influx of the mass of blood into the left ventricle and auricle from the pulmonary vessels, though such mass of blood will *afterwards* act upon the arteries, &c.

Action and beating of the heart.

By the before mentioned structure of the heart, it is adapted for its perpetual and equable motions, which are an alternate systole and diastole, or contraction and relaxation of the auricles and ventricles in succession. The use of the heart, as forming part of the circulating system, is to receive the blood from the veins, and to propel it again through the arteries. This is accomplished by the contraction of its fibres, by which the cavities of the heart are diminished in size, and their contents necessarily forced out.(*b*) The diastole of the heart contributes mainly to carry on the circulation of the blood by exerting the power of suction, and thus drawing

(*u*) Brous. Phy. 397; Jackson, Prin. Med. 505.
(*x*) 1 Bost. 305.
(*y*) Id.
(*z*) Id. 305; Jackson, Prin. Med. 476.
(*a*) 1 Bost. 306, 308.
(*b*) 1 Bost. 270; 3 id. 314; Ell. Blum. 88; and see Dr. Goodwyns upon the diastole of the heart contributing *mainly* to carry on the circulation of the blood, as set forth 3 Bost. 314; 2 Dungl. Phy. 126, &c.

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into its cavity the blood from the trunks of the veins.(*c*) Thus, as often as the auricles contract to impel the blood which they have respectively received into their appropriate ventricles, the latter are at the same moment relaxed (from having previously propelled their contents) to receive the blood; immediately afterwards, when the distended ventricles are contracting to impel the blood into their two great arteries; namely, the pulmonary artery and the aorta, the auricles relax, and receive a fresh supply.(*d*) But the simple diminution of the cavities, and the mere pressing out of the blood, would not be sufficient for the purpose of the circulation, for it is not only necessary that the blood be moved, but that it be moved in the right direction: for this purpose the heart is furnished with an elaborate mechanism of *valves*, which are attached to the orifices of the ventricles and the mouths of the arteries, and which are so constructed, that when the *heart* contracts and the blood is forced out, the current is necessarily prevented from returning, and is propelled in the proper direction.(*e*)

On applying the ear or a stethoscope to the region of the heart, the distinct *sounds* of the action of the ventricles and auricles may be at once perceived. At the moment of the arterial pulse is heard a dull sound, and immediately afterwards, without any interval, a clearer sound, similar to the noise of a valve, or to the licking of a dog. The former arises from the action of the ventricles, the latter from that of the auricles. The former occupies about two-fourths of the whole time, the latter one-fourth or one-third, and then a pause occurs of another one-fourth. This is termed the rhythm of the heart's action.(*f*)

The *sounds* of the heart are ordinarily heard in health between the cartilages of the fifth and seventh ribs, and under the inferior part of the sternum; those of the left side of the heart in the former situation, and those of the right in the latter. The *shock* or *stroke* occurs as above at the contraction of the ventricles. The force and extent of the sound and of the shock, and the rhythm of the heart's action, are variously altered in disease, and other sounds superadded.(*g*)

Beating of the heart.

With respect to the *striking* or beating *of the heart against the ribs*, the cause is assigned to be the injection of blood into the arch of the aorta, and its then consequent effect to straighten its curvature, and which raises up the apex of the heart, by which it is brought into contact with the ribs.(*h*) The vena cava is considerably increased in size during inspiration, and which is to be ascribed to the partial vacuum which is then formed in the chest. The force which the venous blood exerts in entering the right auricle of the heart, in consequence of such expansion of the chest and the great vessels behind the heart, is supposed to push the heart forward, and thus to cause it to strike against the rib. The expansion of the chest thus attracts the blood, and causes it to fill the great veins, in order to occupy the partial vacuum which would otherwise be produced.(*i*) Dr. Bostock observes, that the exact *order* of succession in which the different parts of the heart contract, has been a question that has given rise to much discussion. He observes, that it is obvious that each auricle must contract before its corresponding ventricle, but that it has been questioned whether any of these events are synchronous (i. e. *simultaneous*,) or whether they do not each of them occur in succession. But it is now very generally admitted, that the parts of the same description con-

(*c*) Dr. Goodwyns on the derivation of the blood; and 3 Bost. 314.

(*d*) Brous. Phy. 395.

(*e*) 1 Bost. 270.

(*f*) Ell. Blum. 96; and Sharp's Manual of Percussion and Auscultation, 73, &c.; 2 Dungl. Phy. 130.

(*g*) Id.

(*h*) J. Hunter on the blood, 146, note; 1 Bost. 277; 3 id. 313, 314.

(*i*) Dr. Barry's Experiments on the Beating of the Heart, and 2 Bost. 31.

tract precisely at the same point of time as the two auricles and the two ventricles, and that the contraction of the auricles exactly alternate with that of the ventricles; and that the contraction of the arteries is simultaneous with that of the auricles.(*j*) It is necessary, however, to apprize the student, that recently Dr. Alderson has raised an objection against the mode by which William Hunter endeavoured to explain the cause of the beating of the heart,(*k*) whilst a very able anatomist of the present time has stated, that the best explanation of the beating of the heart against the ribs is, that the *auricles* being tied down to the spine by the pericardium, and the ventricles remaining loose when the *blood fills the auricles*, the ventricles are necessarily tilted up, to accommodate the heart to the change of form at its base.

It has been disputed in what manner and to what extent the ventricles contract, but it is now generally admitted, that the cavities of the ventricles are diminished in every direction.(*l*) Dr. Bostock observes, that the beating is not felt at the instant when the ventricle begins to contract, but when the contraction has produced its effect in filling the arch of the aorta.(*m*)

Rapidity of the circulation of the blood through the heart

Every part of the blood passes through all the four cavities of the heart in the course of a complete circulation; it therefore necessarily follows, that if all the four cavities contract an equal number of times during the same interval, they must propel the same quantity of blood, and consequently if they differ in size, that a portion of the contents of the larger of them will not be expelled. It is, however, conjectured, that the auricles do not on each contraction propel the whole of their contents.(*n*)

The quantity of blood expelled from each ventricle at each contraction is estimated at *two ounces*, and taking the weight of the whole of the blood in circulation at thirty-three pounds, and the number of pulsations are taken at seventy-five in a minute, we shall find on this data that the blood will complete its circulation, or the whole of it pass through the heart in about two minutes and one half, and that a mass of the fluid equal to the blood would be carried through the heart twenty-four times in an hour.(*o*) But this will necessarily vary in different ages and constitutions,(*p*) and it must be observed, that the different portions of blood complete the circulation in very different periods of time, partly depending upon the length of the course which they have to follow, and partly upon the degree of resistance which they meet with. When the blood is sent into the aorta it soon begins to pass into the different arterial branches that are connected with the great trunk; a part only circulates through the arteries and veins of the heart itself; another portion takes a longer circuit through the chest, and others through such as are more extended, until a part of the blood is carried to those organs that are most remote from the heart;(*q*) and it may reasonably be concluded, that the blood that makes the shortest circuit soonest returns to the heart.

It has been stated that the auricles and ventricles are filled and emptied alternately, so that there is no period in which the whole of the heart is either full or empty, but that as the *substance* of the ventricles is much more considerable than that of the auricles, and as the former belong more particularly to the heart itself, the terms systole and diastole of the heart

(*j*) 1 Bost. 289; 2 Dungl. Phy. 130, 131.

(*k*) Dr. Alderson's observations in Quarterly Journal, vol. xxviii. p. 223; 3 Bost. 313, 314; see also Dungl. Phy. 132.

(*l*) Sabatier, Anat. tom. ii. p. 229; Bichat, Anat. Descrip. tom. iv. p. 113; 1 Bost. 292.

(*m*) 3 Bost. 314.

(*n*) 1 Bost. 288; 2 Dungl. Phy. 131.

(*o*) Id. 288; Lizars, part ii. p. 145, 146, 179, 180.

(*p*) Lizars, part ii. p. 145, 179, 180.

(*q*) 1 Bost. 288.

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are applied to the contraction and dilatation of the ventricles respectively, and are of course reversed with respect to the auricles.(*r*)

Cause of the action of the heart.

It has in general been considered that this constant and equal action or motion of the heart depends upon the *irritability* (more properly *contractility*) of its muscular parts, excited by the renovated scarlet blood flowing into its *own coronary arteries* from the aorta close to its origin, from the left ventricle,(*s*) and as it has been said, influenced by its nerves.(*s*) But with respect to the latter, we have seen that it is supposed that in *ordinary* circumstances the nerves have little or no influence upon the action of the heart, or the circulation of the blood, though mental emotion in particular cases will influence.(*t*) If by the suspension of respiration black and carbonated, instead of scarlet oxygenized blood, should be carried into the coronary arteries of the heart from the aorta, the muscles of the heart, it is supposed, would no longer be excited, and they would cease to propel the blood into the aorta in its ordinary circulation.(*u*) It is said to be *universally* allowed that the renovated blood is the true stimulus to the muscles of the heart, and causes its action, and which occasions the circulation of the blood.(*x*) But though the renovated blood so acts on the *left* auricle and ventricle of the heart, it cannot so act upon the *right* auricle and ventricle, as the blood flowing to them is venous and effete, and this consideration has occasioned a difficulty in the mind of some physiologists, (*y*) and Mr. Brodie has suggested, that this contractility or action of the heart is attributable to some influence transmitted to it in the same manner as with respect to the diaphragm, and not upon the blood in its cavities,(*z*) and there appears to be still a doubt upon the cause of the action of the heart.(*a*) Dr. Bostock observes, that we know that distention excites a muscle to contract, and that where a muscle has contracted, relaxation ensues: in the present case, therefore, we can only say, that in the formation of the body the degree of contractility bestowed upon the heart, the quantity of distention which it receives from the blood, the size and texture of the arteries which are to transmit the blood, and the quantity of resistance which it has to overcome, are all so nicely balanced, that each particular action is retained in due subjection to the rest, and contributes to form one harmonious whole.(*b*) But *why* it is so we have no certain precise knowledge. Another question has arisen, what is it that enables the heart to proceed for years together without fatigue, pulsating at equal intervals, and propelling the same quantity of blood? Some have considered it to be the result of certain nerves from the brain.(*c*) Others, anciently, (when the supposition of the existence of some unknown invisible agent prevailed) to the *anima* or soul supposed to reside in man, and superintend his actions, and which, knowing the fatal effects that would ensue from the interruption of so important a function, was supposed to be constantly careful to preserve it in a proper state of action.(*c*) But both these doctrines are now considered untena-

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(*r*) 1 Bost. 288, 289.

(*s*) El. Blum. 92; and see 2 Par. & Fonb. 17 to 25; 1 Bost. 303, &c.; 2 id. 140. In 2 Bost. 140, it is observed, that the contractility of the heart is occasioned principally, if not entirely, from the blood of its own coronary arteries, proceeding from the great trunk of the aorta, in the highest state of renovation, from the lungs, and not from the great mass of blood which is poured into the left ventricle from the pulmonary veins.

(*t*) 1 Bost. 243, 303.

(*u*) 2 Par. & Fonb. 19. 20.

(*x*) 1 Bell, Anat. 485; 2 Dungl. Phy. 135, &c.

(*y*) 1 Bost. 306, note.

(*z*) See Cooke on Nervous Diseases, Introd.; 1 Bost. 307, note.

(*a*) 1 Bost. 305, 307.

(*b*) Id. 310, 311; and ante 81 to 89, as to the muscles.

(*c*) This was called the Stahlian doctrine; see 1 Bost. 309; and ante 40; 2 Dungl. Phy. 134.

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ble, though it is confessed that we do not know the cause of this continued regularity in the heart's action.(*d*) If the renovated blood has power to excite the peculiar muscular fibres of the left auricle and ventricle to contract on one occasion, why may not a repetition or continued flow of the same description of blood occasion a regular repetition of the contraction? and if the veins propel and the right ventricle acts by suction on the *venous* blood, and occasions contraction of the left ventricle, why may not that operation also be repeated in like regular succession? We may here add, that though the heart thus propels the blood into the arteries, yet the *continuation* of the circulation is not now attributed to the mere projectile force of the heart, but to a joint power, compounded of the action of the heart and of the arteries themselves, which also have a contracting and projectile power,(*e*) and perhaps the veins themselves also have and act as a propelling power.(*f*) It is now the general opinion, that the heart is not the only propelling force of the blood, but that the muscularity and irritability of the arteries also materially assist.

State of circulation at different ages.

It is said that at birth the heart contracts from 130 to 140 times in a minute; at one year old 120; at two years old, 110; at three years, 90; at seven years, 85; at fifteen years, or puberty, 80; at mature age from 65 to 75; and in old age between 60 and 70. All, however, vary considerably in different individuals, but the general difference of the pulse at certain ages should be carefully considered by the practitioner, that he may be able to calculate the abberrations in disease.(*g*)

The cause of a single sensation of a palpitation of the heart, is the contraction of the ventricles, arising from a change of the situation of the apex of the heart striking against the cartilages of the ribs, and at the same moment that the ventricles are contracting, the left auricle is filling; which cavity being placed posteriorly or dorsal, will strike the vertebræ, so as to assist in producing this sensation.(*h*)

It has been said, that the heart has the same repose as the brain, the auricles and ventricles acting in succession, and a pause occurring before their action is renewed; but that during the very short time while these parts are only acting, their functions continue, because they are becoming distended by the blood, the function, therefore, of the heart constantly goes on, while that of the brain entirely intermits in sound sleep.(*i*)

Discovery of the course of circulation of the blood through the heart.

The course of the circulation of the blood from the heart into and through the arteries, and from thence into and through the veins back to the heart, was discovered by Dr. Harvey, Physician to St. Bartholomew's Hospital, and promulgated by him in an anatomical and surgical course of lectures at the College of Physicians, in A. D. 1619. He is entitled to the glory of having made it, says Hume, in his History of England, Chap. 62, by reasoning alone without any mixture of accident. He informed Boyle that he was led to it by reflecting on the arrangement of the valves of the heart and veins, as exhibited by his preceptor Fabricius; nothing he knew was placed in vain, and they clearly allowed a fluid to pass but one way. By this argument, and the fact of a ligature upon an *artery* causing the blood to accumulate in it on the side *nearest* the heart, and upon a *vein beyond* the ligature, and that animals bleed to death by wounds in arteries or veins, he chiefly established his doctrine. But his supposed discovery at first met with general ridicule and abuse, and even caused a great diminution of his practice; and when the truth could no longer be denied, he was pronounced a plagiarist.(*k*)

(*d*) 1 Bost. 305 to 313; 3 id. 313 to 316.

(*e*) 2 Good, 23; 2 Dungl. Phy. 139.

(*f*) Brous. Phy. 390, 391; 2 Dungl. Phy. 147.

(*g*) 2 Dungl. Phy. 157, 159; Jackson, Prin. Med. 484.

(*h*) Lizars, part ii. p. 145, 146.

(*i*) 2 Dungl. Phy. 131.

(*k*) El. Blum. 4th ed. 108, 109; 1

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Use of the *double* circulation.

The occasion for or use of two hearts is thus explained: suppose the blood, so essential to our existence, to have in it some principle of life, which is constantly lost, or in its passage through the body to be impregnated with something noxious, which should be thrown off, that principle must be continually renewed, or an opportunity given to send off what is thus offensive to life. The heart, or that part of the heart, which fills the *arterial* system, must not be taken from its appointed office, nor disturbed; nature, therefore, appoints a *second* heart, which belongs entirely to this most important of all functions, namely, *renovating the blood* by its exposure to the action of the atmospheric air. In all breathing creatures, the lungs, with the assistance of the second heart, perform this office. The lungs are next to the heart itself essential to life. It is for the purpose of this second circulation, that nature has appointed in all warm-blooded animals *two hearts*, namely, a heart for the lungs, and a heart for the body; *two auricles, two ventricles, and two great arteries; one the pulmonary artery or artery of the lungs; the other the aorta or artery of the body.*(*l*)

First, Description of the lesser or pulmonic circulation.

The entire heart, or rather the two hearts, alternatively receive and propel the blood in these two distinct circulations; the one into and through the *lungs*, called the *lesser* or *pulmonic* circulation, the other into and through the *arteries* and veins called the larger or *aortic* or *systemic* circulation.(*m*) The blood that has passed in the latter circulation into the veins, together with the chyle and other absorbed fluids, by means of the superior and inferior vena cava, and from the coronary veins, flow into the right or anterior auricle of the heart, so termed from the resemblance to an *ear* (*auricula*) and from thence into the right ventricle. The pulmonary artery is so termed, from its being an artery attached to the lungs (*pulmo*,) and arises from the base of this right ventricle, from which it proceeds upwards and towards the left side for the space of about two inches, where it bifurcates or divides into its right and left branches, which, with their minor branches, extend to their final terminations around the air vesicles of the lungs, where they become capillary, that is, hair-like and minute. Through the pulmonary artery and its branches, the blood thus carried to the right auricle from the veins is propelled into and through the lungs, where it is renovated by atmospheric air, as stated in the next section, and is then returned from the lungs, through the pulmonary veins, to the *left* or *posterior auricle* of the heart, into which such renovated blood is poured, and this constitutes *one circulation* called *pulmonic*.

Secondly, Description of the larger or aortic circulation.

From this *left* ventricle, towards the right side of the thorax, arises the great artery of the body, called the *aorta*, not quite an inch in diameter, and which turns in form of an arch, not directly upwards from the left ventricle, but rather backwards towards the spine. It then makes a turn downwards, and where it so turns downwards, it hooks round the pulmonary artery.(*n*) The renovated blood is propelled from the left ventricle into this aorta, and thence into the large arterial vessels of the head, body and extremities, and ultimately into the smallest arteries, and excites and nourishes the whole, and then the blood, after performing the offices of nutrition and secretion, and having become carbonized and effete and incumbered and black, returns through the veins into the right auricle.(*o*)

Bost. 275; 2 Dungl. Phy. 127; Forsyth, 39, 40; 2 Good, 2; 1 Par. & Fonb. 8, 9; 2 id. 17; see the summary in Dr. Stevens on the Blood, 1, 2.

(*l*) 1 Bell, 449; 2 Good, 3; 1 Bost. 268, &c.; 2 Dungl. Phy. 117, &c.

(*m*) 1 Bost. 270; 2 Dungl. Phy. 117.

(*n*) 2 Horn. Anat. 198.

(*o*) Ell. Blum. 85; 1 Bell, 456 to 479, 449; 2 Dungl. Phy. 117, &c.; 2 Horn. Anat. 152; Brous. Phy. 364.

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No part of the human frame retains its functions in vigour, nor the living properties which are inherent in it, while the whole economy is entire and correct, unless the blood be thus regularly circulated,(p) and even the heart itself is supplied with arterial blood, not from the vessels which open into it,(q) but from the two *coronary arteries*, which spring from the arch of the aorta and encircle the heart, and supply every part of it with the renovated blood, by which the muscular structure of the heart is supplied and excited.(r) If by the suspension of the respiratory function, these coronary vessels are not supplied with the fresh scarlet oxygenized blood, the excitement and action of the heart is suspended, and it ceases to act.(s)

The principal veins; venæ cavæ, the one descending from the head, the other ascending from the abdomen and lower parts.

The *veins* which thus return the incumbered and black blood to the right auricle, are the two *venæ cavæ*, the one *descending* from the head, and being a continuation of the right jugular vein, and the other *ascending* from the belly and the lower parts by two trunks, and they empty themselves into the *right auricle* of the *right* side of the heart, and which is a larger bag or reservoir of blood than the left auricle. When this acts, it throws the blood into its right ventricle and fills it. The pulmonary *artery*, or artery of the *lungs*, arises from this right ventricle, to carry out the blood it has thus received through the lesser circle or circulation of the lungs; and after it has there become renovated, it is poured by and through the *pulmonary veins* into the *left* side of the left auricle of the heart, from which the process of circulation is repeated as long as life continues.(t) There is a continual flow of the blood from the heart into the arteries, from the arteries into the veins, and from the veins to the heart again, thus completing the circular career.(u)

This second or principal course of circulation, it is said, is proved by the circumstance that the cavity, which first ceases to contract at death, is the left ventricle; secondly, the left auricle; thirdly, the right ventricle; and lastly, the right auricle, which last continues longest to vibrate; and that when the heart is laid open, very little blood is found on the left side whilst it is accumulated on the right side; and this order, it has been suggested, should be considered in medical jurisprudence.(x) But other well-informed and experienced anatomists, on the contrary, now state that blood is more generally found in the *left* ventricle than in any other cavity.

Of the pericardium. (y)

The heart, containing its two auricles and ventricles, is enclosed in a membranous bag or pouch, called, from its situation and surrounding the heart, *Pericardium* (περι καρδια.) This membrane in part assists in regulating the posture or position of the heart, and although it passes loosely round it, yet it protects and supports it in its palpitation and more violent or irregular action.(z) This pericardium is firmly fixed to the *Diaphragm* which may be termed the floor of the thorax, and separates it from the viscera of the abdomen, nearly or about the level of the sixth rib, in the *front* part of the chest, but somewhat higher at the base, which is placed in the posterior part of the chest.(a)

Of the liquor pericardii.

From the internal surface of the pericardium, and its exhalent arteries in particular, a serous fluid issues called the *Liquor pericardii*, which

(p) Jackson, Prin. Med. 494.

(q) 2 Horner, Anat. 195.

(r) Broussais, Phy. 366; 2 Paris & Fonb. 19, 20.

(s) 2 Paris & Fonb. 19, 20.

(t) 1 Bell, 449, 456 to 479; Jackson, Prin. Med. 462.

(u) 2 Bell, 322; Forsyth, 40.

(x) Lizars, part ii. p. 144.

(y) As to the pericardium in general, see El. Blum. 87; 2 Good, 4; 2 Horner, Anat. 186; 1 Bost. 269.

(z) 1 Bell's Anat. 489; 2 Dunglison, Phy. 183; Jackson, Prin. Med. 469.

(a) But see Lizars, part ii. p. 147, who appears to describe the level at about the *fourth rib*.

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moistens and prevents the adhesion of the heart to the pericardium.(*b*) This fluid is sometimes found to exist in considerable quantity, to the amount of several ounces; but so large a quantity has been considered as the effect of disease; and it is a question, about which there have been many disputes, whether any perceptible quantity of the liquor pericardii exists during life, and in the state of health; and the better opinion seems to be that, in health only, a very small quantity can be detected, because as fast as it is discharged by one set of vessels, it is, in general, absorbed by another. But when in disease, these actions do not correspond, and when either the discharge is too rapid, or the removal too slow, an accumulation may take place.(*c*)

Defects and diseases of the heart. (*d*) Malformation.

The heart may be subject to malformation or *malconformation*, such as the foramen in the septum of the auricles remaining open after birth, and allowing a part of the venous blood of the right to enter the left auricle, and pass off into the general circulation unoxygenized. So the heart is liable to diseases, preventing the due oxygenation of the blood, besides others whith may affect the frame in general.(*e*) These are scarcely remediable, but though the art of medicine may be unavailing, yet it will be important to observe palliatives and preventives of consequences, and, in particular, perfect tranquillity, a light diet, and attention to the state of the bowels.(*f*) Malformations may be in the pulmonary artery, so as to prevent the blood from freely passing from the right auricle into the lungs, and being there renovated;(*g*) or the aorta may be improperly placed;(*h*) or, instead of two hearts, *there may be a third, and each imperfect.* In these cases life, in general, is very short and painful, subject to great difficulty in breathing, palpitation, fits, and sudden death.(*i*) Of these descriptions is the disease called Cyania, or blue skin, where the skin is more or less blue, the lips purple, with a general hebetude and inactivity, which is produced mostly by a connate congenital communication of the two ventricles of the heart, and, consequently, an imperfect discharge of the carbon of the blood in the lungs, which constitute the proper organ of its elimination.(*j*) The heart, also may be too small for the system to which it belongs, or too large. So the muscular walls of the heart are liable to increase, or diminution of their ordinary thickness. Without any apparent traceable cause, the walls of the ventricles, and, occasionally, of the auricles, increase in thickness and in the firmness of their texture, and the whole heart acquires a magnitude nearly double that of its original and healthy condition. This increase of thickness, to which the left ventricle is more subject than the right, may be attended with dilatation of the cavity, or otherwise. When it is accompanied with dilatation of the cavity, it is now technically called "*active aneurism*" of the heart.(*k*) Its occasional cause

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(*b*) 1 Bost. 290; 1 Bell, Anat. 489; 2 Horner, Anat. 187; 2 Good, 4; Jackson, Prin. Med. 469; 3 Paris & Fonb. 56.

(*c*) 1 Bost. 290, 291.

(*d*) As to the effect of anger, &c., 4 Good, 92; and as to palpitation, see 4 Good, 312; and as to the diseases of the heart in general, see Dr. Hope on Diseases of the Heart and Great Vessels; and see 2 Bell, 76 to 84; Dewees, Prac. Phy. 550; 2 Par. & Fonb. 178; Liz. 146, 147; A. Burn on Diseases of the Heart; Abercrombie's contributions to the Pathology of the Heart; Dr. Laennec's Traité de L'Auscultation Mediate et des Maladiés des Poumons et du coeur, 2d edit. 1826. This last work is particularly interesting and valuable, as are all the works of that author.

(*e*) 2 Bell, 56; Brous. Phy. 397.

(*f*) 3 Good, 324.

(*g*) 2 Bell, 58.

(*h*) Id. 59.

(*i*) Id. 56 to 70.

(*j*) 3 Good, 335; 1 Bost. 296, 297, and *quære* if this does not arise from an imperfect congenital communication of the two *auricles*, as above.

(*k*) 2 Bell, 73 to 81; Jackson, Prin. Med. 504.

is obstruction from disease of the semilunar valves of the aorta, but it may arise from various other causes. Again, the walls of the ventricles may become soft and thin, so that even the pressure of the finger may rupture the texture of the wall without difficulty. This, when accompanied by dilatation of the ventricle, is called "*passive aneurism.*" In this condition of the heart its walls may yield or give way, and occasion sudden death; but such a rupture never occurs unless caused by external violence, nor without some previous degeneration of the muscular structure of the organ."(*l*)

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But the *aneurism* of the *aorta* is a disease more frequent and more dreadful than all the others. It is a disease more frequent in the decline of life than at earlier periods. The aorta then begins to ossify; its middle coat is converted into a hardish bony substance, commencing in various points, and extending throughout a considerable portion of the caliber of the vessel. Thus the elasticity of the artery and its muscular power is lost. In this state it may burst, and uniformly destroy life instantaneously.(*m*) There may also be an aneurismal enlargement of the larger vessels in the immediate neighbourhood of the heart.(*n*) These disorders sometimes arise from too violent exertions, independent of all predisposition; sometimes from blows; more frequently from shocks or falls; but still more often from those kinds of exertions which are accompanied with a rapid pulse and hurried respiration.(*o*) As to the symptoms, palpitation and quick breathing are the most common, but these may be symptoms of quite different disorders.(*p*)

For *aneurism* of the aorta, rest with abstemious diet, repeated small bleedings, issues in the region of the heart, and attention to the circulation by dietetic means, it is said, is all that can be done.(*q*)

Angina Pectoris.

In a very valuable recent publication, *Angina Pectoris*, or acute *breast pain*, has been treated as a *distinct disorder*, arising from a *structural disease* in the *heart* or *aorta*, or both, or *in some of its vessels* too much accelerating the flow of blood, or suddenly increasing the action of the heart, and occasioning most agonizing pain, and which is to be treated differently during the paroxysm and in the interval, as there directed;(*r*) and in Sauvages this affection is termed Cardiogmus Cordis Sinistri, importing that this disorder proceeds from the *left side* of the heart; whilst, according to others, angina pectoris is to be classed amongst the diseases of the *respiratory functions*, and affecting the lungs.(*s*) But the affection was not recognised as a distinct disease by medical authors until Dr. Heberden described it as such in the Medical Transactions of the London College of Physicians;(*s*) and one of the ablest anatomists of the present time still insists, that angina pectoris is a symptom of more than one disease of the heart, and is not of itself a disease. Its seat seems to be usually in the heart, or in some of the organs of circulation, and not in those of respiration. It has by Dr. Copland, in his valuable work, been recently defined to be "acute constrictory pain at the lower part of the sternum, inclining to the left side, and extending to the arm, accompanied with great anxiety, difficulty of breathing, tendency to syncope, and feeling of approaching dissolution," and the alleviating remedies are there described.(*s*)

(*l*) I have been favoured with the above passage between inverted commas by a most experienced anatomist.

(*m*) Smith, 37; 2 Bell, 82, 83; 2 Gibson, Sur. 79.

(*n*) 2 Gibson, Surg. 83.

(*o*) Ibid.

(*p*) 2 Gibson, Surg. 79.

(*q*) Ibid. 81.

(*r*) Amer. Cyclop. Prac. Med. tit. Angina Pectoris.

(*s*) Copland, Dict. Prac. Med. tit. Angina Pectoris.

Rupture or broken heart.(*t*)

The notion of what is commonly termed a *broken heart*, merely from mental suffering, seems to be questionable; and it is said that though violent passions of the mind very commonly produce syncope, yet that the person must have laboured under some previous organic affection of the heart or its vessels if death ensue.(*u*)

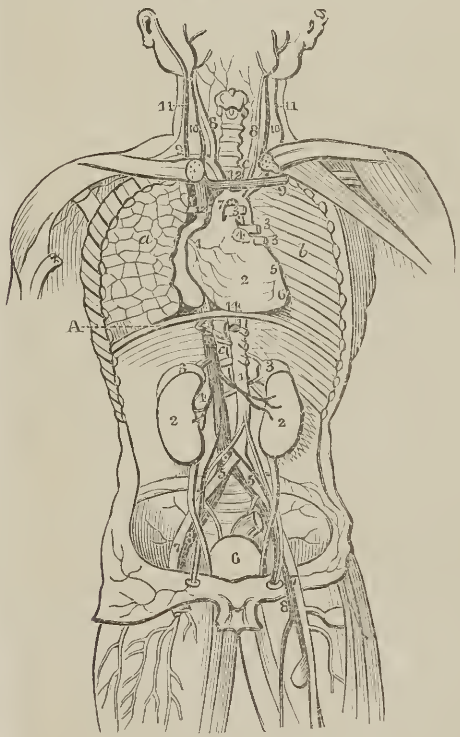
Injuries to the heart, as wounds.

Wounds of the heart, even of the slightest and most superficial kind, have been generally considered as fatal, and the exceptions are few. The heart cannot be wounded without the pericardium, which surrounds it, being injured; but that membrane may be pierced without extending to the heart itself, and wounds of the pericardium merely are not necessarily mortal.(*x*)

SECT. I. 2. THE ARTERIES.

2. Of the Arteries.(*y*)

First, above the Diaphragm.(*a*)



1. The right Auricle of the Heart.(*b*)
2. The right Ventricle, resting in part on the Diaphragm. A.
3. The Pulmonary Artery.
3. 3. 3. Its Branches, passing to the right and left Lobes, or parts of the Lungs.
4. The left Auricle.
5. The left Ventricle.
6. The Apex of the Heart, formed by the left Ventricle, which pulsates between the 5th and 6th Ribs, on the left side of the Sternum, removed from the Clavicles or Collar Bones above, to show the situation of the heart.
7. The Aorta, which curves to the left, and is seen again at 1. 1. below the Diaphragm.

8. 8. The two Carotid Arteries, passing upwards to the Head. The Trachea, Epiglottis, &c. are seen in the centre of the Throat.

9. The left Subclavian Vein.

10. 10. The two internal Jugular Veins.

11. 11. The two external Jugular Veins.

12. 12. 12. The Superior Cava, formed by the two Venæ Innominatæ.

(*t*) Brous. Phy. 397; 4 Good, 96; as to rupture of aorta of Geo. II., see 3 Par. & Fonb. 58; Smith, 37.

(*u*) 2 Par. & Fonb. 26, 27.

(*x*) Smith, 277; 1 Gibson, Surg. 139.

(*y*) Angiology, Amer. Cyclop. Prac. Med.; ante, 51.

(*a*) See description of the diaphragm, ante, 98; and plate thereof, ante, 94, No. 14. It is the base of the thorax, on which the heart and lungs rest, and is the central division between the thorax and abdomen.

(*b*) The terms *right* and *left* would be more properly *frontal* and *posterior*, see explanation, ante.

14. The termination of the Inferior Cava in the right Auricle of the Heart.
a. The Right Lung.
b. The Cavity of the Chest, exposed by removing the left side of Lungs.
c. The Thoracic Duct, appearing just above the Aorta and near the left Carotid Artery, and is seen again below the Diaphragm, close to 1. 1. the Aorta Descendens.

Secondly, below the Diaphragm.

1. 1. Parts of the Descending Aorta.
2. 2. The two Kidneys.
3. 3. The two Renal Capsules.
4. The right Renal Vein.
5. 5. The termination of the Aorta in the two Iliac Arteries.
6. The Bladder. (*d*)
7. 7. The external Iliac Arteries.
8. 8. The external Iliac Veins.
9. 9. The Inferior Cava.
10. 10. The Hepatic Veins, terminating in the Inferior Cava.
e. Thoracic Duct.

The Arteries have been termed vital agents, endued with the properties of living matter, and forming part of an organized system endowed with *vital* powers, and have an important share in the circulation of the blood,(*z*) and they are stated to be in number about 1000,(*a*) but at least, as regards the named arteries, there are not perhaps even 300.

Arteries are elastic canals or vessels receiving and conveying the blood *from* the heart *to* the different parts of the body, whereas *veins* carry *back* the blood from the different parts to the heart; arteries are also distinguishable from veins by their pulsation. It has been observed, that to the surgeon the knowledge of the arterial system is valuable beyond calculation or belief, for he can perform no operation in which arteries are not engaged, nor can he cure any great wound in which arteries are not first to be tied, and without a knowledge of the arteries he can neither reason correctly nor act safely.(*b*) Nerves accompany and influence the arteries; the lymphatics and veins twine round them; the glands and various organs contain a large distribution of them. The intimate structure of parts is known only by understanding such distribution of their vessels; and as each individual part is nourished by arteries, he who has studied the arteries thoroughly, possesses a more general knowledge of the whole;(*c*) so that every surgeon ought to learn familiarly the general distribution of the arterial system.(*d*)

The pulmonary artery and the aorta

The original and principal trunks of the *arteries*, or of those which arise from the heart, are two in number, the *pulmonary* artery and *aorta*, both of which are nearly of the same diameter; and the measure of each, on being slit, is about three and three-eighth inches, or, according to others, the area of the aorta is about three-fourths of a square inch.(*e*) The *pulmonary* artery arises from the *right ventricle* of the heart, and conveys the blood as there received from the veins into the lungs, where it is renovated and returned back, as hereafter described, to another part of the heart, and from thence the blood is propelled into the *aorta*. From the latter, all the other arteries are derived, and branches are dispersed through the whole body.(*f*)

(*d*) The two vessels, passing from the kidneys to the bladder, are the ureters, described, post. The vessel immediately above the bladder is part of the rectum.

(*z*) 2 Dungl. Phy. 139.

(*a*) 2 Bell, Introd. xxv.; ante, 5.

(*b*) 2 Bell, Anat. Introd. 23; El. Blum. 81.

(*c*) 2 Bell, Introd. xxii.; 2 Good, 9, 17.

(*d*) 2 Bell, Introd. 25, 26.

(*e*) 1 Bost. 334.

(*f*) El. Blum. 82; 2 Horner, Anat. 198; 2 Bell, 92; Brous. Phy. 368; Coop. Dict. tit. Aorta, and tit. Aneurism; Amer. Cyclop. Prac. Med., same titles.

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The Aorta and its branches, being similar arteries.

It is the trunk from which the general tree of the arteries is to be explained. It commences deep in the flesh or muscles of the *left* side of the heart, and mounts upwards and backwards from the heart till it begins to form its peculiar arch or curvature, and then bends downwards to the left side of the spine opposite the third or fourth dorsal vertebra, along which it proceeds gradually, reaching the front of the spinal column through the diaphragm into the abdomen. At the commencement of the aorta the two *coronary* arteries branch from it, and proceed on the heart itself, in order to supply it and cause its successive contractions; and from the *arch* of the aorta go off *three* great arteries, which rise to the head, or bend sideways towards the arms, and so nourish all the upper parts of the body, namely, *first,* the arteria innominata, dividing into the *right carotid* and right subclavian artery. *Secondly,* the *left* carotid artery, going to the head; and *thirdly,* the left subclavian artery, going to the left arm.(*g*)

The aorta in the chest nourishes the lungs by the bronchial or small nutrient vessels, and when it gets below the diaphragm gives out *three* great abdominal arteries; first, the *cœliac,* going in three branches, one to the liver, one to the stomach, and one to the spleen; *secondly,* the *superior mesenteric,* which furnishes all the smaller and a great portion of the large intestines; and *thirdly,* the *lower mesenteric* artery, which supplies a portion of the great intestines down to the rectum. The arteries of the kidneys and of the testicles may be added to these, and are branches of the aorta, and afterwards the aorta divides into two great branches for the pelvis and legs. The *iliac* arteries are the two great branches into which the aorta divides within the abdomen, and these again are each subdivided into two great arteries, the internal iliacs to supply the pelvis, and the external iliacs to go to the thigh. These are only a very few of the principal great arteries; and there are a great many others, formed by successive divisions and subdivisions of these, which are distributed to every part of the body, receiving names according either to their size or to the importance of their distribution.(*h*) The *vena cava,* proceeding upwards, leaves the aorta a little above the pelvis, and inclines gradually towards the right, that it may enter into the right side of the heart, which it does by passing under the liver, and penetrating the diaphragm.(*i*)

The principal trunks run in the centre or deepest and most protected parts of the body and extremities, where they are the least exposed to danger, deriving support or defence from the bones and muscles.(*k*) They are distinguished from veins by the whiteness of their colour and thickness of their coats; also in the circumstance of their not having like veins any valves, except at the roots of the aorta and pulmonary artery.(*l*) Arteries thus *commencing* from the aorta or from themselves are found to *terminate* in several ways, as by one artery anastomosing or inosculating, that is, communicating with another, or in red veins, or in glands or follicles, by secerning or secreting orifices which separate a fluid from the general mass of blood by exhalent vessels, which discharge their contents into the internal cavities, or upon the external surface of the body; and finally, arteries terminate in that structure called erectile tissue.(*m*) Other authors observe, that in the present state of our knowledge the umbilical vessels are to be regarded as the only exceptions

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(*g*) 2 Bell, 93, 94; 2 Horn. Anat. 198.
(*h*) Id. 199.
(*i*) Id. 276; see an enumeration and plates, 3 Gregory's Economy of Nature, 243 to 255.
(*k*) 2 Good, 18; 2 Dunglison, Phy. 123.
(*l*) 2 Good, 9; 1 Bost. 272.
(*m*) El. Blum. 83; Jackson, Prin. Med. 476; 2 Good, 2.

to the termination of arteries in veins;(*n*) at all events many of the arteries do not terminate immediately in veins, but in some degree the effete and altered blood in the arteries first passes into the *capillaries*, which are hair-like terminations of the arteries, and thence into the incipient radicles of the veins, which convey it into the larger branches, from which it is forwarded to the trunks that open into the right auricle of the heart.(*o*) Dr. Good says, that in reality the capillary system constantly intervenes between the arteries and the veins.(*p*) Many physiologists insist that the large arteries are merely mechanical tubes to convey the blood to remote parts, and the capillaries, in which the arteries terminate, are the part of the vascular system in which all the important objects of the circulation are mainly prepared and accomplished as nutritious secretion, the oxidation of the blood, its decarbonization, &c.(*q*) The distinction between artery and veins at the point of union is lost.(*r*)

Every artery has its *sheath*, which is a tissue of cellular membrane surrounding it, and material to be distinguished by the surgeon from the artery itself.(*s*) Each artery also has or rather is composed of three arterial coats, now generally termed external, middle, and internal.(*t*) The *exterior*, by some called the tunica cellulosa propria, by others the nervous, cartilaginous, tendinous, &c., is composed of condensed cellular membrane, externally more lax, internally more and more compact, and blood vessels are seen creeping upon it; and it gives great tone and elasticity to the arteries. The *middle* coat consists of transverse fibres, lunated or falciform, and almost of a fleshy nature; hence this has the name of muscular coat, and appears to be the chief seat of the vital power of the arteries, and is the chief assisting power propelling the circulation of the blood. The *inner* coat, lining the cavity of the arteries, is highly polished and smooth, but which is much more distinct in the trunks and larger branches than in the smaller vessels.(*u*)

The *powers* of an artery in moving forward the blood are elasticity and muscularity. Their elasticity marks their difference, from the veins, by keeping their sides apart and open, even when they are empty; and the muscular power increases in the proportion in which the artery is remote from the heart, which compensates for the decreased power of the heart over the distant vessels from it, and thus the blood is circulated with nearly equal velocity throughout the arteries.(*x*)

Dr. Bostock makes the following observation on the arteries:—The arteries which perform the office of conveying the blood from the heart are flexible elastic tubes, not perfectly cylindrical, but conical, the narrower end of the cone being situated towards the heart.(*y*) The arteries are principally composed of membranous matter, formed into distinct layers, and composing what are called the coats of the arteries. Of these *membranous coats*, anatomists usually describe two as possessing a sufficiently determined structure to be easily distinguished from each other, the *outer one* partaking more of the nature of the cellular texture, and therefore called the cellular,(*z*) and an *inner* membrane, white, firm, and smooth, possessing more of the physical properties of tendon, and by some erroneously called the *nervous* coat, but more properly the interior

(*n*) El. Blum. 83; but see 2 Dungl. Phy. 125.
(*o*) 2 Horn. Anat. 159; 2 Good, 18.
(*q*) Id.
(*r*) El. Blum. 83; 2 Horn. Anat. 159.
(*p*) 2 Good, 18.
(*s*) 2 Bell, 293.
(*t*) 2 Good, 5; 2 Bell, 293; El. Blum. 81, 82; 2 Horn. Anat. 164; and see a good practical description in Coop. Dict. tit. Hemorrhage.
(*u*) Id. 2 Horn. Anat. 164 to 168; 2 Dungl. Phy. 124.
(*x*) El. Blum. 93, 94; Brous. Phy. 576; 2 Bell, 295 to 297; 2 Good, 7, 12, &c.
(*y*) Hunter on the Blood, 168; 2 Horn. Anat. 163.
(*z*) See observations, 1 Bost. 271, note.

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coat.(*a*) The *muscular* coat lies *between* these two membranous coats, and is a stratum of transverse fibres, and this has been supposed, like other muscular parts, to possess a *contractile* power, and to give the artery the capacity of alternately contracting and relaxing, thus assisting the heart in the propulsion of the blood.(*b*) Dr. Bostock afterwards states the different discussions and arguments upon this contractile power of the arteries, and concludes by stating that we are fully warranted in the conclusion, that *the arteries possess a proper contractile power*, and that it is to be presumed that this power resides in their transverse fibres, and that it is established that this contractile power is principally seated in the *capillary* arteries, while the *large arteries* and the *veins*, although not destitute of it, possess it in a less degree, and that the large arteries are to be regarded as canals transmitting the blood from the heart, where it receives its great impulse, into the smaller branches, and that it is principally in them that it exercises its various functions, and that we are therefore to consider the larger arteries in the light of a mechanical or hydraulic system, and the *capillaries* as physiological or vital organs, and that this distinction is of the greatest importance to be attended to.(*c*) He further observes, that although *veins* exhibit the transverse fibres in small quantities, and have a small contractile power, yet they are to be considered merely as elastic tubes, and return the blood to the right auricle of the heart by mere mechanical means and upon hydraulic principles.(*d*)

It is further observed that it is generally agreed that *blood vessels* possess no proper *sensibility* in their healthy and natural state, being in this respect analogous to many other parts of the body, which are principally composed of membranous matter, and are not subject to the control of the will. How far the blood vessels resemble the other membranous parts in the capacity of feeling pain, when suffering from inflammation or any other morbid state, is a question which appears to have been but little attended to; but that analogy would induce us to suppose that they possessed *sensibility* under those circumstances.(*e*)

The *use* of the arteries is to convey the blood from the heart to the different parts of the body, to nourish the same, and promote its growth; to assist in preserving the fluidity of the blood, and the heat and life of the body; to form the different secretions and to renew the growth of parts destroyed by accident or disease.(*f*)

Of the pulse and bleeding.

The *pulse is felt* by compressing an *artery* (not a vein) usually at the wrist, and where the artery lies superficially, by which it is supposed the force and fulness of the circulation of the blood by the impulse of the heart through the *arteries*, and the general condition of the patient's health may be ascertained.(*g*) But that subject will be more fully considered hereafter. *Bleeding* is very rarely employed from an artery, excepting in certain cases, (as from the temporal artery,) (*h*) but from a vein, usually in the arm, close to the bend of the elbow,(*i*) for reasons hereafter explained.

The system of the arteries is more *simple* than that of the veins.(*k*) It has been observed that the wisdom with which the structure of the body is contrived is most convincingly exemplified in the vascular

(*a*) 1 Bost. 271; 2 Horn. Anat. 168.
(*b*) Id.
(*c*) Id. 313 to 325.
(*d*) Id. 325, and post.
(*e*) Id. 314.
(*f*) Tuson, 102.
(*g*) 2 Bell, 304; Jackson, Prin. Med. 485; 2 Good, 28 to 34; 2 Dungl. Phy. 157; see post as to *Veins*.
(*h*) 4 Good, 452.
(*i*) 2 Bell, 302; 2 Dorsey, Surg. 355.
(*k*) 2 Bell, 298.

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system; we have instances of it in the universal situation of the arterial trunks; in the direction of the flexion of the joints, whereby they are hindered from being overstretched, and are protected from external injury in their occasional tortuosities, by which they are enabled to adapt themselves to the continually changing positions of organs without suffering from extension; and in their anastomoses or frequent communications with one another, by which the necessary supply of blood to parts is rendered secure, when any particular trunk is temporarily obstructed by pressure, or permanently obliterated by aneurism, or other causes.(*l*)

Diseases of arteries. (*m*)

Arteries, especially the aorta, are liable to aneurism or ossification, especially in their acute angles.(*n*) Arteries are subject to ossification, and ossification leads to dilatation or aneurism, whilst aneurism leads to rupture and hemorrhage; they are also liable directly to rupture and consequent hemorrhage, occasioning sudden death, as in the case of George the Second.(*o*) The former, it has been said, is frequently relieved by the process of nature, termed anastomosis or inosculation, being the communication of blood vessels with each other, by which the free circulation of blood may be continued, notwithstanding the obstruction of the main trunk.(*p*)

Injuries to arteries.

Though generally deep-seated and well protected, yet arteries are subject to various *injuries*, as *wounds*, and to the danger of hemorrhage, which will hereafter be considered.(*q*)

Of each artery in particular.(*r*)

The enumeration of each particular artery would follow the same arrangement as that pursued with respect to the other parts of the frame.

SECT. I. 3. CAPILLARIES.

3.—OF THE CAPILLARIES.(*s*)

In the direct and natural course of the circulation of the blood from the left ventricle of the heart into the aorta, and from thence through all the large arteries, and then into the veins, there *intervene* between such arteries and veins, innumerable small hair-like branches of the former, called the CAPILLARIES, which have been considered to be distinct as well from the arteries as the veins.(*t*) It is true that some authors have contended that the blood passes *directly* from the arteries into the veins, but the best modern physiologists observe, that in reality the capillary system constantly intervenes between the veins and arteries,(*u*) and it is supposed that therein are performed all the principal objects of the circulation of the blood; for in the passage of the blood through these capillaries into and through the cellular membrane from the arteries to the veins (being one branch of the important function of secretion) (*x*) secretion and nu-

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(*l*) 2 Good, 18.

(*m*) See in general, Hodgson on Diseases of Arteries and Veins; Guthrie on Diseases of Arteries; Coop. Dict. tit. Arteries; Aneurism, Amer. Cyclop. Prac. Med. tit. Aneurism and Arteries; 2 Gibson, Surg. 62 to 109.

(*n*) Jackson, Prin. Med. 498; Brous. Phy. 405; Amer. Cyclop. Prac. Med. tit. Aneurism; and id. tit. Arteries.

(*o*) 3 Paris & Fonbl. 58.

(*p*) Coop. Dict. tit. Anastomosis, and tit. Inosculation; 2 Good, 18; but it appears that anastomosis cannot relieve aneurism, for such aneurism will advance and destroy life in spite of it. It only relieves the extremity from the want of blood. The *obstruction* is not the evil, but the *rupture* is.

(*q*) See tit. Hemorrhage, Coop. Dict.

(*r*) See enumeration, 2 Horn. Anat. 198 to 257; 2 Bell's Anat. 92 to 293; Lizars, part ii. &c.; Quain's Elements, 237 to 274, 398 to 411, 466 to 482, 550; 3 Gregory's Economy of Nature, and plate, 252 to 255.

(*s*) 2 Horn. Anat. 159.

(*t*) Jackson, Prin. Med. 466; 2 Dungl. Phy. 125.

(*u*) 2 Good, 18.

(*x*) We say, *one branch*, because many

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trition, and all other benefits of the blood, are principally performed,(*y*) for the large arteries and the veins have been considered as mere mechanical canals, conduits or conductors of the blood; whilst the capillaries have been considered as physiological or vital organs, because the blood, by oozing and penetrating through them deposites its renovating qualities, whilst the carbon, and other effete parts, accumulated in the adjacent cellular membranes or tissues, are carried off by and through such capillaries into and through the veins, and ultimately into the lungs, where the blood loses its carbon and acquires new oxygen, by the renovating operation of respiration.(*y*) It may be considered that in the capillaries is performed a function the very converse of that of the lungs, for in the lungs the blood becomes decarbonized, aerated, and renovated, whilst, by passing through the capillaries, it becomes encumbered with carbon, afterwards carried into the veins towards the lungs, and hence, in case of undue secretion, the capillaries are in general the seat of local inflammation.(*z*)

These capillaries, however small, have a muscular coat, and in which it appears to be agreed that the *contractile* power is stronger, even than in the large arteries, and hence the blood is propelled through them with considerable force.(*a*) The action of the *capillary* vessels has, since the time of Cullen, been generally regarded as the principal agent in all the vital actions of the body, either physiological or pathological, by which any permanent changes are produced in its form or composition; and, with respect to the *circulation* of the blood in particular, there seems every reason to conclude, that it is very materially influenced by or in these capillaries, not merely as one of the means employed to *propel* the blood along the vessels in its ordinary course, but as the power by which all the subordinate changes in the state of the circulation are principally, if not entirely, effected.(*b*) But the mode in which these changes in the capillaries is occasioned or operated, are confessedly but very imperfectly known.(*c*) We extract from the best authors the following substance of their observations respecting the capillaries. After having divided and ramified, to considerable extent and in a manner generally resembling the branching of a tree, the arteries, both of the greater and lesser circulations, terminate in the general *capillary* system, sometimes termed capillary circulation. The exact point at which the arteries end and the capillaries begin, cannot be demonstrated; this part of the capillary system intervenes between the arteries and the secerning terminations and the veins. Dr. Bostock observes, that we are to consider the large arteries or trunks in the light of a mechanical or hydraulic system, and the *capillaries as physiological* or *vital organs*, and that this distinction between the two descriptions of vessels is of the greatest importance.(*d*) The capillaries are the *minute* arteries or tubes, and part of the vascular system, in which all the important objects of the circulation are mainly prepared and accomplished, as nutrition, secretion, the oxygenation of the blood, its decarbonization, &c.; for the use of the great arteries is rather as canals to carry the blood from the heart into the capillaries, in which the blood exercises its various functions,(*e*) and it is afterwards passed into the veins, and through them back to the heart. The capillaries possess

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other branches of the function of secretion are placed in other parts of the frame, especially those which carry off *superfluous* and excrementitious particles, such as urine and fæces, &c.

(*y*) 1 Bost. 316; 2 Good, 19; 2 Bell's Anat. 322; Jackson, Prin. Med. 466.

(*z*) 1 Bost. 337.

(*a*) 1 Bost. 316, 317.

(*b*) Id. 316.

(*c*) See Brous. Phy. 373.

(*d*) 1 Bost. 322.

(*e*) Id. 2 Dungl. 149; 2 Good, 18, &c.; 2 Bell, 322.

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more contractility than the larger arteries.(*g*) They are those extreme branches from the arteries which are as minute as hairs; but this, though the literal, is not the general meaning of the term, for, by capillary vessels, is rather understood those branches in which the changes are wrought from the blood, and which are either so minute as not to allow the promiscuous flow of the particles of the blood, or are possessed of such a degree of irritability and appetency as only to allow certain parts of that fluid to be transmitted.(*h*) Through some of these capillaries, other parts of the red blood perpetuate the flow from the arteries to the veins, whilst the several secretions are performed in the other capillaries, and thus render the blood dark, and are then passed into the veins.(*i*) So that some of the arteries terminate in red veins, and others in the capillaries.(*k*) These capillaries readily anastomose or communicate with other vessels, (that is, if a capillary be destroyed or injured, the blood therein will pass in a new chanel until it reaches another vessel, and passes in a collateral circulation,) as where there is a stoppage in an artery or vein.(*l*) This freedom of anastomosis, between the capillary terminations of different vessels, may be considered as a provision against the consequences that would otherwise follow the obliteration of any of the main vessels of a limb, by an injury or by operation.(*m*) We here mention the change occasioned in the blood by passing through the capillary vessels as *part* of the function of *circulation* as well as part of the *function* of *secretion*. We shall presently consider the latter function separately and more particularly.

Fourthly.—Of the Veins.

Fourthly. —Of the Veins.

The veins are said to be in number three times as many as the arteries, and to amount to about 3000,(*n*) but the most experienced anatomists treat this as entirely matter of conjecture, and there are scarcely two hundred veins which are known or distinguished by any particular name.

The *veins* are elastic flexible tubes, conveying *back* to the heart the residue of blood remaining after the different functions of secretion and nutrition have been performed by the arteries. The effete and altered blood passes from the capillary terminations of the arteries into the incipient radicles of the veins.(*o*) Veins are constructed with three coats, which are thinner, firmer, and less elastic than the three coats of the arteries.(*p*) The muscular coat is loose, like cellular substance, thinner and more indistinct than that of the arteries, and the coats of veins are furnished with minute arteries and veins not essentially different from the nutrient vessels of the arteries. Their exhalents and absorbents are supposed to be but few, and their supply of nerves much inferior to what the arteries possess.(*q*) The veins are nearly destitute of that texture with transverse fibres which is seen in the middle coat of the arteries, and have consequently but little contractile power, and are therefore to be regarded as little more than elastic tubes, transmitting the blood to the right auricle upon hydraulic principles, and it is only in the *large* trunks of the veins that any fibrous appearance can be traced.(*r*) The force with which the

(*g*) 2 Good, 25; 1 Bost. 322.
(*h*) 2 Bell, 322, 323.
(*i*) Id. 324, 325.
(*k*) Id. 325.
(*l*) See Dissection of an Aneurismal Limb, by Sir A. Cooper, Med. Chir. Trans. vol. ii.
(*m*) 2 Horn. Anat. 159.
(*n*) Lizars, 202; 2 Bell, Anat. 298.
(*o*) 2 Horn. Anat. 159.
(*p*) El. Blum. 84; 2 Bell, 299; 2 Good, 9; 2 Horn. Anat. 172.
(*q*) 2 Good, 11.
(*r*) 2 Good, 9, 10; 1 Bost. 323.

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veins resist any power tending to rend them is much greater than might be expected from their apparent tenacity. Their area is much larger in proportion to their size than that of the arteries, and the veins bear greater distention than the arteries without bursting.(*s*) The venous like the arterial system appears to be capable of carrying on a collateral circulation when any part of it is impervious; and even after the obliteration of the vena cava inferior the blood has been known to be conveyed with facility to the heart through the lumbar veins and vena azygos.(*t*) To prevent a retrograde movement of the blood, where the veins are exposed to muscular action, they are furnished with *valves*, formed by a semilunar fold at the inner side, and placed in pairs at irregular distances, and which are concave towards the heart, and when closed somewhat resemble the finger of a glove, or may be likened to so many minute flood-gates, all inclined in the direction towards which the stream flows; but these valves are not, it is said, to be found in the deep-seated veins of the viscera, or in those of the cranium, neck, thorax, and abdomen, excepting in the spermatic vein, and sometimes the internal mammary veins.(*u*) The veins during life, and whilst filled or extended with blood, are in a cylindrical form, but when dead they are compressed and not like the arteries, the tubes of which remain open. The veins are transparent and the blood is seen through their coats. The capacity of the veins has been considered greater than that of the arteries;(*x*) the veins, it being supposed, containing three-fourths or more of the entire mass of the blood, and the arteries only about one-fourth.(*y*) The manner in which the branches of veins join the trunk has a peculiarity which always distinguishes them from the ramifications of arteries which branch direct and at an acute angle, but the veins in a direction more removed from the course of the trunk, and in general with a curve or shoulder.(*z*)

The commencement of the minute branches of some of the veins is from the extreme ramifications of the arteries, others from the capillary vessels, and such veins are continuous until they have carried back the blood to the heart.(*a*) The series of tubes, the aggregate of which constitutes the venous system, has been compared to a tree, the trunk being implanted into the heart and the branches diffused through the body at large.(*b*) These, in the first instance, and in their commencement most remotely from the heart, are so minute as to elude vision, but they gradually increase in size and diminish in number, forming successively vessels larger and larger, until finally all terminate in a large trunk, being the very reverse of the arterial vessels, which are smaller towards their extremities.(*c*) Though the caliber of any given vessel in the series is larger than either of the branches which open into it, yet its diameter is less than the sum of their diameters taken together, whence it follows by a necessary consequence, that the diameter of the common trunk is less than the sum of the diameter of the smaller vessels, whose contents it receives. Now when a current flows from a wider into a narrower bed, (its level remaining unaltered,) it necessarily becomes more rapid as it advances; and by an extension of the same principle, when a number of tributary streams open into a channel, whose width is less than that of their currents taken together, a certain impetus is given by the mere fact of such an

(*s*) 2 Good, 9, 10; El. Blum. 95.

(*t*) Coop. Dict. tit. Veins; id. tit. Anastomosis, and tit. Inosculation.

(*u*) 1 Bost. 272; El. Blum. 84, 86, 95; 2 Good, 10; 2 Bell, 300, where see a plate of the form of a valve; 2 Horn. Anat. 172.

(*x*) 2 Bell, 299; 2 Dungl. Phy. 117.

(*y*) Jackson, Prin. Med. 465.

(*z*) 2 Bell, 303.

(*a*) Id. 302; 2 Good, 3.

(*b*) 2 Horn. Anat. 171.

(*c*) 1 Bost. 272.

arrangement, which materially aids any other collateral means that may have been devised for expediting its progress,(*d*) as from the ordinary process of respiration.(*e*) The venous system, considered as a whole, seems to have been constructed on a general hydraulic principle, which materially influences the passage of the blood it contains.(*f*)

Why no pulsation in veins. (*g*)

There is no *pulsation* to be observed in the veins but what they receive laterally from the contiguous arteries, because the veins are removed at a greater distance in the course of the blood's circulation from the heart, and do not receive what is termed the shock of the heart's action in their trunks as do the arteries, but only by their widely spread branches, and also because the contraction of the heart and of the arteries so alternate with each other as to keep up a perpetual and uniform stream of blood into the veins, whereas, the pulsation in the *arteries* is owing to the sudden and interrupted contraction of the heart.(*h*) Hence, pulse feeling is always by pressing an artery conveying the blood *from* the heart, and not in a vein carrying back the blood to the heart.(*h*) There is, however, an exception in the large veins around the heart, in which an irregular pulsation or rather flapping motion exists to some extent.

Bleeding, in what vein.

On the other hand, we have seen that *bleeding* is rarely performed in an artery, but in a vein whilst the blood is returning towards the heart, and usually in the median *cephalic vein* or the *median basilic vein* in the *arm*,(*i*) though in cases of injuries to the head it may be advisable to bleed in the *jugular vein*.(*k*) The etymology of the term phlebotomy, (from the Greek φλεψ, a *vein*, and τεμνω, to cut,) shows that the operation is properly in a vein,(*l*) and bleeding from it requires great discretion with reference to the occasion of performing the operation, as well as care in relation to the mode of performing it.(*m*) The system of the veins is not so simple as that of the arteries, for while there are only two great arteries carrying the blood from the heart, namely, the pulmonary artery and the aorta, there are *three great* sources of the venous blood, namely, the four *pulmonary veins*, which return the blood from the circulation through the lungs into the heart, and the superior and inferior *vena cava*, which are trunks of the great veins of the body, and the *vena portæ*, which collects the blood of the intestines and conveys it to the liver.(*n*) There are also a greater variety in the distribution of the veins than in that of the arteries.(*o*)

In the extremities the veins consist of two sets, one running immediately under the skin, termed subcutaneous, and the other deep-seated, accompanying the arteries. The anastomoses or inosculations of the veins are greater and more frequent than in the arteries; those of the veins are by large branches, whilst the arteries inosculate generally by small.(*p*)

Diseases of veins.

The veins rarely if ever *ossify* like the arteries,(*q*) but they are subject to several diseases, as inflammation, relaxation, tumours, ruptures, &c.(*r*) Veins also are subject to varix, and when affected by it are called varicose. The term varix is a disease, as respects veins, what the true or encysted aneurism is to arteries. It is applied by surgeons to the permanently dilated state of a vein attended with an accumulation of dark-coloured blood, the

(*d*) 2 Horner, Anat. 155, 156.
(*e*) 2 Dungl. Phy. 148, 149.
(*f*) El. Blum. 122 to 130; 2 Dungl. Phy. 153.
(*g*) Ante, post, *Second Part*.
(*h*) 2 Bell, 304; El. Blum. 105 to 107, where see some exceptions. 2 Dungl. Phy. 157.
(*i*) Ante; 2 Bell, 314; 2 Dorsey, Surg. 355.
(*k*) Coop. Dict. tit. Jugular Vein; 2 Dorsey, 356.
(*l*) Coop. Dict. tit. Bleeding.
(*m*) Coop. Dict. tit. Hemorrhage, and Veins.
(*n*) 2 Bell, 298; 2 Horner, Anat. 152.
(*o*) 2 Bell, 298; 2 Horner, Anat. 171.
(*p*) Coop. Dict. tit. Anastomosis, and tit. Inosculation, id.; 2 Horner, Anat. 257 to 281.
(*q*) 2 Good, 10; 5 Good, 237.
(*r*) See, in general, Hodgson on Diseases of Arteries and Veins; Arnott, Med. Chir. Trans. vol. xv. 47; Coop. Dict. tit. Veins, diseases of; Brous. Phy. 410 to 417.

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circulation of which is materially retarded in the affected vessels. When veins are varicose they are not only dilated but they are also evidently elongated, for besides being irregular and in several places studded with knots, they make a variety of windings, and coiling themselves form actual tumours. Varices are most commonly observed in the lower extremities, reaching sometimes even as far up as the abdomen. They have, however, been noticed in the upper extremities, and, it is probable, that the whole venous system is susceptible of the affection. As a well-informed writer observes, the great venous trunks sometimes become varicose. When the disease is situated near the heart it is attended with pulsation, which renders it liable to be mistaken for aneurism.(*s*)

Injuries to veins. Veins are liable to ruptures, wounds and laceration. Hemorrhage from veins, though not so dangerous as from arteries, is yet attended with danger.(*t*)

Of each vein in particular. The enumeration of each of the three thousand veins, even if practicable, would occupy more space than can here be afforded, and, therefore, we can only refer to the particular authors who have written upon them distinctly.(*u*) We have seen that they have been estimated at even 3000, but the most intelligent anatomists do not distinguish by name even two hundred.(*x*)

Section II.—Of the Blood.(*y*)

1. Its importance.
2. Its general Description, Composition, Materials, and Circulation.
3. Transformation of Aliment into Chyme, Formation of Chyle, and its ultimate assimilation with perfect Blood.
4. Colour of Blood.
5. Its Smell, Feel and Taste.
6. Heat of Blood.
7. Salts and Sulphur in Blood.
8. Animal Substances.
9. Chemical Properties.
10. Weight and Quantity of Blood.
11. Its Vitality.
12. Coagulum or Crassamentum.
13. Fibrin, Gluten, or Coagulable Lymph.
14. Properties of Fibrin or Lymph.
15. Red Globules.
16. Of the Serum.
17. Of the Buffy Coat or Crust.
18. Cause and Course of its Circulation.
19. Rapidity of Circulation.
20. Diseases and Disorders of the Blood in its Circulation.
21. Of Fainting.
22. Of Hereditary Diseases through Blood.
23. Of infusion and Transfusion.
24. Of Animal Temperature.

1. The importance of the blood. Although in a preceding page the impropriety in general of any allusion to Scripture in support of physiological positions, lest the due respect for Holy Writ should be prejudiced by incompetent or hasty advocates, has

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(*s*) See, further, Coop. Dict. tit. Varicose Veins; 3 Good, 331.

(*t*) Coop. Dict. tit. Hemorrhage; 3 Good, 126; as to hemorrhage.

(*u*) See enumeration, 2 Horner, Anat. 257 to 281; 2 Bell, 307 to 321; Lizars, parts ii. iii.; Wistar, Syst. Anat. 301 to 322; see plate and enumerations, 3 Gregory's El. Nature, 255 to 261.

(*x*) See the names of the principal veins and their situations, 3 Gregory's El. Nature, 261.

(*y*) See Divisions of the subject, ante; and as to *Blood*, ante, 20; and see 2 Horner, Anat. 175 to 183; 2 Dungl. Phy. 40 to 52; Jackson, Prin. Med. 458 to 462.

At present, (A. D. 1834,) there is a strong dispute in France between the faculty and its followers, and the Hygeists and their partisans, and it is said the latter are there gaining ground. Their doctrine has at least the merit of simplicity over that of the old school. A pupil of Majendie, M. D., who is a hygeist, describes the principal tenets of their doctrine to be, 1. The blood is the *life*, the *primum mobile*, the first agent from which others derive their origin. 2. Health depends on the purity of the blood. 3. The purity of the blood depends upon its having free outlets for its decayed particles. 4. Disease is induced by the choking up of these outlets in the bowels by reason of an accumulation of glairy mucus on the inner surface of the intestines. 5. This accumulation is occasioned by any thing that weakens the circulation or hurts digestion,

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been admitted,(*z*) yet there is something so strikingly true in Leviticus, "*that the life of the flesh is in the blood*,"(*a*) that I for once venture to deviate from the rule I have on all other occasions resolved to observe. It is true that it has long been the prevalent doctrine, that health or disease depends on the state of the *solids*, or rather on the influence of the *nerves and nervous function*, and not on the state of the *blood*, or *any other* fluid, and the influence of the latter has been lost sight of almost entirely. But, happily for the welfare of mankind, that injudicious limited opinion of the cause of disease is gradually weakening,(*b*) and, as regards *practical remedies* for diseases, the most judicious modern practitioners take into consideration not merely the condition of the solids or of the nervous formation, but also the state of the fluids, and more especially the blood, as the *primary* and principal cause of most diseases, especially fevers. Aliment is converted into blood; and the latter, after having been aerated in the lungs, occasions almost all the important organs, i. e. the heart and the nerves to perform their actions, which, if the blood be diseased, are inadequately exerted; and if the aliment be unwholesome in itself, or be received in undue or irregular proportions, the new blood is consequently unhealthy, and becomes either injurious, or not duly nutritious, and hence originally and primarily the origin of many diseases.(*c*) The fatal consequence of the infusion of poison into the blood, or the vessels through which they are absorbed, or the infusion of any small proportion of the blood of a diseased animal into that of a healthy animal, manifest the direct effect of blood on the general state of the frame.(*c*)

2. The general description, composition, materials, and circulation. (*d*)

Physiologists, when speaking of the nature of blood, describe it to be a compound fluid, consisting of several ingredients of various physical and chemical properties, dissolved, or at least suspended, in a considerable quantity of water. In a valuable and truly scientific work on chemistry, treating of the blood and other connected subjects, it has been observed, that of late the constitution of blood in disease has been almost entirely disregarded, and yet that it is difficult to imagine any natural disease of the solids without the blood being thereby more or less affected; and hence the importance of inquiry into the constituents of the blood has been urged with considerable weight.(*e*) We have seen that this is the primary and chief fluid, the vehicle of those successions of oxygenous and carbonaceous particles that cease with life only, the nourisher of the

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but chiefly by poisonous drugs and bad treatment of the faculty. 6. The impurities thus detained in the blood occasion every species of disease, according to the quality of the humour, or the particular locality in which it is lodged. 7. All diseases proceed from one source, therefore they may all be cured by one medicine. 8. This medicine must be a *purgative*, innoxious in itself, yet sufficiently powerful to pervade the whole system, clear away the above-mentioned mucus, and purify the blood. 9. The purgatives administered by the faculty in France are inadequate to the task, and ruinous to the constitution of the patient.

(*z*) Ante, 17.

(*a*) Leviticus, ch. xvii. vers. 11; but observe that the expression was not there intended to be used in a *physiological* sense.

(*b*) I venture to make this assertion, not merely upon the authority of many ancient as well as modern publications, and amongst the latter Stevens on the Blood, 163, 164, and Dr. Turner's El. Chem. 4th ed. 551, but because some of the most experienced medical practitioners have expressed to me their decided opinion to this effect. See post, 165, 166.

(*c*) Consequences of eating unwholesome food, 2 Beck, Med. Jur. 461. It is well known that if a very small part of the blood of a glandered horse be infused or introduced into the healthy blood of another, it will shortly afterwards become fatal.

(*d*) See J. Hunter's Treatise on the Blood, *passim;* Good, Study of Medicine, vols. 2 and 3, *passim;* Jackson, Prin. Med. 458; El. Blum.; 2 Dungl. Phy. 40 to 52; 1 Bell's Anat.; 2 Horn. Anat. 175 to 183.

(*e*) Dr. Turner's Chem. 547 to 552, referring to Dr. Stevens's Treatise on the Blood, and ante, 148, note (*y*).

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frame, the source of almost every other fluid, that *into* which the crude fluid is converted, and *from* which all the secretions are derived, and which, with the exception of some exsangueous parts, as the epidermis, the amnion, the vitreous substance of the teeth, and the body of the crystalline lens, is universally diffused through the system; in various proportions, indeed, according to the different natures of parts; i. e. abundantly in the muscles, and still more so in certain viscera, as the spleen, and in the placenta, and uterus, at an advanced period of pregnancy, but very sparingly, on the other hand, in the tendons and cartilages.(*f*) The blood, in its most perfect state, immediately after it has been exposed to atmospheric air in the lungs, *excites* the heart to contraction, and distributes *oxygen* to every part, thereby *propelling* the blood through the arteries and into the veins,(*g*) and conveys away the *carbon* to the excreting vessels, giving rise by this change to *animal heat*. It supplies the materials of the *solids* originally, and ever afterwards their *nourishment*, and from which all the other fluids, with the exception of the crude, are *secreted* and derived, consequently it has been justly termed the most important fluid of the animal structure.(*h*)

Composition, materials, and formation of the blood, and its circulation in general.

The *formation* of the ingredients of *new* blood from the aliment is technically termed hematosis, (from αιματοω, to make blood,) and will be more fully considered when we examine the function of digestion. It may suffice here to observe, that it begins in the stomach and small intestines, principally in the duodenum, and thence, after passing through the absorbents into the thoracic duct and thence into the right auricle of the heart, is completed in the lungs. (*i*) In the stomach the nutritive parts of the aliment are converted into chyme, and in the small intestines into chyle, and in the lungs the whole is oxygenated and perfected. Blood is to be considered with reference to its composition; *first*, *before* it has been perfected by respiration in the lungs; and *secondly*, to its parts and condition, when, after that salubrious operation, it has been passed into the left ventricle of the heart, ready for new circulation through the arteries.

3. Transformation of aliment into chyme and chyle, and its assimilation with perfect blood.

All the constituents of the body may be found in the blood, and secretion consists merely in their separation from that fluid.(*k*) The principal *materials* for the renewal of blood are obtained from the digested nourishment received into the stomach, and thence, under the denomination of *chyme*, in a pulpy state, passed into the small intestines, where the nutritive parts are converted into *chyle*, which has the appearance of a milky coagulable fluid;(*l*) from thence it passes by absorption into the lacteals, and is conveyed into the thoracic duct. Other absorbed fluids and lymph are also conveyed from the different parts of the body by the lymphatic vessels, and are also supposed to be carried into the same thoracic duct, in which there are many valves, and where the whole are mixed, and there are many valves in the thoracic duct at the angle formed by the internal jugular and subclavian veins of the left side. This mixture of chyle and absorbed materials enters the subclavian vein, where the chyle and other absorbed materials are blended with the effete and black blood returned from the left side of the head and the upper extremity. This subclavian vein of the left side soon after unites with the subclavian vein of the *right* side, returning the blood of the head and arm of the same

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(*f*) 1 Ante, 21; El. Blum. 6, 7.

(*g*) As to the effect of respiration in general, ante, 107 to 117; and as to the introduction by inspiration of fresh oxygen, ante, 108, and 2 Bost. 112.

(*h*) El. Blum. 10, 382; 2 Good, 40, &c. 2 Horner, Anat. 180.

(*i*) 2 Dungl, Phy. 95, &c.

(*k*) 3 Bost. 325.

(*l*) 1 Good, 10, 11; 3 Bell, 238, 239, 310; Jackson, Prin. Med. 348 to 359.

side, and forms the *vena cava descendens*, which is immediately joined by the vena azygos. The *vena cava descendens* carries the blood onwards to the *right* or pulmonary auricle, where, meeting with that returned by the *vena cava ascendens*, which is the trunk of the *venous* system of the lower extremities and the abdomen, and that returned by the coronary vein of the heart, the fleshy parietes (walls or sides) of the auricle are distended, stimulated to action, and contracting, propel the blood through the tricuspid valve into the right or pulmonary ventricle. The mixture of chyle and of absorbed fluids and of the effete and dark blood then enters the pulmonary (or right) ventricle, which being stimulated, contracts and propels the fluid through the pulmonary artery, namely, to the lungs, where the whole receives its ultimate perfection by means of atmospheric influence in the lungs, throwing off its black and carbonaceous matter, and becoming oxygenated and purified, assumes a vermilion or scarlet hue, and then becomes *complete and perfect* blood, fit for the due continuance of animal heat, and for its exciting and nutritious circulation through the frame. It then has the different parts and qualities presently enumerated, and is thereupon conveyed by the four pulmonary veins into the left auricle of the heart; which being similarly excited by the renovated blood in its own coronary arteries, contracts and propels the blood through the left auriculo ventricular opening into the left ventricle, which also similarly contracting, propels the blood into the aorta. Two branches of this main artery immediately circulate the renovated blood though the coronary arteries, and thus continuously excite the heart itself to action according to the opinion of some authors: and the rest of the branches of the aorta maintaining the like contractile motion, propel the blood into all the arteries and their capillaries, and thence into the veins and over all the system; its renovating particles being nevertheless dispensed and retained in the various parts of the frame through which the general mass of the fluid passes. One portion of this renovated blood flows to the brain, to stimulate the source of the nervous system, the larger portions throughout the arteries of the trunk, and the upper and lower extremities; other portions are dispersed through the peculiarly formed labyrinths of the glands, and in the excretory ducts and the exhaling vessels, forming the various secretions and exertions, whilst the remainder of the blood, impregnated with carbon, and of a dark colour, verging to purple or black, returns by the veins towards the right auricle of the heart.(*m*)

In the *veins* and other remote parts of the body such blood loses a certain quantity of its original invigorating constituents, and is thus gradually more and more reduced to the state of *venous blood*, whilst the thoracic duct gradually pours into the great subclavian vein the *new materials*, arising from digestion and absorption necessary to supply the loss which it has thus experienced in the capillaries and veins; and then the whole of the materials collected as before in such subclavian vein are again and again successively passed into the right auricle and ventricle of the heart, and from thence into and through the lungs in perpetual and unremitting succession as long as life continues.(*n*) According to this view of the subject, the process of the conversion of venous into arterial blood will consist in the addition of a quantity of carbon, hydrogen, and oxygen, with a proportion of nitrogen. In passing through the lungs a portion of carbon, oxygen, and hydrogen are separated, under the form of carbonic acid and water, merely abstracted from

(*m*) 2 Dungl. Phy. 35 to 58; El. Blum. 377 to 381, tit. Sanguification; 3 Bell, 238, 239; 2 Bost. 479. This summary is principally from Lizars, 141 to 143, who is particularly clear upon the subject: and see Dr. Stevens on Blood, 1 to 3, where an interesting account of the blood is given.

(*n*) Liz. 141 to 143; 2 Bost. 479.

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the pulmonary blood by a species of secretion, while in the course of the circulation we may presume that the excess of nitrogen, which must be thus produced, will be separated from the blood in the form of muscular fibre or of membrane, or still more of urea discharged in urine, of which nitrogen composes so large a proportion.(*o*)

4. Its colour.(*p*) The blood, when returned from the lungs into the left auricle of the heart and into the aorta, and whilst it continues in the aorta, is in health, a fluid of *a rich scarlet or vermilion colour*, and is replete with oxygen; but when it has passed into the veins, it becomes *carbonized* and of a *dark purple*, and when returned in the veins near to the heart, is almost black.(*q*) In the veins it has become effete, and, therefore, in cases of plethora, or when the body is incumbered with too much or impure blood, and it becomes expedient to withdraw a portion by bleeding, an operation is usually performed on a vein.(*r*) Hence, Blumenbach, instead of terming blood in the arteries *arterial*, and that in the veins *venous*, (the usual appellation) suggests the expediency of terming the former *oxygenized* blood, and the latter *carbonized* blood.(*s*)

The blood, before it has become coagulated, varies in *colour* according to the part of the frame where it is found. It is vermilion or scarlet coloured in the arteries, because it has but just before been oxygenated; strong purple in the veins, because in passing through the arteries into the same, it has become in a degree carbonized and incumbered with various particles, and almost black, before its intermixture with the materials of the new blood from the thoracic duct; because, in its passage through the capillaries and veins, it has become completely carbonized and incumbered.(*t*) The exchange of colour from the dark purple or almost black venous blood, to the scarlet arterial blood, takes place in the lungs, and is, it is supposed, occasioned by the oxygen of the arterial blood acting upon the small particles of *iron*, and thus changing the colour.(*u*)

It has been observed that in surgical operations, after a tourniquet has been applied to an arterial trunk, the blood which first flows, when we remove the instrument, is perceived to be of the venous colour, and it was remarked by Hunter, that extravasated blood is always purple, even in cases where there is every reason to suppose that it may have proceeded from an artery; from whence a conclusion has been drawn that the change from the arterial to the venous state may take place by the action of the constituents of the blood upon each other while it remains in the great trunks in a situation where it is incapable of receiving any addition of extraneous matter.(*x*) But some of the most distinguished anatomists and physiologists of the present time deny this result.

5. Smell, feel, taste, &c., of blood. Blood has a peculiar *odour;* at first, especially when still warm, it emits a vapour, of late denominated an animal gas, and shown to consist of hydrogen and carbon suspended by caloric.(*y*)

When extracted, blood *feels* thick and unctuous, is of a slightly saline

(*o*) Bost. 479.

(*p*) See Dr. Turner's Chem. 547.

(*q*) 1 Bell, 521; Dr. Turner's Chem. 548.

(*r*) See post, tit. Bleeding; 1 Bell, Anat. 499. The reason for so bleeding has been said to be because if blood were subtracted from an *artery* the frame would be deprived of the *best* and nutritious blood, whereas, by bleeding in a vein, the no longer useful blood is subtracted, *id. ibid.* But *semble* that reason is incorrect, for it is fresh and *arterial* blood that is most likely to feed or increase inflammation.

(*s*) El. Blum. 9, note.(*i*)

(*t*) 1 Bell, 521; 1 Bost. 386.

(*u*) 2 Bost. 98; 1 Bost. 372; 3 Bost. 317; see Respiration, and also Stevens on the blood, but this is a disputed point.

(*x*) 2 Bost. 99.

(*y*) El. Blum. 7; 1 Bost. 354; 2 Dungl. Phy. 45.

taste, rather mucous, and varying in the different parts of the body. In the heart or at the centre of the circulation, it differs from what it is in the glands, excretories, and all the extremities of the body; different in the liver, among the intestines, in the cheeks and lips, in the reservoir or sinuses of the head and womb.(*z*)

6. Heat of the blood and temperature generally. (*a*)

It seems now to be agreed that one of the *principal* effects of respiration is the arterialization of the blood by means of the introduction of free oxygen and the discharge of carbonic acid.(*a*) But it has been generally insisted that this occasions combustion and consequent heat in the lungs.(*b*) Some authors, however, have insisted, that if oxygen do communicate heat, "it does so, not to the lungs, nor to the blood in the lungs in particular, but to the *whole* body through the medium of the blood," namely, by the continual passing and action of the blood through *all parts* of the frame.(*c*) The *heat* of the blood at the heart in health is usually from 96 to 100 Fahrenheit's thermometer, but sometimes in diseases it rises to 106.(*d*) The temperature of the natural atmosphere is generally much lower than that of the blood, but sometimes it exceeds it, and man is capable of living in a temperature exceeding his own.(*e*) The heat of all parts is *ceteris paribus*, commensurate with the quantity of blood circulating through them, and our temperature depends upon respiration.(*f*) It is supposed that at and near the heart the temperature is 100, and the weight of authority seems to establish, that the temperature of the arterial is somewhat, though not much greater, than that of the venous blood;(*g*) in the large arteries, to a degree or a degree and a half higher than in the corresponding veins.(*h*) The conclusion which Crawford deduced was, that the specific heat of arterial is greater than that of venous blood in an average proportion of 114.5 to 100, but that the general temperature is nevertheless equalized by a threefold operation, and by the completion of the combination of the oxygen and carbon, in the capillary part of the circulation, and not entirely in the lungs, where they are first in a degree only combined.(*i*)

7. Of the salts in blood.

Certain *salts* are always found in blood, and which it is said are rather more than 9 grains in 1000 grains of serum; of these 9 grains, about 6½ are muriate of soda combined with a small quantity of muriate of potash, and about 1½ of the subcarbonate of soda, with minute quantities of the sulphate of potash, and the phosphates of lime, iron, and magnesia.(*k*) The *use* of the salt in the blood has been said to be that they stimulate the nerves of the heart, and thus contribute to the contraction of its muscular fibres,(*l*) that they aid in the operation of the secreting organs, and contribute to the process of digestion; but others observe that these suppositions are gratuitous.(*m*) However, there are certainly numerous be-

(*z*) 1 Bell, 521, 522; El. Blum. 7.

(*a*) See post, *Temperature*.

(*b*) 1 Bell, 543; 2 Dungl. Phy. 94 to 106; 2 Bost. 195 to 229, stating the general results of experiments and opinions; and see Respiration, post; and 2 Bost. 192; chap. vii. of Animal Temperature; and Stevens on the Blood.

(*c*) 1 Bell, 545, 547, notes; and Dr. Stevens on Blood, 27.

(*d*) Coop. Dict. tit. Inflammation; El. Blum. 7, 155, 158, says its temperature is about 96 of Fahrenheit; Dr. Good, 98, (see vol. ii. 34,) in which latter Dr. Bostock appears to agree, 1 Bost. 348, 349.

(*e*) 2 Dungl. Phy. 170 to 194; 2 Bost. 192, &c.

(*f*) El. Blum. 164, 165, 167.

(*g*) 1 Bost. 387, note; 2 Bost, 208, note.

(*h*) 1 Bost. 387, note.

(*i*) See 2 Bost. 204 to 206.

(*k*) Dr. Marcet, Med. Chir. Trans. vol. ii. p. 370; 1 Bost. 384; Turner's Chem. 548; muriate of soda is the chief saline ingredient in the blood, Dr. Stevens on Blood, 296; large doses of muriate of soda and other active salines should be administered in fever, id. ibid.; salty taste, 2 Horner, Anat. 175.

(*l*) Whytt's works, p. 26.

(*m*) 1 Bost. 385; Stevens on Blood, 319.

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neficial effects arising from the saline particles in the blood, and they directly tend to prevent putrefaction and assist vitality and the continuance of general health.(*n*) Some physiologists also insist that *Sulphur* is one of the constituents of the blood, but others deny its presence.(*o*)

8. Animal substances. Although the animal substances which enter into the composition of the blood possess properties both chemical and physical, which are sufficiently characteristic to distinguish them from each other, yet they may all be resolved into the same ultimate elements, namely, Carbon, Oxygen, Hydrogen, and Azote, also termed Nitrogen. The following is the scale of proportions, according to MM. Gay Lussac and Thenard,(*p*) but the results of experiments vary.

	Albumen.	Fibrin.	Jelly.
Carbon, ...	52.883	53.36	47.881
Oxygen, ...	23.872	19.685	27.207
Hydrogen, ...	7.540	7.021	7.914
Azote or Nitrogen, .	15.705	19.934	16.998
	100.000		

The following is the latest analysis of *healthy* blood that has been made in *this country*, [England,] but the exact proportions vary.(*q*)

Water, ...	756
Albumen coagulated, ...	121
Colouring matter, ...	59
Free Carbon, ...	32
Fibrin pressed and dried, ...	18
Muriates of *soda* and potassa, carbonate of soda and animal extractive, . .	14
	1000

Azote or nitrogen. The proportions of *azote*, (from *a* privative, and ζωη life, because it is unable, of itself, to support the respiration of animals,) or nitrogen, to which it is synonymous, it is supposed increases as age advances, and there is more fibrin in the blood of the adult than in that of the infant.(*r*)

9. Chemical properties. With respect to the *chemical* properties of fibrin, they appear exactly to resemble those of the muscular fibre. It is acted upon in the same manner by nitric acid and the other re-agents, so as to be fully entitled to the ancient appellation of *liquid flesh*.(*s*)

10. Weight and quantity of blood in entire human frame. As respects the specific *gravity* of blood in general, when it is in its ordinary healthy and mixed state, it may be estimated as 1050, to water being 1000.(*t*) The specific gravity of the serum of arterial blood has been generally found to be less than that of venous.(*u*) Hunter, in his celebrated treatise on Blood, states that it appeared to him impossible to ascertain the entire *quantity* of blood in the body, and that the knowledge of it would probably give but very little assistance towards better understanding the economy of the animal; but that the quantity is probably as permanent a circumstance as any, and not depending on immediate action.(*x*) It should seem, however, to be desirable to endeavour to ascer-

(*n*) Stevens on the Blood, 318.
(*o*) 1 Bost. 385.
(*p*) Stevens on Blood, 3; and 1 Bost. 385.
(*q*) Stevens on Blood, 3 and 4. But see Copland's Dict. tit. Blood.
(*r*) 1 Bost. 386.
(*s*) Id. 349, 350.
(*t*) El. Blum. 7; 2 Good, 34; 2 Dungl. Phy. 40.
(*u*) See 2 Bost. 78, note, fully.
(*x*) Hunter on the Blood, 69.

tain the entire quantity of blood to be found in the healthy state, and what subtraction of that fluid can be borne without danger to life,—it is indeed essential, as regards the remedies for various diseases by *bleeding*, to know *precisely* what will be the effect of the diminution in the states of various diseases, and consequently more precision as regards the knowledge of the usual quantity of blood, would be interesting and most desirable.(*y*) As respects *weight*, Dr. Davy's experiments tend to establish that pure fibrin is heavier than serum, but that the mixture of fibrin and serum, which constitutes the buffy coat, is lighter than the mixture of fibrin, serum and red particles, and therefore floats on the surface; and that in inflamed blood the serum and coagulable lymph are less viscid, that is, less glutinous or tenaceous than ordinary. The specific gravity of the red particles he found to be 1087. That the formation of the buffy coat does not appear to bear any exact relation to the specific gravity of the blood. In acute disease the blood, whether buffed or not, is generally of greater specific gravity than ordinary; in diseases of debility the reverse,(*z*) That the formation of the buffy coat is supposed to depend on the viscidity (glutinous or tenacious quality of the blood) as connected with the proportion of water, or the complete mixture of its ingredients, and that heat is not extricated during the coagulation either of fibrin or of serum.(*z*) With respect to the actual quantity and *weight* of blood in the *entire system*, our means of determination are so inexact, and consequently the *calculations*, or rather the *conjectures*, that have been offered upon the subject, are so strikingly discrepant, that it is not easy to reach a satisfactory conclusion. It is only necessary to state a few of the different opinions that have been offered, to show the singularity of several. Allen, Muller and Abildgaard estimate the weight, even in an adult, at very little more than *eight* pounds, at 12 ounces to the pound; Harvey at 9, Blumenbach, at 10, Borrelli at 20, Planche at 28, Haller at thirty pounds, Lizars the same, Dr. Young at 40, Hamberger at 80, and Keil at 100:(*a*) Perhaps this discrepancy may have arisen from the latter calculators including other fluids besides proper blood. Of these enumerations it has been observed by Blumenbach, that the former are nearer the truth,(*b*) and that the proportion to the weight of the body is as 1 to 5;(*c*) but in another part of that excellent work, it is supposed that the mass of the blood is only 10 pounds of 12 ounces each, or 120 ounces.(*d*) But this seems contradictory, for few adults weigh less than 150 pounds, and one-fifth of that weight would be 30 pounds. Dr. Good observes, that the mean number, as given by Baron Haller and Dr. Young, making the amount from 30 to 40 lbs., appears most reasonable, and that the same perhaps fall not short of the sum intended by Professor Blumenbach, but that the subject requires further examination, and a nicer estimate.(*e*) Lizars observes, that according the most unexceptionable calculations, the quantity of blood in the body is estimated at *thirty pounds*, each pound being twelve ounces;(*f*) and Dr. Bostock seems to consider that thirty-three pounds, of twelve ounces each, may be properly considered as the weight of the whole mass of blood,(*g*) and that of this about three-fourths are constantly in the veins, and one-fourth only in the arteries.(*h*) Certainly it would be extraordinary, if there be only eight or ten pounds

(*y*) Dr. Stevens on Blood, 338, mentions an instance of taking *forty ounces* of blood from the arm at one bleeding, and not unfrequently a much larger quantity has been taken at a time; and an instance recently occurred at one of the public offices, of 120 ounces having been subtracted, and the party survived *ten days*.

(*z*) Ed. Med. Jour. vol. xxix. page 244; 3 Bost. 322.

(*a*) 2 Good, 20, 21; El. Blum. 7, note (*e*,) 91; Lizars, part ii. p. 146; 2 Dungl. Phy. 117.

(*b*) El. Blum. 7, note, (*e*.)

(*c*) El. Blum. 11; 1 Bost. 388.

(*d*) El. Blum. 91.

(*e*) 2 Good, 21.

(*f*) Lizars, part ii. page 146.

(*g*) 1 Bost. 388.

(*h*) Id. 288, 388; 1 Haller, El. Phy. 3.

CHAP. V. SECT. II. OF THE BLOOD. weight of blood in the frame, that in bleeding, upwards of one pound, or two pounds, weight of blood, or as we have seen even forty ounces, or three pounds and a third, or still more, should be subtracted with impunity.(*i*)

11. Vitality of blood. The *vitality* or life of blood has long been a subject of dispute. Harvey insisted upon its being the principal if not the sole cause of life,(*q*) whilst others have maintained that it has no vitality.(*r*) Modern physiologists admit this vitality, but deny that it is the sole cause of life.(*s*) It seems certain that the blood when oxygenated in the lungs is the exciting power of the heart, and that without such excitement the heart and the brain would instantly cease to act and death ensue,(*t*) and that parts die if deprived of a supply of blood; but it has been observed that although this may prove that blood is necessary as a *material agent* to maintain the life of parts, yet that is not therefore necessarily proved that it is *itself* vital.(*u*) But it is admitted that the essential nature of life is an impenetrable mystery, and some have unphilosophically observed that it would be an inquiry not to be pursued for any useful purpose.(*x*) Dr. Bostock observes that Mr. Hunter's celebrated hypothesis of the life of the blood is founded upon the principle, that a fluid is capable of organization, and that it may possess functions either identical with or very similar to those which are the most characteristic of the living animal *solid*. According to this doctrine, the blood is supposed not merely to be the substance which gives life to the animal, by carrying to all parts what is necessary for their support and preservation, but that it is properly itself an organized living body, and even the peculiar seat in which the vitality of the whole system resides.(*y*)

12. Coagulation or crassamentum.(*z*) *Coagulation.*—When any quantity of blood is extracted from the circulation, and allowed to flow into a vessel, in the course of some minutes it separates into two parts, namely, a thin watery fluid, of a whitish somewhat opaque colour, called the *serum*, and a solid substance of a deep red colour, assuming more or less the form of the vessel in which it is deposited. This is called the *crassamentum* or *cruor*. The crassamentum, again, is composed of two materials, *first*, the *fibrin*, or the coagulable lymph, as it is called, which is of a pale colour, and the red globules, by which, before coagulation, the whole blood is coloured, but which, from their greater specific gravity, sink to the bottom of the crassamentum. When the crassamentum is cup-shaped with an inverted margin at the top, has a coat of buff on its surface, and is tenacious when pulled asunder, the blood is considered inflammatory.(*a*)

The coagulation of the blood has been considered by some as quite unconnected with its vitality or life, but as entirely a *chemical* result, attributable to the escape of carbonic acid.(*b*) But as regards coagulation it is important to observe, that blood coagulates slowly, in regular proportion to the *tonic* state, or that condition of the system in which the

(*i*) Ante, 154, 155, note(*y*;) Dr. Stevens on Blood, 338; Copl. Dict. 178.

(*q*) 2 Good, 42; and see Dr. Pring's Principles of Pathology, &c.; Dr. Turner's Chemistry, 551; Stevens on the Blood 119, 121; "*For the life of the flesh is in the blood,*" Leviticus, xvii. v. 21; 2 Dungl. Phy. 507.

(*r*) El. Blum. 32, 33, 62, 63; 1 Bell, 503 to 521; but see note of Charles Bell, p. 521.

(*s*) But see 1 Bell, 521, note of Dr. C. Bell, observed upon in Stevens on Blood, 119, to 135; Dr. Elliotson's note to Blumenbach, 61, 62.

(*t*) Ante, 92; 2 Good, 22, to 24.

(*u*) Dr. Elliotson's note, Blum. 63.

(*x*) Id. 64; ante, 19, (*c*) (*d*)

(*y*) 1 Bost. 355.

(*z*) As to the coagulation of the blood, see in general Dr. Scudamore, Dr. Davy, Ed. Med. Journ. vol. xxx. 248; 2 Dungl. Phy. 46.

(*a*) See, further, El. Blum. 7, 12.

(*b*) El. Blum. 13. But see Dr. Stevens on Blood, 5, 6, who seems to attribute coagulation to the loss of the *vitality* of the blood; 2 Dungl. Phy. 507.

vital powers are strongest.(*c*) As affording evidence in some cases, whether or not the death has been occasioned by criminal means, the subject of coagulation has been treated as exceedingly important to be examined.(*d*) The coagulated blood is also considered as a source of useful information to medical practitioners; for certain appearances of the blood after its coagulation are a general indication of its inflammatory or non-inflammatory state.(*e*)

When the temperature of the blood, either after death or when separated, has fallen from its medium of about 96 to 98 Fahrenheit, it usually then begins to separate into two portions. The coagulation is first formed from the surface, whence exudes, as it were, a fluid of a yellowish slightly red colour, denominated *serum;* the more abundantly this exudes the greater is the contraction of the glutinous *coagulum*, which has received the appellation of *crassamentam*(*f*) Soon after it leaves the vessels, if it be suffered to remain at rest, blood coagulates when it has escaped from the human body, whether warm or cold, in the air or in vacuo, diluted within certain limits or undiluted, at rest or in motion.(*g*) Some have supposed that venous blood coagulates more slowly than arterial, and that it contains less fibrin, but that its specific gravity is greater; however, Dr. Bostock observes, that these points are not very accurately ascertained.(*h*) Large quantities of blood are found fluid in every dead body, and the blood of the vessels is found most frequently in opposite states, fluid in one part, coagulated in another; but it is said that the blood is *always* coagulated in the heart after death by *natural* means.(*i*) The blood generally coagulates in the living human body on escaping from its vessels, and even in its vessels if its motion be prevented by ligatures. It almost always coagulates also in the vessels running through healthy parts to others in a state of mortification, and in large vessels adjoining to pulmonary tubercular abscess, in which case the final cause, namely, prevention of hemorrhage, is evident. The immediate cause, however, in all these examples is unknown. Blood, when removed from a healthy person, coagulates in from three or four to seven minutes.(*k*)

The non-coagulation of the blood after death proceeds from arsenic, opium, and some other narcotics, and from lightning(*l*) and electricity, (though Dr. Scudamore found it to coagulate as usual in the latter case,) from hard running, anger, or a blow in the stomach, all three of which deprive the muscles of their usual stiffness, which may depend upon chemical changes. The admixture of opium with the blood has been said to prevent its coagulation; but Dr. Scudamore found that the admixture of prussic acid and belladonna, both strong poisons, had no such effect, but that many salts weaken or prevent its coagulation.(*m*)

Dr. Bostock, in an early part of his work, stated, that strong agitation prevents the coagulation of the fibrin.(*n*) But in a subsequent volume he candidly admits that Dr. Davy had shown that that position is incorrect, and that notwithstanding strong agitation the blood actually assumes the solid form, but that being in small particles separated only, it is diffused through the fluid, and thus escapes observation.(*o*) It appears that carbonic acid is disengaged during the coagulation of the blood; that blood which has the highest specific gravity coagulates the most rapidly;

(*c*) 3 Bost. 322; Mr. Thackrah's observation on the Blood.

(*d*) El. Blum. 13; 2 Good, 35.

(*e*) 2 Good, 35; Coop. Dict. tit. Inflammation; 2 Dungl. Phy. 508.

(*f*) El. Blum. 7.

(*g*) Id. 12.

(*h*) 1 Bost. 387; pure fibrin is heavier than serum, per Dr. Davy, Ed. Med. Journ. vol. xxix. 244; 3 Bost. 323.

(*i*) Quære as to its state in case of death by criminal means, as poison, &c. See post.

(*k*) El. Blum. 15; 2 Good, 34; 1 Bost. 348, 349.

(*l*) 2 Beck, 13; that the blood does not coagulate in animals killed by *lightning*.

(*m*) El. Blum. 63; 2 Good, 35.

(*n*) 1 Bost. 351.

(*o*) Dr. Davy on the Coagulation of the Blood.

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that coagulation is promoted by the blood being drawn slowly from the vessel, and by being received into small shallow cups, probably in consequence of its heat being in this case abstracted more rapidly. When blood exhibits the buffy coat it coagulates more slowly when it is extravasated or remains in the blood vessels; after they have lost their vitality it coagulates very slowly. Drs. Bostock and Scudamore consider that heat is disengaged during coagulation, although in small quantity only.(*p*) But Dr. Davy maintains that heat is not extricated during the coagulation either of fibrin or of serum;(*q*) and Drs. Bostock and Scudamore observe that it has been found that the quantity of fibrin is considerably increased in blood, that it exhibits the buffy coat, and that the proportion of fibrin is then much nearer the surface of the clot than at its lower part.(*r*)

Putridity.—It has been said, that blood when drawn from the young is sooner putrid than when drawn from old persons, and that such result probably arises from its *inferior* qualities,(*s*) and yet it might have been supposed that the blood of youth having to serve two purposes, namely, *growth* as well as *nutrition*, would be endowed with even higher qualities, and that hence, if the result be correct, it must be attributable to some other cause.

Of the clot cake or *crassamentum*, and of the fluid or *serum.*

Upon the coagulation of the blood it separates, as we have just seen, into two parts, namely, first, into a red mass floating in, secondly, a yellowish fluid. The red part is called the *clot* or *crassamentum*, and the fluid part the *serum;* a portion of the serum always remains attached to the clot. It has been supposed that the crassamentum amounts to about one-third of the weight of the serum, but the proportions vary considerably in different individuals, and even in the same individual at different times,(*t*) and others say that they are nearly of the same weight. Arterial is said to differ from venous blood in containing a larger proportion of crassamentum, and it is supposed that the crassamentum is immediately produced from the chyle which enters the vessel just before the blood is exposed to the action of the air in the lungs.(*v*)

13. Of the fibrin or gluten, or coagulable lymph of the crassamentum. (*x*)

The *crassamentum*, when removed from the serum, appears under the form of a soft solid cake, of such consistence as to bear cutting with a knife. It frequently assumes, and actually has, a *fibrous* appearance, very similar to the pure muscular fibre, though it is said to differ from it in its minute particles. It has been designated by several names, as *coagulable lymph, gluten,*(*y*) *fibre of the blood, and fibrin.* The latter name is in more general use.(*z*)

This coagulation is generally attributed to *rest* and exposure to the atmosphere, but sometimes the blood will coagulate *internally*, and on the other hand agitation or the introduction of certain neutral salts and poisons will prevent it.(*a*) But the actual cause of coagulation of the fibrin or gluten has never been satisfactorily explained.(*b*) Sudden death from lightning and electricity, a blow upon the stomach, or injury to the brain, the bite of a venomous animal, such as the viper and the rattlesnake, some acrid vegetable poisons, as laurel water, also excessive exercise, and even violent mental emotion, when they produce the *sudden extinction* of

(*p*) 3 Bost. 323; and Dr. Scudamore's Essay on the Blood.
(*q*) Ed. Med. Journ. vol. xxix. 144.
(*r*) See reference note (*p*,) supra.
(*s*) El. Blum. 63.
(*t*) 1 Bost. 347 to 349.
(*v*) 2 Bost. 153.
(*x*) See, in general, 2 Good, 34 to 37; 1 Bell's Anat. 503, 522, 523; El. Blum. 7 to 11; Coop. Dict. tit. Inflammation; 2 Horn. Anat. 179.
(*y*) Cullen first gave it this name, 1 Bost. 349; Cullen's Institutes, s. 4, c. 11; 1 Bell, Anat. 526, 527.
(*z*) 1 Bost. 349; Jackson, Prin. Med. 460.
(*a*) Id. 351 to 353.
(*b*) Id. 354.

life, prevent the usual coagulation of the blood from taking place. (*c*) There is a singular coincidence in these cases between the want of coagulability in the fibrin of the blood, and the diminution of contractility in the muscles after death. They all are found in a state of relaxation, incapable of being excited by their accustomed stimuli; and it has been further observed, that the body is disposed to run rapidly into a state of decomposition. These facts appear to identify, at least to a certain degree, the property of muscular contraction with that of the coagulation of the fibrin, and this identity is further supported by considering that the chemical composition of fibrin is similar to that of muscle. (*d*)

It has been suggested that perhaps the most obvious and consistent view of the subject is, that the fibrin or gluten has a natural disposition to assume the solid form when no circumstance prevents it from exercising this inherent tendency, as it is gradually added to the blood, particle by particle. While this fluid is in a state of agitation in the vessels, it has no opportunity of concreting, but when it is suffered to be at rest either within or without the vessels, it is then able to exercise its natural tendency. (*e*) In this respect the coagulation of the fibrin of the blood is very analogous to the formation of organized solids in general, which only exercise their property of concreting or coalescing under certain circumstances, and when those causes, either chemical or mechanical, which would tend to prevent the operation, are not in action. (*f*) Upon this principle it has been observed, that we should be induced to regard the coagulation of the blood as analogous rather to the operation by which the muscular fibre is *originally* formed, than to that by which its contractile power is afterwards occasionally called into action.

14. Properties of fibrin or lymph.

This *fibrin or gluten* is the most essential part of the blood. (*g*) The principal property of this part of the blood, which constitutes the fibrin or lymph or gluten, (besides that of continually nourishing and supplying new materials to the frame in the *ordinary* course of its circulation,) is that of *repairing injuries* to the solids. (*h*) We have seen that by this fibrin, gluten, or lymph, fractured bones reunite, (*i*) and lacerated muscles, arteries, and veins, and even nerves, are reunited or reproduced. (*k*) It causes the *reunion* of divided parts: thus when two newly cut surfaces of flesh (*even those which had not been previously connected*) are laid in close opposition they will unite; and when the operation has been performed under the most favourable circumstances, the trace of the wound will be scarcely perceptible either to the eye, or in the structure, or in the performance of the useful operation of the original part. What will appear more wonderful is, that parts of *different* structures are capable of *forming* this close union; and even the coats or parts of arteries, veins, and nerves, become repaired and renovated; and even portions of the body, which had been entirely cut off from other parts of the same body, or *even from a different body*, if speedily applied to a recently divided surface, will unite by means of the fibrin or gluten, and renew and retain their original function. (*l*)

Dr. Bostock observes, that though there is reason to believe that the *fibrin* is the intermedium by which the process is effected, yet that no rational method is known by which the successive steps of the operation

(*c*) 1 Bost. 354; Hunter on the Blood, 26.

(*d*) Id. 238.

(*e*) 1 Bost. 356. But if this position be true, how can it be reconciled with Dr. Davy's experiments, where the blood coagulates during agitation, a fact well established?

(*f*) 1 Bost. 356.

(*g*) 1 Bell, Anat. 526, 527; 2 Horn. Anat. 179.

(*h*) 1 Bost. 359, 362; J. Hunter's Treatise on the Blood, p. 208; 1 Bell, Anat. 526, 527; El. Blum. 29, 62; Dungl. Phy. 47.

(*i*) Ante, 21, 42, 43; 1 Bost. 100 to 104, 170; 2 Horn. Anat. 179.

(*k*) 1 Bost. 190, note.

(*l*) 1 Bost. 360; J. Hunter on Blood, 208.

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can be explained. We may indeed conceive of the divided end of an artery which belongs to the cut surface nearest the heart discharging a portion of its fibrin, which may coagulate and form a basis, (or nidus, as it has been termed,) through which the current of blood may afterwards form a new channel; but in what way is this stream to discover the ends of the arteries of the other surface, and by what power is it to enter them, and how are these insulated parts to propel their blood into the veins, and how are the veins of the divided part to transmit their contents into the veins of the body? These are questions that at present we are not able to answer.(*m*) Sir Everard Home has stated that a quantity of *carbonic acid* is always present in the blood, and that during its coagulation this acid is extricated, and that by its extrication it forms *linear* passages or *tubes* in the substance of the blood, into which the vessels of contiguous parts are elongated, and which become the rudiments of future arteries, and that the serum is the nidus in which these tubes are formed, as they are said to be altogether independent of the globules which are supposed to be the more immediate constituents of the fibrin; but Dr. Bostock insists that as the formation of regular tubes could not be the result of the extrication of gas in a viscid fluid, therefore the formation of the tubes must be the result of a tendency in the fluid in question to assume an organic arrangement:(*n*) but it appears to be still a disputed point whether it is carbonic acid or azote, or some other gas, that occasions the formation of these tubes.(*o*)

15. Of the red globules or particles.

The *second* constituent of the crassamentum (after considering the fibrin) is the *red particles or globules*. When considering the subject of respiration, and its effect upon the blood, it has been observed that the crassamentum itself is composed of fibrin and red particles, and the red globules are regarded as that part of the crassamentum on which the air more particularly acts. Their organization is peculiar to themselves, and they are the only parts of the blood which is known to possess any specific chemical characters; and we have reason to suppose that they are easily decomposed and are more readily acted upon than either the serum or the fibrin of the blood; and it is principally by their change of colour that we are enabled to form our judgment respecting the action of the air upon the blood. The nature of this action is, however, obscure, and we know nothing *more than* that they appear to have a strong attraction for oxygen; for although it has been shown that they contain a *small quantity* of *iron*, there appears, Dr. Bostock says, no foundation for the opinion that the iron is the part by which the oxygen is altered, nor is it the *immediate* cause of the red colour.(*p*) Great differences of opinion as to the form and size of these particles have existed,(*q*) and the composition and chemical properties of these bodies still remain the subject of controversy.(*r*) It seems established that some, though but a small quantity of iron is to be found in the globules of the blood, from which it is inferred it receives its red colour;(*s*) and it is supposed by some that it is the red particles of the crassamentum on which the air more particularly acts, and that the iron, however minute in quantity, is the agent by means of which the blood acts upon the atmosphere.(*t*) The quantity

(*m*) 1 Bost. 360, 361. The *blood* of the entire living frame operates like sap from the stock of a tree, which oozes through the inoculated bud or engrafted cut, and thus assimilates the one with the other.

(*n*) 1 Bost. 362; Phil. Trans. for A. D. 1818, p. 181, et seq. and A. D. 1820, p. 2.

(*o*) 1 Bost. 362, note.

(*p*) 2 Bost. 110 to 113, 478, 479. But see Stevens on Blood, and other publications in A. D. 1833, relative to the cause of Colour of Blood, 2 Horner, Anat. 180.

(*q*) 1 Bost. 363 to 375; 3 id. 320, 321, as to iron.

(*r*) Id. 368.

(*s*) Id. 368 to 375.

(*t*) Id. 371; 2 Bost. 478, 479; 1 Bell's Anat. 524, 525.

of the globules in the blood, in regard to the whole mass, varies, so that the appearance of the blood has been considered as a real index of health or disease. In disease and weakness the blood is poor and colourless, whilst in health and strength it is rich and florid; and by labour or exercise the red particles may be increased in appearance in a great degree.(*u*)

Of the serum or albumen.

The *serum* (sometimes called *albumen*) is the thin yellowish fluid part of the blood, which is left after the separation of the clot or crassamentum, in consequence of the spontaneous coagulation of the fibrin, gluten, or lymph. It is a transparent homogeneous liquid, of a light straw colour, saline taste, and adhesive consistence. Its specific gravity varies in different subjects, but it is always greater than that of water; the average is probably about 1025. It converts blue vegetable colours to green, thus proving that it contains a quantity of uncombined alkali; and besides this, it is found to hold in solution various earthy and neutral salts. Its most remarkable and characteristic property is its coagulation by a considerable degree of heat above the natural temperature, which we have seen is from 96 to 100. When the serum of the blood is exposed to a temperature of 160 it becomes white and opaque, and acquires a firm consistence, and exactly resembles the white of the egg when hardened by boiling, and is found to be essentially the same with that substance, whence it has obtained the name of *albumen*.(*x*) When in the living frame the serum dilutes the blood, and contains and carries off all such foreign bodies as might be injurious to the system, namely, the secretions, as urine, perspiration, saliva, tears, &c.(*y*) As the coagulation of serum is not a natural process, but obtained only by the application of heat above any ordinary temperature, it will suffice merely to state, that if so coagulated there will still be a liquid detached, which is called the *serosity of the blood*, upon which much has been written, unnecessary to be examined in this summary.(*z*)

Buffy coat of the fibrin or lymph in inflammation.

The formation of what is termed the Buffy Coat, or crust, on the clot or crassamentum, is supposed to depend on the diminished *viscidity* of the blood as connected with the proportions of water, or the complete mixture of its ingredients; or, in other words, when such buffy coat appears, the blood is less glutinous, and tenacious, and is poorer (*a*) When the *upper* part of the crassamentum contains no red particles, but exhibits a layer of this buff-coloured substance lying on the top of the red clot, this is called the size or *buffy coat* of the blood. (*b*) It is generally formed when the system is labouring under *inflammatory fever*, and when, according to the modern doctrines of pathology, there is supposed to be an increased action of the arteries, (or perhaps a diminished action of the capillaries,) so as not adequately to transfuse the blood that has accumulated in the arteries;(*b*) and it is conceived that in all inflamed blood the serum and coagulable lymph are less viscid than ordinary.(*c*) The *immediate* cause of this appearance in the crassamentum is obvious; the globules, or other matter, which give it the red colour, begin to subside before the coagulation is completed, so that the upper part of the clot is left without them. The *remote* cause of the buffy coat, it has been admitted, is not yet ascertained.(*d*) Dr. Stoker's experiments establish that the formation of

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(*u*) 1 Bell, 524, 525; and Dr. Stevens on Blood, *passim*.

(*x*) 1 Bost. 375; 2 Horner, Anat. 177 to 179.

(*y*) 1 Bell's Anat. 527 to 529.

(*z*) See fully 1 Bost. 375, &c. 380 to 383; 2 Dungl. Phy. 46.

(*a*) 3 Bost. 357. As to *buffy coat*, see 2 Dungl. Phy. 508.

(*b*) See *Inflammation*, 1 Bost. 337; but the *invariable* appearance of a buffy coat in inflammation is denied, Copl. Dict. tit. Blood.

(*c*) 1 Bost. 358, 359; 3 Id. 323.

(*d*) 1 Bost. 357.

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the buffy coat has no relation to the length of time which the blood requires for coagulation, and that it does not depend upon any purely mechanical cause, but upon a *diseased* state of the blood, and which is referred more especially to a changed or imperfect chylification.(*e*) We have stated the important observations of Dr. Davy as relates to the buffy coat.(*f*)

SECT. III. Function of circulation, its cause, course, and manner.(*g*)

SECT. III. THE FUNCTION OF CIRCULATION AND ITS INCIDENTS.

1. Cause and Course of Circulation.
2. Rapidity and Force of Circulation.
3. Circulation of the Blood through the Arteries and Veins.
4. Diseases of Blood and Organs in general.
5. Disease of or Injury to the Blood itself.
6. Of Fainting.
7. Of Hereditary Disease through Medium of Blood.
8. Of Infusion or Transfusion.
9. Of Animal Temperature.

In considering the structure of the heart, much that might properly be here considered has been anticipated. The circulation would soon terminate and life cease, at all events after the lapse of a few days, if it were not from the formation of what the French term *materiel* or *new materials* for fresh and renovated blood by digestion of food in the stomach.(*h*) It is supposed that the stimulating cause of circulation is the oxygen received into the blood in the lungs by the process of respiration, or, as Dr. G. Smith has termed it, *atmospherisation* of the blood;(*i*) that the blood thus oxygenated and passing into the coronary arteries of the heart excites the heart to contraction, and propels the blood into the arteries, which also, and particularly their capillary terminations, are excited, and thus by the joint power of the excited heart and arteries the blood is propelled some part to the heart itself, to stimulate its action, another part to the head and brain, to stimulate the source of the nervous system, another into the chest and lungs, to nourish and support those parts, and another part into the upper extremities, and the great bulk into the trunk and lower extremities, and ultimately into the veins.(*k*) These veins also, which increase in size and diameter as they approach the heart, are capable of contracting, though not to the extent of the arteries and capillaries, especially when the contraction of the adjoining muscles affect the veins by pressure;(*l*) and the action of the atmosphere on the cavity of the thorax is considered as propelling the blood through the veins.(*m*) The right auricle also acts by *suction* and *derivation;* and when emptied by the blood having been propelled from the same into the right ventricle, draws up and receives the blood from the veins, which is pressed upwards by these different concurring circumstances(*n*) until it arrives in its return near to the right side of the heart, where being mixed in the subclavian vein with the new chyle. and other absorbed fluids poured into it from the thoracic duct, it is passed into the right auricle, and thence into the right ventricle, and then through the pulmonary artery into the lungs, and the operation is repeated.(*o*) Dr. Bostock, however, confines the efficient causes of the circulation to *the contractility of the muscular fibres*

(*e*) Dr. Stoker, &c.; 3 Bost. 322.
(*f*) Ante, 157, and see 3 Bost. 322, 323.
(*g*) See, in general, ante, 113, 367; 1 Bost. 325 to 337, and Dr. Stevens on Blood, 1 to 3.
(*h*) 1 Bost. 266, 267.
(*i*) G. Smith, 33, and introd. tit. Blood
(*k*) Ante, 136, 137, as to the circulation through the heart, and 1 Bost. 325; 1 Bell's Anat. 447; 2 Bell's Anat. 322; 2 Good, 21 to 34; 2 Par. & Fonb. 142; 2 Dungl. Phy. 126 to 157.
(*l*) 1 Bost. 328 to 332.
(*m*) El. Blum. 122 to 130.
(*n*) Ibid.; 2 Dungl. Phy. 148.
(*o*) El. Blum. 98, 99; 2 Horner, Anat. 152, 153.

of the heart; that of the capillary arteries and the external pressure upon the veins principally produced by the contraction of the muscles.(*p*)

Rapidity and force of circulation.

The heart is the salient point of the circulation, and pours forth, it is said, about two ounces of blood at every jet.(*q*) It is said that as each ventricle can hold between two and three ounces of blood, it is consistently supposed that this quantity is impelled into the arteries at each time, and that as the entire quantity of blood in the body is about 30 pounds, or 360 ounces, and 2 ounces leave the heart at each contraction, and there are 70 contractions in each minute, the whole mass of the blood circulates through the heart and the body *twenty-three times* in an hour, or once in two minutes and a half.(*r*) But, in some parts, the blood takes shorter circuits, as through the heart itself, and through the chest, and there some of the blood circulates even more frequently than the rest, which has to pass through the more remote parts of the larger circuit.(*s*) The precise celerity of the blood, in health, cannot, however, be determined, because it varies not only in different persons but in different parts of the same person,(*t*) and certainly, in general, in all persons, the blood moves more slowly in the veins than in the arteries, and in the small vessels than in the large trunks, although these differences have been denied by some physiologists.(*t*) It is said that the mean velocity of the blood, flowing into the aorta, is 8 inches for each pulsation, or about 50 feet in a minute.(*u*)

But the blood is not impelled from the left side of the heart into and through the arteries, in a continued flow, like a current, and so as to fill all the vessels at once, nor does it move onwards by the single stroke or effect of the heart to the very extremities of the body, but so as merely to give a sense of fulness and tension to the vessels; the force is merely such as to excite and support that action which the arteries every where perform in the various parts of the body, each artery for its appropriate purposes, and each in its peculiar degree,(*x*) each successive current of blood, as it were, impels those which have progressively become more remote from the heart, forwards into the veins, and thence back to the *right* auricle.(*x*)

Circulation of the blood through the arteries and veins.

It has been observed, that when we consider the great aggregate size of the veins, compared with the arteries, we must conclude that the blood flows but slowly in the venous system; that, from the narrowness of the trunks of the veins near the heart, the blood must be accelerated as it approaches the heart, and that, on the other hand, receiving the impulse from the left ventricle, it must take a rapid course through the arteries until again approaching the extreme branches of the arteries, and passing into the veins, its motion becomes more languid and slow.(*y*) The blood thus circulated is conveyed, with a very few exceptions, into the most internal and extreme recesses, and which, even without dissection or scientific examination, is proved by the well known fact of blood issuing from almost every part on the smallest scratch.(*z*)

Diseases or disorders of

The blood itself has usually been considered to be subject to some diseases, which will be hereafter fully considered;(*a*) or there may be

(*p*) 1 Bost. 326.
(*q*) 2 Good, 12; El. Blum. 91; Lizars, part ii. p. 146; 1 Bost. 287, 288.
(*r*) Lizars, part ii. p. 146; and see tit. Veins, El. Blum. 95; 1 Bost. 288; 2 Dungl. Phy. 116, 117.
(*s*) 1 Bost. 288.
(*t*) El. Blum. 90, 91.
(*u*) Id. ibid.; but see, as to the force, 1 Bost. 334 to 337.
(*x*) 1 Bell, 496.
(*y*) 2 Bell, 303.
(*z*) El. Blum. 81.
(*a*) As to diseases of blood, see 2 Good, and 3 Good, *passim;* in particular 2 Good, 40, 41; 1 Bell, 518; Coop. Dict. tit. Inflammation; Thackrah on Blood; and 3 Bost. 322; Stevens on Blood, *passim;* and Jackson, Prin. Med. 495; Brous. Pathol. 93, &c.

CHAP. V. Sect. III. Circulation.

the blood, or its circulation and other incidents.

causes impeding its due flow and circulation, which do not constitute any disease in the blood itself, but only in the vessels of circulation, as aneurism.(*b*) These are numerous, and some of them very considerable; they may all be referred to the head of *mechanical causes*, because any circumstance which tends to diminish or improperly increase the vital energy of the *heart*, or arteries, or capillaries, acts merely in a *negative* manner, diminishing the effect of their *due* contractility.

The following paragraph is from the pen of one of the most eminent physiologists of the present time:—

The *Diseases* of the blood itself in general.

"The blood, itself, is rarely the subject of positive *disease*. Doubtless it is liable to certain *variations* in its composition, which are intimately connected with the health of the individual. Anemia, plethora, and determination of blood, it is true, are sometimes, though improperly, classed as diseases of the blood: but we use the terms *Plethora* and *Anemia* as expressive of *quantity;* and we find, coupled with the increased quantity of fibrin contained in the former, as in the diminished proportion in the latter, a correspondent state of health, and this without wishing to advocate or oppose the doctrines of the *Solidists*, who would wholly attribute to the condition of the *muscular frame* and *nervous system* the liabilities or freedom from disease observed in different constitutions. Recently, however, the doctrines of the *Fluidists* have been revived, and some of whom have referred to the *blood* and other fluids as the principal cause of disease, and to this the general condition of the blood, ascribing to its acid, or alkaline, or saline qualities, the general origin of disease. It is not improbable that truth lies between these theorists. We daily see important and serious diseases held in check, and even inflammation itself restrained, by improved diet and fresh air. Can this be otherwise than through the agency of the blood? There can be no medium between such remedial means and the muscular and nervous systems, but the blood; there is no direct mode of giving strength but through the medium of the food. On the other hand, no improvement of diet or air can effect such changes in any constitution as to subvert its original character or disposition."(*c*)

It was formerly the doctrine that changes in the state of the blood were almost the *sole cause* of every deviation from health, and even that an *original* difference in the nature of the fluids gave rise to those different conditions of the constitution called *Temperaments;* and for a long time after that doctrine had been modified, chemists and others still regarded the blood as the origin of most diseases, and which were ascribed either to an acid or an alkaline, a watery, a saline, a putrid, or some other peculiar condition of the fluids, and the mathematical physiologists ascribed diseases to some change in the condition of the *particles of the blood* connected with their weight, size, viscidity, or other qualities, which might be supposed to affect their motion and their changes: but in more modern times, the general doctrine has changed to what is termed of *Solidism,* that is, that diseases are not in general to be attributed to the blood or other fluids, but, on the contrary, to the solids of the human frame, and especially to the nervous function; and even Dr. Bostock, and the generality of physicians, conclude that both our original temperaments and our subsequent diseases are more affected by the condition and properties of the *muscles* and *nerves* than by any physical or chemical differences in the nature of the blood. It seems at present, however, to be more correctly considered by many, and the opinion is daily acquiring advocates, that the *Solidists* have gone too far in asserting that there is no original

(*b*) Ante, 138 to 140, 145, as to Aneurism; and 1 Jackson, Prin. Med. 499.

(*c*) And see, further, Copl. Dict. tit. Blood, 169 to 181, and 193, as to the effect of the nerves on blood; and see, further, post, *Second Part.*

difference in the state of the fluids, and at present it is supposed by many that as the sources from which the chyle (the new material of the blood) are so various, its properties must in all probability vary, and that the state of the blood and other fluids must be equally, if not more, consulted in diseases, than the solids, and that both must be examined.(c) We have seen that the formation of the buffy coat usually indicates inflammation, and inflammatory fever is now supposed to depend on the viscidity of the *blood*, as connected with the proportion of water or the complete mixture of its ingredients.(d) There may also be a morbid state of the blood, in which the urine coagulates by heat, and which we shall in the Second Part more fully consider. (e)

Anemia or deficiency of blood.

Anemia and *Plethora*, though commonly so arranged, are not *diseases* in the blood, but merely refer to either a deficiency or too great a quantity of that fluid. *Hemorrhage* has no relation to any particular part of the blood; an *aneurism* refers to a morbid dilatation of a vessel. A morbid state of any one of the *organs* or functions destined to form or perfect blood, may lead to a state of *Anemia* (from α privative or without, and αιμα blood,) before alluded to, and importing a *defieient* quantity of the circulating fluid, or *bloodlessness*, and may be either general or local, affecting only a particular organ,(f) and which seems to be a complaint affecting persons in coal and other mines, from want of sun and air.(g)

Plethora and determination.

Plethora, on the other hand, is a disease where there is *too mueh blood*, generally, throughout the frame,(h) and *Determination* of blood is usually to a particular part.(i)

Hemorrhage.

Hemorrhage is a sudden loss of blood, generally arising from *external* injuries, but *internal ruptures* and other causes may be the occasion. These will form a subject of separate inquiry when we speak of *wounds*.(k)

Of fainting.

Fainting is in general the result of a defective quantity of arterial blood being sent by the heart to the brain; but it may proceed from other causes. To maintain the action of the heart in a firm and regular order, it is necessary not only that the blood should flow into it in an equal and uniform stream, but also that it should flow with the same regularity to and from the head and brain; for if its volume be altered from any cause, whether of obstruction, surcharge, or sudden deprivation in any considerable degree, its motion will be checked and enfeebled, and the brain and respiratory organs will participate in the defect, and *syncope*, *vulgo fainting*, will frequently be the result,(l) and although fainting may and usually does proceed from other causes as connected with the blood or its vessels, yet as it is sometimes attributable to the state *of the blood* itself (though more frequently to the state of the digestive organs, or the nervous or sentient functions,) (m) it is fit to name it here. When the due and regular conversion of arterial blood into the venous state is impeded by *any cause*, fainting will be one consequence. It may also be attributable to a temporary cause that may not again recur, as a blow or extensive pressure on a considerable range of blood vessels, or from the substraction of blood in bleeding, or it may be attributable to an organic structural disease of the heart or the large arteries that immediately issue

(c) 1 Bost. 389, 390; Stevens on Blood, *passim;* see also Jackson, Princ. Med. 495, and ante, 151.

(d) Dr. Davy, Ed. Med. Journ. vol. xxix. p. 244.

(e) 3 Bost. 324.

(f) Amer. Cyclop. Prac. Med. tit. Anemia; 1 Bell, 518. See further, as to anemia and plethora, Jackson. Princ. Med. 495; Id. 6, Amer. Jour. Med. Sci. 114.

(g) Copl. Dict. tit. Anemia.

(h) 3 Good, 121; Jackson, Princ. Med. 493.

(i) Coop. Dict. tit. Determination; and see Copl. Dict. tit. Blood, as to determination.

(k) Id. tit. Hemorrhage, *internal*, 3 Good, 125 to 140; 3 Par. & Fonb. 58.

(l) 4 Good, 373 to 378; Brous. Pathol. 562.

(m) Id. 374, as to fainting from sudden and violent mental emotion, pains, &c.

CHAP. V. SECT. III. CIRCULATION.

from it, as an ossification of the valves, polypous concretions, or enlarging or thickening of the substance of the heart, or an accumulation of matter in the pericardium, or an aneurism. In the latter cases the predisposition to faint must be cautiously anticipated and guarded against, as well by medicine and sedatives as by other regimen.(*n*)

Of hereditary diseases through the medium of the blood.(*o*)

Some authors attribute the unhappy prevalence of *hereditary diseases*, or predispositions towards diseases, and even insanity, to the influence of the *blood;* and Dr. Good observes, that if the blood be once impregnated with a peculiar taint, it is wonderful to remark the tenacity with which it retains it, though often in a state of dormancy or inactivity for years, or even entire generations, for as every germ and fibre of every other part is formed and regenerated or renovated from the blood, there is no other part of the system that we can look to as the seat of such taints, or the predisposing cause of disorder.(*p*) We shall hereafter have to enumerate the disorders which are considered hereditary, and to suggest the counteracting remedies. We must, however, here notice that there are many hereditary diseases which it is insisted are not attributable to any taint in the blood, but rather to some affection of the blood vessels themselves, or the absorbents, or the nerves, and not to the blood itself.(*p*)

Of infusion, transfusion, or injecting of liquids into the blood.

It has been ascertained that medicated liquids, injected into the blood, exert their specific powers exactly as when swallowed, and purgatives and emetics, so administered, empty the stomach in like manner as if swallowed.(*q*) The artificial *infusion* or *transfusion* of a minute portion of any even mild fluid into the blood, may occasion the most dreadful symptoms, such as palpitation, convulsion, &c.(*r*) Hunter appears to have considered that the blood of man and all warm-blooded animals is nearly alike;(*s*) and hence it would seem that the blood of a healthy animal might, in case of exhaustion from hemorrhage, be usefully applied;(*t*) at least it appears to be established, that the infusion of healthy human blood of another person is not prejudicial; but in case of exhaustion and loss of blood from hemorrhage, the infusion of it into the vein through the double pump, otherwise employed for emptying the stomach, or a common syringe capable of holding four or six ounces, will frequently save life.(*u*)

Of animal temperature.

We have partially considered the subject of temperament and temperature.(*x*) Although the definitions in the books of those terms are nearly similar, yet strictly the subjects are dissimilar; for the varieties of *temperament* depend as much on the *mental* as the corporeal structure, though not, as the ancients supposed, merely on the state or quality of the blood,(*x*) whilst *animal temperature*, in the sense here used, is peculiarly a state of the blood, and in comparison with the surrounding atmosphere, it is the power and degree which the living animal, and in particular mankind, possesses, of resisting, to a certain extent, the changes of the *external* temperature, or of maintaining a more or less uniform

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(*n*) 4 Good, 377.

(*o*) See Part II. of *Hereditary Diseases.*

(*p*) 2 Good, 40.

(*q*) El. Blum. 21; 2 Good, 40; 1 Bost. 278, 279: see post, titles Transfusion and Wounds; and see 2 Dungl. Phy. 160 to 162.

(*r*) El. Blum. 366, note (*e*,) an account of the direct infusion of a material unassimilated, instead of the regular more gradual introduction, through the absorbent vessels; and see 2 Good, 40; as to the operation of transfusion, see 1 Bost. 278, 279; 2 Dungl. Phy. 160 to 162.

(*s*) Hunter on Blood, 13.

(*t*) El. Blum. 21.

(*u*) El. Blum. 21, 22; 2 Good, 57; 3 Bell, 250, 251; and Hunter on the Blood, 13; 4 Amer. Jour. Med. Sci. 224, 226.

(*x*) As to temperament, ante, 49; and as to temperature, ante, 112, 113.

degree of heat, independent of that of the air, and of the substance with which it is in contact. It is an unquestionable fact, that whilst the body is surrounded by an atmosphere which is frequently 40, 50, or even a greater number of degrees colder than itself, so that the heat must be constantly rapidly abstracted from it, yet that it possesses the power of continually supplying the loss thus occasioned, and of continuing that degree of internal animal heat which is so essential to life, thus constituting one of the principal distinctions between animate and inanimate bodies. We will first state the usual degrees or state of the temperature in man, and then shortly examine the causes of this singular difference between external and internal temperature.

The usual temperature or degrees of heat in mankind.

All animals and mankind have a power of generating heat as well as cold, so as efficiently to adapt the frame to the external medium under all ordinary circumstances. The natural and ordinary temperature of birds is the highest, and about 107 or 108 degrees; that of the viviparous quadrupeds is about 100 or 101 degrees, while the human temperature is a little lower, being 97 or 98, or according to Blumenbach, 96 degrees;(*y*) whilst Dumas insists that it ranges from 87 to 108 degrees, though he fixes the habitual degree at 95 or 96;(*z*) and Magendie supposes that the variations to which the human *temperature* is subject, depend upon constitution, *temperament*, &c. He also agrees with Dr. Edwards, that the arm-pit (being the external part nearest the heart, and the least exposed, and therefore most likely correctly to represent the internal heat in the centre) is the proper situation for applying the thermometer in order to ascertain the temperature of the individual.(*a*) In the same climate, however, there is not, in general, according to Magendie and Dr. Edwards, much difference between the temperature of different individuals; but during infancy it is even 3 or 4 degrees less than in the adult.(*b*) In all it becomes gradually higher towards the spring, and gradually sinks towards and during the winter.(*b*) In acute fevers it may increase several degrees, and it has occasionally risen even to 120 degrees, but such instances, it is said, are rare, and the increase is seldom beyond 107 degrees,(*c*) and Hunter has remarked, that the actual temperature in inflammation is not so much increased as the sensation would seem to indicate.(*d*)

Causes of the internal temperature differing from the external.

The ancients erroneously supposed that the cause of the greater internal heat, compared with that of the atmosphere, was an innate or primary quality of the heart. That doctrine was first denied by Mayow, who first attributed its true cause.(*e*) The experiments of Black and Crawford throw further light upon this subject, and the now established (*f*) doctrine is, that the source of animal heat is principally in the action of the air upon the blood, and that it ultimately depends upon the abstraction of carbon from that fluid, and the conversion of oxygen into carbonic acid;(*g*) so that it is the union of oxygen and carbon that produces heat. But it is admitted, that with respect to the *mode* in

(*y*) El. Blum. 96; and therefore warm baths are usually regulated at that degree, termed *blood heat*.

(*z*) Dumas, Physiol. chap. vi. tom. iii. p. 126.

(*a*) Magendie, Physiol. tom. xi. p. 403.

(*b*) Id. ibid.; and see observations of Despretz, in Edin. Med. Journ. vol. iv. p. 185.

(*c*) Currie's Medical Reports; and Ed. Med. Journ. vol. xxii. p. 363; Dr. Edwards, Phys. tom. ii. 400, 490.

(*d*) Hunter's Animal Econo. note to pages 113, 296, &c.; see fully 2 Bost. 192 to 246; 2 Dungl. Phy. 170 to 194.

(*e*) Mayow's Tract. p. 151, 256, 257; and see Haller's El. Phys. viii. p. 5 and 6; and as to animal heat, Jackson, Prin. Med. 560 to 570.

(*f*) But see the different opinions entertained at different times, 2 Bost. 192 to 246. Hunter, in his Treatise on Blood, appears to doubt the cause of heat, see p. 15.

(*g*) 2 Bost. 192 to 246; and see Copl. Dict. tit. Blood, 189.

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which the heat is distributed through the various parts of the body, we are still unable to form a decisive conclusion.(*h*) It is further considered, that the *nervous* system affects the temperature, but that it is by an indirect operation, in as far as it contributes to bring the air into contact with the blood.(*i*) We have seen that the lungs regulate the temperature;(*k*) they are the apparatus by which the heat of the system is evolved, and its temperature regulated, either by an increase or decrease of heat, and this is accomplished by the discharge of carbon and water,(*l*) the first depending upon a chemical combination of the oxygen of the atmosphere with a portion of carbonaceous matter, by which combination heat is necessarily extricated; the second, upon the abstraction of a portion of the heat thus extricated, in consequence of the evaporation of water from the surface of the pulmonary cavities;(*m*) the perspiration of the skin materially assists in this cooling process, as it serves to abstract the excess of caloric.(*n*) It appears to be established, that when from any cause the conversion of arterial blood into the venous state is impeded, as was observed by Hunter to take place during fainting, the temperature is always lowered, and consequently sometimes shivering, or a state of chill is experienced.(*o*)

(*h*) 2 Bost. 229 to 246.

(*i*) Id.; Stevens on Blood, 29, 39, 40.

(*k*) 2 Bost. 240.

(*l*) Id.; Stevens on Blood, 39, 40.

(*m*) See the observations and authorities, 2 Bost. 240.

(*n*) Id. 241.

(*o*) Hunter on the Blood, 68; 2 Bost. 220; 4 Good, 373 to 378.

CHAPTER VI.

OF THE FUNCTION OF DIGESTION AND ITS SEVERAL ORGANS.

CHAP. VI. SECT. I. ALIMENTARY CANAL.

SECTION I.—OF THE ALIMENTARY CANAL AND DIGESTION IN GENERAL.

SECT. I. OF THE ALIMENTARY CANAL AND DIGESTION IN GENERAL.

As the suspension, for a time, of the function of digestion, would not occasion instantaneous death, it has usually been regarded as in a degree of less importance than the functions which we have previously considered, but as the human frame cannot long subsist without a supply of nourishment and new materials, the function of digestion is, in truth, as important for the well being of the human frame as those which are treated as of more primary consequence. It has been correctly observed, that digestion, absorption, and secretion, are so connected, that it is impossible to give an account of one, without presuming upon a certain acquaintance with the other; for the secretion cannot be formed until the blood has been already elaborated by the digestive and assimilating processes; while digestion, in its turn, cannot be effected until the stomach has secreted the *gastric juice*, the principal secretion and chief agent in converting aliment into the materials of the blood.(*a*) As, however, there are peculiar organs for digestion, and for absorption, and for secretion, we will examine each subject separately.

Digestion defined and its eight several parts described.

Digestion, in its most extensive sense, is that function or process by which *aliment* is made to undergo a *succession of changes*, so as to adapt it for the purposes of *nutrition*, though that word (from *digestio*) in its primary import, merely signifies the operation by which the food is concocted in the *stomach*. Magendie, in his work, treats digestion as constituted of *eight* subordinate actions, namely; 1st, reception of the food; 2d, mastication; 3d, insalivation; 4th, deglutition; 5th, action of the stomach; 6th, the action of the small intestines; 7th, that of the large intestines; 8th and lastly, the expulsion of the fæces; and that of these, the 5th and 6th are to be regarded as the most essential operations.(*b*) These collectively, but principally the 5th and 6th, acting upon the received food, create chyme, and afterwards chyle, which are the essential ingredients for keeping up the supply of *new blood*, and which, with perhaps some nourishment introduced externally through the pores of the skin by absorption, recruit and sustain the human frame.(*c*) The whole of the process of digestion is carried on in the *alimentary canal*, which extends from the lips and mouth through the whole range of the pharynx, œsophagus, (vulgarly gullet,) and into and through the stomach and the whole range of the intestinal canal, including the small and large intes-

Alimentary Canal.

(*a*) 2 Bost. 248.
(*b*) Magendie, Physiol. tom. xi. p. 33; 2 Bost. 342, note.
(*c*) 3 Bell's Anat. 236 to 238.

CHAP. VI. SECT. I. ALIMENTARY CANAL.

and terminating at the extremity of the rectum, the anus. In the mouth, where this alimentary canal commences, it is comparatively wide; it contracts in the œsophagus, which is about an inch in diameter, it then widens in the stomach, and then again contracts into the tube of the intestines.(*d*) As man can sometimes subsist for several days without fresh aliment for digestion, this function is comparatively subordinate to respiration and circulation, but as the frame cannot long be sustained in complete abstinence, digestion is substantially as important as those vital functions. We will first consider every organ and part employed in this function and its peculiar office in regular order, descending from the highest to the lowest. These may properly be divided and considered as those which are above the diaphragm, and those below. Those above, are, from the lips inclusive, through the mouth, fauces, and pharynx, and down the œsophagus or gullet, through the aperture in the diaphragm; and those *below*, are the stomach and the small and large intestines, and all the contents of the abdomen to the anus for discharging the fæces, together with the different *viscera*.(*e*) In the organs *above* the diaphragm, and especially in the mouth and fauces, are performed the two important offices of *mastication* and *deglutition*, which, after examining the organs themselves, will be considered. In those *below*, the masticated and deglutinized food is digested by being first, through the influence of the gastric juice, converted in the stomach into a uniform pultaceous mass, called *chyme;* and afterwards, when separated in the duodenum, being the first portion of the small intestines, by the influence of the mixture of bile and pancreatic juice, is converted into *chyle* and other liquid secretions, and the chyle is taken up by the absorbent vessels, and carried into the thoracic duct, and from thence into the subclavian vein, and then into the right auricle of the heart; whilst the effete and useless parts of the aliment are in the larger intestines converted into fæces or excrement, and finally carried off as waste in the manner presently explained.(*f*)

SECT. II. Of the Organs of *Mastication, Deglutition* or Swallowing into the Stomach, and the *Functions* themselves.

SECTION II.—OF THE ORGANS OF MASTICATION, DEGLUTITION OR SWALLOWING INTO THE STOMACH, AND THE FUNCTIONS THEMSELVES.

As there appears to be a natural and obvious division of the alimentary canal between that part above and that below the diaphragm in the different functions performed in each, we will divide the subject accordingly,—the upper division containing the organs of mastication and deglutition, and the lower division the proper organs of digestion, namely, the stomach, &c.

The organs in the upper division, of *mastication* and *deglutition*, involve the consideration of,

First, The Organs or Parts.

1. Mouth including the
    1. Lips.
    2. Jaws.
    3. Teeth.
    4. Gums.
2. Tongue, of Taste and Tasting.
3. Palate, Bones and Soft Palate.
4. Fauces.
5. Velum Palati.
6. Uvula.
7. Tonsils.
8. Salivary Glands.
9. Saliva.
10. Pharynx.
11. Œsophagus.

Secondly, The Functions of Mastication, Deglutition, and Swallowing, and Incidents.

1. Mastication or Chewing.
2. Deglutition or Swallowing.
3. Of Administering Nutriment through Rectum, &c.

(*d*) 1 Good, 2.

(*e*) Although within the abdomen, the kidneys, the ureters, the bladder, and urethra, not being organs of *digestion* but of secretion and *micturition*, or for discharging the urine, will be more properly considered in the chapter relating to *secretion*.

(*f*) 2 Bost. 343. 344.

Of the mouth.

The *Mouth* includes a space, bounded above partly by the bony and partly by the soft palate, on each side by the cheeks; in front by the lips; behind by the fauces or opening into the pharynx, or by the soft palate when drawn downwards; below by muscles covered by mucous membrane and the sublingual glands, extending inwards from the lower gums. The opening between the mouth and the pharynx is somewhat narrower, and from the middle of the soft palate, over this contracted part, hangs the uvula, which is considered a part of the soft palate, and from which there extends downwards on each side two folds of mucous membrane, one passing forwards, lost on the side of the tongue, the other backwards, and in like manner lost in the pharynx.(*g*) The anterior of these two folds contains a few muscular fibres, which, in mastication, draw the uvula and the rest of the soft palate down on the back of the tongue, and these are named the constrictores isthmi faucium. Between the two folds or half arches of each side is formed the tonsil, a body composed of a number of small mucous glands and very liable to inflammation, abscess, and enlargement.(*h*)

Of the lips.

The *lips* and cheeks are formed of the skin and reflected mucous membrane, with muscular fibres intervening, to give them motion, and with minute *glands* to discharge the moisture on their inner surfaces. The glands of the lips are technically called *glandulæ labiales*, and are very numerous; those of the cheeks are called the *glandulæ buccales.*(*i*) The lips are *moved* in different directions by various muscles, called levator labii superioris, levator anguli oris, depressor labii superioris, levator or depressor labii inferioris, depressor anguli oris, buccinator;—and these and other muscles occasion the susceptibility of the aperture of the mouth to considerable dilatation and contraction.(*k*) Both the lips may be malformed with fissures, in part dividing them so as to constitute what is termed *hare* lips, and which may be remedied by a surgical operation, ably explained in a recent publication.(*l*) The lips, gums, cheeks, and tongue, from their glandular structure, are very subject to malignant ulceration, to warty excrescences, and various kinds of tumours, and to cancer, most of which are remediable by proper attention.(*m*)

The jaws. (*n*)

The inferior maxillary bone, or *lower* jaw, is the chief organ of mastication, for the upper jaw is comparatively passive.(*n*) The lower jaw is connected with the skull by a remarkable articulation or junction, which holds a middle rank between arthodia and ginglymus, already explained,(*o*) and being supplied with an interarticular cartilage, and two synovial membranes, has easy motion in every direction;(*p*) and the masseter, the temporal and the internal and external *pterygoid* muscles, give various motions to the lower jaw.(*q*) The digastric muscle, assisted somewhat by the geniohyoideus and mylohyoideus muscles, draw the lower jaw down when we *open the mouth.* The masseters and temporal chiefly raise it

(*g*) And see, further, 2 Bell, 194, 200, 201; 1 Horner, Anat. 503; 1 Dungl. Phy. 415.

(*h*) See further description in 2 Bell, 194, 209; El. Blum. 313; 1 Dungl. Phy. 420; 1 Horner, Anat. 536.

(*i*) 3 Bell, 194; from bucca, the hollow inner part of the cheek, or the cheek itself: *bucca* is Latin for a mouthful; 1 Horner, Anat. 536.

(*k*) 1 Dungl. Phy. 419.

(*l*) Coop. Dict. tit. *Hare Lip.*

(*m*) Coop. Dict. tit. *Lip;* 2 Gibson, Surg. 223 to 241.

(*n*) See description, El. Blum. 313; and the plate of the bones of the head disarticulated and described, post, in the chapter of the Head and Nervous Function.

(*o*) Ante, 77.

(*p*) 1 Dungl. Phy. 416.

(*q*) Ibid.

CHAP. VI. SECT. II. MASTICATION.

again when we bite off any thing; and are most powerfully contracted when we break hard substances. Its lateral motions, which are most apparent in ruminating animals, are accomplished by the internal and external pterygoid, and the latter also draw it forward, as in projecting the chin.(r) In case of disease, considerable portions of the lower jaw have been successfully amputated.(s)

The teeth.

Each jaw is supplied with sixteen teeth of four orders, termed *incisores, canine, bicuspides* and *molares*. The *incisores* are situate in front of the canine teeth, and are designed for the purpose of biting off, or dividing a small part, to be masticated at one time. The *canine* teeth are placed on each side between the incisores and molares, by which we divide hard substances. The *molares* are of different sizes, situate on each side behind the canine teeth, and are adapted for grinding and perfecting the operation of mastication.(t) Teeth are too well known to be the source of great misery, and may be variously affected.(u)

The gums.

The gums, investing the alveolar processes on each side, and surrounding the neck of each tooth, to which they adhere, are formed of a compact interstitial substance, thick in consistence, and very vascular, that is full of blood vessels. They run into or unite with the mucous membrane and the periosteum,(x) and assist in the nourishment as well as the support of the teeth. They may be affected by various particular disorders, as by *odontia excrescens*, or excrescent gums, as when they become fungous or spongy, or have distinct exuberances on the surface;(y) or by *parulis*, which is the term for an inflammation, bile, or abscess on the gums.(z)

The tongue.(a)

The *tongue*, which is the chief organ of tasting, considered as regards its structure, consists of an inextricable union of many muscles ascending to form it, these arising for the most part from the os hyoides, are distinct till they meet, and the fibres then unite, become paler, intermixed with small quantities of fat, and are no longer traceable but with difficulty. It has likewise blood vessels; nerves both of taste and of motion and sensation;—all being covered by mucous membrane, which, reflected on its under surface, forms the floor of the mouth, and is continued laterally on the gums and in the middle. The back of the tongue forms the frenum linguæ, and presents various kinds of small eminences called the *papillæ*. The tongue is covered with the cuticle and *rete mucosum*, like the skin in other parts. The *base* or *root* of the tongue is that part which is connected with the os hyoides; and its apex is anterior.(b) Its *body* consists of mucular fibres with intermingled fat and cellular membrane. The *surface*, or top, is called *dorsum*, and there is a middle line seeming to divide the tongue into two lateral portions, in each of which are distinct

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(r) El. Blum. 313, 314; 1 Dungl. Phy. 417.

(s) Coop. Dict. tit. *Jaw-bone.*

(t) El. Blum. 313, 314; 2 Bost. 345, 346, and authors there referred to; and see more fully 1 Horner, Anat. 505 to 527; 1 Dungl. Phy. 415; and notes as to the teeth in general; and see, as to the diseases of the teeth, &c., 1 Good, 29 to 68; Hunter, on the Teeth; and the very valuable Treatise on the Teeth, by T. Bell, principally as regards their diseases and best modes of preservation.

(u) See enumeration of diseases and sources of pain, 1 Good, 29 to 68.

(x) 1 Horner, Anat. 513.

(y) 1 Good, 66 to 68.

(z) Coop. Dict. tit. *Parulis.*

(a) See Coop. Surg. Dict. tit. Tongue; and 4 Good, 200 to 203; where, also, see its threefold power, namely, of motion, sensation or touch, and power of taste, id. 201, note; 1 Horner, Anat. 528 to 533; 3 Bost. 134; post.

(b) As to this bone, see 1 Good, 339; El. Blum. 318.

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muscles, blood vessels, and nerves, and on this dorsum there are *papillæ*, which are a glandular apparatus causing a roughness, and is the chief organ of taste, this peculiar papillary structure being adapted for receiving the impression of sapid bodies.(*d*) The *under part*, or bottom of the tongue, is similar to the general lining membrane of the mouth, being a villous and secreting surface, and immediately underneath this is the *frenum linguæ*, which is evidently intended to limit the motion of the point of the tongue backwards, and is sometimes, although injudiciously, severed in children.(*e*) The tongue turns over the masticated food in the mouth and mixes it with the saliva and mucus, and assists in the operation of deglutition, as presently described. These motions are all performed in very rapid succession, and require but a short space of time. This important motion of the tongue also protects the glottis; for, by being shortened, the frenum epiglottis is relaxed, and the *epiglottis* falls, so as to prevent food from escaping into the trachea whilst in the act of swallowing.(*f*) The tongue also is greatly concerned in the functions of speech and voice, though we have seen that it has been said the loss of it does not necessarily occasion complete dumbness.(*g*)

Of the taste.

The *organs* of tasting may be said to reside in all the soft parts of the mouth, from the lips to the fauces, and probably also in part in the gullet itself, but is principally in the extreme parts of the tongue.(*h*) The interior surface of the whole of the mouth is lined with a soft vascular mucous membrane, immediately beneath which, a profusion of small mucous glands are situated. This mucous membrane is an extension of the cutis vera, or true skin, hereafter described, modified to perform this other function, and is also covered by the cuticle. The osseous structure of the mouth is formed by the superior maxillary, the palate, and the inferior maxillary bones, together with the teeth.(*i*) The tongue, like other acutely sensitive organs, is plentifully provided with nervous filaments and with blood vessels, and it has a peculiar papillary structure, which it may be presumed is adapted for receiving the impressions of sapid bodies. As regards its nerves, those that are destined to receive the impressions of *taste*, are derived from the fifth pair of nerves; those for the general purposes of the nervous influence, namely, motion and common sensation, proceed from the eighth and ninth pair of nerves.(*k*) The state of the tongue is frequently influenced by the stomach, and by its appearance it may be ascertained whether the stomach is disordered.(*l*)

Diseases and injuries to tongue.

The tongue is subject to ulcers of a simple or malignant nature. It may be partially amputated and yet speech, mastication, and deglutition continue in some degree, although necessarily impaired.(*m*) It may also be *injured* and become swollen by stings, as by that of a wasp in eating fruit, or by the undue use of mercury, so as to render bronchotomy necessary after an ineffectual attempt to aid respiration by the introduction of a catheter, already alluded to, and the practicability of which, we have seen, has been questioned by eminent authority.(*n*)

(*d*) 3 Bost. 134, and references.

(*e*) When and how to be effected, and of the Frenum Linguæ in general, see Coop. Dict.; Dewees, Treatise on Dis. of Children, 326.

(*f*) El. Blum. 315, 316; and see post, 181, Deglutition.

(*g*) 1 Good, 370.

(*h*) 3 Bost. 134; 1 Dungl. 92, 93.

(*i*) 1 Horner, Anat. 503.

(*k*) 3 Bost. 134; as to the nerves, see, further, 4 Good, 201, in note.

(*l*) 3 Bell, 293.

(*m*) Coop. Dict. tit. Tongue, and tit. *Ranula;* El. Blum.; 1 Good, 370 to 373.

(*n*) Ante, 93, note (*m*;) Coop. Dict. tit. Bronchotomy.

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Palate bones, velum pendulum palati, or soft palate, fauces, uvula.

At the top of the mouth, and also behind, are the palate bones.(*o*) The top of the mouth anteriorly constitutes the *hard* palate. The *velum pendulum palati*, or the *soft* palate, is the vascular and fleshy substance, which, hanging from the bones of the palate, forms a partial and moveable curtain between, and divides the mouth from the pharynx. The *arches* of the palate or *fauces* descend on each side from the velum palati. There are two on each side, so that the isthmus of the fauces resembles the double arched gateway of a citadel, or the arched roof of a cathedral, with the *uvula*, (said to have been so called from its supposed resemblance to a grape, or a bunch or cluster of grapes,) hanging as from the central union of four semicircular arches.(*p*) Behind the soft palate is the opening of the nostrils backward into the throat. The anterior arch is also called the isthmus of the fauces, as it marks the narrowed interval between the mouth and the pharynx.(*q*)

Uvula.

The Uvula is the round, soft, spongeous body, suspended from the palate near the foramina of the nostrils over the glottis. Its use seems but little known, though it is considered as more sensible in tasting even than the soft palate, and is also a guard over the fauces or soft palate, and by its sensibility in a great degree governs the operations of these parts, and is also part of the organ of voice.(*r*)

The use of the *velum pendulum palati* is, that in swallowing it may draw up like a valve to exclude the posterior opening of the nostrils into the throat; and there being at the same time an action of the arches of the palate, the whole is brought into a funnel-like shape, directing the morsel into the pharynx and gullet.(*s*) In vomiting and sneezing, the valvular action of the velum is not so accurate. The velum is also a part of the organs of voice.(*t*) It is said also that the tremulous motion of the uvula with the mouth open in sleep occasions snoring.(*u*)

The tonsils.

Between the arches of the soft palate on each side, and consequently at the back of the mouth, lie the *tonsils*, or *amygdulæ*, which are large oval mucous *glands*, full of large cells like *lacunæ*, which communicate, and the mouths of the ducts open into them. The use of the tonsils is evidently to lubricate the passage of the throat, and facilitate the swallowing of the morsel.(*x*)

From the naturally loose texture of the tonsils, and from their being a vascular and secreting body, exposed to the immediate vicissitudes of weather, they are often the seat of inflammation, which may extend to the soft palate. This inflammation in its mild form is very common; when more acute, it terminates in abscess of a very painful kind, and from which large quantities of matter escape by puncture. This is called quinsy.(*y*)

Salivary or salival glands.

The sources of the *saliva* are very numerous; the parotid glands, or superior maxillary glands, and the *socia parotidis*; the inferior maxillary or submaxillary glands; the sublingual glands; and (according to the opinion of many) the glandular follicles of the root of the tongue; the palates, and even the *buccales* and *labiales*, or glands of the cheeks and lips, are also to be enumerated as sources of saliva.(*z*) But the parotid, submaxil-

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(*o*) 1 Horner, Anat. 146.

(*p*) 3 Bell, 200; 1 Horner, Anat. 534. The Latin word *uva* not only denotes a grape, but a *cluster* or *bunch*, and is sometimes used as the name of a disease of the uvula.

(*q*) Ibid.; 1 Dungl. Phy. 419.

(*r*) El. Blum. 316; its uses, 3 Bell, 200, 214; 1 Good, 77, 78; Coop. Dict. tit. Uvula; where see also as to its diseases and remedies.

(*s*) See post, 181, Deglutition.

(*t*) 3 Bell, 201; Quain, El. 135, 136, 448.

(*u*) Ante, 117, Respiration; El. Blum. 143.

(*x*) Coop. Dict. tit. Tonsils; 3 Bell, 201, 202; 1 Horner, Anat. 536.

(*y*) 3 Bell, 202; 2 Good, 302 to 307; Coop. Dict. tit. Tonsils, where the remedies and operations are stated; and see tit. Pharyngotomus; 2 Gib. Surg. 230 to 235.

(*z*) 3 Bell, 197, 198.

lary and sublingual glands are considered the principal.(z) They differ in size and situation; they are of a pale ash colour, not unlike the cineritious substance of the brain, and are composed of minute granules aggregated into lobules and lobes, and they secrete the *salivary fluid*, which is conveyed into the mouth by ducts that arise by various roots from the granular structure of each gland. The parotid gland is so called from its position with regard to the ear, and is the largest of the last three. The *submaxillary* gland lies beneath the basis of the jaw. The *sublingual* gland, as its name imports, lies beneath the tongue, immediately underneath the mucous membrane.(a)

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Diseases of salivary glands. Mumps.

The salivary glands, from the rapidity of their secretion, are little liable to disease.(b) The parotid is enlarged by inflammation in the disease called *mumps*, but the general enlargement about them is referrible to some contiguous glands.(b)

Of the Saliva.

During mastication, (which is performed principally by the lower jaw and teeth, with the assistance of the tongue in placing the food in a proper situation,) there occurs a flow of *saliva*.(c) This flows from the glands we have just considered.(d) According to some authors saliva is composed of water, a peculiar animal matter, mucus, alkaline muriates, lactate of soda, animal matter, and pure soda; from being constantly applied to the tongue, it is insipid, although it contains some microcosmic salt, as well as muriatic, and invariably a small portion of oxalic acid. It is antiseptic, and very resolvent.(e) According to the recent joint experiments and observations on digestion made by the Heidelberg professors, Tiedemann and Gmelin, "the solid contents of saliva vary from one to twenty-five per cent.; there are three proximate animal principles which are essential, namely, proper salivary matter, mucus, and osmazome, to which, in some cases, is added a little albumen and a little fatty matter containing phosphorus. The salts are numerous, and no less than nine; six soluble in water, and three insoluble. The soluble salts are an alkaline acetate, carbonate, phosphate, sulphate, muriate, and sulphocyanate; it is to the second of these that the saliva owes its alkaline properties, and which had been generally ascribed to the presence of an uncombined alkali. These authors announce the curious circumstance that the alkali which exists in these various salts is in man almost solely potash, while in the dog and sheep it is soda with very little potash. The sulphocyanic acid is most abundant in the human saliva. The insoluble salts are the phosphate of lime, the carbonate of lime, and magnesia in very minute quantity.(f) A comparative view is afterwards given by the same authors of saliva and pancreatic juice, which will be presently stated.(g)

The effect of the saliva upon the aliment is conceived by some authors to be partly mechanical and partly chemical; it softens some of the substances, and breaks down their texture, whilst others are completely dissolved by it, and they think that this process is promoted by the alkaline salts which the saliva contains. But Dr. Bostock says he cannot admit the justice of the suggestion, that the sulphocyanate of potash may contribute in the manner they suggest.(h) The rival physiologists of the

(z) 2 Dungl. Phy. 222; El. Blum. 314; Coop. Dict. tit. Parotid Duct; 1 Horner, Anat. 537 to 540.

(a) See the full description, 3 Bell, 197 to 199; 1 Horner, Anat. 537 to 540; Coop. Dict. tit. Parotid Duct.

(b) As to diseases of salivary glands, see Coop. Dict. tit. Parotid Duct; and tit. Tumour; Dewees, Prac. Phy. 422.

(c) 1 Dungl. Phy. 471.

(d) Ante, 176.

(e) 2 Dungl. Phy. 222; 1 Good, 10.

(f) Recherches Experimentales sur la Digestion, traduites par Jourdan, vol. i. 23, 24; 3 Bost. 330 to 338.

(g) Post, and 3 Bost. 333.

(h) 3 Bost. 336.

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same period, MM. Leuret and Lassaigne, contrary to Dr. Bostock's opinion, insist that the chemical properties of saliva are essentially the same in all animals.(*i*)

All physiologists appear to agree that saliva greatly assists in lubricating the aliment preparatory to deglutition, as bringing *sapid* bodies under the influence of the organ of taste, and as softening the food for digestion, and that its animal principles serve to assimilate unazotised aliment. (*k*)

The quantity of the secretion of saliva varies considerably; it is said it usually is equal to a pound weight in twelve hours, and is increased by stimuli and mechanical pressure. The former, when acrid substances are taken into the mouth, which are thus properly diluted, or when stimulated by the imagination, as when the mouth waters during the desire for food. The latter cause is greatly favoured by the situation of the parotids at the articulation of the jaws, and occurs when we chew hard substances, which thus become softened.(*l*) Under the influence of the irritating passions, and especially of violent rage, the saliva assumes a frothy appearance,(*m*) for the nervous influence materially affects most of the secretions, and it is well known that the idea of savory food materially increases the flow of saliva.(*n*)

When the saliva is secreted in a healthy proportion, and the various muscles of the mouth perform their proper office, saliva is not discharged from the mouth, unless voluntarily, (which as a habit is to be repressed,) but passes readily from the fauces into the œsophagus.(*o*) The secretion of saliva may become morbidly profuse as in ptyalism, which is an involuntary flow of saliva from the mouth, and constitutes salivation.(*p*)

The Pharynx.

The *Pharynx*, from the Greek φᾶϱυγξ, Latin *Fauces*, the throat, (*q*) is situate above and behind the larynx.(*s*) It is a musculo membranous tube, extending from the centre of the base of the skull to the œsophagus, with which it is continuous, gradually diminishing in the form of a funnel. It lies behind the nasal fossæ, the soft palate, the isthmus of the fauces, and the larynx, which opens into it in front of the vertebral column and between the great vessels of the neck. The posterior and lateral parts of the pharynx are loosely connected to the adjacent structures by cellular tissue, but anteriorly it presents the several apertures that lead into the nose, mouth, and larynx. Its structure is made up, externally, of muscular fibres, disposed in a very peculiar way, being formed into three lamellæ on each side, partially overlapping one another; and, internally, of mucous membrane prolonged from the mouth and nares. These layers of muscle are called the constrictors of the pharynx. The pharynx also has its proper arteries, veins, and nerves.(*t*) In *eating*, as a preparatory measure to swallowing, the pharynx is drawn up, and also the os hyoides; and as a means of security, the larynx at the same moment is made to ascend so as to be brought under cover of the epiglottis, which prevents the food from escaping into the wrong passage, namely, the trachea.(*u*) The pharynx also exerts an important influence in the modulation of the voice in the production of its higher tones.(*x*) The diameter of the smaller part of the

(*i*) 3 Bost. 338.
(*k*) 1 Good, 10; 3 Bost. 335.
(*l*) El. Blum. 315; 1 Good, 70; 1 Dungl. Phy. 470.
(*m*) 1 Good, 69.
(*n*) Jackson, Prin. Med. 329. The flow of saliva in the mouth of a hungry dog in immediate expectation of receiving food before him, establishes this position.
(*o*) 1 Good, 69.
(*p*) 1 Good, 70 to 77.
(*q*) 1 Horner, Anat. 540 to 543; Coop. Dict. tit. Pharyngotomy.
(*s*) Ibid.
(*t*) Ibid; where see a full description, and see 3 Bell, 269.
(*u*) 1 Dungl. Phy. 473; Walker's Dict. tit. Pharynx, supposes this to be *below* the larynx; Brous. Phy. 322; 1 Good, 77, 78.
(*x*) See 1 Dungl. Phy. 363, &c.

pharynx is rather more than that of a *pistole*.(*x*) Inflammation of the tonsils, or soft palate, already described, when severe, frequently extends to the pharynx.(*y*)

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Œsophagus.

The *Œsophagus* (from the Greek οιω, to carry, and φαλω, I eat, or the passage for food, and vulgarly called the *gullet*, and hence the act of swallowing at one swallow, perceptible in dogs, is termed gulping,) is a *musculo membranous* tube, generally about an inch in diameter in its most extended state,(*z*) and proceeding from the lower end of the pharynx, which is considered its superior termination, into the stomach. It commences opposite the cricoid cartilage, and descends behind the trachea, deviating however a little to the left side; at the lower part of the neck, in the thorax, it rests on the vertebral column, inclining at first towards the middle line, but as it descends it will be observed gradually to incline forwards so as to reach the œsophageal opening in the diaphragm, whilst in the neck, the trachea and the left recurrent nerve lie in front of it, and the cervical vessels on each side. In the middle of the thorax it is close to the right side of and a little anterior to the aorta, and there becomes invested by the plexus formed by the vagus nerves; lower down it passes over the aorta. The tube is lined by mucous membrane, which is invested by a muscular tunic, composed of longitudinal and circular fibres.(*a*) Although it is termed a cylindrical tube, and may be so when dissected and inflated, yet during life it lies collapsed, with its inner surfaces in close contact, and it transmits the morsel only by the continued succession of the contraction of its fleshy coat.(*b*) It has only two proper coats, its muscular or external, and its internal coat; the former greatly surpasses in strength and in the coarseness of its fibres, any part of the whole tract of the intestinal canal, the latter or inner coat is soft and glandular; villi (or like the pile of velvet) (*c*) are described as being distinguishable on its surface, and it is invested with a very delicate cuticle, which dulls the acute sensibility and prevents pain in swallowing, and in every respect resembles the lining membrane of the mouth. This inner coat has an exhaling surface like the rest of the body, with particular glands to secrete and pour out that mucus which lubricates the passage for the blood. This coat is capable of a great degree of distention.(*d*) The external tunic of the œsophagus is muscular, and the muscular fibres are both transverse and longitudinal; when the œsophagus has entered the thorax it descends behind the bifurcation of the trachea into the bronchi and the arch of the aorta; when it descends further upon the dorsal vertebræ it lies on the right side of the aorta, and as it passes further down it gets gradually more in front of the aorta; it then perforates the diaphragm and expands into the upper orifice of the stomach, called the superior or *cardiac* orifice, which being below the diaphragm will be described in the next division.(*e*)

(*x*) See instance of 9 pistoles wrapped up in cloth nearly occasioning death in a lad of fourteen years old, Coop. Dict. tit. Bronchotomy.

(*y*) Ante, 176; and see 2 Good, 302 to 307; Coop. Dict. 977, from which it may be collected that this organ is subject to one of the four descriptions of sore throat called the *pharyngic quinsy*.

(*z*) 1 Horn. Anat. 543. A boiled chesnut may not pass, Coop. Dict.; but nine pistoles, wrapped in a piece of cloth, after sticking some time in the narrow part of the pharynx, were forced down by a probe, and after some days evacuated, Coop. tit. Bronchotomy. A pistole is less than an inch in diameter, value 17 shillings. Nineteen large clasped knives, swallowed at different times, have been found in the stomach, showing the capacity of the œsophagus to pass a substance of that length and thickness, El. Blum. 06.

(*a*) 1 Horner, Anat. 343; Coop. Dict. Œsophagotomy.

(*b*) 2 Bell, 268; 1 Dungl. Phy. 475.

(*c*) 1 Dungl. Phy. 421.

(*d*) 3 Bell, 269, 370; see El. Blum. 316, 317; 1 Horner, Anat. 544.

(*e*) Id. 543; 3 Bell, 270, 271.

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The *fluids oozing* from the œsophagus are very distinct from those of the stomach, and have probably no digestive property.(*e*)

The propulsion of the food from the fauces into the stomach commences (as we have seen) (*f*) in the action of the circular fibres of the pharynx, which contract in succession and in a downward direction, and as this direction is continued to the muscular fibres of the œsophagus, the swallowed morsel is carried forward into the stomach by a progressive or peristaltic action.(*g*)

Diseases of the œsophagus.

The œsophagus is subject to *stricture* from a spasmodic or permanent contraction of the œsophagus, or *atony* from debility of the muscles of deglutition. It is liable to the sensation in nervous persons of a seeming ball ascending into the œsophagus and producing a sense of strangulation.(*h*) These, with their surgical and medical treatment, will hereafter be considered.(*h*) In the first case the joint object of enlarging the diameter of the œsophagus by a gradual pressure, and of conveying any quantity of liquid food that may be desirable, may be effected by passing an elastic gum tube, a quarter of an inch in diameter and two feet and a half in length.(*i*)

Injuries to the œsophagus.

Foreign bodies not unfrequently lodge in some part of the œsophagus, as at the lower part of the pharynx, or just above the diaphragm, but seldom in the intervening portions of that canal. These should, if possible, be extracted upwards by a urethra forceps, or other instrument, but if not of a hurtful kind may be pushed down into the stomach by a probang, and if neither can be effected, then irritation must be avoided, and if respiration or obstruction of nourishment be endangered, œsophagotomy may be performed.(*k*)

This organ also may be *ruptured* in two ways, *viz.* across, by the tearing of the longitudinal fibres, and longitudinally by the *separation* of such fibres,(*l*) and which may occur from the action of vomiting.(*m*) The œsophagus may also be *wounded*, but it is so deeply situated, lying so close to the bodies of the vertebræ and behind the trachea, that it is not often concerned in any incised wounds which do not immediately and previously prove fatal in consequence of the division of other important parts, such as blood vessels, and consequent hemorrhage. But stabs and gun-shot wounds may obviously sometimes injure this organ, and even so as not to endanger life, and in that case food may be administered by an elastic gum catheter passed through one of the nostrils as before suggested.(*n*)

Secondly, Of the *Functions* of *Mastication*, *Deglutition*, and *Swallowing*.

Having thus endeavoured to describe the several organs and parts of the alimentary canal above the diaphragm, we will now concisely describe their functions of mastication, deglutition, and swallowing. The subject of *food*, whether solid or liquid, will be discussed when we presently speak of the stomach, and also when we examine the regimen to be observed for the due continuance of health.

1. Of Mastication or chewing.

The process of *Mastication* or *Chewing*, sometimes termed *Trituration* or pulverizing the food between the teeth, is exceedingly essential in relation to health, and in that respect not sufficiently observed; for the ultimate facility of digestion in the stomach greatly depends on the state and sufficiency of the mastication in the mouth, especially when the digestive power of the stomach is weak.(*o*) Hence the bad consequences

(*e*) 3 Bell, 271.

(*f*) Ante, 178, Pharynx.

(*g*) 1 Good, 78; 1 Dungl. Phy. 475.

(*h*) 1 Good, 77 to 88; Coop. Dict. tit. Œsophagus Stricture.

(*i*) 1 Good, 85.

(*k*) Coop. Dict. tits. Œsophagus, Œsophagotomy, Bronchotomy, and *Probang;* 2 Gibson, Surg. 242 to 244.

(*l*) 3 Bell, 269, in notes.

(*m*) 3 Par. & Fonb. 63.

(*n*) Post, 182; see Coop. Dict. tits. Throat, and Œsophagotomy; 1 Gibson, Surg. 133.

(*o*) El. Blum. 322; 3 Bell, 290.

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that may arise either from hurried mastication and swallowing, or from eating indigestible food.(*p*) If the teeth be lost, the gums usually become in a great degree hardened and, though imperfectly, supply the place; but the nutriment should be either fluid or cut in very small particles, so as to be rendered readily digestible in the stomach. The *Saliva* just described, is mixed with the *mucus* of the labial and buccal glands, and of the tongue, as well as the moisture which transudes from the soft parts of the mouth. The mixture of these fluids with any substance which is chewed, renders it not only a pultaceous and easily swallowed bolus, but likewise prepares it for further digestion, as well as for assimilation with blood, and consequent nourishment.(*q*)

2. Deglutition, and the operation described. (*r*)

It has been generally considered that the mechanism of *Deglutition* is very complicated. It is performed by a peculiar operation, vulgarly when rapidly performed, called *gulping*, in which externally the projection termed the pomum adami is seen to move.(*s*) It requires the concurrence of many agents from the mouth, where it begins, to the stomach, where the operation terminates. The following description of the operation from the pen of one of the most eminent anatomists and experienced surgeons, is submitted to consideration, as by far the most lucid and satisfactory account of this complicated operation.

"Deglutition is performed as follows:—During mastication the food is mixed with the saliva, and its escape backwards is prevented by the Constrictores Isthmi faucium. When masticated, it is placed by the conjoined action of the buccinators or muscles of the cheek and the tongue on the dorsum of the latter. The soft palate then performs a new office, namely, that of a *valve*, preventing the escape of the food upwards towards the nose. This it accomplishes by its being drawn *horizontally*, backwards, to reach the back of the pharynx, the muscles of which contract to meet it. The posterior openings of the nose and the Eustachian tubes are then above it, as it forms a roof to the pharynx. The apex of the tongue is now placed against the roof of the mouth, and becomes the fixed point for the muscles of the organ to act upon. The base of the tongue with the os hyoides, and consequently the larynx, are raised by the muscles passing between them and the lower jaw, and the tongue, which is a soft moveable floor to the mouth, is raised and pressed upwards into the mouth, and by that action, the glottis or opening of the larynx is pressed under the cartilaginous trap-door or epiglottis, which falls upon it, and the food is forced backward over the epiglottis by the pressure of the tongue against the roof of the mouth. The constrictors of the pharynx are drawn forwards to receive it, and they propel it into the œsophagus."

Food, at least that of a more solid nature, can only be received into the stomach by the act of *deglutition*, and which cannot be performed without the intervention of the nervous system.(*t*) But when in a more *fluid* state, food may be introduced by means of an elastic catheter and swallowed into the stomach without deglutition. Drs. Good and Bostock observe, that there is perhaps no part of the human frame which exhibits a more beautiful specimen of mechanism than the organs that are thus concerned in the operation of deglutition.(*u*)

3. Of administering nutriment

Though the natural passage for food is through the mouth, and thence into the œsophagus, yet in case these have been injured, prepared fluid nourishment and medicines may be introduced into the stomach through

(*p*) El. Blum. 325, and post as to the circumstances essential for the continuance of Health.

(*q*) El. Blum. 315; 1 Dungl. Phy. 472.

(*r*) As to Deglutition in general, and its defects and diseases, see Copl. Dict. tit. Deglutition; 1 Dungl. Phy. 472 to 476.

(*s*) El. Blum. 315; 1 Good, 77, 78; 2 Bost. 346, note; Brous. Phy. 322, 323.

(*t*) 1 Brous. 323.

(*a*) 1 Good, 77, 78; 2 Bost. 346, note.

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and medicine through the nostril, rectum, &c.

a flexible elastic gum catheter passed through one of the nostrils down the *œsophagus;*(*t*) or the same operation may be performed in case of a locked jaw, by removing one or two of the teeth.(*u*) In cases of diseases or wounds of the pharynx, œsophagus, larynx, or trachea, the former may become necessary, in order to avoid the disturbance of the inflammation or wound, which the convulsive elevation and depression of the larynx and trachea would naturally occasion.(*x*) Some degree of nourishment may also be administered by injection up the rectum.(*x*) In tetanus or lock-jaw, the power of deglutition may be so totally suspended as to prevent the useful introduction of aliment through the mouth.(*y*) In that and other cases the injection of nourishing liquids in the shape of clysters administered up the rectum, may, by the small powers of absorption in that organ, assist in protracting existence for a time.(*z*) To which may be added the process of immersion in nourishing liquids, which, by absorption through the skin, may also assist.(*a*)

SECT. III—ORGANS OF DIGESTION, &c., BELOW THE DIAPHRAGM, AND DIGESTION.(*b*)

1. The Abdomen and parts in general.
2. The Peritonæum.
3. Organs of Abdomen and Digestion in general.
4. The Stomach.
5. The Gastric Juice.
6. Digestion in Stomach in general.
7. The Chyme.
8. Irregularities and Diseases of Stomach.
9. Of Hunger and Thirst, Food and Drink, &c.
10. The small Intestines.
11. The Chyle.
12. The large Intestines.
13. The solid Viscera, *i. e.* Liver, Gall, Bladder, Bile, Spleen, Pancreas and pancreatic Juice.
14. The other parts of the Abdomen, and incidents.

SECT. III. DIGESTION.

1. The abdomen and its parts in general.

Of the ORGANS and VISCERA *below* the DIAPHRAGM.—The *Abdomen* (vulgarly belly) is that division of the trunk which is between the thorax and the pelvis.(*c*) It lies immediately under the diaphragm, and is bounded behind by the spine, on the sides and fore part by the abdominal muscles, and below, it is supported by the alæ ilii and the ossa pubis, which we have seen are bones of the pelvis. It has been usual to speak of the *cavity* of the abdomen, but that has been treated as an inaccuracy of language, because there is in reality no cavity.(*d*) When medical practitioners speak of the *Abdomen*, they in strictness exclude the parietes or surrounding walls, and, consequently, the peritonæum, and also the kidneys and all the viscera of the pelvis.(*e*) We will, however, concisely notice the muscles of the abdomen and the peritonæum, and some incidents, before we consider what are strictly the organs of the abdomen. Externally the parts, as well of the thorax as of the abdomen are, for the purpose of better exploring or discovering the precise situation and state of disease, technically divided into *regions* (as already noticed;) but the full consideration of which will be more proper when we examine, in the second part, the modes of discovering the seat of disorder or injury.(*f*)

Muscles of the abdomen, and herein of hernia or ruptures. (*g*)

The *muscular* surrounding parietes, (that is, walls, as they are technically called,) of the abdomen or belly consist of three lamellæ, made up of fibres placed over each other. The arrangement of these fibres in the *greater part* of their extent is well calculated to support the peritonæum and

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(*t*) Coop. Dict. tit. *Throat;* id. tit. *Epiglottis;* id. tit. *Bronchotomy*, and tit. Œsophagotomy; 1 Good, 85; El. Blum. 318.

(*u*) Coop. Dict. tit. Tetanus.

(*x*) Coop. Dict. tit. *Throat;* and *Œsophagotomy*, 1 Good, 85.

(*y*) Coop. Dict. tit. Tetanus.

(*z*) 2 Bost. 396.

(*a*) 5 Good, 180; see post, Lymphatics.

(*b*) See Division, ante, 171.

(*c*) 3 Bell, 251; Amer. Cyclop. Prac. Med. tit. Abdomen.

(*e*) Id. and Coop. Dict. tit. Abdomen.

(*f*) Ante, 37, and post, Second Part.

(*g*) See, in general, 1 Bell, 312 to 328.

viscera, and prevent their protrusion.(*h*) The external set incline downwards and inwards, those subjacent to them run in the opposite direction, whilst the internal ones take a transverse course, so that they afford to each other a mutual support. But this arrangement does not obtain throughout the entire extent of these muscles, for in the *lower part* of the abdomen the fibres of the muscles are quite differently disposed, they all incline downwards and inwards, and thus lose the advantage obtained by the arrangement above noticed, viz. of the *transverse* course of muscles,(*i*) and from this and other causes *hernia*, or rupture, being the protrusion of parts of the intestines, or viscera, of various descriptions, (and hereafter considered,) arise, especially in persons who are occupied in digging, or in straining, as a sailor must do in the working great guns, and when pulling at the oar, and other pursuits which strain the muscles and peritonæum.(*j*)

2. Of the peritonæum.

The *Peritonæum* (from the Greek περιτεινω, to extend around the abdominal viscera,) is next to be considered. This is the most extensive serous membrane in the body, as it not only lines the parietes (walls) of the abdomen, but is also reflected over some of the organs which it contains; for it forms several folds of considerable extent, (somewhat as the pleuræ do over the lobes of the lungs, and the resemblance to which, as regards its diseases, we have already noticed.) (*k*) This membrane has been compared to a shut sack.(*l*) It is a white firm thin contexture of cellular substance, consisting of an expansion of dense cellular membrane, in which no fibre or striated appearance is to be observed. By its outer surface it adheres to the adipose membrane on the inside of the abdominal muscles, and to the surface of the several viscera. But it does not surround any part of the œsophagus, or extend to the rectum, which does not pass out of its cavity.(*m*) It has arteries as well as veins and nerves.(*n*) Its use is to serve as a dense and outer coat to the abdominal viscera, most of which it covers, and conveys the vessels to them as in the mesentery, and having its inner surface smooth and lubricated by a watery secretion, it allows the parts to lie in contact, and at the same time affords in the intestinal canal a capacity of motion without friction. It has been considered that one great use of the peritonæum is to retain the viscera in their place, for when it is wounded they escape, and sometimes with a sudden impetus; but this, it is said, is rather from the tendons or muscles having been cut which support the peritonæum, and that the peritonæum itself constitutes a very inadeqate support.(*o*) The *omenta*, presently more fully considered, are termed secondary processes of the peritonæum;(*p*) and the *mesentery* also is a *production* or part thereof.(*q*)

Diseases and injuries to the abdominal muscles and peritonæum in general.

The *peritonæum* is liable to peculiar or *local diseases*, as inflammation, called Empresma peritonitis, and which, with reference to the particular part of the peritonæum affected, is called *propria*, or inflammation of the general range of the peritonæum, or *omentalis*, when the region of the omentum itself is more particularly affected, and *mesenterica*, where the inflammation is more deeply seated.(*r*) We have noticed the resemblance of the inflammation of the *pleuræ* of the lungs to that of the peritonæum.(*s*) Hermia or rupture is one of the most common and dangerous

(*h*) 3 Bell, 259; and see 1 Horner, Anat. 423 to 429, as to the muscles of the abdomen in general.

(*i*) 3 Bell, 259, 260; Amer. Cyclop. Prac. Med. tit. Abdomen.

(*j*) Id. and see Coop. Dict. tit. Hernia, and post; 2 Gibson, Surg. 276.

(*k*) Ante, 16.

(*l*) 2 Horner, Anat. 9; 3 Bell, 255, 276, where it is fully described.

(*m*) 3 Bell, 257, 258, in notes, 261; 2 Horner, Anat. 10, 11.

(*n*) 3 Bell, 258.

(*o*) Id. 259, 260; Amer. Cyclop. Prac. Med. tit. Abdomen.

(*p*) Id. 262, 263; as to the great omentum in general, see Coop. Dict. tit. Hernia; 2 Horner, Anat. 12; Amer. Cyclop. Prac. Med. tit. Abdomen.

(*q*) 3 Bell, 262, 300; 2 Horner, Anat. 33; 2 Wistar, Anat. 116.

(*r*) 2 Good, 345.

(*s*) Ante, 16.

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diseases of the *abdominal muscles*, causing the bowels to protrude.(*t*) Sometimes also acute rheumatism attacks the peritonæum.(*u*)

Wounds of the abdomen are of two descriptions, either penetrating the cavity of the belly itself, or only intersecting the skin and muscles. The former are necessarily most dangerous, but both are hazardous, in consequence of the danger of inflammation thereby caused, and the risk of the bowels protruding.(*x*) It is stated that a wound through the belly, though with a rapier or small sword, will probably wound six turns of the intestines,(*y*) but there is frequently more danger when withdrawing the weapon of drawing some small particle of dust into the wound than from the wound itself.(*z*)

3. The organs in the abdomen in general.

The organs contained below the diaphragm and in the abdomen and pelvis are divisible into *three sets*, viz. the *digestive*, the *urinary*, (parts of the secernent organs, noticed in the eighth chapter,) and part of the *generative*. The *first* class includes the proper abdominal organs, viz. the *stomach*, the *small* and *great intestines*, the *spleen*, the *liver*, and the *pancreas*, and also the *lacteal* vessels with their glands. The *second* comprises the kidneys and supra venal capsules, with the *ureters* and *bladder;* and the *third*, the *Spermatic vessels* and ducts, with the vesiculæ seminales in the male, and the uterus, ovaries and Fallopian tubes, and the vagina in the female.(*a*) In other words, the belly, as it is vulgarly called, contains the *viscera*, which term not only includes the bowels or entrails, but also all the organs in that cavity, such as the liver, spleen, pancreas, mesentery, and omenta,(*b*) as well those which are for the purpose of receiving and digesting the food as the organs for the secretion of the urine, namely, the kidneys. The generative organs will be considered hereafter in a subsequent chapter, as attached to another function than that we are now examining. Some elementary writers upon anatomy divide the abdominal viscera under two heads, as, *first*, the *membranous viscera*, namely, the stomach, and then the different parts of the small and great intestines, the gall bladder, mesentery, the mesocolon and ligamentous processes, and the omenta; and, *secondly*, what are termed the *solid viscera*, namely, the liver, spleen, and pancreas.(*c*) The stomach, intestines, gall bladder, and bladder of the urine, have muscular coats, and the power of contracting their cavities; while the liver, spleen, pancreas, and kidneys have no muscularity excepting in their vessels and excretory ducts, a distinction important to be kept in view.(*d*) But there are other distinctions to be observed.

The intestinal canal in general.

The *Intestinal Canal* is divided into three parts, namely, first, the *stomach;* secondly, the *small intestines;* and, thirdly, the *great intestines.* The small intestines, again, are subdivided into the duodenum, jejunum and ileum. The great intestines are subdivided into the cæcum, colon, and rectum. The stomach is the principal seat of the *digestive* process; and in the *duodenum* the chyme receives the addition of the secretions from the liver and pancreas, and is still further changed in the long tract of the jejunum and ileum; the nutritious part is absorbed by the lacteal and other absorbent vessels (fully considered (*e*) in the next chapter;)

(*t*) Coop. Dict. tit. Hernia.

(*u*) 2 Good, 454.

(*x*) See Coop. Dict. tit. Wounds, where see treatment. 1 Gib. Surg. 143.

(*y*) Coop. Dict. tit. Wounds.

(*z*) At the time when duelling with swords was so frequent in France many instances of this danger occurred; and a well authenticated anecdote is narrated of a gentleman, who had in a rencontre been perforated and pinned to the wall by his antagonist, immediately very coolly begging, as a particular favour, that the latter would be so obliging as to wipe the point of his sword before he withdrew it, lest the wound should be rendered more dangerous.

(*a*) 2 Horn. Anat. 6.

(*b*) Amer. Cyclop. Prac. Med. tit. Abdomen.

(*c*) 3 Bell, 266, 267.

(*d*) Id. 267.

(*e*) Post.

and, finally, in the great intestines. The refuse parts of the aliment unfit for nutrition, becoming fæces, are carried slowly downward, suffering a further absorption of fluid, and lodge in the lower part of the colon, and then are retained a short time in the rectum, or last division of the canal, and are finally expelled.(*f*) From this general view it is apparent that each division of the intestinal canal is marked by some peculiarity in its use or function, and that we must therefore carefully examine their minute structure as individual parts, at the same time we must not forget the universal connexion, or the integrity of the circle of actions, and the economy *as a whole*. With this precaution, and following the natural course of the food, which we have traced below the diaphragm, we have now *first* to consider the *stomach*.(*g*)

4. The stomach.(*h*)

The *Stomach* is that hollow capacious membranous bag into which the food is delivered through the œsophagus, and in it is performed the important renovating process of *digestion*, consequently, in point of importance, it stands in the first rank of organs.(*i*) It has been termed one of the most capricious organs of the entire system,(*k*) and from this and other circumstances the ancients considered the stomach, and especially its pylorus, as the seat of the soul.(*l*) Its form is somewhat conical, being also curved so as to incline downwards and forwards.(*m*) Some describe it as resembling a large leathern bottle; others as the pouch of a bagpipe, or the tube of a hunter's horn; and others, perhaps more accurately, as resembling a sportsman's curved powder horn. It is capable in the adult of containing without difficulty *three pints and upwards* of liquid, and is capable of greater extension, and even from five to eleven pints.(*n*) Whilst the circular fibres of the stomach, which in their utmost extent and dilatation may be expanded even to a foot in circumference, or four inches in diameter, may after much fasting be reduced to the circle of an inch,(*o*) and it has been supposed that repeated over distention, or the deglutition of indigestible food, will increase the actual capacity of the stomach, though that notion has been contradicted.(*p*) At all events, it is established that the membranous substance of the stomach is peculiarly distensible, and its muscular fibres give it a high degree of contractility, and by these means the bulk of the stomach is always exactly adapted to its contents.(*q*)

Orifices of the stomach, the cardiac and pylorus.

The stomach has two openings or orifices, the one receiving, and the other discharging the food, namely, the *superior*, called the *cardia*, at which the œsophagus, folded and opening obliquely into the stomach, is placed, towards the left side of its fundus; whilst the *inferior*, called the *pylorus*, (from the Greek word πυλωρος, custos,) is that end at which the *right* and narrower part of the stomach terminates, and which descends somewhat into the cavity of the duodenum.(*r*) The *cardiac* is most capacious, its upper side or border is concave, and is termed the *lesser curvature*, extending from the œsophagus to the pylorus, and is only about three inches in length, whilst its lower border or side is convex, and is termed its greater curvature. The cardiac orifice is the chief seat of all sensations of the stomach, both natural and unusual, as it is the most sensitive

(*f*) 3 Bell, 267, 268.
(*g*) Id.
(*h*) See, in general, 3 Bell, 272 to 294; 1 Good, 7, 8; 2 Horn. Anat. 22 to 27; El. Blum. 319 to 352, 354; 3 Paris, Index, tit. Stomach; 2 Bost. 346 to 352, and note and authors there referred to.
(*i*) 3 Bell, 272 to 294; 1 Dungl. Phy. 421.
(*k*) 1 Good, 140.
(*l*) 2 Bost. 351, note.
(*m*) 2 Horn. Anat. 22.
(*n*) El. Blum. 319; 1 Good, 7; 3 Bell, 275; 1 Dungl. Phy. 421.
(*o*) 4 Good, 225.
(*p*) El. Blum. 306.
(*q*) 2 Bost. 349.
(*r*) El. Blum. 319; 1 Good, 7; 2 Horn. Anat. 23; 3 Bell, 273; 1 Dungl. Phy. 421.

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part of the stomach, it being provided in a peculiar manner with nerves, the branches of the par vagum,(*s*) and this upper orifice has power of contraction on the application of unusual stimulus.(*t*) The *cardia* is liable to the disorder *cardialgy*, (or *cardialgia*,) which occasions an impaired appetite, with a gnawing or burning pain in the stomach or epigastrium, and a tendency to faint, and is of three varieties, called heart-burn, sinking heart-burn, and black-water, or water brash.(*u*) The *pylorus* is an *annular* fold, consisting, not like the other rugæ of the stomach, of merely the villous, but also of fibres derived from the muscular and nervous coats of the stomach; all these connected form a *conoidal* opening or circular ring of muscular fibres, which may be compared to a sphincter muscle, at the termination of the stomach, projecting into the duodenum, and in a manner embraced by it, so as to retain the food until it is in a proper pulpy and chymous state for being discharged.(*x*) This lower opening contracts and relaxes according to the state of the chyme in the stomach, and, as it were, refuses to relax or pass the food into the duodenum until it has been properly digested, and sometimes rejects and returns the food with so much force as to occasion *vomiting*.(*y*)

Coats of the stomach.

The *coats* of the stomach, according to Blumenbach, are *four*, separated by the intervention of three others, which are merely cellular. The first or *external* is the membranous, the second muscular, the third *nervous*, and the *interior* villous;(*z*) whilst others divide them into the outer, the muscular, the nervous, the villous, and three cellular coats;(*a*) and others state that the stomach is composed of *three* coats, connected together by two lamellæ of cellular tissue.(*b*) These accounts will be found not to differ substantially, and are merely verbal.(*c*) Dr. Bostock states that the structure of the stomach may be considered physiologically as threefold.(*d*) The *muscular* coat is not, like the other muscles of the body, constituted of long straight fibres, but like the heart and bladder is composed of irregular interlacing fibres, and which obviously serve to promote the contraction of this organ in *every* direction, so as to diminish its size in all its dimensions.(*e*) The stomach is lined internally with a mucous membrane, which appears to be more immediately connected with its secretions.(*f*)

The blood vessels and glands of the stomach.

With respect to *blood vessels*, few parts are more largely supplied with them than the stomach;(*g*) and this is essential, since it is well established that digestion can only be performed by blood in a peculiar state being conveyed to the minute arteries of the stomach, after it has received its proper action in the lungs.(*h*)

The stomach, it is also supposed, is furnished with *glands*, and from which indeed it is conceived the gastric juice is secreted, and oozes into the stomach;(*i*) though it has been observed that such glands have not been demonstrated.(*k*) It is said that these glands are small but in great numbers, especially around the termination of the œsophagus, and near the cardiac orifice of the stomach.(*l*)

(*s*) 3 Bell, 293, 272; El. Blum. 322, 323; 2 Bost. 350, and authorities there referred to; 1 Dungl. Phy. 423, 424.

(*t*) 3 Bell, 278, 280, note.

(*u*) 1 Good, 115, 116; see Copland's Dict. Prac. Med. tit. Cardialgia, and tit. Indigestion. Brous. Pathol. 204.

(*x*) El. Blum. 322; 2 Horn. Anat. 23; 3 Bell, 276; 2 Bost. 351, 352.

(*y*) 3 Bell, 278.

(*z*) El. Blum. 320, 352, 354; 2 Horn. Anat. 24, 27.

(*a*) 3 Bell, 275.

(*b*) Quain's El. 503; G. Smith, 550.

(*c*) 2 Bost. 347.

(*d*) Id. 2 Horn. Anat. 25.

(*e*) 1 Bost. 311, 312.

(*f*) 2 Bost. 347.

(*g*) 1 Good, 7; 2 Bost. 350.

(*h*) 2 Bost. 248.

(*i*) 3 Bell, 286; 2 Bost. 349, 381, and note.

(*k*) 2 Bost. 350, infra; but see 1 Dungl. Phy. 481, 482.

(*l*) 3 Bell, 286.

The nerves of the stomach.

The stomach is also amply supplied with *nerves* from each part of the nervous system, and especially with branches of the par vagum, principally over the cardia, whence the great sensitiveness or sensibility of the stomach, especially of the cardia, and which is so readily affected by all kinds of stimuli, whether external, as cold, or internal, as food and its own fluids, *or mental;* whence also the great and surprising sympathy between the stomach and most functions of the system to which sympathies are referrible, and the influence of all passions upon the stomach, and the healthy condition of the stomach upon the tranquillity of the mind.(*m*) Its nerves are derived from the semi-lunar ganglion of the sympathetic, and from the terminal branches of the par vagum.(*n*) It not only partakes of ganglionic nerves with the neighbouring viscera, but it likewise derives another supply of nerves from the spinal cord, and is distinguished from every other part, except the organs of sense, by having a pair of cerebral nerves *almost entirely devoted to it*, though it is situated at so great a distance from the brain.(*o*)

The position of the stomach.

The stomach occupies part of the left hypochondriac epigastric region, and lies under the margin of the ribs of the left side, and its greatest extremity on the left side is in contact with the diaphragm, but towards the right the long edge of the left lobe of the liver is between it and the diaphragm.(*p*) But its position in situ varies accordingly as it is in a state of repletion or depletion; for when *empty* it is flaccid and shrivelled, and hangs into the cavity of the abdomen, its greater curvature inclining downwards, while the pylorus, being directed upwards, forms, by doubling, an angle with the duodenum; but when *full*, the larger curvature is rolled forwards, so that the pylorus lies more in a line with the duodenum, while the cardia on the contrary is folded, as it were, into an angle and closed.(*q*) When the stomach is distended with food, a large part of its contents are below the level of the pylorus, so that it must require a considerable force of muscular contraction in the stomach to discharge its contents into the duodenum, and in which it is probably aided by the diaphragm and the abdominal muscles.(*r*) By this happy arrangement, whilst the food is undergoing the process of complete digestion in the stomach, its pressure upon and return through the cardia into the œsophagus is prevented, as well as its pressure upon and too hasty discharge through the pylorus.

5. Of the gastric juice.

The arteries, ramifying infinitely upon the cellular membrane and glands of the stomach in their capillary extremities, *secrete* that peculiar liquid termed the *Gastric Juice*, which is considered to continually ooze from the inner surface of the stomach,(*s*) and has been supposed to proceed partly from such extreme arteries and partly from the glands.(*t*) But although it is admitted that this secretion arises from the renovated blood passing from the lungs very soon after it has been aerated, into and through the capillary arteries of the stomach, yet the precise manner in which it is created has not, it is stated, been explained.(*u*) Dr. Bostock observes, that although the stomach has been supposed to possess glands that secrete

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(*m*) El. Blum. 320, 321, 327; 3 Bell, 293; 1 Good, 19; 2 Bost. 350; 1 Dungl. Phy. 423, 424.

(*n*) 2 Horner, Anat. 27; 1 Dungl. Phy. 423.

(*o*) 1 Good, 7; 2 Bost. 350.

(*p*) 3 Bell, 273; 2 Horner, Anat. 6.

(*q*) El. Blum. 319; 3 Bell, 274; 2 Bost. 352, note.

(*r*) 2 Bost. 351, 352, and note.

(*s*) El. Blum. 321; Brous. Phy. 314; 2 Bost. 349, 381 to 383; 1 Good, 13, 14; 3 Bell, Anat. 287. Cheselden led to this discovery, and Haller and others established it, 1 Good, 13; 2 Par. & Fonb. 164, &c.

(*t*) Id., excepting 2 Bost. 349.

(*u*) 2 Bost. 248. But more recently these minute vessels have been traced from the aorta and other smaller arteries near the heart into the stomach. See Quain's El. 2d edit. 595.

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the gastric juice, yet the existence of any distinct glands for that purpose is rather inferred from the effects which it is supposed that they produce through the intervention of their secretions, than from our being able to demonstrate their existence.(*v*) In its general composition this fluid is analogous to saliva; it is equally antiseptic, very resolvent, and capable of again resolving the very milk which it has immediately before coagulated. It is acid.(*x*) When pure it is a pellucid mucilaginous liquor, a little salt and brackish to the taste, like most other secretions, and having the power of retarding and completely suspending putrefaction and dissolving the food.(*y*) Some experiments have established that the gastric juice contains water and an animal substance, "savoneuse et gelatineuse," muriate of ammonia, and an earthy matter, similar to what it is said is found in all animal fluids;(*z*) also a little volatile salt, and a large quantity of a muriatic salt; and it tastes salt and bitter, and frequently acid. Dr. Bostock observes, that it is not a little remarkable that when the gastric juice has been examined, with relation to its chemical properties, nothing has been detected in it which appears adequate to the effects we observe to be produced, and that it seems to resemble saliva, or the ordinary secretions of the mucous membrane.(*a*) The two principal characteristic properties of gastric juice are its astonishing antiseptic power of counteracting putrefaction, and of dissolving the toughest and most rigid substances in nature.(*b*) In consequence of the first property, game, and some other food in the most putrified state, may be eaten with impunity; and the introduction of the gastric juice of animals into the human stomach has sometimes been found a most effectual remedy in cases of indigestion from a debilitated stomach; and it operates externally as a check to gangrene, and also as a stimulus to indolent ulcers:(*c*) and, as regards the latter property, it is so powerful a solvent that bones, and even the handles of clasp knives, have been found half digested, and the blades themselves blunted in the stomach and intestines of a man who had some time previously swallowed them.(*d*) It has been observed, that this juice acts by corroding and dissolving the bodies received into the stomach, and that it is itself at the same time converted into a new fluid distinct in its properties.(*e*) The power of this juice is so great, that it has been found to have in part destroyed the stomach itself; but this, it is said, is only in case the stomach has been previously in a diseased state, or after death;(*f*) and the power of worms in the stomach and alimentary canal to resist the digestive effect of the gastric juice is attributed to similar previous disease of the stomach, and its incapacity to secrete gastric juice of full vigour and activity.(*g*) The gastric juice, however,

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(*v*) 2 Bost. 349; id. note, citing Haller's El. Phys. xix. 1, 14; Bell's Anat. 58. But see 3 Bell's Anat. 286, 287, and 2 Bost. 381, as to the *glands*.

(*x*) El. Blum. 321, 323; 1 Good, 15. It is upon the coagulating power of the gastric juice from the surface of the stomach of a calf that the power of making *cheese* depends. A very small piece of what is termed *rennet*, not even of the size of a finger, and which consists of *the infusion of a part* of the digestive stomach of a calf, which has been well kept in brine for a fortnight or three weeks, and then dried, and such small piece cut off and placed in three or four quarts of milk, will convert the albuminous part of it into the state of curd, and which is formed into cheese by pressing out the more fluid part, 2 Bost. 382 to 386; El. Blum. 323, 324; 1 Good, 15; 2 Bost. 381, note, and 385, note.

(*y*) 3 Bell, 287; El. Blum. 323, 324; 1 Good, 15; 2 Bost. 382 to 386.

(*z*) 2 Bost. 381, note, and 385, note.

(*a*) Id. 382. See Jackson, Prin. Med. 345 to 348.

(*b*) 1 Good, 16.

(*c*) Id. 16.

(*d*) Id. 17; 2 Bost. 384; but yet the skins of fruit and the finest fibres of flax or cotton will not be affected by it, ibid.

(*e*) 3 Bell, 289.

(*f*) G. Smith, 52; El. Blum. 323, 324; 1 Good, 18; 3 Bell, 289, 290; 2 Par. & Fonb. 166, 167; 2 Bost. 378; end of note, 408.

(*g*) 1 Good, 18.

it seems, will only act upon dead substances, and not upon living animals introduced into the stomach, and which may account for the presence of living animals in the stomach and intestines, even of healthy persons.(*h*) The professors Tiedemann and Gmelin, from their recent experiments and observations upon the dog and horse, collected, that not only the quantity but the nature of the gastric juice secreted by their stomachs is considerably affected by the vital actions of the part, either as excited by food, or even by mechanical irritation, and that in this latter state it always exhibits acid properties, and contains the muriatic and acetic acids in their uncombined state; and they conceive that the *acetic acid is* always present in gastric juice; and to this is referred the *lactic acid*, which has been said to have been detected in the stomach.(*i*.) They further conclude, that the obvious result of their experiments is, that the digestion of aliment in the stomach consists in its solution in the gastric juice, and that by this agent all kinds of food, both those that consist of single proximate principles, and those that are composed of various principles, are dissolved; that water alone, at the temperature of the body, is capable of dissolving many of the articles employed in diet; and a considerable number of the substances which are not soluble in water are so in muriatic and acetic acid, at an elevated temperature, and to these the principal part of the effect is described; and Dr. Bostock has sanctioned these opinions with his concurrence.(*k*)

Quantity of gastric juice.

It has been supposed that the quantity of this fluid thus secreted is generally about a pound in every twenty-four hours; but that the quantity in health, and still more in disease, varies very considerably according to the demand of the system, or the state of the stomach itself.(*l*) The quantity also greatly depends upon and is affected by the state of the *nervous system;* so that according to its excitement or depression, the fluid appears to be produced in greater or less quantity, the functions of the stomach being proportionably depressed, or even entirely suspended.(*m*)

6. Of digestion in general, and the inception of chyme and chyle. (*n*)

Digestion may be defined to be that operation which converts the aliment, mixed of solids and liquids of various kinds and saliva, from its original masticated state, first into chyme and then into chyle, and separating and absorbing the nutritious parts of the latter, and carrying off the useless parts by evacuation. By proper mastication and trituration, and the union of the saliva with the food in the mouth, it is prepared for the more ready action of the stomach upon it. In the stomach the first change, and probably the most material, is performed, and which, by the succession of actions, fits the nutritious matter for being received into the circulation of the fluids of the living body, *assimilated with the blood,* and for becoming component parts of the animal; for in the stomach the gastric juice, acting on this pulpy mass, quickly dissolves the digestible parts, and, entering into union with it, produces a new mixture called *Chyme*, which is a thick or viscid and turbid fluid. The mass has then changed its sensible and chemical properties, though by means not as yet satisfactorily accounted for. It has suffered the full action of the stomach, and by the gradual and successive muscular action of this organ it is sent into the duodenum. The food has been thus converted into chyme by the operation of the gastric fluid, by an operation peculiarly

(*h*) 2 Par. & Fonb. 164, 165; 2 Bost. 408.

(*i*) Recherches Experimentales sur la Digestion, Traduites par Jourdan, vol. i. p. 166, 167; and see 3 Bost. 335, and Dr. Prout's Observations in Ann. Phil. vol. 12, p. 406.

(*k*) Id. 363; 3 Bost. 335, 336, 338.

(*l*) 1 Good, 14.

(*m*) 2 Bost. 323.

(*n*) See Copland's Dict. Prac. Med. tit. Indigestion.

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animal, a process of life. The contents of the stomach consist of air, (partly swallowed, partly extricated by chemical change, but still more in all probability by the heat,) and of chyme, and of a grosser part, incapable of becoming nutritious, and the separation of which from the chyme is afterwards accomplished by the subsequent action of the canal. Now the stomach being stimulated by fulness, by flatus, and still more by the peculiar irritation of the food prepared by digestion, the muscular coat of the stomach is brought into action, and its contents are delivered into the duodenum.(*o*) We have perceived that digestion is principally performed by the gastric juice. The food, when properly chewed and deglutinized by the saliva, is, when carried into the stomach, dissolved by the gastric juice, and converted into the pultaceous chyme, so that most kinds of ingesta lose their specific qualities, and are defended from the usual chemical changes to which they are liable, such as putridity, rancidity, &c., and acquire fresh properties preparatory to *chylification* in the smaller intestines, and have become neither acid nor alkaline.(*p*) It is further established that digestion depends in some degree on the nervous function, or at least depends upon the immediate and direct agency of the nerves.(*q*)

Peristaltic and anti-peristaltic and other motions.

It is further supposed that the important function of digestion is assisted by various accessary circumstances; such as, amongst others, the *peristaltic motion* (or more properly the *vermicular*) of the muscular fibres of the stomach,(*r*) which, being constant and undulatory, agitates and subdues the pultaceous mass of food and drives the thoroughly dissolved portion downwards, whilst those portions which are not completely acted upon are repelled from the pylorus by an antiperistaltic motion.(*s*) The vermicular motion of the stomach is that alternate contraction and relaxation of the muscular fibres, by means of which its different parts are successively brought into action. This motion is evidently intended *to turn over and mix* all the parts of the alimentary mass intimately together, and to apply each portion in succession to the surface of the stomach, so as to bring it into contact with the gastric juice;(*t*) though, as we shall presently see, the fresh food is kept distinct from that previously received.(*u*) This motion is principally produced by the contraction of the circular or transverse fibres, while it is probable that the longitudinal fibres have more effect in propelling the contents of the stomach from the cardia to the pylorus.(*x*) We have seen that the contraction of the diaphragm in inspiration, and the return of that organ to its quiescent position, perpetually presses upon the viscera of the abdomen, and materially assists in digestion.(*y*) The other aids commonly enumerated are, *first*, that the muscular tunic of the stomach acts upon the food by a slight contraction of its fibres, and which, in connexion with a certain degree of pressure, derived from the surrounding organs, produces, so far as this cause operates, a mechanical resolution; and, *secondly*, that the high temperature of mankind in the stomach (about 100) produces a concoctive resolution.(*z*) In this manner the masticated and moistened food is converted into *chyme*, after which it passes into the duodenum and becomes mixed with secretions, (namely, pancreatic juice and bile,) poured into that organ from the pancreas, the liver and the duodenum itself, and is there con-

(*o*) 3 Bell, 290.
(*p*) El. Blum. 321; 3 Bell, 290, 291.
(*q*) Jackson, Prin. Med. 355.
(*r*) Id.
(*s*) El. Blum. 331, 322; 3 Bell, 278, 291, 292; 1 Dungl. Phy. 500.
(*t*) 2 Bost. 389.
(*u*) Post, 190, n. (*b*,) 191.
(*x*) 2 Bost. 389.
(*y*) Ante, 111.
(*z*) 1 Good, 12; El. Blum. 322; 3 Bell, 291, 292; 1 Dungl. Phy. 484, &c.

verted into *chyle*.(*a*) The *nerves*, namely, the *par vagum*, have also influence on digestion; for if divided in the neck, (though not so if elsewhere,) it has been found that the formation of chyme was either very imperfect or quite prevented.(*b*)

It was formerly supposed that *fermentation* and *trituration* (rubbing to powder) were the causes of digestion; but that doctrine is now exploded, and it is established that there are no signs of fermentation when digestion is perfect, and that it is completed, although the parts of the food be kept separate from each other.(*c*)

Time and course of digestion.

During health the stomach does not transmit the digestible food before it has been converted into a *pulp*. The difference of the various descriptions of food must, therefore, evidently cause a difference in the period necessary for complete digestion; and hence, in all probability, the great importance that persons of weak digestion should partake principally of light and readily digested food, and be very careful to masticate thoroughly each morsel. The time of digestion will also vary according to the quantity of the ingesta, and the more or less complete previous mastication and the strength of the digestive powers. It may, however, be stated generally that the *chyme gradually* passes the pylorus between *three to six hours after the meal;* (*d*) previous to which, it is conveyed with rather a sudden impulse into the pyloric extremity of the stomach, where the process of chymification is completed.(*e*) But the digestive process does not go on equally through the whole mass of food, but takes place chiefly where the food is in contact with the stomach, and proceeds gradually from the surface to the centre of the mass, so that the food at the centre is entirely different from that at the surface, and as soon as a portion is reduced to a homogeneous consistence, it passes into the duodenum, without waiting till the same change has pervaded the whole.(*f*) The cardiac portion of the stomach is the chief seat of the process; and when a part of the food has been tolerably digested, it passes along the large curvature to the pyloric portion, where the process is completed.(*g*)

Digestion is commonly supposed to take place in the stomach alone; but this is an erroneous view, though the stomach may be regarded as the chief link in the great associate chain. In the stomach the food is only broken down into the pultaceous mass called chyme, and thus converted into the mixed principles of oil, gelatine and sugar, and little else; for though we have some traces of animalization, they are rudiments, and nothing more; yet this, which is the first, is the most important stage of digestion, and its perfection depends upon the vital power. Where that is small or enfeebled, the process of chymification is necessarily impaired or interrupted. If the remarkable machinery of the stomach, which finds no parallel, not only without the body, but in any other part thereof, is disturbed or impeded in its operation, its fluids are then poured forth too sparingly or too inconditely.(*h*)

Gas and air in the stomach and intestines.

Besides the portions of air swallowed, gas is created in the stomach, containing besides azote and carbonic acid gas, oxygen, and very little hydrogen; while the gas of the small intestines contains, besides the two former gases, no oxygen, but abundance of hydrogen; and the gas of the large intestines has less hydrogen and carbonic acid, and likewise no

(*a*) 1 Good, 12.
(*b*) Id. 19; El. Blum. 327.
(*c*) El. Blum. 323; 1 Good, 13, 14; 2 Bell, 277, 288, 289; 1 Dungl. Phy. 485.
(*d*) El. Blum. 322; 3 Bell, 291; 292.
(*e*) 2 Bell, 291; 2 Paris & Fonb. 171, 172.
(*f*) Prout on Digestion, in Annals of Philos. 1819; El. Blum. 323, 324; 1 Good, 20; 2 Bost. 378, note and post.
(*g*) El. Blum. 324; 1 Good, 20; 3 Bell, 291.
(*h*) 1 Good, 136.

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oxygen. Not unfrequently gas is found in the stomach during chymification.(*i*) The gases are probably disengaged from the contents of the canal; but it is supposed that the canal itself often secretes gaseous fluids; for mental emotion will suddenly cause extreme discharges of air from the stomach, and the intestines to swell with wind.(*k*)

7. Chyme and its formation.

We have already stated that the food acted upon in the stomach by the gastric juice, and the peristaltic contractions of the stomach, is completely changed in its properties, and is converted into *chyme*. This is not always of the same quality, its properties depending very much upon the nature of the food. The general result is that all the animal principles, except liquid albumen, undergo a total change in their elementary constitution during *chymification*, and which change generally consists in their being made to approach nearer or to assimilate in their nature to albumen.(*l*) The chyme, whilst in the stomach, and before it has been affected in the duodenum by the *pancreatic* juice and bile, is a grayish pultaceous turbid mass,(*m*) and the chyme thus formed has undergone an animal process, becoming neither acid nor alkaline.(*n*) But Dr. Bostock has supposed that the generation of acid in the stomach is a necessary part of the digestive process, and contributes in some way to the formation of chyme.(*o*)

It has been further considered that the more recently supplied food is always kept distinct from that previously received into the stomach, and that the former is in the centre of the latter, and the food is naturally more digested the nearer it is in contact with the inner surface of the stomach, whilst it is the least digested in the small curvature, and more digested at the larger end, and still more in the middle of the great curvature. The state of the food in the cardiac differs from that in the pyloric portion; in the latter it is more completely digested and more uniform in its consistence; it is also more compact and dry in this part. It appears that the act of digestion is principally performed at the large end of the stomach; that the mass is gradually moved forwards to the small end, becoming more digested as it advances, and we may, therefore, presume that the secretion of the gastric juice principally goes on at the large extremity, and that its chemical action on the aliment takes place in that part whence it is slowly propelled to the pylorus. It is accordingly the great end of the stomach, which is found to be digested after death, by the action of the gastric juice upon it.(*p*)

Passing of the chyme into the duodenum.

When, from the circumstance of a great quantity of food having been successively and rapidly received into the stomach, it has become greatly extended, the two orifices are drawn horizontally upon each other and upon the œsophagus and duodenum, so that sometimes a difficulty is produced of the stomach discharging its contents when greatly distended, the orifices being in a great measure turned from the œsophagus and duodenum.(*q*) Hence the inexpediency of taking too much food at a time, which may, until the discharge through the pylorus into the duodenum has gradually relieved the stomach, produce at least a temporary inconvenience.

(*i*) El. Blum. 356, where see the calculations; see also 2 Bost. 387.

(*k*) El. Blum. 358.

(*l*) 1 Good, 21; 3 Bell, 288, 289, 237; 2 Bost. 379, 387.

(*m*) 3 Bell, 210, 269, 291, 296.

(*n*) 2 Bell, 291, 296.

(*o*) 2 Bost. 388; and see 3 Bost. 334 to 339, as to the presence in the stomach and in gastric juice of acetic, and muriatic acids in the secretions of the stomach.

(*p*) Dr. Philip, Inq. Ch. Lect. 140, 155; 2 Magendie, Phys. 81, 82; 2 Bost. 378.

(*q*) 3 Bell, 274.

It frequently is necessary to ascertain, in cases of death under suspicious circumstances, whether it is attributable to poison, and it will be essential to describe after dissection the difference in the *appearance* of the stomach in case of death by natural means, and in those of death occasioned by poison. The action of *corrosive poison* will, on dissection, generally be seen in the *inflamed state* of the villous coat of the stomach.(*r*) The observations and plates in Dr. Christison's work, taken from actual stomachs inflamed by different poisons, and the one of a deep red, and the other green, are exceedingly illustrative, and will, in the second part, be fully examined. Dr. G. Smith observes that, with regard to the stomach, where death has occurred from sudden affection of that organ, we may or may not meet with conclusive appearances; for sickness must, in the great majority of instances, in which this organ has been the seat of disease, precede dissolution, a circumstance that necessarily takes the case from among those of a criminal nature; and he says that we are indebted to Dr. Hunter and Dr. Yellowly and others for a caution as to certain appearance in the stomach of persons who have died by violence, or suddenly in the healthy state; and it appears from their observations that the gastric juice in such cases may even dissolve the substance of the stomach, and that great vascularity, liable to be construed into inflammation, and to be considered in some cases as the consequence of deleterious ingesta, is generally found in such cases.(*s*) In case of death from corrosive poisons, besides other symptoms, in examining the interior of the œsophagus and stomach, the following appearance will generally be presented. The parts over which the poison has passed will be found more or less excoriated, if the texture be not destroyed. In the stomach and sequent intestines there are generally marks of the most violent inflammation, indicated by destruction of the villous coat, and even extending to gangrenous spots and eschars, nay, frequently to perforations. In various parts of the intestinal canal constrictions also are found, and ulceration is often observed in the colon. Separation of the coats of the intestines likewise takes place, and this circumstance has been considered conclusive. But cases have occurred in which detachment of the villous coat of the stomach and intestines has taken place, without the slightest ground to suspect the administration of poison.(*t*) On the other hand, it is often the case, where a small quantity of corrosive poison has been swallowed, or where the greater part has been rejected by vomiting, that there are no distinct traces of it until the examination of the larger intestines.(*u*) As to narcotic poisons, such as laudanum, prussic acid, &c., which affect the system, especially the nervous system, with torpor or stupor, they do not seem to act upon the structure of the parts to which they have been applied, but destroy by absorption, and will not be observed on the examination of the coats of the stomach.(*x*)

CHAP. VI. SECT. III. DIGESTION. Appearances of stomach in various states.

The Stomach, even when in a healthy state, is subject to *irregular* performances of its function. Sometimes there is a peculiar sensation in the stomach, called *Nausea*, which frequently exists alone, and does not terminate in actual vomiting. This is excited by disgust even at the sight or smell of certain articles, or in pain, by sympathy of the stomach with other organs not in health, or by general derangement or disease of the

Irregularities, diseases, and *disorders* of the stomach, and incidents

(*r*) 2 Par. & Fonb. 163, 164, 175, 176, 230, 393; Ryan, Med. Jur. 204, 205.

(*s*) G. Smith, For. M. 52, 549, 550; 2 Paris & Fonb. 162 to 182, some valuable observations; 3 Paris & Fonb. 61 to 63 2 Beck's Med. Jur. 157, 158.

(*t*) G. Smith, 71, 72; 2 Paris & Fonb. 174; Ryan, Med. Jur. 204.

(*u*) Id. 72; 2 Beck, 274.

(*x*) G. Smith, 73, 74; 2 Paris & Fonb. 393; Ryan, Med. Jur. 238.

CHAP. VI. SECT. III. DIGESTION. in general. 1. Nausea. (*y*)

stomach, or by turning round or swinging, or very generally from the motion of a ship, and from the latter cause, it has been supposed, it takes its name (*i. e.* ναυσ, navis, a ship.) During nausea the pulse is small, the temperature low, and the head giddy, and a large quantity of fluid is secreted.(*z*) It is accompanied by a general disturbance of the different functions of the body, as well as a diminution of the powers of the muscular and nervous systems, and when it is continued for any length of time, it produces an effort to vomit,(*a*) which, if ineffectual or interrupted, is termed *Retching.*(*b*)

2 Retching.

3. Vomitting.(*c*)

When nausea increases to a *considerable extent*, it usually terminates in *vomiting;*(*d*) this, however, ensues in other cases. Vomiting is a rejection and returning of the food, and ensues when there is an unusual or unnatural irritation in the stomach, or when it is violently stimulated or opposed in its natural course of action; and the motion becomes inverted, and drawing, by sympathy, other muscles to its aid, the contents of the stomach are evacuated by vomiting, which consists in an inversion of the peristaltic motion of the stomach, beginning at the pylorus and proceeding to the cardiac or œsophageal end, by which the contents are carried back into the œsophagus, and finally rejected from the mouth. Although the action commences in the muscular fibres of the stomach itself, it is promoted by the co-operation of the muscles of the abdomen and the diaphragm, which contribute very considerably to the ultimate mechanical effect.(*e*) This may occur, *first*, where the food undergoes changes inconsistent with healthy digestion; or, *secondly*, when solid matters lodge in the stomach, and the pyloric fibres refuse the necessary relaxation, and throw back the food; or, *thirdly*, when secretions of the duodenum pass into the stomach through the pylorus, or when unusual actions are propelled backwards upon the stomach, from the upper portion of the canal; or, *fourthly*, where emetics are taken, which act as unusual stimuli; or, *fifthly*, when there is inflammation in the stomach, which, from giving greater sensibility, produces the same effect as more violent stimuli; or, *sixthly*, when the coats of the stomach are corroded or ulcerated.(*f*) To these have been added, *seventhly*, certain irritations applied to various parts of the body, more or less remote from the stomach, but connected with it either by the intervention of the nerves, or in some way which cannot as yet be satisfactorily explained, although their operation is constantly observed. Amongst these may be enumerated certain affections of the brain, the motion of a vessel at sea (which has of late been attributed to a change in the distribution of the blood, the descending motion of the vessel tending to cause an accumulation of blood in the brain;) (*g*) certain visible impressions upon the retina; peculiar flavours and odours; certain medical agents when applied to *other* parts of the body, as to the fauces, the rectum, or even to the external surface; calculi in the kidneys, and hernia of any part of the intestinal canal; and, *eighthly*, to mental impressions of various kinds, depending altogether or in a degree upon association.(*h*) In all these cases vomiting may be produced.(*i*)

(*y*) See, in general, Copl. Dict. tit. Digestive canal.

(*z*) El. Blum. 327; 1 Good, 128; 1 Dungl. Phy. 519.

(*a*) 2 Bost. 420.

(*b*) 1 Good, 128.

(*c*) See, in general, 1 Dungl. Phy. 518, to 526.

(*d*) El. Blum. 327; 1 Good, 128; 2 Bost. 420.

(*e*) 2 Bost. 420, n. where the disputes upon this subject are stated.

(*f*) 2 Bell, 278, 282.

(*g*) 2 Bost. 421; and Dr. Wollast. Phil. Trans. for A. D. 1818; 1 Dungl. Phy. 518, to 526.

(*h*) 2 Bost. 422.

(*i*) 3 Bell, 282, 278.

In these cases, the stomach, diaphragm, and abdominal muscles have been usually considered as concurring in the rejection and expulsion of the food, though it has been disputed that the diaphragm is concerned.(*k*) Dr. Hall, in his recent publication, has argued that there is no connexion between the act of vomiting and the state of the organs of respiration, and that the diaphragm is passive in the operation, and the larynx is closed, and hence he concludes that vomiting is a modification of expiration, or that the muscles of expiration, by a sudden and violent contraction, press upon the contents of the stomach, and propel them through the œsophagus.(*l*) But Dr. Bostock observes, that, though this view of the mechanism of vomiting is correct, provided we add a previous step of a sudden and violent inspiration, yet that this mechanical action would be incapable of producing vomiting, were not the state of nausea previously induced on the stomach itself, which primarily affects the muscular fibres of the stomach, probably through the intervention of the nerves.(*m*) It is clear that the nerves are concerned in vomiting, because, if the par vagum nerve be divided, although there may exist nausea, no vomiting will ensue.(*n*)

It has been observed, that the full action of vomiting is preceded by inspiration, which seems a provision against the violent excitement of the glottis, and the danger of suffocation from the acrid matter of the stomach entering the windpipe, for, by this means, the expiration and convulsive cough accompanying or immediately following the action of vomiting, frees the larynx from the ejected matter of the stomach.(*o*)

Vomiting is to be carefully avoided by all practical means in certain cases, as when the œsophagus or trachea have been wounded, or are ulcerated or injured by disease, or there is danger of rupture of some blood vessel. In other cases it may be useful, and is frequently resorted to as a remedial process.(*p*)

4. Eructation and belching, &c.

The contents of the stomach consist partly of *air*, and the residue of the chyme; such air is partly extricated by chemical change, but still more in all probability by the heat, and this, in the ordinary process of digestion, is carried into the duodenum, and sometimes through the whole channel of the intestines, without its passage being perceptible.(*q*) But from hurried deglutition and want of proper timely suppression, or from habitual indulgence, the air may be abruptly expelled, either upwards by the vulgar process called *belching*, or by another still more offensive crepitus, each of which (excepting in certain *positive* infirmities,) may, by due care, be avoided. The results may, however, be sometimes attributed to *diseases* classed under the term *limosis flatus* or *flatulency*, which may appear either as a rumbling of the bowels, or eructation, (belching,) or crepitus, the latter being a rejection of wind downwards.(*r*)

Other diseases, &c. (*s*)

The *other* more decided diseases or disorders of the stomach are so multifarious that it will be preferable to suspend the consideration of them until we examine diseases and their treatment in general.(*t*) Dyspepsia or *indigestion* (the very converse of its due function, digestion,) seems one of the most frequent disorders that affect this organ.(*u*) Inflam-

(*k*) El. Blum. 326; 3 Bell, 282 to 285; 1 Good, 7, 8; 2 Bost. 420 to 422.

(*l*) Dr. M. Hall, on the mechanism of the act of vomiting, Quart. Journ. July, A. D. 1828, p. 388, and see 2 Bost. 420.

(*m*) 2 Bost. 421.

(*n*) Id. 421, note.

(*o*) 3 Bell; 284; see Dungl. Phy. 520 to 526.

(*p*) 1 Good, 125 to 133; 3 Par. & Fonb. 63.

(*q*) 3 Bell, 290; 1 Good, 120.

(*r*) 1 Good, 120 to 125; 1 Dungl. Phy. 517.

(*s*) See, in general, Copl. Dict. tit. Diarrhœa, and Horner, 1 Amer. Jour. Med. Sci. 9, where see the colour of the stomach in health and disease.

(*t*) Post, part. ii.

(*u*) See 1 Good, 133 to 155; Dr. Johnson on Indigestion, Brous. Pathol. 204.

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mation is another dangerous affection.(*x*) The change in the secretions of the tongue and fauces, from disorder of the stomach, is not, it has been suggested, a consequence of an influence communicated along the whole continuous surface, but has its *origin* in the natural constitution of the parts, a connexion which nature has established between the stomach and the tongue, and between the appetite and the necessity of the system. The state of the tongue, the loose or viscid secretion of the throat and fauces, even the secretion of the saliva, and the irritability of the larynx, are influenced by the stomach. The more permanent and demonstrable effects on the tongue are principally attended to, which, perhaps, is the reason that we only know by this that the stomach is disordered, but not *how* it is effected.(*y*) It has been well observed, that the sympathy of the stomach with the rest of the intestinal canal, the connexion of the head and stomach in their affections, the effect of the disorder of the stomach on the action of the vascular system and of the skin, and the strict consent and dependency between the stomach and diaphragm and lungs, and in a particular manner with the womb, testicles, &c.; and again the connexion of the stomach with the animal economy as a whole, are matters of the most serious importance to be kept in view by every member of the medical profession.(*z*)

Injuries to the stomach.

The *injuries* to the stomach are those which create *indigestion*,(*a*) or by poisons introduced therein,(*b*) wounds,(*c*) or ruptures, which may be occasioned by violent vomiting, or by disorder.(*d*) A blow on the region of the stomach, will sometimes immediately occasion death.(*e*)

Of hunger and thirst, and victuals, solid or liquid.

Whilst thus considering the organ of the stomach and the functions of digestion, we may here with propriety notice the two *appetites* of *hunger* and *thirst*, and the due modes of satisfying them.

Hunger.

Hunger is a *sense* with which mankind, and indeed all animals, are endowed, as a monitor and stimulant to receive aliment when essential for the necessary supply of nourishment, and its dependence on the general state of the body.(*f*) It is the impulse to supply fresh elementary particles for the formation of new blood and materials in the room of those which are constantly wasting.(*g*) Various opinions have existed as to the seat or cause of hunger, but, the better opinion seems to be, that, it is a sensation principally occasioned by the contracted state of the empty stomach, because hunger ceases *immediately* upon the stomach being filled, and, consequently, some hours before the digested food can have become chyle, and much longer before the same has passed into the thoracic duct, or become intermixed with the blood, or has really assisted in renovating the system.(*h*) We are stimulated to take food by two circumstances; on the one hand by the uneasy sensation of hunger, and on the other the anticipation of satiating the appetite and the relish of the palate. The latter certainly assist, and high seasoning and delicacies will excite the appetite even when the stomach is full.(*i*) Some insist that hunger is not to be ascribed to any mechanical friction of the coats

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(*x*) 2 Good, 352.

(*y*) 3 Bell, 293.

(*z*) Id.

(*a*) See, in general, Copl. Dict. tit. Digestive Canal; and tit. Indigestion.

(*b*) 2 Par. & Fonb. 163, 230, 254, 274, 295, 357, 365; 3 id. 61, 63; see the illustrations of the effect of different poisons on the stomach, Dr. Christison on Poisons; also Ryan Med. Jur. Chap. xv.

(*c*) Coop. Dict. tit. Wounds, 1 Gibson, Surg. 145.

(*d*) 3 Par. & Fonb. 63, 64.

(*e*) 2 Par. & Fonb. 174.

(*f*) 3 Bell, 292; 1 Dungl. Phy. 461.

(*g*) El, Blum. 294.

(*h*) Id. 299; and see the different opinions, and their errors observed upon, El. Blum. 294 to 312; and 3 Bell, 292, 293; 1 Dungl. Phy. 461 to 467.

(*i*) 3 Bell, 292.

or sides of the stomach rubbing against each other when in an empty state, nor to the chemical action of the gastric juice, nor to the effect of atmospheric pressure upon the body, as has been supposed, but that it is a specific sensation produced upon the *nerves* connected with the stomach, in the same manner as the organs of sense have their appropriate nerves, each of them adapted to the peculiar perceptions of the organ.(*k*) It is observed, however, that it is not improbable that the action upon the nerves may be in some way affected through the intervention of the gastric juice;(*l*) and the sensation of hunger, as well as thirst, has been attributed to an uneasy feeling produced by a peculiar condition of certain secreting organs, and which uneasiness is almost immediately removed by a change in the condition of these organs, and that they probably depend upon the state of the mucous membrane which lines the stomach and fauces, which is removed by the reception of food and drink(*m*) The effect of habit in modifying the sensation of hunger and appetite, is considerable, and most individuals are much more influenced by habit than by the actual calls of hunger in the reception of food, both as to the time of taking it, to the nature of the food, and upon the influence of eating upon the social feelings. (*n*)

Morbid appetite is a disease of various descriptions, either deficient, or *anorexia* or loss of appetite, or excessive, termed *bulimia*, (from Βȣλιμος,) or it may be depraved; to which may be added heart-burn, flatulency, sickness, and indigestion; all of which we shall hereafter consider.(*o*) *Morbid craving* may proceed from many causes, and a tape worm has occasioned bulimia or excess of hunger, causing incessant appetite.(*p*)

Thirst.

Thirst is considered as seated in the tongue, fauces, œsophagus, and stomach, or, according to some, it depends on the state of the mouth and fauces only, and upon the temporary deficiency of the mucous secretions of those parts.(*q*) But as thirst is only momentarily assuaged by wetting the mouth and throat, because they presently become dry again, and fluids must be swallowed to be effectual, so that they may be absorbed and the part thus preserved moist by constant secretion;(*r*) it should seem that the *stomach* is concerned in thirst as well as hunger, and as in the case of hunger so in thirst it consists in a peculiar action on a certain set of nerves resulting from the effect of an appropriate stimulus.(*s*) Thirst, therefore, depends on the state of the secretions which bedew these parts, and arises either from a deficiency of secretion, or from an unusual acrid state of it. Like hunger, it would appear to be placed as a monitor, calling for the dilution of the fluids by drink when they have been exhausted by the fatigue of the body and by perspiration, or when the contents of the stomach require to be made more fluid, the more easily to suffer the necessary changes of digestion.(*t*) Violent passions also frequently induce thirst; and rage or terror dry up the mouth and throat, and cause violent thirst.(*u*) The desire for drinking may become diseased and morbid, as either excessive or impaired variations from a state of health, which we will hereafter more particularly consider.(*x*) Dr. Copland observes, that

(*k*) M. Magendie, Phy. vol. ii. p. 24; Dict. de Scien. Med. vol. ix. p. 370, tit. Digestion; Soemmering, vol. vi. p. 223, s. 149; 2 Bost. 417 to 419.

(*l*) 2 Bost. 419.

(*m*) Jackson, Princ. Med. 371.

(*n*) 1 Dungl. Phy. 461.

(*o*) 1 Good, 100 to 155; Copl. Dict. tit. Digestive Canal; and Amer. Cyclop. Prac. Med. tit. Abstinence, and see post.

(*p*) 3 Bell, 292, Brous. Pathol. 221, 227.

(*q*) El. Blum. 294, 300; 1 Good, 93 to 98; 2 Bost. 419; 3 Bost. 140.

(*r*) El. Blum. 300; Jackson, Princ. Med. 373.

(*s*) 2 Bost. 419; 1 Dungl. Phy. 515.

(*t*) 3 Bell, 292; El. Blum. 294; 2 Bost. 419.

(*u*) El. Blum. 294, 300.

(*x*) Post, part ii.; 1 Good, 93 to 100.

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thirst has been imputed to irritations or inflammatory actions; but although it is certainly a symptom of this and other diseases of the stomach, and the rest of the digestive tube, it likewise arises from diminished exhalation and secretion in the pharynx and fauces; from the rapid discharge of the aqueous parts of the blood by the surfaces or kidneys; and from the superabundance of saline particles in the serum.(*y*)

Of food and drink in general.

Victuals may import as well liquid as solid food, and is the most comprehensive term.(*z*) Man is omnivorous, i. e. capable of living on all descriptions of food, animal as well as vegetable, not being absolutely poisonous or detrimental; and by habit he may become enabled to live on one alone.(*a*) With respect to the nature and quantity of food and drink to be taken, they are most important to be considered with regard to health, especially when the organs of digestion are weak or disordered; and although the healthy subject need not be very particular in his study of the nature, selection, or extent of the nourishment he is to take "*nam sanis omne sanum*," yet excesses and irregularities will either immediately, or in the course of time gradually induce diseases, undermining the constitution and occasioning most distressing pains and consequences.(*b*) As to the nature and extent of the food and drink to be taken, and the times when, they have occupied much of the attention of authors on physiology,(*c*) and of the most judicious and zealous physicians, surgeons, and other medical practitioners, who should, in cases of disease, or of serious injuries, bestow a part of their time and attention in directing the kinds and quantities of nutriment to be taken by the patient whilst under their care, and for want of which their remedial measures would be frequently counteracted or neutralized.(*d*) The stomach and intestines of man assimilate him, in regard to the nature of his diet, more to the herbivorous than to the carnivorous animals, and yet we find, as a matter of fact, that either kind of diet is perfectly competent to his nutrition and support, and that probably the best state of health and vigour is procured by a due admixture of the two classes of substances,(*e*) and to which may be added a frequent change of every description of food, thereby habituating the stomach to every description of nourishment. Unwholesome food contaminates the chyle and the circulating and secreting fluids, and ultimately occasions co-existent disease of several viscera.(*f*) We will fully consider the subject when examining the circumstances essential to the continuance of health.(*g*) It will here suffice to observe, that such is the necessity for fresh *food* that a healthy person cannot abstain from it a whole day without great prostration of strength, nor scarcely *beyond* two or three days, at the utmost eight days, without danger of life.(*h*) But, with respect to *drink*, it has been observed, that

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(*y*) Copl. Dict. tit. Digestive Canal.

(*z*) On a motion for a new trial in a cause tried at Kingston, on the Home Circuit, under the Game Act, 5 Ann. c. 14, s. 2, Lord Ellenborough and the other judges, after a full inquiry into the import of the term *victuals*, held, that a person who merely kept what is vulgarly called a gin shop, was a *victualler*, although he never provided any solid food.

(*a*) El. Blum. 295 to 313; 1 Dungl. Phy. 438.

(*b*) See Johnson on Indigestion, 78 to 88.

(*c*) El. Blum. 294 to 312; 3 Bell, 272, 287, 288; 1 Good, 4; 1 Dungl. Phy. 438 to 460; Jackson, Princ. Med. 316 to 327.

(*d*) It has been observed by one of the most able and justly celebrated physicians, that, independently of the immediate effects of careful directions in this respect, the kind attention of the practitioner to the diet of the patient, would be to him grateful, and ensure composure: see, fully, Dewees, Prac. Phy. 31.

(*e*) 2 Bost. 363.

(*f*) Copl. Dict. tit. Disease, 598.

(*g*) See post.

(*h*) Amer. Cyclop. Prac. Med. tit. Abstinence, where see some interesting instances of men living even longer. It will be observed that in some fevers and other disorders little or no food is received; and Atticus, whilst affected by fever, having resolved to die by abstinence, actually involuntarily thereby cured the fever.

although *thirst* is a violent desire, drink appears not very necessary to life and health, and that some individuals have lived in perfect health and strength without tasting liquids.(*i*) In general, however, the torment of thirst increases until drink is procured or moisture applied to the surface or imbibed, and inflammation of the mouth and throat and intense fever at length ensue;(*k*) whilst in the absence of any food a moderate supply of fluid, especially water, lengthens life considerably.(*l*) In abstinence equally great imbecility of mind takes place as of body.(*m*)

Intestinal, alimentary, or digestive canal in general. (*n*)

At the Pylorus, (the lower orifice of the stomach,) the *intestinal canal* (otherwise intestines, bowels, or guts,) commences and extends to and terminates with the anus. In the adult human subject it is from thirty to thirty-five feet in length,(*o*) but the entire length considerably varies in different persons, especially in that part called the *small intestines*, and without any proportional difference in the stature of the body; and in infants they are generally, in comparison, double the length than in manhood, although upon the whole, they considerably increase in growth to their ultimate full development of the body.(*p*) The small intestines are usually twenty-six feet long, or from four to five times the length of the body; and the large intestines only one length of the body, or only about six feet.(*q*) In various animals, and in man, it has been wisely ordained that the length of the intestines shall accord with the nature of the food on which they subsist. If the food be entirely or principally *animal* it is the sooner assimilated and adapted to the recruiting and nourishment of the system, and the canal is in general shorter, whilst in those animals that feed on herbs it is proportionally long, and man being omnivorous the intestines are of an intermediate length, so that all the nourishing particles of the food may be the better perfected into chyle and separated and absorbed, and the residue passed off as waste at the lower extremity. The intestinal canal is coiled on itself, so as to form folds or convolutions, and is divisible into two parts, differing in size and situation as well as *external* conformation; the division between them being moreover marked by a peculiar *valvular structure*, which in general prevents a reflux of the ingesta after they have passed beyond the ileum.(*r*) The part of the canal between the pylorus and the valve is called the *small* intestines, and the remainder thence onward to the anus the *large* intestines.(*s*) Beside these, and *contributory* to the function of digestion, and for the purpose of carrying off the waste of fluid matter, there are *several other organs* which surround the intestinal canal, or are near thereto, and are connected with it in a peculiar manner, such as the *Liver* and gall bladder, the *Pancreas*, the *Spleen*, and the *Kidneys*, &c.(*t*)

The coats, nerves, &c. of the intestines in general.

The number of the *coats or tunics* of the whole intestinal canal are the same as those of the stomach.(*u*) The *external*, excepting in a portion of the duodenum, is a continuation of that part of the peritoneum which forms the mesentery. The *muscular* consists of two orders of fibres, the one longi-

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(*i*) El. Blum. 295; 1 Good, 99.
(*k*) Id. 302; Jackson, Prin. Med. 373.
(*l*) Id. 301; 1 Good, 110.
(*m*) Amer. Cyclop. Prac. Med. tit. abstinence.
(*n*) See 1 Dungl. Phy. 429 to 438.
(*o*) 2 Horn. Anat. 28.
(*p*) 1 Good, 2, 3.
(*q*) Id.; 3 Bell, 294.
(*r*) 1 Dungl. Phy. 430; 1 Good, 9.
(*s*) Jackson, Prin. Med. 333.
(*t*) 1 Good, 9.
(*u*) 1 Dungl. Phy. 429; ante, 186; see also 2 Bost. 352; 3 Bell, 296, and 300 to 309 as to the coats of the small intestines, and as to the coats of the colon, 2 Horn. Anat. 28, 36.

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tudinal, interrupted, external, and found especially about the part opposite the mesentery; the other annular and circular, possessing the power of narrowing the canal, while the former shortens it. Upon both depends the very great and permanent contractility or irritability of the intestines.(*x*) *nervous* coat, as it is called, is condensed cellular membrane, easily reduced by handling, or more particularly by inflation, into a spumous tela; in it the intestinal blood vessels which arise from the mesentery are distributed in a beautiful arborescent form; the intestines, no less than the stomach, are indebted to it for their tenacity and strength. The *interior* coat, lined by its delicate epithelium, and deserving the name of villous in the small intestines more than in any other part of the canal, forms, in conjunction with the inner surface of the former coat, here and there undulated ridges and rugous plicæ, which in dried and inflated intestines resemble the blade of a scythe, and are termed the valvulæ conniventes. The villi are innumerable upon the inner surface of the intestines, and their beautiful and minute vascular structure, when distended with chyle, has the appearance of a *mushroom.* The base of these villi is surrounded by innumerable *glandular follicles* adhering chiefly to the nervous coat, and opening into the intestinal canal by a very small orifice, through which they discharge the *mucus* that lines the whole internal surface of the intestines.(*y*)

The intestinal canal also is supplied with *arteries*, *veins*, and consequently *blood;* the duodenum receives branches from the pancreatico duodenalis, the pyloric and the superior mesenteric arteries; the jejunum and ileum are supplied from the ramifications of the great mesenteric artery; the colon from those that come from the concavity of its arch and from the inferior mesenteric; and the rectum from the latter and the hemorrhoidal branches; the veins all converge to form the vena portæ. The *nerves* are derived from the mesenteric plexus.(*z*)

Movements of the intestines.

The intestines agree with the stomach in respect of their having a *peristaltic action*, and which occurs principally when the chymous pulp enters them. In the small intestines this is even more lively than in the stomach. This agitates it by an undulating contraction of different parts of the canal, and propels it from the duodenum towards the large intestines.(*a*) Their peristaltic motion is much *weaker* than that of the small intestines.(*b*) The bile contributes in stimulating the intestinal canal, and when interrupted in its proper flow costiveness is the consequence.(*c*) It has been observed that it is not improbable that the state of compression in which the abdominal viscera are retained by the diaphragm, and the alternate motion to which they are subjected by inspiration and expiration, may have an effect in propelling the chyle along the lacteals and the thoracic duct, but that the influence is not in that degree and extent as heretofore supposed.(*d*)

Division of the intestines into small and great, and of the solid viscera.

Anatomists have agreed in considering the *small* intestines divisible into three parts, viz. the *Duodenum*, *Jejunum*, and *Ileum;* they are, however, but portions of a continuous tube, the lines of division between them being altogether arbitrary and imperceptible.(*e*) They have also divided the *great* intestines into the *Cæcum*, *Colon*, and *Rectum.*(*f*) The structure of all these are alike excepting in diameter, and that the colon has cells, whilst the rectum has none; and that the duodenum is peculiarly con-

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(*x*) El. Blum. 350; 3 Bell, 301, 302; Tuson's Comp. 232.

(*y*) El. Blum. 350, 351; 2 Horner, Anat. 29, 30.

(*z*) El. Blum. 350, 351.

(*a*) El. Blum. 352; 1 Dungl. Phy. 501; 3 Bell, 303.

(*b*) El. Blum. 335; 1 Dungl. 508.

(*c*) 3 Bell, 296 to 298; 1 Dungl. Phy. 509.

(*d*) 2 Bost. 48.

(*e*) 1 Dungl. Phy. 430; 1 Good, 2; 3 Bell, 294; 2 Bost. 352, 353.

(*f*) 2 Horner, Anat. 34; 2 Bost. 352, 353.

structed, and from its operating similarly in some respect it has been termed by some anatomists as the *Second Stomach*.(*g*) We will consider each of these and their adjacent parts in their natural order, and the process of chymification and chyle and of absorption, and then notice what relates to the *solid viscera* which *contribute* to the function of digestion and carry off the waste fluids.

The small intestines in particular.

The *Small Intestines* are *first*, the *Duodenum; secondly*, the *Jejunum;* and *thirdly*, the *Ileum;*(*h*) and these are usually about twenty-seven feet in *length*.(*i*) The *diameter* of the canal of the small intestines gradually and imperceptibly diminishes as it becomes the more distant from the lower orifice of the stomach, so that the termination of the ileum in the caput coli, at the extremity of the ileum, is considerably smaller than in the duodenum;(*k*) namely, at the upper commencement of the duodenum it is in diameter about an inch and three quarters of an inch, whilst at the lower part of the ileum it is only an inch and one quarter.(*l*) It has been observed that the division into the small and large intestines may be considered as founded upon their physiological nature as well as upon their anatomical structure; for it appears to be in the former alone that any part of the digestive process is carried on, the latter being principally intended to remove from the system the refuse matter which is incapable of undergoing the process of chylification.(*m*)

1. Duodenum.

The *Duodenum* is stated to have been so called because it is in length about the same as the breadth of twelve fingers; but this is an error, as it very much exceeds that length.(*n*) It was at one time named ventriculus succedaneus, because from its functions and great distensibility it resembled an accessory stomach; and it has been termed a *secondary stomach*, as again in a degree digesting the food:(*o*) it is of a redder colour than the rest, has a thicker muscular coat, and receives only a partial covering from the *peritonæum*, and is fixed more closely to the body, without floating like the other intestines.(*p*) It is perforated, at the distance of three or four fingers' breadth from the pylorus, by the ends of the biliary and pancreatic ducts for the reception of bile and pancreatic juices. In the duodenum the lacteal vessels begin to appear, but not so numerously as in the jejunum.(*q*) It is greatly larger than any other part of the small intestines, irregular and sacculated, more fleshy, and although it has fewer *plicæ*, it is more glandular, and more vascular; but its greatest peculiarity, and that which must convince us of its importance in the animal economy, and that of the necessity of attending to it in disease, is this, that it is the part which receives the *biliary* and *pancreatic ducts*, and in which a kind of second stage of digestion takes place;(*r*) for the next stage of the digestive process after that in the stomach, takes place in the duodenum, which easily admits of distention, and receives the food in the form of chyme from the stomach. Here the bile (the most highly animalized of all the secretions,) and abundance of the pancreatic juice tempering it, meet the chyme, and a new play of affinities commences, the bile being separated into two parts, its saline principles and its resin.(*s*) The latter is discharged with and gives a colouring matter to the excrement, the former become decomposed, attenuate the chyme, and communicate their azote, and thus complete its

(*g*) 2 Bost. 353, note; 3 Bell, 295, 296.
(*h*) 3 Bell, 294; 2 Horner, Anat. 31.
(*i*) 1 Good, 2; ante, 199.
(*k*) 3 Bell, 299; 2 Horner, Anat. 28.
(*l*) Ex relat. a most experienced anatomist.
(*m*) 2 Bost. 353.
(*n*) 3 Bell, 295.
(*o*) Id. 296; 2 Bost. 446, note; 1 Dungl. Phy. 430.
(*p*) 2 Horner, Anat. 32.
(*q*) Id.
(*r*) 3 Bell, 595; 1 Good, 136; 2 Bost. 446, note. Jackson, Prin. Med. 356.
(*s*) 1 Good, 136; 3 Bell, 268, 238.

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animalization; while the juice of the pancreas dilutes, and holds the material in solution, and probably contributes to some other effect which has not yet been discovered. *In this liquid state it is called Chyle.* The recrementary part which descends into the larger intestines, is attacked, as it proceeds, by the mouths of a considerable number of lacteals, which suck or absorb whatever small quantity of the chyle may accidentally remain intermixed with it, after escaping the innumerable host of the same vessels which concentrate their mouths in the inner surface of the small intestines.(*t*)

The *Duodenum*, in its course, curves on itself, so as to describe a considerable portion of a circle; for having commenced at the pylorus, it ends at the left side of the second lumbar vertebræ, and is divisible into *three portions*, each presenting some circumstances deserving notice. The *first* inclines *upwards* and to the left side, so as to touch the gall bladder, and soon after death becomes tinged yellow by the bile. At this point the intestine turns on itself, and *descends* perpendicularly in front of the right kidney, as far as the third lumbar vertebra, where it again alters its direction, passing *across* the spine, ascending a little, so as to end at the left side of the second lumbar vertebra, where it is continuous with the jejunum. The ascending portion is covered by peritonæum in the same way as the stomach is; the descending part is covered by it only on its anterior surface, whilst the transverse part has no immediate serous investment, as it merely lies in the divergence of the two layers of the transverse mesocolon. Its muscular coat is thick, the circular fibres being more strongly marked than the longitudinal. The internal presents a greater number of transverse folds, called *valvulæ conniventes.* At the angle of union formed by the descending and transverse parts of the intestine, will be observed a small papilla, marking the orifice of the *biliary and pancreatic ducts*, which open into the duodenum at that point. The superior mesenteric artery lies upon its transverse part, and the head of the pancreas is received within its curve,(*u*) It is clearly established, that the duodenum is the part which is most particularly subservient to the important process of chylification, while the office of the jejunum and ileum is principally confined to abstracting the chyle from the residual mass, and which is accomplished by its being gradually transmitted along their cavity; thus permitting the lacteals to absorb the nutritive parts as it is brought into contact with their orifices, and in the manner hereafter described when considering the function of absorption.(*x*)

Diseases of the duodenum.

The study of the diseases connected with the duodenum, it has been observed, is the most important which can occupy the attention of the physician or other medical inquirer, but the full consideration of them here would be misplaced.(*y*)

2. The jejunum.

The *Jejunum* is so called from its generally appearing collapsed and empty after death.(*z*) This and the ileum occupy the interval from the duodenum to the *ileo cæcal* valve; and it is said that two-thirds are assigned to the jejunum, and the residue to the ileum.(*a*) But Blumenbach states, that the ileum is the longest of the three, fuller, and as it were inflated, and sometimes resembling the large intestines by the appearance of bullæ.(*b*) Others contend, that the extent of the jejunum is two-fifths of the whole, and its convolutions are formed in the Umbilical region, whilst the Ileum lies in the Epigastric and Iliac regions, surrounds the jejunum and the sides and lower part, and forms three-fifths of the whole extent of the intestine from the mesocolon to the valve of the

(*t*) 1 Good, 136.
(*u*) 2 Horner, Anat. 32; 3 Bell, 295, 296; Dr. Johnson on Indigestion.
(*x*) 2 Bost. 353, 354.
(*y*) 3 Bell, 298.
(*z*) El. Blum. 350; 1 Dungl. Phy. 431.
(*a*) Quain's El. 505.
(*b*) El. Blum. 350.

colon.(*c*) The Jejunum differs from the duodenum in deriving its common coat wholly from the peritonæum, in its being smaller, in having a weak muscular coat, the external fibres of which are extremely minute, and in the valvulæ conniventes, villi, and lacteals, which proceed from them, being much more conspicuous and numerous.(*d*)

3. The Ileum.

The *Ileum* or *Ileon* is so called from its convolutions(*e*) and from its position in the fossæ of that name. It is said that two-thirds of the space between the duodenum and ileo cœcal valve is occupied by the jejunum, and one-third by the ileum;(*f*) but as just observed, others say, that the ileum is the three-fifths and tbe jejunum only two-fifths of the entire length of the two.(*g*) The ileum differs from the jejunum in being less in diameter and its coat thinner and paler, and in having fewer and smaller laceteal vessels.(*h*)

Functions of the small intestines and the process of *Chylification*, or conversion of the Chyme into *Chyle*.

We have seen that the *chyme* is poured through the *pylorus* into the *duodenum*, and that at the same part of the small intestines is constantly poured through its own vessels a very large quantity of liquid *bile*, and of *pancreatic juice*, and which being mixed up with the mucus secreted from the interior coats of the duodenum and other small intestines, together tend to perfect the operation of chylification, or converting the chyme into the liquid technically termed *Chyle*, which soon becomes assimilated to, and part of the new blood.(*i*) The *bile* proceeds from the *liver* and its *gall bladder*, the *pancreatic juice* from the *pancreas*, and the *mucus* from the internal coat of the small intestines. As it may avoid repetition, we will postpone the minute description of *bile* and *pancreatic juice* until we presently describe the *solid* and *collateral viscera* of the abdomen.(*k*) Most physiologists are of opinion that chylification is performed principally by the action of the *bile*, and that the effect of it is to precipitate the effete matter; but others dispute that doctrine,(*l*) and insist that the precise operation of chylification, and how it is effected, is but little known.(*m*) It seems, however, to be the better opinion, that chylification is essentially connected with the *conjoint action* of the *bile and pancreatic fluids* in the duodenum,(*n*) and that the *bile* causes the nutritious parts of the chyme to be *separated* from the other parts less nutritious or waste, and the former, when so separated, becomes a purer milky coagulated fluid, called *chyle*, and is *attracted* from the residue to the inner surface of the villous coat of the intestines, and from which it is carried through the lacteals and absorbent vessels into the thoracic duct; whilst the residue, being principally feculent matter, thus separated from the more nutritious part, is passed into the larger intestines, and the greater part not there absorbed is carried off as fæces.(*o*) However, Mr. Bell has observed that it is more natural to suppose that the very peculiar property of life, the *coagulation* of the chyle, is bestowed through the influence of the villous surface of the intestine, than produced by the mere pouring in of a secretion like the bile,(*p*) and Tiedemann and Gmelin contend, that the only use of the bile, in chylification, is that of accomplishing the solution of fatty substances, and to which solution is attributable the white colour or appearance of chyle, and which it does

(*c*) 3 Bell, 299; 2 Horner, Anat. 33.
(*d*) 1 Dungl. Phy. 431.
(*e*) El. Blum. 350.
(*f*) Quain, El. 505.
(*g*) El. Blum. 350; 3 Bell, 299; 2 Horner, Anat. 33.
(*h*) 3 Bell, 299; Tuson's Comp. 233.
(*i*) El. Blum. 352; 1 Good, 21.
(*k*) Dr. Johnson on Indigestion; 1 Good, 21; 1 Dungl. Phy. 502.
(*l*) 8 Bell, 310, 311, 296; 1 Good, 22.
(*m*) 1 Good, 21 to 25.
(*n*) Id. 21; 1 Dungl. Phy. 504 to 506.
(*o*) Id. 21; 3 Bell, 310, 307, 308, 237, 238, 296, 297.
(*p*) 3 Bell, 311.

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not exhibit unless the food contain fatty matter;(*q*) and they attribute six uses to bile, 1st. By its stimulant properties it excites the flow of the intestinal fluids, as is proved by the unusual dryness of the fæces in jaundiced persons, and the costiveness that ensues when the due flow of bile from its ducts is interrupted.(*r*) 2dly, It probably stimulates the intestinal muscular fibres to action. 3dly, As it contains an abundance of *azotised* principles it may contribute to animalize those articles of food which have no azote in their composition, as in vegetable food. 4thly, It tends to prevent the putrefaction of the food during its course through the intestines, because, when it is prevented from flowing into them their contents are much further advanced in decay than in the healthy state. 5thly, It probably tends to liquify and render soluble the fatty part of the food. 6thly, It is to be regarded as an important secretion,(*s*) carrying off with the fæces the excess of carbon introduced into the system with vegetable food, and not thrown off by the lungs.(*t*) In the jejunum, the *bile* being undecomposed and mixed with the equable pulp of the intestines, and consequently diffused and diluted, connot exhibit its true colour. But after its separation into two parts, the excrementitious part mixed with the precipitated fæces, and as it were again concentrated, now discovers its original colour, and imparts it to the fæces.(*u*)

More recent discoveries and observations.

The more recent experiments and examinations of the same professors, Tiedemann and Gmelin, have induced them to observe that, with respect to the small intestines, their upper part contains a considerable quantity of uncombined acid, which is principally acetic, mixed with a little butyric, and rarely with the muriatic, and that advancing along the small intestines this acid disappears, while in their lower part the fluids are found to be alkaline; and they explain the functions of the small intestines as follows. The acid chyme is mixed with the bile, pancreatic juice, and the secretion from the mucous membrane; the muriatic acid unites with the soda of the bile, disengaging the acetic or carbonic acids with which the alkali was previously combined, and likewise the cholesterine of the bile; and hence are produced the white flakes, which have *erroneously been supposed to be chyle.* Chyle, these professors insist, cannot exist in the intestines, "dans l'etat normal," because it is only in the liquid state that it can enter the absorbents, and it is said that it can never be detected except in those vessels. The pancreatic juice and the intestinal mucus are considered to contribute to the effect, but it is not ascertained in what their actions precisely consist, but it may be presumed that the operation is in a great measure mechanical.(*x*)

Of the chyle.

The ancient physiologists did not sufficiently distinguish between *chyme* and *chyle*, (both χυμοσ and χυλοσ having been indiscriminately used to express any juice,) but treated each under the former denomination, and it is uncertain when the present distinction was first recognised. Modern physiologists have, however, long limited the term *chyme* to that pultaceous mass when it is poured from the stomach, and after the same has become mixed with the bile and pancreatic juice in the small intestines. The term is now uniformly *chyle.*(*y*) It is admitted by the ablest modern physiologists that the mode in which chyle is formed has not been ascertained with any adequate degree of certainty.(*z*) But although it is

(*q*) 1 Good, 23; 1 Dungl. Phy. 505.
(*r*) 3 Bell, 297.
(*s*) 1 Good, 23, 24; El. Blum. 335, 336; 3 Bell, 297, 298; Jackson, Prin. Med. 357.
(*t*) 1 Good, 24, 25.
(*u*) El. Blum. 353, 336.
(*x*) Tiedemann and Gmelin, Recherches, &c., vol. i. 396; 3 Bost. 330 to 338.
(*y*) 2 Bost. 342, note 389, note.
(*z*) 2 Bost. 390; 1 Good, 27; Jackson, Prin. Med. 358.

admitted that the precise *process* of *chylification* is still involved in considerable perplexity and obscurity, yet it is assumed that the properties of *chyle* itself are well known.(*a*) The term *chyle* is from the Greek χυλος, juice, or fluid. It is composed of the same mixed alimentary materials as the chyme which has been passed into the duodenum, and then intermixed principally near the orifice of the biliary duct, and there acted upon and influenced by the pancreatic juice from the pancreas, and the bile from the liver, and from other secretions found in the duodenum itself.(*b*) Chyle, however, varies in some degree according to the part in which it is found, and its then degree of perfection. By the moving powers and solvents which we have noticed, the *chyme* poured through the pylorus into the duodenum undergoes therein, and in the other small intestines, but principally in the former, remarkable changes.(*c*) When found in the intestines it is observed to consist of albumen, serum, globules, and salts.(*d*) In the *jejunum* the chymous matter becomes a more liquid pulp, equally mixed, of a gray colour, and acidulous odour. In the Ileum it begins to separate into two parts, namely, into the fæces, of a pale yellowish brown colour and nauseous smell; and the *genuine* chyle, not previously absorbed, swimming upon the former, and extracted from the chyme and separated by the bile from the fæces, is destined for absorption by the lacteals.(*e*) But Dr. Prout and Dr. Elliotson observe, that a great part of the chyle is generally formed and actually absorbed before the digested mass reaches the ileum;(*f*) and, indeed, as the jejunum has infinitely more lacteals than the ileum, it may be inferred that more chyle is absorbed in the former than the latter.(*g*) The chyle, when thus produced from chyme, and separated from the residual mass, is a white opaque substance, considerably resembling cream in its aspect and physical properties, and if removed from the body, *it begins to concrete, and finally, like blood, separates into two parts, a dense white coagulum, and a transparent colourless fluid*, an operation which appears to be very analogous to the spontaneous separation of the blood into the crassamentum and the serum. Hence, it appears that in its chemical properties, as well as in its physiological relation, we may regard *chyle* as a kind of intermediate substance between the chyme and the blood.(*h*)

If the man or animal from which the chyle is extracted has eaten animal or vegetable substance of a *fatty* nature, the liquid drawn from the *thoracic duct* is of a *milky* appearance, a little heavier than distilled water, of a strong spermatic odour, of a salt taste, slightly viscid, and plainly alkaline. It soon separates into three parts, a solid one, that remains at the bottom, a liquid one nearest the top, and a third, which forms a very thin layer on the surface, at the same time the chyle assumes a bright *rose colour:* but when the food has been void of fat, instead of being of an opaque white colour, the chyle is *opaline* and nearly transparent, and the layer on the surface is less evident. However, notwithstanding fat food thus alters the appearance of the chyle, it never, in other cases, takes the hue of the colouring substances that may have been in the food.(*i*) The appearances and quality of chyle, however, are considerably modified by the kind of food. Chyle derived from sugar contains hardly any fibrin, while that from flesh has a very large proportion of such fibrin.(*k*)

(*a*) 1 Good, 27; 2 Bost. 390.
(*b*) 2 Bost. 391, 395.
(*c*) El. Blum. 353, 1 Dungl. Phy. 506.
(*d*) 3 Bell, 238.
(*e*) El. Blum. 353; 2 Bost. 354.
(*f*) El. Blum. 356.
(*g*) Ante, 202, 203, Ileum.
(*h*) 2 Bost. 392; Jackson, Prin. Med. 358.
(*i*) 1 Good, 27.
(*k*) Id. 27.

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In that part of the small intestines called the jejunum, principally, and in a small degree in the ileum, the most important function of *absorption* of the chyle is performed; for here the chyme in a great degree having become chyle, is moved slowly onward through a great length of intestine, namely, four times the length of the body, and exposed to a surface amazingly extended by the pendulous and loose duplicatures of the inner coat, and in these the fæces are gradually separated from the chyle, and the greater part of which adhering to the villi, is absorbed through the lacteals before it reaches the ileum, and is carried into the thoracic duct and thence into the blood vessels and becomes fresh blood.(*l*) And it is supposed that, except in certain morbid states, very little, if any part of the chyle escapes into the larger intestines, and is there absorbed;(*m*) and it is agreed, that, at all events, the greater part of the chyle is passed by the lacteal absorbent vessels into and through the mesenteric glands, and thence into the thoracic duct. There have, however, been disputes of late respecting the termination of the lacteals and lymphatics, namely, whether they belong ultimately and solely to the principal trunks, the thoracic duct and the subclavian vein, or whether they are inserted at once and directly into neighbouring veins;(*n*) but these points more properly belong to the functions of absorption and secretion, which will presently be considered.

If the intestines be wounded, chyle and fæces will not so readily escape as blood.(*o*) The pressure and alternate motion of the diaphragm during inspiration and expiration have, it is admitted, an effect in propelling the chyle along the lacteals and the thoracic duct, but not to such an extent as was formerly supposed.(*p*)

Of the large intestines, in particular.

Immediately following the ileum begin the *great* or *large intestines*, consisting, as we have seen, of the *Cœcum*, *Colon*, and *Rectum*, and usually in length, about the same as the height of man, or six feet, and are accounted to bear a relation to the small intestines as five to twenty-five.(*q*) The great intestines, like the small, form one continued canal, which tapers gradually in diameter from its upper to its lower extremity.(*r*) These differ essentially from the small intestines in their size, being wider, shorter, straighter, and in being irregular in their outer surfaces and in their general character and texture, or rather in the *thickness* of their coats,(*s*) but which in other respects are very nearly the same as those of the stomach and small intestines.(*t*) The colon, however, has cells which give lodgement to the fæces and retain the matter, and, thereby, prevent its too rapid descent or motion towards the rectum.(*u*) Its *blood vessel* and *nerves* have also been considered.(*x*) The large intestines may be considered as performing the office of glands of waste, for they are furnished very scantily with absorbents, and very abundantly with a set of glands which secrete or withdraw from the system a fluid which serves to lubricate the canal for the passage of the fæces, and which fluid, together with the fæces, is destined to be discharged from the system.(*y*)

The great intestine, beginning on the right side of the belly, rises before the kidney, passes across the upper part of the belly under the liver, and

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(*l*) 3 Bell, 229; El. Blum, 356; 2 Bost. 395; Jackson, Prin. Med. 359.

(*m*) 1 Good, 136; 2 Bost. 395.

(*n*) El. Blum. 361, 363, note n.; id. Dr. Elliotson, note D, 369, 370 to 373, and the authorities there referred to.

(*o*) Coop. Dict. tit. Wounds.

(*p*) 2 Bost. 48.

(*q*) Ante, 199; 3 Bell, 294, 312; 1 Good, 2, 3; 2 Horner, Anat. 34.

(*r*) Ibid. 35.

(*s*) 3 Bell, 311, 316; El. Blum. 355; 1 Dungl. Phy. 433, 434.

(*t*) Ante, 186; 2 Horner, Anat. 36; 3 Bell, 316.

(*u*) 3 Bell, 316; 1 Dungl. Phy. 434.

(*x*) Ante, 199, 200.

(*y*) 3 Good, 142.

before or under the stomach, then making a sudden angle from under the stomach and spleen, it descends into the left iliac region. Here making a remarkable turn and convolution, it descends into the pelvis by a curve running in the hollow of the sacrum.(z) The *peristaltic* motion is much fainter in the great than in the small intestines. On the other hand they experience to a greater degree the pressure of the abdominal walls, to which the whole length of the colon is contiguous. They gently propel the fæces into the rectum, which then becomes internally stimulated to discharge its contents. Such discharge is facilitated by the absence of transverse rugæ, and especially by the great quantity of mucus at the extremity of the bowels.(a) It is principally effected by the pressure of the abdomen downwards, overcoming the resistance of both sphincters, the inner of which is a remarkable bundle of circular fibres, the outer a truly cutaneous muscle.(b) The valvula coli, or *valve of the colon*, as it is termed, (though it might be more properly termed the valve of the ileum,) (c) is a short process or continuation of that portion of the ileum that penetrates into and is surrounded by the cavity of the large intestines. Its external lips, while a neighbouring fold of the large intestine at the same time projects considerably, are composed, not like other similar folds, merely of the interior and nervous coats, but of fibres from the muscular coat also. Hence it performs the double duty of preventing the passage of too great a quantity of fæces, and with it part of the chyle, into the large intestines, and also prevents regurgitation into the small.(d) This valve in general prevents clysters, injected up the anus, from passing out at the mouth, unless in a weak and diseased state of the intestines;(e) and also prevents the fæces from being returned into the ileum and vomited, excepting in the colica ileus or iliac passion,(f) which is a griping pain, attended with vomiting and costiveness, accompanied with retraction of the navel and spasms of the muscles of the belly, and in which there is not only a vomiting of bile from the duodenum, but of *stercoracceous* matter from the large intestines, or even of injection introduced into the rectum, forcing their way through the strong muscular valve of the colon,(g) and not unfrequently occasioning an inflammation over a considerable part of the intestine *chiefly affected;*(h) sometimes occasioning the ileum to pass into the cæcum, an *introsusception* or involution of the coats of one part of the intestine within the other.(i)

Valve of the colon.

The *cæcum* has a vermiform process. It is a round or slightly *conical* sac or bag, from two to three inches in length, and nearly of the same diameter,(k) or, as others describe it, a round shut bag, only about three or four fingers' breadth in length, and nearly the same in diameter.(l) It is attached by cellular membrane to the iliacus internus muscle. It is not a regular sac, but is divided into large cells, like those in the rest of the colon, and has some variety of form in different subjects.(m) It has been said that the use of the vermiform process is unknown to man;(n) but others insist that the entire cæcum is one of the very many means of retarding the too precipitate descent of the fæces through the colon.(o)

The cæcum.(j)

(z) 3 Bell, 311; 2 Horner, Anat. 38.
(a) El. Blum. 355.
(b) Id.
(c) 3 Bell, 313; 2 Horner, Anat. 38; sometimes called valvula *Bauhini*, (from its supposed discoverer,) and sometimes valvula Tulpii, (from the author who gave a particular description of it,) 1 Dungl. Phy. 432
(d) El. Blum. 354; 3 Bell, 312; 1 Dungl. Phy. 432.
(e) El. Blum. 354, note s.
(f) 3 Bell, 313; 1 Good, 156, 157.
(g) 1 Good, 156, and post.
(h) Id. 157.
(i) Id. ibid.; Coop. Dict. tit. Introsusception.
(j) As to diseases, &c., of cæcum, see Copl. Dict. tit. *Cæcum.*
(k) 2 Horner, Anat. 37.
(l) 1 Dungl. Phy. 432.
(m) 3 Bell, 314.
(n) El. Blum. 354; 1 Dungl. Phy. 433.
(o) 3 Bell, 314.

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The cæcum, properly so called, is that part of the intestine which lies upon the right iliacus internus muscle, though frequently the dilated beginning of the colon is known by the same name. It rests in the cavity of the os ileum, at the upper end of the right kidney, and is concealed by the last convolutions of the ileum. The bottom of it is turned downwards, and forms a shut sac, the mouth of which is directed towards the colon, and may be considered as forming the cæcum or caput coli.(*p*)

The colon. (*q*)

The bowels are so disposed of within the abdomen, that the *Colon* encircles all the other intestines, and is *contiguous* to most of the abdominal viscera.(*r*) It begins on the right side, in a blind sac, called the caput coli, or head of the colon; it then goes upwards and crosses the belly, so as to support the stomach and separate the stomach, liver, and spleen from the small intestines; it then descends into the pelvis at the left side, forming the rectum; and all the small intestines hang by their mesentery in the central part of the abdomen, surrounded by this great intestine, and the upper and lower mesenteric arteries lie within the two lamellæ of the mesentery or supporting membrane of the intestines, so that they are called mesenteric arteries.(*s*)

The *colon*, by reason of the curve it describes, presents three parts: the *ascending* passes from the right iliac fossa, where it is continuous with the cæcum as far as the inferior surface of the liver, supported on the quadratus muscle and right kidney, its external border being in contact with the wall of the abdomen; the internal with the convolutions of the small intestines.(*t*) The *transverse* part passes across from right to left beneath the liver and stomach, concealed by the great *omentum*, and supported by the ascending layer of the transverse mesocolon. The *descending* portions extends from the spleen to the left iliac fossa, where it makes a double curve, so as to resemble the letter s placed horizontally; hence it is termed the sigmoid flexus of the colon. From this part the intestine inclines inwards, passing over the border of the pelvis, and assumes the name of *Rectum*.(*u*) The colon, through its whole extent, is fixed to the body by means of the *Mesocolon*, presently considered. The most characteristic distinction in the general appearance of the great and small intestines is the notched and cellular appearance of the former, or at least of the colon. The cells of the colon being formed between the ligamentous-like stripes, which run in the length of the gut, have a regular three-fold order; these cells give lodgement to the fæces and retain the matter and prevent its rapid descent or motion to the rectum. Here the fluids are still more exhausted, and the fæces take often the form of these cells. When the great intestines are torpid and inert in their motions, the fæces remain too long in the cells of the colon and become hard balls or scybalæ. But when in this state of costiveness the intestines are excited by medicine, not only is the peristaltic motion of the intestines increased, but the vessels pour out their secretions, loosening and dissolving such undue accumulations.(*x*) But sometimes irritating undigested matters will lurk in the cells of the colon, notwithstanding daily purgation, even for two, three, or four months, and at length come away in little round balls enveloped with layers of inspissated mucus, or in a black kind of powder or thin lamina, like tea leaves soaked.(*y*) The colon is usually more particularly the seat of dysenteria acuta, or dysentery, and thence, therefore, sometimes called colonitis.(*z*)

(*p*) Tuson's Comp. 233, 234; Tuson's Dissector's Guide, 161.

(*q*) See, in general, Copl. tit. *Colon*, and tit. Digestive Canal.

(*r*) 2 Bell, 232; 1 Dungl. Phy. 433.

(*s*) 2 Bell, 332, 333.

(*t*) 2 Horner, Anat. 38; 3 Bell, 315; 1 Dungl. Phy. 433.

(*u*) 2 Horner, Anat. 39.

(*x*) 3 Bell, 316; 1 Dungl. Phy. 434.

(*y*) Dr. Johnson on Digestion.

(*z*) 2 Good, 417, 423.

The *Rectum* (perhaps improperly so termed, because it is not straight, but curved like the shape of the sacrum,) (*a*) is the terminal part of the great intestines, beginning in a line with the last lumbar vertebra, descending upon the foreside of the sacrum and os coccygis, and extending from the left sacro-iliac symphysis to the anus, and terminating in the anus a little beyond the extremity of the os coccygis. Its direction is at first obliquely from left to right, as it descends to gain the median line of the sacrum. When deep in the pelvis it changes its direction in order to pass forwards in front of the lower part of the sacrum and the coccyx, and behind the bladder, prostate gland and vesiculæ seminales in the male, and the uterus and vagina in the female. When opposite the prostate, it makes its final turn, inclining downwards somewhat, so as to leave an angular interval between its upper surface and the neck of the bladder, These curves may be said to indicate a division of the rectum into three parts. The entire length of the rectum is about *nine inches*. The first part of the intestine included between the sigmoid flexure, and the first turn, which is about *half* its length, is covered by peritonæum in front and at the sides, and also is connected by it, though loosely, to the sacrum. The *middle* portion, or that between the curves, is about *three* inches long, its direction being forwards and a little downwards, and it rests on the lower part of the sacrum, the coccyx, and the coccygei muscles, whilst its upper surface lies immediately beneath the base of the bladder and the prostate gland, being separated from the former on either side by the vesiculæ seminales, and between them merely by some loose cellular tissue. This part is stripped altogether of the peritoneal coat, which is reflected off it where it arrives opposite the parts at which the ureters infringe on the base of the bladder. The lower portion is about an inch or an *inch and a half* in length, its direction being downwards and a little backwards from opposite the prostate to the anus.(*b*) The rectum has not cells like the colon,(*c*) and it differs from the other intestines in becoming wider in its progress downwards, and forms below a reservoir for the fæces: at the anus it contracts into a narrow orifice, the sides of which are disposed in close longitudinal folds.(*d*)

CHAP. VI. SECT. III. DIGESTION. The Rectum.(*a*)

The longitudinal fibres of this intestine cease about three or four lines from the margin of the anus, but the circular ones become considerably increased, forming a thick ring surrounding the gut so as to be properly termed a sphincter, (*sphincter internus*.)(*f*) This sphincter is in general in a state of great irritation in acute dysentery.(*g*)

Sphincter ani, or internus.(*r*)

The rectum is subject to peculiar *defects*, as imperforate anus;(*h*) also *disorders*,(*i*) as piles, hemorrhoidal excrescences, and other tumours,(*k*) to prolapsus ani, and fistula in ano; and to dangerous obstructions by masses of indurated matter,(*l*) and to *strictures;*(*m*) and it may become necessary to perform operations in and through the same for the purpose of extracting a *calculus* from the bladder, or perforating it for retention of urine.(*n*)

The *Diseases* of, and *Injuries* to the Rectum and Anus.

(*a*) 3 Bell, 317, ante, 8, note b; but perhaps it was so termed, not with reference to the term *straight*, but because it has no *cells* or *sacculi*, like the colon, see Tuson's Comp. 234, 236.

(*b*) 2 Horn. Anat. 39.

(*c*) 1 Dungl. Phy. 434.

(*d*) Id.

(*e*) As to the sphincter ani muscle; and the levator ani muscle, see 1 Wistar, Anat. 206, 207.

(*f*) 2 Horn. Anat. 39.

(*g*) 2 Good, 422.

(*h*) See 2 James' Burns, Prin. Med. 203.

(*i*) Coop. Dict. tit. Hermorrhoids. 2 Gibson, Surg. 322.

(*k*) Id. tit. Anus, 2 Gibson, Surg. 330.

(*l*) Coop. Surg. Dict. tit. Alvine *concretions;* Copl. Dict. tit. *Colon.*

(*m*) Id. tit. *Rectum*, and id. tit. *Strictures;* Salmon on Strictures of the Rectum; and see Dr. Baillie, Med. Trans. vol. 5, art.ix.

(*n*) Coop. Surg. Dict. tit. *Bladder*, and tit. *Lithotomy*, tit. Urine, Retention of.

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In cases of death, the cause of which has not been previously discovered by the ordinary examination, beginning with the upper parts of the intestines, it may become necessary to examine the rectum, as death has been occasioned by criminal means there particularly introduced; as in the case of King Edward the Second, by a red hot poker or some other instrument thrust up the rectum, and cased in a sheath to conceal any apparent injury, or by an empoisoned clyster administered in the same way, as in the case of Sir Thomas Overbury, and by which the upper part of the rectum will have become inflamed.(*o*)

The functions of the large intestines in general.

Dr. Bostock observes that the obvious and essential use of the large intestines is to carry off from the system the refuse matter after the separation from it of the chyle.(*p*) We have seen how the fæces are separated from the chyle in the small intestines, and that such fæces, after becoming more and more inspissated in their long course through the ileum, have to overcome the *valve of the cæcum* and pass into the large intestines; and to facilitate this, the extremity of the ileum is lubricated very abundantly by mucus.(*q*) On arriving in the large intestines, the unabsorbed mass undergoes fresh changes, hitherto unexplained, and is gradually converted into excrement. Here it is that the true succus intestinalis is poured forth, for the secretion into the small intestines is probably nothing more than mucus and a simple watery fluid. The excrementitious mass, consisting of the indigestible part of the food, the resin, and colouring and fatty matter of the bile with intestinal mucus, loses its fluids gradually as it descends, and in the rectum generally becomes particularly dry.(*r*) In the cæcum and beginning of the colon, the remnants of the food coming from the ileum are retained for some time, and in consequence of absorption, acquire a greater degree of consistency, and acquire a fetid smell.(*s*) But in this, as well as in all other analogous instances, some secondary purpose of utility is served even by such residuary matter, for the larger intestines have a number of lymphatic vessels connected with them, which successively absorb the more fluid parts of the fæces, and thus extract from them what may ultimately contribute to nutrition; and to this power of absorbing nourishment, even by injecting nutritious fluids into that part of the intestines, exists the power of sustaining life for a short time when food cannot be received through the œsophagus.(*t*) This is attributable to the process of absorption still continuing throughout the great intestines, and still contributing considerable moisture and nutrition to the frame until every quality of nourishment has been extracted, and the excrement has been rejected.(*u*) The principal purpose, however, of the construction of the lower intestines is to afford the power of retaining only, until a convenient time and proper occasion, the accumulating fæces, instead of troublesome and rapidly succeeding discharges.(*x*) In vigorous health, they should take place once or twice a-day, but medical men do not consider delay, even for three days, to be attended with serious consequences.(*y*) Some, indeed, have considered that excrement, whilst retained in the intestinal canal, has vitality; and others have insisted that the longer it remains in the frame, without sensible inconvenience, moisture and nutriment ensue: but it seems to have been more rationally observed, that the excretions must be regarded as dead matter, useless, and foreign

(*o*) 3 Paris & Fonb. 64; 2 id. 222, 230.
(*p*) 2 Bost. 395.
(*q*) El. Blum. 353.
(*r*) Id. 356; 3 Bell, 319; Jackn. Prin. Med. 360;
(*s*) 1 Dungl. Phy. 508.
(*t*) 2 Bost. 395, 396.
(*u*) 3 Bell, Anat. 319; 1 Good, 136.
(*x*) El. Blum. 254, 255, 359; 2 Bost. 396; 1 Dungl. Phy. 508.
(*y*) See extraordinary instances of prolonged constipation, Copl. Dict. 405; where also see that "*in a healthy person the fæces are constituted principally of secreted matter, and the residue only of small parts of the food that have escaped the changes produced by digestion.*"

to the system, and that they all run with the greatest rapidity into decomposition. In operating for retention of urine the surgeon finds the fluid more or less fetid; the fæces become so when not discharged in due time, and the neglect of washing even the surface of the frame is the source of filth and disease,(*y*) and the appearance of the alvine discharge is one of the best indications of the state of the hepatic function.(*z*)

Besides these offices, secretion, or rather excretion, is performed in the great intestines. The surface of the intestine is the organ by which that matter, the waste, incident to the changes of the economy, which is not carried away in the urine, is thrown out of the system.(*a*)

The discharge of the fæces is occasioned partly by gravity, and partly by the peristaltic motion of the intestines and the powers of respiration, which push the fæces downwards by slow degrees to the rectum,(*b*) and usually, in a healthy state, an expulsion takes place at least once in twenty-four hours, but this is very various, and instances frequently occur, even in a healthy state, of habitual retention of the fæces for a much longer time, and of more frequent rejection without any apparent illness.(*c*) The fæces contained in the great intestines, though offensive, are not putrid, and the rapid change which takes place in the alimentary matter, by chemical combination when voided, implies that there is a controlling influence of the great intestines over the contents.(*d*) Hence, perhaps, in derangement of function of the bowels, this controlling influence being lost, putrefaction may ensue, whilst the fæces are retained, and render them a source of morbid irritation.(*e*) After the excretion, the effort of the abdomen having ceased, the *levator ani* chiefly retracts the intestine, and which is again closed by its sphincter.(*f*)

Diseases and disorders, and injuries to the small and great intestines, and solid viscera in general. (*g*)

Sometimes a *derangement*, termed *intus susceptio*, takes place in the intestines, more particularly in the smaller intestines, especially where the ileum terminates in the colon, and is frequently fatal; it consists in a portion of gut passing for some length within another portion and dragging along with it a part of the *mesentery*. In infants the natural peristaltic motion of the entrails will probably disentangle them; but in adults, an unrelenting *obstruction* is sometimes established and inflammation follows, and life is soon terminated, as was exemplified in the case of the infant Princess Elizabeth of Clarence.(*h*) The great intestines, and principally the colon, are usually the seat of the disease called dysentery, or bloody flux.(*i*)

The *solid viscera*, viz. liver, pancreas, spleen, &c.

Having thus considered the *membranous viscera*, viz. the stomach and the small and great intestines, we will now consider those organs which are usually termed the *solid viscera*, namely, the *liver*, *pancreas*, and *spleen*.(*k*) It must be kept in view that the stomach, intestines, gall bladder, and bladder of urine, have muscular coats, and the power of

(*y*) El. Blum. 64.
(*z*) Dr. Johnson on Indigestion.
(*a*) 3 Bell, 319.
(*b*) 1 Dungl. Phy. 508.
(*c*) El. Blum. 359; ante, 210, note (*y*)
(*d*) 3 Bell, 319.
(*e*) Id. 320.
(*f*) El. Blum. 355.
(*g*) Coop. tit. Wounds; 2 Good, 417 to 442; 1 Gibson, Surg. 145.
(*h*) 3 Paris and Fonb. 65; and see 1 Good, 156, 157; Coop. Dict. tit. Introsusception; Copl. Dict. tit. Digestive Canal, 553; 3 Bell, 313; Intestinal Turgescence, 1 Good, 334; contusion and other injuries of abdomen, Coop. 1297; as to strictures in rectum or colon, see 1 Good, 180 to 182.
(*i*) 2 Good, 417.
(*k*) 3 Bell's Anat. 267, 320. The kidneys, the capsulæ renales, the ureters, the bladder, the urethra, prostate gland, scrotum, and urine, will be more properly considered in the chapter relating to secretions.

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contracting their cavities; but that the liver, spleen, pancreas, and kidneys, have no muscularity, excepting in their vessels and excretory ducts. This division of the viscera, it has been observed, may lead to important distinctions in pathology; because, during inflammation, it has been observed, that though the parts possessing a power of contraction may sometimes be inactive without pain, yet that in those parts, when roused to action, there is excruciating pain; whilst, on the other hand, it often happens that the glandular and *solid* viscera are the seat of long continued disease, which is attended only with a dull or low degree of pain; although the anatomist is often struck, upon examining the body after death, with the wide ravages of the disease.(*l*) The description of the viscera, situated in the large cavities, whether in the brain or abdomen, and which minister to the more important functions, is termed *splanchnology*, from the Greek.(*m*)

The liver, gall bladder, and bile.(*n*)

The largest and most important of all the solid or glandular viscera is the *Liver*, by which the bile is prepared. It is the seat of a great variety of diseases, and appears to produce a very powerful effect on the blood itself by the removal of several of its noxious principles, independently of its principal office as a *digestive organ*.(*o*) It has been observed that, notwithstanding the magnitude of the liver, and its importance in the animal economy, and the destructive and grievous consequences arising from its diseases, have induced the most diligent experiments and inquiries, yet that physiologists are not as yet in possession of clear information respecting the functions of the liver and the uses of the bile.(*p*) The better opinion seems to be that the liver, with the bile there secreted, perform an office, in regard to the purification of the blood, analogous to the lungs; the bile being formed in a great measure of the combustible matter of the blood, thus making the liver auxiliary to the lungs.(*q*) The liver is dense, heavy, and of a deep red colour, with a slight purple tinge along its thin margin, which is a characteristic of its perfectly healthy condition.(*r*) When torn or divided, the liver presents a granular appearance, so that it has been classed amongst the conglomerate glands.(*s*) It is of delicate texture. It is situated in the upper part of the abdomen, immediately under the diaphragm, above the stomach and arch of the colon, and behind and under the cartilages of the ribs, and towards the right side and in the right hypochondriac region, and partly in the epigastric region, extending also somewhat into the left hypochondriac.(*t*) It is convex on the upper surface, where it is in close contact with the diaphragm, and on its lower surface it is more irregularly concave, and there receives the convexity of the stomach, and of the duodenum and colon. In a healthy adult the liver does not extend from under the margin of the ribs, excepting near the pit of the stomach; but if it become enlarged, as in disease, its hard margin comes down so as to be felt through the abdominal parietes under the border of the chest.(*u*) In this situation the liver is retained by four folds of peritonæum, called *ligaments*, namely, the falx or falciform fold on its upper surface, and the coronary and two lateral placed at its posterior border.(*x*) The liver is thick and massy behind and towards the right side; but anteriorly, and

(*l*) 3 Bell, 267.
(*m*) Ante, 52; Quain's El. 35; but see 1 Good, 281, 282.
(*n*) See fully 2 Horn. Anat. 47 to 56; 3 Bell, 320 to 345.
(*o*) 1 Good, 9; Quain's El. 512.
(*p*) 1 Good, 21; 3 Bell, 321; 2 Dungl. Phy. 228.
(*q*) 3 Bell, 339, 340; El. Blum. 332, 340, 341; 1 Good, 21, 22, 24.
(*r*) See 2 Horn. Anat. 48.
(*s*) Id. 50.
(*t*) Id. 47; as to these regions ante, 37, 38; post, part ii.
(*u*) 8 Bell, 332.
(*x*) 2 Horn. Anat. 49, 50; 3 Bell, 323.

towards the left side, it is thin, and has an acute edge, so that it lies smooth over the distended stomach.(*y*)

The vessels of the liver.

There belong to the liver five distinct systems of *vessels;* the vena portæ, the arteria hepatica, the venæ hepaticæ, the biliary and lymphatic ducts; these, with their nerves, form a very intricate but important system of vessels.(*z*) The extreme subdivision of these blood vessels in the liver are inconceivably minute, and are collected into very small glomulerates, from which arise the *pori biliarii,* which are very delicate ducts, secreting the bile from the venous blood;(*a*) and which bile is discharged from the liver through the common duct, which is formed from the union of the hepatic and cystic ducts. The bile flows slowly, but constantly, along the hepatic duct, the greater portion passing constantly through the ductus communis choledochus into the duodenum, as before described, but some regurgitates from the hepatic into the *cystic duct,* and is received by the gall bladder, where it remains for a short period, and acquires the name of cystic bile.(*b*) The *gall* bladder is not furnished with muscular fibres; and it has been observed, that, therefore, it has no means of evacuating its contents except what is derived from external pressure, and probably the pressure of the diaphragm upon the liver and gall bladder, during inspiration, occasions that salutary and necessary evacuation.(*c*)

The gall bladder.

The *gall bladder* is sunk in the substance of the liver, and the pit or excavation which receives it has been considered, though improperly, as a fissure or fossa.(*d*) It is attached to the lower surface of the right lobe of the liver, and partly buried in its sinus. It is an oblong sac or bag of a pyriform shape, its greater end or fundus is contiguous to the colon, its smaller end or neck to the duodenum. It is generally of a size to contain an ounce or an ounce and a half of bile, and adheres to the concave surface of the liver, and consists of three coats.(*e*) The bile which has passed into the gall bladder is retained, until, from a reclined posture or pressure, it flows from thence into the duodenum.(*f*)

Consequences of diseases or irregularities.(*g*)

The retention of the *bile,* surcharging the ducts, and distending the gall bladder, and the sudden discharge of accumulated bile, and the irregularities of its course, when influenced by disorder of the viscera, are the source of the most severe and distressing symptoms.(*h*) The gall bladder is considered merely as a receptacle and reservoir of the bile, and it is established that the bile therein is not secreted thereby or through its own coats.(*i*)

Bile.

Bile has been defined to be a thick, yellow, bitter liquor, separated in the liver, collected in the gall bladder, and discharged by the common duct. The exact nature of bile has been the subject of much controversy, and it is admitted is not as yet perfectly ascertained.(*k*) It however is clearly formed, in a great measure, of what has been treated as

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(*y*) 3 Bell, 324.

(*z*) El. Blum. 332, 333; 2 Horner, Anat. 51, 52, where see a full description.

(*a*) 5 Good, 171; 2 Horner; Anat. 52.

(*b*) El. Blum. 332, 333; 5 Good, 171. For a further description of the minute anatomy of the liver, see an admirable paper by Mr. Kiernan, recently read before the Royal Society.

(*c*) 2 Bost. 48.

(*d*) 3 Bell, 327; 2 Horner, Anat. 53.

(*e*) Id. 332; El. Blum. 333.

(*f*) El. Blum, 334; see 2 Dungl. Phy. 231.

(*g*) Johnson, 34

(*h*) 3 Bell, 332, 335; Morgagni Adversa Ann. 111, A. xx to xxvii.

(*i*) 3 Bell, 333.

(*k*) Id. 339, 340; El. Blum. 334, 335, 427; 1 Good, 283; 2 Bost. 288, 289, note; and see more fully, 3 Bost. 333; 2 Dungl. Phy. 231.

CHAP. VI. SECT. III. DIGESTION.

the combustible matter of the venous blood, which is passed through the numerous blood vessels entering the liver, as presently noticed, and there purified in a manner somewhat similar to the operation in the lungs, and thus the liver is auxiliary to such lungs.(*l*) Upon the last experiments it has been observed, that the primary use of the liver in the animal economy, consists in its separating from the venous blood certain substances which contain an excess of carbon and hydrogen, thus fulfilling a function very analogous to that of the lungs, which we have seen remove those elements from the system, under the form of gas and vapour, and the liver under that of a fluid or semifluid substance. It is to be remarked, however, that there is an essential difference between the respective excretions of these organs, namely, that the first are burned, or rather are similar to the products of combustion, while the latter are still combustible.(*m*)

The bile is secreted from the capillaries of the *vena portæ* derived from the returned blood of most of the abdominal viscera.(*n*) It is derived from the red particles of the venous blood, which contains an abundance of carbonaceous element,(*o*) and its substance is analogous to resin.(*p*) It has been observed, that when the course of the vessels in the liver and the fluids they contain are considered, we perceive that two sorts of blood are brought to each granule by the veins and arteries, and that a different sort is conveyed away by the hepatic vein, whilst at the same moment a new fluid (*the bile*) is received and carried down to the duct, so that each granule forms the centre of a minute eddy, round which the fluids turn, the mere fact of making the turn being sufficient not only to change their direction, but also to impress upon them a total alteration of character.(*q*) The natural bile of the adult system is of a *deep yellow colour;* when concentrated by the absorption of its liquid parts, it is brown;(*r*) whilst bile taken from a fresh adult subject, is rather viscid, of a brownish green colour, inodorous, and if compared with that of brutes, scarcely bitter.(*s*) Its constituent parts, obtained by chemical analysis, are, besides a large proportion of water, albumen, resin, soda partly united with phosphorus, sulphur, and muriatic acid, a small portion of phosphate of lime and iron, and a variable quantity of a remarkable and peculiar yellow matter.(*t*) But the composition of bile varies greatly both from the proportion of its parts, particularly of the albuminous and resinous, differing under varying circumstances, and also from the addition of other constituents during *morbid* states, especially of an adipocerous substance, which gives origin to most biliary calculi, for these consist either of it alone, or of it combined with the yellow matter just mentioned.(*u*) But others insist that the bile contains alkali and salt in the same proportion as the blood, and that no resin exists in it, but a peculiar matter of a bitter and afterwards somewhat sweet taste, which possesses characters in common with the fibrin.(*x*) The complicated nature of bile necessarily gives rise to a proportionably operose and complicated mode of analysis. Tiedemann and Gmelin appear to have paid the most minute attention to this part of the subject. The result of the whole is, that 91.51 per cent. is water, and that the solid contents consist of twelve proximate animal principles, and ten neutral or earthy salts.

(*l*) 3 Bell, 339, 340; El. Blum. 332, 340, 393; see 2 Dungl. Phy. 228 to 230.

(*m*) 3 Bost. 337, referring to the observations of Tiedemann and Gmelin, Recherches Experimentales sur la Digestion, traduites, par Jourdan, tom. i. p. 60.

(*n*) 5 Good 170, n. 2 Bost. 291.

(*o*) El. Blum. 393; 2 Bost. 292.

(*p*) 2 Bost. 288; 2 Dungl. Phy. 231, 232.

(*q*) Quain, El. 516.

(*r*) 3 Bell, 344; 2 Horner, Anat. 55.

(*s*) El. Blum. 335; 2 Dungl. Phy. 231.

(*t*) Id.; 2 Bost. 288 to 290.

(*u*) El. Blum. 335,

(*x*) Id. 337.

The proximate animal principles are some of them in small quantity, and not very well defined. Of those that are more so, and exist in greater proportion, we have cholesterine, biliary resin, what is termed biliary asparagin, picromel, osmazone, and mucus. The salts are principally combinations of soda, but there is not any uncombined soda according to the common opinion. The bile of the dog did not differ very essentially from that of the ox, although the number of ingredients which entered into its composition was smaller. It contained cholesterine, resin, picromel, and mucus, with various salts, and as far as the confessedly incomplete analysis which was made of the human bile allowed them to form an opinion, it appeared to contain the same proximate principles. Hence we learn that the analysis of Tiedemann and Gmelin, although not agreeing in every respect with that of Thenard or that of Berzelius, approaches more nearly to the former.(*y*)

Use and functions of the bile and liver. (*z*)

With respect to the real *use* or *function* of the bile, or even the final use of the liver, where it is secreted, Dr. Good, observes, who shall explain them?(*a*) One of the supposed uses of bile is to maintain the peristaltic action of the bowels.(*b*) The more common opinion has been, that the bile precipitates the feculent matter of food from its chylous fluid, and though this has been questioned,(*c*) it is the doctrine now generally received;(*d*) and it is further considered, that the bile is immediately useful in promoting the process of digestion, and that the serous part of the bile is intermixed with the chyle, and carried into the thoracic duct, and there mixed with the other absorbed materials of the new blood.(*e*) Dr. Bostock admits that the bile probably assists in digestion, but regards it as essentially an excrementitious substance.(*f*) It has been observed, that we may safely conclude that the *liver*, linked in close sympathy with the intestines, connected by nerves, blood vessels, and ducts, holds a control over their action by the stimulating fluid which it supplies to them.(*g*) The bile secreted in the liver from the venous blood, is formed, in a great measure, of the combustible or carbonated matter of the blood, thus making the liver auxiliary to the lungs.(*h*) Fourcroy also considered that the liver is intimately connected in function with the lungs;(*i*) and Dr. Bostock observes, that when the venous blood becomes loaded with inflammable matter, which cannot be discharged from the lungs, principally in consequence of the high temperature to which the animal is exposed, and when, from certain causes, one of which appears to be the increase of cutaneous perspiration, this excess of inflammable matter is not employed in the deposition of fat, the liver would appear to be the organ by which it is removed. In ordinary cases, the quantity of bile discharged is small, probably no more than what is sufficient to preserve the liver itself in its healthy state, and to perform the secondary object of digestion, to which the function is subservient; but when from a conjunction of circumstances there is an excess of inflammable matter, its accumulation is prevented by an increased discharge of bile.(*k*) Tiedemann and Gmelin ascribe the following uses to the *bile; first*, by its stimulant properties it excites the flow of the intestinal fluids, as is proved by the unusual dryness of the fæces in jaun-

(*y*) 3 Bost. 332, 333, extracting from Tiedemann and Gmelin, vol. i. p. 88, 89.

(*z*) See ante, 203 to 206, when considering the functions of the small intestines.

(*a*) 1 Good, 283.

(*b*) Id. 284; El. Blum. 336, 338, 339.

(*c*) 3 Bell, 344.

(*d*) El. Blum. 336; Dr. Johnson on Indigestion.

(*e*) El. Blum. 336 to 339; 2 Bost. 292.

(*f*) 2 Bost. 292.

(*g*) 3 Bell, 345.

(*h*) Id. 339, 340.

(*i*) 1 Good, 22.

(*k*) 2 Bost. 292.

diced persons; *secondly*, it probably stimulates the intestinal muscular fibres to action; *thirdly*, as it contains an abundance of azotised principles, it may contribute to animalize those articles of food which have no azote in their composition; *fourthly*, it tends to prevent the putrefaction of the food during its course through the intestines, and which is proved by the circumstance of the food being much further advanced in decay in the entrails when the bile does not sufficiently flow into them as when in the healthy state; *fifthly*, it probably tends to liquify and render soluble the fatty part of the food; and, *lastly*, that it is to be regarded as an important excretion.(*l*)

Effects of passions and affections upon the liver and gall-bladder.

Anger, when long indulged, is well known to affect the functions of the liver, and has often laid the foundation for jaundice, and consequently for a deeper colour, as well as other properties of the blood that circulates through the heart; a fact so well known, that the actual seat of anger, instead of being properly attributed to a mental affection, has, in the poetical language of most countries, been erroneously transferred to this organ; and bilious, or choleric and irascible, are convertible terms in the popular though incorrect language of our own day.(*m*)

Diseases of the liver.

The liver is the seat of numerous and important diseases,(*n*) such as jaundice,(*p*) abscess, obstruction, inflammation, and malignant tumours.(*r*) It is the seat of *jaundice*, whose proximate cause consists in an impeded flow of the bile into the alvine canal, and its retrograde passage into the blood.(*s*) One of the immediate effects of the calorific rays of the sun is to stimulate the liver to an excessive secretion of bile; and hence the alimentary canal may become overloaded with it, and perhaps the blood impregnated; and hence again the greater violence of bilious cholera, and its accompaniment with peculiar symptoms in hot climates.(*t*) The functions of the liver and the stomach are so intimately linked, that a derangement of one, especially of the liver, very commonly produces derangement in the other, and it is difficult to say, in many cases, which has the priority.(*u*)

Injuries to the liver.

The liver may be ruptured, or otherwise injured, so as to occasion almost immediate death, and many instances of this nature have been described:(*x*) and when criminal death is suspected, the liver requires particular examination.(*y*) A wound in the *gall-bladder*, occasioning extravasation of bile, has generally been considered as necessarily mortal, but it is said this is not so;(*z*) and, in general, wounds of the liver, if slight, are not fatal, but if deep are as certainly fatal as a wound of the heart.(*a*)

The pancreas and pancreatic juice.

The *Pancreas* (the organ in the calf termed *sweetbread*) is the largest of the conglomerate *glands*, (that is, consisting of lesser parts united,) excepting the breasts, and extremely analogous to the salivary glands in every part of its structure, even in the circumstance of its excretory ducts arising by very minute radicles, and uniting into one common duct,

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(*l*) 1 Good, 23, 136, where see observation on these suggestions.

(*m*) Cogan on the Passions; 4 Good, 92. Lord Coke, in his Institutes, affected knowledge of natural history, alluding to the elephant as having no gall, bile, or rancour, and that a member of parliament ought, in such respect, to resemble that animal.

(*n*) 1 Good, 21; Jackn. Prin. Med. 341.

(*p*) 1 Good, 282 to 285. See Dewees, Prac. Phys. 559, 570.

(*r*) Id. 364 to 370; Brous. Pathol. 211 to 218.

(*s*) Id. 282, 285; see post.

(*t*) Id. 293.

(*u*) Dr. Johnson on Indigestion; and see id. as to organic diseases of the liver.

(*x*) 3 Par. & Fonb. 65 to 67.

(*y*) Id. 65; Ryan, Med. Juris. 179.

(*z*) Coop. Dict. tit. Wounds; 1 Gibson, Surg. 115.

(*a*) Id.

which penetrates the tunic of the duodenum, and supplies the cavity of that intestine with a constant stillicidium of *pancreatic juice*.(*b*) This organ is of a long form, like a dog's tongue, and lies across the spine and behind the stomach.(*c*) The weight of the human pancreas is about three times that of all the salivary glands together.(*d*) The quantity of the pancreatic juice cannot be accurately ascertained. It is no doubt produced copiously during chylification, and cannot be expected to flow readily at other times, because the stimuli are the fresh and crude chyme entering the duodenum, and the bile flowing through the opening common to it and the pancreatic juice.(*e*) It was formerly erroneously supposed that the pancreatic juice was *acrimonious*, but that doctrine has long been refuted.(*f*) Dr. Elliotson observes, that the use or function of the pancreatic juice is unknown; but that Blumenbach's opinion that it assimilates the chyme more to the nature of the fluids is more precisely given by Tiedemann and Gmelin, who conceive that it animalizes the unazotized principles of vegetable food. It is certainly much larger proportionably in herbivorous than in carnivorous animals. They assign the the same purpose to the saliva.(*g*) The general opinion has been, that the pancreas is useful in secreting a fluid which dilutes, tempers, and moderates the acrimony of the bile,(*h*) and that it is materially useful in chylification or dissolving the chyme.(*i*) This fluid has been supposed to be similar to saliva, and that the pancreas is a gland of dilution, and serves, like the saliva in the mouth, further to dilute the food when requisite.(*k*) But it is said, that upon recent examination of the fluid, it has been represented to differ materially from saliva, and that it never contains any sulpho cyanic acid, free soda or mucus, and that its proper use is to animalize the unazotized principles of vegetable food.(*l*) Dr. Good has observed, that we know but little respecting the use of the pancreas, or the function of digestion, but that we do know that the pancreas pours forth a considerable portion of the fluid which holds the solid part of our food in solution, and that therefore it is highly probable that the pancreas and spleen are both affected in many cases of dyspepsia.(*m*) Tiedemann and Gmelin's experiments have established that the secretions of saliva and pancreatic juice differ in the following respects:—1st. The amount of the solid contents in the saliva is only half as much as that in the pancreatic juice. 2. The saliva contains mucus and proper salivary matter, with perhaps very minute quantities of albumen and gaseous matter; whereas in the pancreatic juice the proportion of these principles is reversed, the two latter existing in great abundance, and the two former in very minute quantity. 3. The pancreatic juice is either neutral or contains a little alkaline carbonate. 4. There is no sulphocyanate in the pancreatic juice of the sheep, although it is found in the saliva of this animal. It must be kept in view, however, that these examinations do not appear to have been made upon *human* pancreatic juice.(*n*) But the French chemists, MM. Leuret and Lassaigne, have stated quite different results in their examination of this secretion; and whilst the Germans have informed us that it is essentially acid, the French chemists contend it is alkaline. Dr. Bostock appears to concur with Dr.

(*b*) El. Blum. 329; 3 Bell, 345; 2 Horn. Anat. 60; 2 Bost. 396; 2 Dungl. Phy. 223, 224.
(*c*) 3 Bell, 345; Brous. Phy. 448; 3 Par. & Fonb. 66.
(*d*) El. Blum. 330.
(*e*) Id. 329, 330; Jackn. Prin. Med. 344.
(*f*) Id. 328.
(*g*) El. Blum. 330; see also 1 Good, 25, 26; Jackn. Prin. Med. 345.
(*h*) 3 Bell, 238, 347.
(*i*) 1 Good, 25; El. Blum. 329.
(*k*) 3 Bell, 348, 349; El. Blum. 328.
(*l*) 1 Good, 24, 25; El. Blum. 330.
(*m*) 1 Good, 134.
(*n*) Researches, &c. vol. i. 41, 42.

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Prout in favour of the German results.(*o*) It has been suggested that the use of the pancreatic juice may be to animalize the unazotised particles of vegetable food;(*p*) and it has been also observed, that the juice tempers the acrid bile,(*q*) and that the bile is diluted by the pancreatic juice.(*r*) But the supposed use of the pancreas and spleen will be presently more particularly considered.(*s*) It has been conjectured by Haller, though it is said erroneously, that the secretion and pouring of this pancreatic juice from the pancreas into the duodenum is equal to *eight pounds* in the twenty-four hours.(*t*)

Diseases of pancreas.

Diseases of the pancreas occur but rarely;(*u*) but it may be affected by turgescence, or by chronic induration or enlargement, sometimes accompanied with calculous concretions.(*x*)

The spleen.

The *spleen* is a soft spongy and exceeding vascular organ. Its colour is deep red, with a tinge of blue, particularly round its margin. Its form is somewhat oval, being smooth and convex on the exterior, where it is in apposition with the diaphragm, and irregularly concave on the opposite side, which is divided into two parts, but unequally, by a transverse slit, for the transmission of its vessels. The spleen has a peritoneal investment prolonged to it from the stomach, by which, as well as by vessels, it is connected to the stomach; but it has also a smooth and fibrous tunic proper to itself. The *splenic artery* is of considerable size. The *vein* terminates in the vena portæ, and its nerves are derived from the solar plexus.(*y*) The spleen secretes no peculiar fluid, its blood is of a dark livid colour, and coagulates with difficulty. It is even destitute of an excreting duct, and in some instances has been extirpated without injury to the general health.(*z*) The spleen is *situate* in the left hypochondriac region between the diaphragm and the stomach, and beneath the cartilages of the false ribs.(*a*)

With respect to the use or function of the spleen, it has been observed that it is as yet but little known, but that it may be affirmed to be subservient to digestion.(*b*) It has been observed, that upon the whole it should seem that the stomach, duodenum, liver, pancreas, and spleen, are united in function;(*c*) and that the spleen is an organ subservient to the stomach; that it is a provision for giving the vessels of the stomach an *occasional* power and greater activity, enabling them to pour out a quantity of fluid proportioned to the necessity of the digestion;(*d*) and that we may conclude that it is not the means of retarding the blood in its circulation, but of giving force to it;(*e*) and that the probability is, that the venous blood of the spleen is useful to the function of the liver, either by supplying venous blood in proportion to the wants of the liver, or in that venous blood carried to the liver there may be some peculiar change wrought by the spleen, and fitting it for the secretion of bile.(*f*) Some have suggested that the spleen is a mere diverticulum for the blood during digestion. Others, that the specific function of the spleen is to secrete from the blood a reddish fluid that has the property of coagulating, and

(*o*) 3 Bost. 338, 339.
(*p*) 1 Good, 25, 26.
(*q*) 6 Bell, 238.
(*r*) El. Blum. 336.
(*s*) Post, and 2 Bost. 397.
(*t*) El. Blum. 352.
(*u*) 1 Good, 325, 326; Jackson, Princ. Med. 345.
(*x*) 1 Id. 325, 326.
(*y*) 2 Horn. Anat. 56 to 60; 3 Bell, 349, 350.
(*z*) 1 Good, 26; 2 Dungl. Phy. 247.
(*a*) 2 Horn. Anat. 56; 3 Bell, 349, 350; 3 Paris & Fonb. 66.
(*b*) 3 Bell, 238, 349, 352; 1 Good, 26. 2 Good, 371; 2 Bost. 397; and see fully 2 Dungl. Phy. 245 to 250.
(*c*) 3 Bell, 238, 354.
(*d*) Id.
(*e*) Id. 238, 355.
(*f*) Id. 356, 357; 1 Good, 306.

which is carried to the thoracic duct, and being there united with the chyle changes it into blood; but neither of these doctrines is to be considered as established.(*g*) Dr. Bostock and others have inferred that as there are instances of continuing life and health notwithstanding the total destruction of the *spleen*, it is not absolutely essential to life, and that consequently the office of the spleen is only of a supplementary nature, and though *occasionally* useful, is not indispensable.(*h*)

Diseases of spleen.

The spleen may be affected by turgescence or enlargement, called *parabysma splenicum;*(*i*) and although this organ is not to be regarded as vital, or one of sensibility, and it be wholly wanting, or be extirpated without affecting life, yet the more the spleen exceeds its natural size the greater is the emaciation of the individual and the impairment of his health;(*k*) because, being a diverticulum, it retains blood that ought to go to the general fund. The spleen may also be *inflamed*, but it is less subject to it than many other of the abdominial viscera.(*l*) It may also become ossified, and have tubercles formed in its substance, but there is seldom suppuration in it.(*m*) So the spleen, like the liver, may be ruptured by blows, falls, wounds, or other violence, and which will generally prove fatal.(*n*)

Injuries to spleen.

Collateral parts connected with the small and great intestines.

Having thus considered the digestive organs, the intestinal canal, and the collateral or solid viscera, it may be proper to notice the peritoneum, with its folds, the mesentery, the mesocolon, and omenta. The viscera of the abdomen, which we have thus considered, are fixed in their position by an extended seous membrane, the *peritonæum*, already mentioned,(*o*) forming numerous folds, which are called *ligaments*. It is closely adapted to the liver, gall bladder, stomach, intestines, spleen, and on the pelvic viscera. From the great arch of the stomach it forms a very extended fold, which invests the front of the intestines, called the *great omentum* or *epiploon;* and the great omentum is reflected back to form attachments for the small intestines in the centre of the abdomen, and called the *mesentery*, and a large duplicature around it for the large intestines is called the *mesocolon*, and ligaments of the colon, the spleen, the liver, bladder, and rectum. A very cursory notice of the peritonæum will suffice, for it is comparatively uninteresting and unimportant, whether physiologically or surgically. Its precise course is most difficult to trace; it is not to be classed amongst the viscera of the abdomen, though, in fact, it invests or surrounds them.

The *mesentery*, *mesocolon*, and *omenta*, are ligaments and plicæ, or folds, formed by the peritonæum. The mesentery and mesocolon are *primary* processes reflected off from the spine upon the intestines, whereas the *omenta*, (from the Latin *omentum*, and *signifying the caul* in which the bowels are wrapped,) (*p*) are secondary processes of the peritonæum reflected from the surface of the stomach and intestines. The *mesentery* is the ligament of the *small* intestines, whilst the *mesocolon* is the ligament of the *large* intestines; and the *omenta* are floating membranes of great delicacy expanded over the surface of the small intestines, and attached to the great arch of the stomach.(*q*)

(*g*) 1 Good, 25, 26.
(*h*) 2 Bost. 399.
(*i*) 1 Good, 325; 3 Bell, 351; see *diseases of spleen in general*, Cyclop. tit. Spleen.
(*k*) 1 Good, 325, 326.
(*l*) 2 Good, 371.
(*m*) 3 Bell, 351.
(*n*) 3 Paris & Fonbl. 66; Ryan, Med. Jur. 179.
(*o*) Ante, 183; and see its diseases, Dewees, Prac. Phys. 552, 559.
(*p*) Ventriculus atque intestina pingui ac tenui omento teguntur.—*Plin.*
(*q*) 3 Bell, 262, 263.

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Of the mesentery in general.

The *Mesentery* is formed by a doubling of the peritonæum, which is detached forward, and includes the intestines, as in a sling. It is named from its situation in the *middle* of the intestines, and is divided into two parts, one connecting the *small* intestines, and retaining the name of *mesentery;* the other the great intestines, and termed *mesocolon.*(*r*) The proper *Mesentery* begins at the last turn of the duodenum, and runs obliquely downwards, and towards the right side along the *vertebræ* of the loins, to the first, second, and third of which it is chiefly connected. Between the two layers of the mesentery are enclosed a considerable quantity of cellular substance and fat, with the numerous blood vessels, nerves, lacteals, and glands of the jejunum and ileum. Its anterior edge is much more extensive than the posterior, being plaited and folded, and corresponding with the convolutions of the intestines to which it is fixed.(*s*) The surface of the mesentery has a moisture exuding from its pores. Its use is to give a smooth surface and to strengthen the intestines, and in a great measure to limit the degree of their distention.(*t*) The

Mesenteric glands.

mesenteric glands are of the greatest importance, for the chyle absorbed by the lacteal vessels, before it is carried into the thoracic duct, is deposited in them, and there at least delayed until it is again absorbed and carried forward.(*u*)

The mesocolon.

The *mesocolon* is the continuation of the mesentery, which, after reaching the lower extremity of the ileum, contracts and obtains this name. It follows the course of the *great* intestines, and fixes them in their right place. Below the right kidney it is narrow and firm, and forms the right ligament of the colon. Opposite to that kidney it appears to be lost by the immediate adhesion of the colon to the duodenum in front of the kidney. It then turns across and forms a broad expansion, which encloses the arch of the colon at its anterior edge, and behind it separates and encloses the anterior part of the duodenum, and is fixed to the spine. It adheres a little to the under part of the extremity of the stomach, and then descends over the left kidney, at the lower part of which it forms the left ligament of the colon. It afterwards adheres to the left psoas magnus muscle, and forms a loose fold, which retains the sigmoid flexure of the colon. At the last vertebra of the loins it forms the *mesorectum,* which by degrees becomes narrower and disappears towards the under part of the pelvis, the rectum being then immediately connected to the os sacrum. Between the layers of the mesocolon are placed the arteries, veins, and nerves, with the absorbents and glands of the colon.(*v*) The *mesentery* in general suspends, connects, and retains the intestines in their places, furnishes them with an external coat, receives their glands, vessels, and nerves, and allows the two last to be properly distributed.(*x*)

The omenta in general.

The *omentum,* or *caul,*(*y*) formerly called epiploon, from its seeming to float on the intestines, is a fine membranous bag, intermixed with much fat, and covering a large portion of the anterior surface of the abdominal viscera. It is divided into omentum gastro colicum, and omentum colicum, the former common to the stomach and colon, the latter proper to the colon; they are, however, a continuation of one and the same substance.(*z*) The omentum is the principal seat of *fat.*(*a*) The uses of the

(*r*) 2 Horner, Anat. 33, 34; 3 Bell, 262, 300, 301.

(*s*) Id.; 2 Wistar, Anat. 116 to 119.

(*t*) 3 Bell, 300.

(*u*) Id. 237.

(*v*) 2 Horner, Anat. 34, 35; 3 Bell, 262, 300, 301.

(*x*) Tuson's Comp. 237.

(*y*) Ante, 219.

(*z*) 2 Horner, Anat. 12, 13; 3 Bell, 262, 263.

(*a*) 5 Good, 201.

omenta seem to be, that they fill up the inequalities which arise from the rounded forms of the viscera, and lubricate and give mobility to the intestines.(*b*) But the idea of the oil or fat exuding is unfounded, nor is it subservient to the liver.(*c*) Sometimes the omentum is affected with a peculiar disease, termed parabysma omentale or turgescence of the omentum, being an indurated and diffused tumour.(*d*) The omentum may suffer strangulation, and require operation and peculiar treatment in hernia epiplocele.(*e*) Sometimes the omentum will become the seat of excessive accumulation of fat.(*f*)

Diseases and injuries to omenta.

The *omentum gastro colicum*, or magnum, consists of an anterior and posterior part, each of which is formed of two membranes, ultimately united. In young subjects, the omentum forms a distinct bag, but, in old people, the layers of which it is composed, become more or less incorporated. The anterior layer is a continuation of the peritoneal coats produced by the upper and under surfaces of the stomach.(*g*) This omentum is a peculiar process of peritonæum arising immediately from the external coat of the stomach.(*h*) The longest and most remarkable process of peritonæum is this omentum. It is a large, empty, delicate sac, hanging from the large curvature of the stomach, extended over the greater part of the small intestines, applying itself closely to their convolutions, and in some measure insinuating itself into their interstices.(*i*)

Of the omenta gastro colicum or magnum in particular.

The *omentum colicum* arises from the right part of the arch of the colon, in the same manner as the other part of the omentum arises from the stomach, and sends downwards and to the right side a *cuneiform* process to be connected to the cæcum.(*k*)

Of the omentum colicum in general.

Besides these omenta, there is a membrane much smaller, situated between the liver and stomach, termed *omentum hepato gastricum*, or *omentum minus of Winslow*. It passes from the fore part of the sinus of the porta to the under and back part of the liver, to be connected to the whole edge of the small curvature of the stomach, and to the beginning of the duodenum. It is composed of two layers, but is thinner, has less fat, and is more uniform in its structure than the omentum magnum, and also differs from it in having no reflection upwards.(*l*)

Other Omenta.

(*b*) El. Blum. 349.
(*c*) 3 Bell, 266; El. Blum. 349.
(*d*) 1 Good, 336, 337.
(*e*) Coop. Dict. tit. Hernia.
(*f*) 5 Good, 201.
(*g*) 2 Horn. Anat. 12, 13; 3 Bell, 264.
(*h*) El. Blum, 348.
(*i*) Id. 349, where see a full description.
(*k*) 2 Horn. Anat. 13; 3 Bell, 265.
(*l*) Id. 12.

CHAPTER VII.

OF THE FUNCTION OF ABSORPTION; ITS ORGANS AND PARTS.

CHAP. VII. SECT. I. DEFINITION. &c.

SECTION I.—THE DEFINITION AND GENERAL DESCRIPTION.

SECT. I. DEFINITION AND GENERAL DESCRIPTION. (*a*)

It has been truly observed, that *absorption* is one of the most important functions in the system, and one of the most frequent channels through which disease is caused, perpetuated, or removed, and that the importance of entertaining accurate ideas, as to the channels through which the noxious agents affect the system, must be manifest.(*b*)

General description of the absorbent function, and of the lacteal and lymphatic vessels.

The function of *absorption*, from the Latin term, is defined by its name signifying sucking up, or imbibing, and consists in certain vessels and organs, viz. lacteals, lymphatics, glands, and thoracic duct, termed *absorbents*, receiving or taking up certain fluids, and transporting them from one part of the system to the other. The fluids thus taken up are, principally, two, namely, the *chyle* and the *lymph*, the former received by the *lacteals*, and the latter by the *lymphatics*. The immediate objects of the action of those sets of vessels is essentially different; that of the lacteals is to convey the *chyle* from the small intestines into the thoracic duct, and from thence into the subclavian vein, to be there intermixed with the general mass of the blood, in order that it may directly serve for the nutrition of the body;(*c*) whilst the *lymphatics*, it is supposed, serve to *remove* what is useless or noxious, and to dispose of it in such a manner, that it may either be applied to some secondary purpose of utility, so that nothing useful may be wasted, and that what would otherwise be injurious may be discharged from the system.(*d*) The *glands* collect and retain for a time the absorbed lymph, and probably, in some degree, influence its cha-

(*a*) See an excellent practically useful article on Absorption, Amer. Cyclop. Prac. Med.; and see, in general, Elliotson's Blumenbach, 360 to 377; 2 Bost. chap. xi. p. 423 to 480; 5 Good, 168 to 192; 2 Bell, 322 to 365; Jackson, Prin. Med. 382 to 403; and Coop. Dict. tit. Absorption; see an account of the discovery of the absorbent system, El. Blum. 374 to 376; 2 Horn. Anat. 292 to 302; 2 Dungl. Phy. 1 to 65; see derivation of Adenology, ante, 52; and, as to the diseases of the function and remedies, Amer. Cyclop. Prac. Med. title Absorption.

(*b*) Copland's Dict. Prac. Med. tit. Absorption.

(*c*) 2 Bost. 423.

(*d*) Id. 437.

racter; whilst the thoracic duct acts as a great reservoir preparatory to the new materials of blood passing into the subclavian vein and being there mixed with the mass of blood. In other words, absorption is principally the process by which the *new materials*, arising from food and nourishment, and converted in the stomach and smaller intestines into chyle, and serving for the nourishment, growth, and support of the body, are separated and in a degree more assimilated, and ultimately carried into the blood.(*e*) This is the primary and most essential office of the *absorbent function,* and is principally performed by one description of the absorbent vessels, which thus receive the recent new matter, the products of aliment and digestion, and convey it principally through the thoracic duct to the blood. But there is also a further and distinct object effected by another and totally different set of absorbents; for it is at least supposed, if not established, that all the particles of which the body is composed from time to time lose the power of performing their appropriate functions, and that, therefore, to continue the animal economy perfect, they must be *removed* and new matter deposited in lieu, and which object is effected by this other branch of the system of absorption (though not perceptible to our faculties) so that a *continual exchange of particles* takes place, the former constituent being taken up by certain absorbent vessels, namely, the *lymphaties,* and returned into the general circulation to be either discharged or employed under some new form;(*f*) and the vessel employed in the latter functions are termed the *lymphatics,* from the circumstance of the fluid which they contain being *lymph.*

CHAP VII. SECT. I. DEFINITION, &c.

SECTION II.—THE ORGANS AND PARTS OF THE FUNCTION OF ABSORPTION.

SECT. II. THE ORGANS AND PARTS OF THE FUNCTION OF ABSORPTION.

In general.

The absorbent vessels, which imbibe the *fresh* materials for new blood from the digested food, are principally found in the small intestines, where they receive into one common reservoir (the thoracic duct) all the new and recruiting materials for new blood, and which are from thence conveyed gradually into the subclavian vein; and from thence into the right auricle of the heart: and from thence, as we have seen, in considering the course of circulation of the blood,(*g*) into the lungs, and there exposed to atmospheric air, and returned through the pulmonary veins into the left auricle and ventricle of the heart, and thence passed into and through the aorta in circulation through the arteries, &c.(*h*) It is obvious, that were it not for such contrivance the nutritious qualities of the chyle would pass off uselessly from the frame through the small, and then through the large, intestines, the same as the fæces.

The materials thus absorbed are principally the *chyle,* which is found in the intestines from the nutriment received into the stomach and separated from the fæces in the small intestines, as explained in the last chapter.(*i*) But there are various other materials from other parts of the body, many of which are particles of the refuse matter separated by the secreting vessels, which are not wholly wasted, but much of it absorbed and passed into the thoracic duct and there mixed with the chyle, and also becomes part of the blood passed into circulation.(*k*) By this arrangement there is great saving of animalized fluids, which, however they may differ from

(*e*) 2 Bost. 423, 437.
(*f*) 2 Bost. 423, 436; 5 Good, 176; 2 Dungl. Phy. 3.
(*g*) Ante, 126 to 170.
(*h*) 2 Bost. 477 to 480; Coop. Dict. Absorption; El. Blum. 377, 378; 2 Bell, 331 to 364; Amer. Cyclop. Prac. Med. tit. Absorption.
(*i*) 3 Bell, 237.
(*k*) 5 Good, 169; El. Blum. 377, 378; Jack. Prin. Med. 390.

CHAP. VII. Sect. II. Organs and Parts.

each other in several properties, are yet far more easily reducible to genuine blood than mere new and unassimilated matter obtained from without.(*l*) For the purpose of this absorption, there are also the halitus of the cavities, the gall bladder, and not a small portion of the *stillatitious* fluids which are applied to the common integuments.(*m*) It is curious to observe and consider the winding course which nature has provided for the purpose of changing and assimilating the chyle and other absorbed fluids, before their admixture with the blood, and which, if introduced immediately with the blood, would, probably, occasion instant death.(*n*)

Enumeration of the absorbent vessels.

These several numerous absorbent vessels are divided into *four*, namely, *first*, the *lacteal* vessels; *secondly*, the *lymphatic* vessels; *thirdly*, the conglobate *glands;* and, *fourthly*, the "*thoracic duct.*"(*o*) The exact apertures or orifices of these cannot be traced, but they may be followed up either singly or in conglobate glands, until (with the exception of a few, which enter directly into the right subclavian vein) (*p*) they, in general, terminate in the thoracic duct, which finally pours the whole of this mixed fluid, steadily and slowly, by means of a valve placed at its opening, into the subclavian vein of the left side.(*q*) The use of that valve is, probably, not so much to prevent the influx of the blood, as to modify the entrance of the chyle, or to secure the gradual intermixture in the thoracic duct, and thence into the subclavian vein, and to cause it to enter by drops rather than in a stream.(*r*) The lymphatic system consists of an elaborate set of vessels, being more numerous than either the arterial or venous, and a number of glands distributed in various parts in the course of these vessels.(*s*)

First, the lacteals. (*t*)

The *Lacteals* are so termed from their general *milky* or white appearance; but it is said they ought more properly to be called the *chyliferous* vessels; and they are sometimes termed the *nutrient absorbents.*(*u*) These originate amongst the *villi* of the internal coats of the small intestines, and partly in the duodenum, but principally in the jejunum and ileum; by them the *chyle* is conveyed from those intestines into the thoracic duct, and thence into and through the subclavian vein into the right auricle; and although so much of this supposition as respects the *villi* has been disputed, the residue appears to be universally assented to.(*x*) and it is agreed that the orifices in the small intestines have a peculiar absorbent or attractive quality, like capillary tubes, so as to attract and imbibe the chyle:(*y*) and, it is further agreed, that, after the chyle has been thus once absorbed through such orifices, then by the contractile power of the lacteal vessels, assisted by the mechanical action of their valves, and, probably, by other causes, the chyle is necessarily propelled along these vessels, and prevented by the valves from retrograding until it has finally entered the thoracic duct.(*z*) One remarkable peculiarity of these lacteal vessels is agreed to be, that they select and absorb only chyle, and never, or very rarely, imbibe any other fluid.(*a*) The lacteals are vessels in part of the same description in construction as lymphatics;

(*l*) 5 Good, 175.

(*m*) El. Blum. 366.

(*n*) Id. 366, note(*c*;) see *Infusion*, ante, 168.

(*o*) El. Blum. 360; Jackson, Prin. Med. 384 to 388; 3 Bell, 238.

(*p*) El. Blum. 365.

(*q*) 5 Good, 175, 176.

(*r*) El. Blum. 364.

(*s*) 2 Horn. Anat. 298.

(*t*) See one of the fullest descriptions, 2 Bost. 424 to 431.

(*u*) 1 Good, 10; Jackson, Prin. Med. 385; 2 Bost. 424 to 431.

(*x*) Id. ib. 2 Bost. 425, 426; and 2 Dungl. Phy. 4 to 7.

(*y*) 2 Bost. 458, 459.

(*z*) Id. 460.

(*a*) 5 Good, 177; El. Blum. 360, 364; 2 Bell, 325; 3 Bell, 237, 238; 2 Dungl. Phy. 4 to 7; 2 Bost. 437.

but the former, arising between the commencement of the duodenum and the termination of the ileum, are confined to the small intestines, the jejunum and ileum.(*b*) The lacteal vessels, which take up the chyle are therefore only one branch of the system of absorbents.(*c*) Within the last few years, however, there have been disputes respecting the termination of both lacteals and lymphatics, viz., whether they belong ultimately and *solely* to the principal trunks, the thoracic duct and subclavian vein, or whether they are not in a great measure inserted into and connected immediately and directly with neighbouring veins, and also whether absorption is a function peculiar to them, it being also ascribed by some to the mesenteric as well as to other *veins.*(*d*)

The non-absorption, or imperfect absorption of chyle, must proceed from some mischief in the lacteals or mesenteric glands, and which may either labour under an inertness in carrying on their proper functions, or may be so obstructed in their course as to be prevented from exercising their functions, notwithstanding their being in a state of health, and this will occasion diarrhœa alba, or loose or fluid alvine evacuations.(*e*)

Secondly, the lymphatics.

The *Lymphatic* vessels are so called from their usually containing *lymph.* They are nearly similar in their structure and composition to the lacteals; but in consequence of their contents being transparent and colourless, they are the less easily discerned. They are provided with numerous valves, and form frequent anastomoses, and possess a degree of contractility similar to the lacteals; and it is said that the main branches of the lymphatics are finally reduced into three or four great trunks, which probably, like the lacteals, terminate in the thoracic duct.(*f*) They differ, however, materially from the lacteals, as well in their situation as in their contents and offices; for whilst the lacteals are confined to the mesentery and small intestines, and imbibe and convey only chyle, the lymphatics are found in the larger intestines and in almost every part of the body; and with respect to their contents, they not only take up fluids, containing particles adapted for the nourishment of the body, other than chyle, but also absorb all worn out or decomposed particles of the frame of every description separated from it, and which we have seen is an incessant operation, whether it be a fluid or the densest substance, such even as the particles of decayed bone, and reduce and mix the whole into the fluid called lymph, and carry the same into the thoracic duct, to be again carried into circulation, some part to serve useful purposes, and the rest to be carried off as effete and useless.(*g*) This *lymph* is a transparent and colourless fluid, which, as its name imports, was supposed to consist principally of water:(*h*) but it is said that it bears a very strong analogy to chyle, especially in the characteristic property of separation by rest into parts; one more solid and fibrous, and the other, which remains fluid, and more resembles albumen.(*i*)

But nutrition is not the sole use or even the primary function of the lymph or of the lymphatic vessels, although it may be a secondary office.(*k*) The exact use of the lymphatics is still a very questionable point in physiology; the common supposition has been that they absorb

(*b*) 2 Horn. Anat. 298.
(*c*) 3 Bell, 238.
(*d*) El. Blum. 363, note (*u*;) 2 Bost. 440 to 450, where Dr. Bostock, although he does not entirely assent to venous absorption, yet appears to acknowledge that it may exist; see, in particular, id; See 2 Dungl. Phy. 35 to 58.
(*e*) 1 Good, 195; Copland's Dict. tit. Diarrhœa; Dewees, Prac. Phys. 575.
(*f*) 2 Bost. 432; but this is doubted, id. 477, 478.
(*g*) 2 Bost. 437.
(*h*) Id. 431.
(*i*) 2 Dungl. Phy. 29. 30.
(*k*) 2 Horn. Anat. 301.

all the old and redundant materials of the body, and also various kinds of superfluous fluids formed within its textures and cavities,(*l*) as well from the external common integuments as from the fauces and œsophagus, the pleura and peritonæum, and from the thoracic and abdominal viscera themselves.(*m*) They accompany every part of the frame closely and with great minuteness of structure, and exist very numerously even in the coats of small arteries and veins.(*n*) They have numerous valves, so disposed in pairs opposite each other, that the whole cavity is accurately closed.(*o*)

Magendie having ascertained, by a train of experiments, the degree of effect which certain narcotic substances produce upon the system, so as to be able to refer to these as a standard of comparison, was induced to examine how far the absorbing power of the vessels was promoted or retarded by the states of plethora or depletion. The result seemed to be that plethora uniformly retarded, and depletion as constantly promoted, absorption; and hence he concluded that it must consist in a mere mechanical action, independent of any principle connected with vitality, and he therefore attributed absorption to the capillary action, exercised by the sides of the vessels upon the substances to which they are exposed, and that absorption is merely a filtration through the sides of the vessels;(*p*) but subsequent physiologists deny this doctrine of lateral filtration, and limit the passage of the lymph through the orifices of the vessels.(*q*)

Of the solution and absorption of even solid parts of bone.(*r*)

It is admitted that there is much difficulty as well in ascertaining the nature of the lymph to be found in the lymphatics as in accounting for its production.(*s*) It is said to be uniform in its nature and appearance as previously described,(*t*) and yet to be an aggregate of various particles, fluids, and substances, materially differing from each other. Nor is there any satisfactory explanation how or by what means the densest solids as well as more fluid components of the body, are absorbed and taken up by these vessels.(*u*) All modern physiologists appear to agree in the supposition that every part of the human frame is perpetually changing, and old parts removed and carried off, and new parts deposited in lieu; but how in the removal of parts of bone and other solids, the same are solved before they can be absorbed, and how reduced to and blended with and assimilated to the rest of the fluid lymph, seems to be undiscovered.(*x*) We know only of the gastric juice in the stomach as an adequate solvent for such solids, but that has not been discovered in any other part of the frame. Some have supposed that the parts taken up by the lymphatics must have been previously decayed and absolutely dead, and that then they are more readily and rapidly decomposed; but still, as we know bone will retain its solidity and resist decomposition for many years after death, it remains unexplained how parts of that substance are rapidly broken up and solved into liquid, so as to pass the minute orifices of the lymphatics and become undistinguishable from the residue of the lymph.(*y*)

(*l*) Lizars, part xii. 13; 5 Good, 176 to 178; El. Blum. 325; 2 Bost. 438.

(*m*) El. Blum. 364; 5 Good, 178; 2 Bell, 325, 331; Amer. Cyclop. Prac. Med. tit. Absorption; 2 Dungl. Phy. 58 to 61.

(*n*) 5 Good, 178, 179; Quain, El. 280, 281; see a clear account of the lymphatics, 2 Bost. 428 to 432; 2 Horn. Anat. 294.

(*o*) 5 Good, 178.

(*p*) M. Magendie, Journ. Phy. 6; 2 Bost. 466; 2 Dungl. Phy. 53.

(*q*) 2 Bost. 467.

(*r*) Ante, 42, 43.

(*s*) 2 Bost. 461.

(*t*) Id.

(*u*) Id. 465; as to this operation see Cruickshank on the Absorbing System, p. 108, &c.

(*x*) Ante, 42, 43; 2 Bost. 465; 2 Dungl. Phy. 58, 59.

(*y*) 2 Bost. 464, 465.

Utility of absorption in moulding and preserving the form of all parts of the body.

There is another most important office or function ascribed by modern physiologists to the lymphatics, viz. that their primary use is to mould and fashion the body so as to give it its proper form, and to enable it to increase in bulk, while its individual parts retain their appropriate figure and proportionate size.(*z*) It has been observed, that when we reflect upon the mode in which an organized part is enlarged, we perceive that it does not grow by accretion, like a crystal, nor by simple distention, but by a numerical as well as a specific increase of each individual part. With respect to the muscles, for example, the *number* of fibres are augmented at the same time that each individual fibre is increased in size; and the same thing takes place with respect to its tendinous extremities, and the other membranous parts that are dispersed through the body. This extraordinary operation is supposed to be affected by absorption; and hence, we conclude, that the lymphatics alone, or, at least, in conjunction with the veins, are the agents employed for this purpose.(*a*) By these, small particles, even of bones, are supposed to be gradually removed, and a deposition made of other materials in their proper situations, so as to create or continue the perfect bone.(*a*) This property in the absorbents is obviously connected with that universally admitted principle in the animal economy so often noticed, that the matter of which the organs of the body are composed, during the performance of their various functions, undergoes some change, which renders it no longer fit for its original purpose, and that it, therefore, becomes necessary that it should be removed, and new materials deposited in its place;(*b*) but, like most parts of the absorbent system, we are ignorant as well of the nature of this change as of the means by which it is effected.(*b*)

Upon the whole, we may conclude, that, the lacteals and the lymphatics are essential to the growth of the body, although in different ways. The lacteals procure the materials, and convey them into the blood, whence they are abstracted by the secreting arteries, while the lymphatics regulate the mode of their deposition, and contribute to reduce the parts into their proper form and dimensions.(*c*)

Of cutaneous absorption.

It seems, also, to be established, that there are absorbent vessels upon the *surface of the body*, and, that, even through the external skin there are nutritious liquids as well as poisons, that may, especially by rubbing and friction, be absorbed and carried into the circulating system;(*d*) and instances are stated, by high authority, where, from a stricture in the œsophagus, or from the suspension of the power of deglutition, no nourishment could be taken into the stomach, yet the patient was supported for a time by means of absorption from the surface, aided by the aliment of nutritive clysters.(*e*) Dr. Barry has from his experiments inferred, that, the whole function of external absorption is a physical effect of *atmospheric pressure;* and he even contends, that the circulation in the absorbing vessels and in the great veins depends on the same cause, and that vital action is not concerned in absorption;(*f*) but this doctrine has been questioned, at least, as regards the lacteals.(*g*) Dr. Bostock observes, that, under certain circumstances, the absorbents are able to take up substances applied to the skin, especially when aided by friction, which is sufficiently proved by the effect of various medical agents which

(*z*) 2 Bost. 454.
(*a*) Allen's Lectures on the Animal Economy, and other authorities; 2 Bost. 454, 455. But some physiologists doubt this conclusion.
(*b*) 2 Bost. 456.
(*c*) Id.
(*d*) Amer. Cyclop. Prac. Med. Absorption, 5 Good, 179, 180; 2 Bost. 473 to 477.
(*e*) 5 Good, 179, 180; Amer. Cyclop. Prac. Med. tit. Absorption.
(*f*) 2 Bost. 471, note.
(*g*) Id. 472.

CHAP. VII. SECT. II. ORGANS AND PARTS.

are enabled by this means to enter into the circulation, and to act upon the system in the same manner as if they had been received into the stomach. Thus mercury applied to the surface produces its specific effect upon the salivary glands, and lead upon the muscular fibre, while opium, tobacco, and other narcotics, manifest their peculiar action upon the nervous system;(*h*) and, although some modern physiologists, after numerous experiments, have agreed, that mere immersion in warm water, or even in a solution of a saline substance, as corrosive sublimate, occasions no absorption, (excepting what may enter through the lungs,) and thence, have concluded, that the cutaneous absorbents are not capable of taking up substances that are merely applied to the external surface, unless they are forced by friction or an abrasion of the cuticle, or a destruction of some of the adjacent parts to perform this function;(*i*) yet it is considered, that Dr. Edwards has by his more recent experiments fully established that the function of absorption is actually carried on by the skin to a considerable extent, and, probably, without interruption, whether the body be immersed in water, or in certain gases;(*k*) and hence, the probable utility, in certain cases, of immersion in warm water, and nourishing liquid aliments, and in medicated or other air baths.(*l*)

Conglobate or lymphatic glands.(*m*)

The conglobate or lymphatic *glands*, it has been observed, compose a most considerable portion of the absorbent system, and they are met with in different parts of the body, but always connected with the lacteals or lymphatics.(*n*) The glands of the body are divided into those which secrete a fluid from the blood for the use of the system, and those which secrete a fluid to be discharged from it; the former may be termed glands of supply, the latter glands of waste.(*o*) Glands are of various sizes, sometimes simple, sometimes in groups or clusters: and although their use may not be perfectly understood, yet it may be presumed that they serve some important purpose, such as a secretion of some peculiar and important fluid, from the circumstance of every absorbent vessel, during its course, passing through one or more of these glands; though another use has been assigned to glands, namely, that they oppose a mechanical obstruction to the otherwise rapid progress of the chyle and lymph, and produce some necessary change in the nature of the fluids which pass through them;(*p*) and even that supposition has been doubted.(*q*) They are very numerous in the mesentery as connected with the lacteals; and, as attached to the lymphatics, there are, also, large clusters of them in the groin, the neck, and the axilla, as well as in the course of the greater lymphatic trunks, not far from their termination in the thoracic duct.(*r*) In another eminent work, it is observed, that those found in different parts of the body, are perfectly similar to those found in the mesentery, consisting, like them, in a great measure, of convoluted absorbent vessels, supplied with an immense number of blood vessels, and liable to the same diseases.(*s*) These glands are chiefly composed of membrane;(*t*) but it is a disputed point whether, as regards their structure, they contain cells, or whether they consist of a mere congeries of vessels, and also whether nerves accompany these glands.(*u*) The form

(*h*) 2 Bost. 473; 2 Dungl. Phy. 62, 63.
(*i*) Currie's Med. Rep. chap. xix.; 2 Bost. 473, 474; 2 Dungl. Phy. 62, 63.
(*k*) Dr. Edwards, de l'Influence, &c. chap. xii. p. 345; 2 Bost. 476.
(*l*) Amer. Cyclop. Prac. Med. tit. Absorption.
(*m*) See, in general, 5 Good, 178, 179; 2 Bell, 280; 2 Horn. Anat. 298 to 301; 2 Bost. 434.
(*n*) 2 Bost. 434.
(*o*) 3 Good, 205.
(*p*) 2 Bost. 438, 439, and id. note.
(*q*) 2 Bost. 436, note, 438 to 440.
(*r*) Id. 434.
(*s*) El. Blum. 367.
(*t*) 1 Bost. 18.
(*u*) See the contradictory authorities, 2 Bost. 434 to 436; El. Blum, 367; 2 Bell, 329.

of the glands in the absorbent system is mostly circular or oval, and somewhat flattened.(*x*) It appears that the *chief office of the conglobate glands* is to prevent the ill effects upon the heart of the improper admixture of crude fluid with the blood by assimilating the extremely various fluids to an animal nature by retarding their motion, and perhaps also by superadding to them some fresh secreted fluid.(*y*)

Fourthly, Thoracic duct.

The *Thoracic duct* is a membranous canal, slender, strong, though transparent, more or less tortuous, subject to great varieties in its course and division, destitute of muscular fibre and nerves, and possessing numerous valves. It is a vessel varying in size between the eighth and the fourth of an inch in diameter, and passes almost perpendicularly near to the spine, running in a somewhat tortuous course from the second or third lumbar vertebra, and penetrating the diaphragm through the aortic opening, passing upwards to about half an inch above the trunk of the left subclavian vein. It is then bent down into the form of an irregular arch; and opens into that vein nearly at its union with the jugular of the same side.(*z*) It is furnished with a peculiar valve at this point of insertion, which is placed at the distance of five or six inches from the termination of the subclavian vein in the right auricle of the heart; its contents being there mixed with the venous blood, is assimilated to it in all its properties, and passed through the lungs, and then becomes perfect blood.(*a*) The contents of the lacteals, the general lymphatics or absorbents and glands, all unite into this receptaculum or cisterna chyli, or rather an extensive reservoir of lymph as well as chyle, and this is found on the front of the body of the second lumbar vertebra in the abdomen.(*b*) The chyle and lymph thus mixed in the thoracic duct is opaque and white, without smell. The whole is poured in a slow and almost stillatitious manner through the last valve of the thoracic duct, and is there intermixed with the venous blood; and sanguification proceeds gradually as the mixed chyle and lymph is poured into the subclavian vein, and by respiration in the lungs all the parts become completely assimilated.(*c*)

Injuries to the thoracic duct.

It might be supposed that the rupture of this important vessel would be fatal, yet nature has in some instances supplied the defect, so that life has continued, although in a very weak state, for many months after the injury.(*d*) But in general if the thoracic duct be wounded, the case is considered necessarily fatal, for it is beyond the reach of aid; and is so very important a vessel, that though its lesion may not cause immediate death, yet through the diversion of its contents from the circulating system, and their extravasation into the cavity of the thorax, fatal results are induced in a twofold manner.(*e*)

Fifthly, The connexion between the absorbent function and the nervous function.

Dr. Bostock, when inquiring into *the relation between the absorbent and the nervous system,* observes, that there may be cases in which the function of absorption is influenced by the power of the nerves, yet that the relation is of an indirect nature, because the examinations of anatomists indicate that there are but very few nerves sent to the absorbent system, and that even these few seem rather to pass by them, in order to be

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(*x*) El. Blum. 367; 2 Horner, Anat. 829.

(*y*) El. Blum. 366, 373; 2 Bell, 330.

(*z*) 2 Bost. 432; 2 Horner, Anat. 324 to 326.

(*a*) Id. 344.

(*b*) El. Blum. 363 to 365, 377; 378; 2 Bost. 438; 5 Good, 175; 1 Id. 10; 2 Horner, Anat. 324 to 326; 3 Bell, 238; 2 Dungl. Phy. 7; but note, some physiologists suppose that some of the lacteals communicate *directly* with neighbouring veins, without at all passing into the thoracic duct. Ante, 225, note (*d*.)

(*c*) El. Blum. 377 to 379; 2 Bost. 432.

(*d*) Id. 363, note.

(*e*) G. Smith, For. Med. 278.

transmitted to more distant organs, than to be ultimately destined for the lymphatic vessels or glands themselves; that the mode of action of the absorbents (at least if we except that of their mouths, which we have seen is involved in obscurity,) is of that kind which may be explained without the aid of nervous sensibility; and that indeed every circumstance connected with them seems to show, that, like the sanguiferous system, their ordinary operations are to be referred to contractility alone. (*f*)

Diseases in the absorbent vessels. (*g*)

These vessels, or at least the *lacteals* and *mesenteric glands*, may either labour under such an inertness or torpitude as to render them incapable of carrying on their proper functions, or may be so obstructed in their course as to be prevented from exercising their functions, notwithstanding their being in a state of health. The non-absorption of the chyle will produce the disease called diarrhœa alba, or white looseness, in which the excremental dejections are milky, or resembling in their appearance a mixture of water and lime, with a frothy scum, and is to be treated in a particular manner.(*h*) The *lymphatic glands* are sometimes so *tumefied* that they obstruct the course of the biliary fluid along the ducts, and produce a disease termed *icterus* or jaundice. (*i*) The bronchial glands, particularly those near the bifurcation of the trachea, are subject to scrofulous enlargement, and to inflammation and suppuration; also to calcareous concretions, to osseous depositions, and to scirrhus. (*k*) The *axillary* glands are very subject to inflammation, suppuration, scirrhus, and cancer, particularly when the last disease affects the mammæ, (*l*) as are other clusters when disease exists in their track, (*m*) and all the lymphatic vessels are subject to inflammation and suppuration. (*n*) The thyroid gland is liable to injuries and diseases. (*o*) So scrofula affects the lymphatic absorbent glands. (*p*) In the process of ulceration the lymphatics appear to be at least as active as the blood vessels. (*q*) Glands also are liable to melanose (*r*) and cancer. (*s*) The consequences of *injuries* to the thoracic duct have already been noticed. (*t*)

(*f*) 2 Bost. 480.

(*g*) See, in general, Amer. Cyclop. Prac. Med. tit. Absorption; Coop. Surg. Dict. tit. Absorption; and 5 Good, 192 to 473.

(*h*) See the proper remedies 1 Good, 197 to 199; Copl. Dict. tit. Absorption.

(*i*) Liz. part xii. p. 18, note. See Dewees, Prac. Phy. 560.

(*k*) Liz. 21, notes.

(*l*) Id. 24.

(*m*) Liz. 26 to 34.

(*n*) Id. 34.

(*o*) Coop. Dict. tit. Thyroid Duct.

(*p*) Id. tit. Scrofula.

(*q*) Id. tit. Ulceration.

(*r*) 3 Good, 229.

(*s*) Id. 252 to 265.

(*t*) Ante, 229.

CHAPTER VIII.

OF THE FUNCTION OF SECRETION AND ITS ORGANS AND PARTS.

SECTION I.—DEFINITION AND DESCRIPTION OF SECRETION.

SECT. I. DEFINITION AND DESCRIPTION OF SECRETION. (*a*)

THE function of *Secretion*, it has been observed, must, with truth and regret, be declared to be among the most obscure parts of physiology.(*b*) The term *secretion*, according to its original and primary meaning, is equivalent to *separation*, but it is limited, technically, to that function of the animal economy which consists in the separation of the various *fluids* of the body, or to the fluids secreted. The same function has however been properly termed *depuration*, from its office of *cleansing* the frame from impure or noxious particles.(*c*) Magendie thus defines this function:—"On donne le nom generique *de secretion* à ce phenomène par lequel une partie du sang s'echappe des organs *de la circulation* pour se répandre au dehors ou au dedans; soit *en conservant* ses propriétés chimiques, soit après que ses éléments ont éprouvés un autre ordre de combinaison."(*d*) In other words, secretion affords the means by which certain parts of the *blood* are *separated* from the mass, either, *first*, to serve some *useful purpose* after such separation; or, *secondly*, to remove some substances which are superfluous or injurious; the former important to be *continued* in the frame, at least, for a time, such as the gastric juice (that important and immediate agent in converting aliment in the stomach into the materials of the blood) (*e*); whilst the latter are *excretory* and rejected as pernicious or useless, as urine, fæces, &c. The superfluous and excrementitious *fluids*, commonly called the excrement of the second digestion, are of two kinds, the one exhaled by perspiration, the other the urine oozing from the kidneys.(*f*) On the other hand, by *absorption* (which we have just considered) the new and renovating materials of the blood are assimilated, or sucked in, or taken up and become new parts of the frame, instead of being *separated* as in the instance of *secretion.*(*g*)

We have seen that all the parts of the human frame are perpetually wearing out, or at least *changing*, by their own action, as well the most firm and solid, even the bone, as the most soft and spongy. But they are as constantly supplied with new parts deposited in lieu of those removed, and for these purposes the waste and the *recrement* are carried off by one description of process, that of *secretory* or *excretory*, and the new materials are supplied by the other description of process, that of *absorption.*

(*a*) Importance of this function; and see, in general, 2 Bost. 247 to 341; 2 Dungl. Phy. 195 to 245.

(*b*) El. Blum. 389; and see 2 Bost. 247 to 341, a perusal of which will establish that knowledge of the secernent function is still in an infantine state. Jackn. Princ. Med. 547 to 560.

(*c*) Copl. Dict. p. 186; and see Walker's Dict. tit. *Depuration.*

(*d*) M. Magendie's Physiol. tom. ii. p. 343; 2 Bost. 249, note.

(*e*) 2 Bost. 248.

(*f*) El. Blum. 405, 389; 5 Good, 169.

(*g*) 2 Bost. 247, 248.

CHAP. VIII. Sect. I. Of Secretion.

It is obvious, that for these purposes there must be two distinct sets or systems of vessels or organs, the one by which the refuse or rejected part is removed, called the *secretories*, or secernent function; and the other, by which the due recruit is provided, called the *absorbent* vessels or function.(*g*)

Some authors (as Dr. Good) have termed the general *conjoint operation* sustained by these two sets or systems of vessels as the *excernent function*, and he considers that the *health* of such function consists in the due balance of power being maintained between these respective vessels, and that its *diseases*, on the other hand, depend on the degree or extent of the *disturbance* of such balance.(*g*) Thus, if the secretory or secernent vessels be supposed to act *more* powerfully than the absorbents, the new matter is either conveyed more *rapidly*, or in greater quantity, than the old matter is removed, so that the bulk of the whole is ultimately increased, and yet the operation is effected so gradually that the general form of the bone, and the relation of its different parts to each other, are not materially altered.(*h*)

Section II.—Of the Organs of Secretion.

Sect. II. Of the Organs of Secretion.

Notwithstanding all the inquiries which have been made into the fabric of the secernent organs, it is admitted, that hitherto, however desirable, there has been no satisfactory result.(*i*) In its simplest state it seems to consist of nothing more than single vessels possessing a capillary or hair-like orifice,(*k*) from which the various substances whereof the body consists, or which are thrown out upon its surface, or ooze into its cavities, are for the most part *separated* or *secreted* from the capillary vessels, the small terminations of the *aortic* system of *arteries*, but with two exceptions, namely, the *bile*, which appears to be secreted from the capillaries of a *vein* (namely, the vena portæ) and the aqueous vapour from the lungs, which is perhaps supplied from the capillaries of the *pulmonary* artery.(*l*)

Of the glands of secretion.

It remains to consider certain glands as parts of the organs of secretion. *Glands* are principally organs of absorption, but there are also *secernent or secreting glands*, and even as many as fifty three different sets of proper secreting glands have been enumerated.(*m*) But it has been considered by high authority, that there is no arrangement of secreting glands which can be of any considerable use.(*n*) *Glands* appear to be composed of a number of small arteries which pass in various directions through a mesh of cellular texture. The glands usually consist of a number of rounded bodies, which may be detached from each other, and compose what are termed lobes; these are again divisible into smaller and smaller lobes, until we at length arrive at the smallest parts into which it is possible to subdivide them, and which have obtained the name of acini. But there is confessedly considerable obscurity respecting the intimate structure of glands, and particularly whether any specific organ intervenes between the secreting arteries and the excreting ducts.(*o*) These secreting glands are provided with *nerves*, but it is admitted to be

(*g*) 5 Good, 169; 1 Bost. 102; 2 Bost. 247, 248.

(*h*) 1 Bost. 102.

(*i*) 5 Good, 169; El. Blum. 389, 398; 2 Bost. 247 to 341.

(*k*) The term "*Capillary*" means small, namely, minute, hair-like; 5 Good, 170: the capillaries between the arteries and veins have been considered ante, 145 to 147.

(*l*) 5 Good, 170.

(*m*) 1 Bost. 18; 2 Bost. 251, note: there are many more than fifty-three absorbent glands, and only *seven* salivary.

(*n*) 2 Bost. 254.

(*o*) Id. 252.

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questionable how far the nervous influence is essential to secretion, or in what way it operates. (*p*) It seems clear, however, that the nervous system powerfully influences many of the secretions. (*q*) But Dr. Bostock observes, that, when we consider the mere act of secretion, we should say that contractility is the only vital power which is essential to the operation. (*r*) It has been said, that, properly speaking, the *conglomerate glands*, (as they are called, to distinguish them from the *lymphatic conglobate* glands) (*s*) are the only true secreting organs, such as the large conglomerate gland, destined to secrete the saliva, (*t*) and the lachrymal glands, the pancreas, and the breasts. (*u*) There are, however, many other organs treated by other authors as secretory, as the liver and kidneys. (*v*) Indeed, Dr. Good observes, that besides the minute connexion by the capillaries between the arteries and veins, which we have previously noticed, (*w*) there is *no part* of the body in which the process of *secretion* is not going forward, and that we trace it, and consequently the fabric which gives rise to it, in the parenchyma or intermediate substance of organs, in the internal surfaces and outlets, and on the external surface of the entire frame, thus forming three divisions of prominent distinction, both in respect to locality, *and to the diseases which relate to them*, and hence the importance of this part of the system, appointed to the function of secretion. (*x*)

Section III.—The Different Secretions.

Sect. III. The Different Secretions.

We will now mention a few points relating to secretions themselves. *Sulphur* is secreted by the brain; *wax*, by the ears; *tears*, in the orbits; *saliva*, in the fauces; *milk*, by the breasts; *urine*, by the kidneys; *bile*, by the liver; *muriate of soda*, by the secernents of almost *every organ*; *sweat*, from every part of the surface; and *semen*, by the testes; (*y*) and Dr. Good observes, that every organ and part of the body secretes for itself the nutriment it requires from the common pabulum of the blood which is conveyed to it, or from secretions which have already been obtained from the blood and deposited in surrounding cavities, as *fat*, *gelatine*, and *lymph*. It seems agreed to be probable, that the several organs of secretion, like the eye, the ear, and the other distinct organs of *sense*, are peculiarly affected by particular stimulants, and excited to some diversity of *sensation*. (*z*)

Influence of the nerves on secretion.

The function of secretion is considered to be remarkably under the influence of the *nerves*. (*a*) Dr. Bostock observes, that there are many well known occurrences which clearly indicate an intimate connexion between the action of the nerves and the formation of the secretions. Certain secretions are increased in quantity and have their qualities materially altered by the intervention of mental emotion, and of various agents, which we can only conceive to operate through the mèdium of the nerves. The secretion of tears from the impression of grief, and the increased flow of saliva from the idea of grateful food, are among the most familiar instances of this nature. The process of digestion, as connected with the secretion of the gastric juice, is peculiarly liable to be affected by the state of the nervous system, so that, according to its excitement or depression, the fluid appears to be produced in a greater or less quantity, the functions of the stomach being proportionably depraved or even

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(*p*) 2 Bost. 251, 338 to 342.
(*q*) Id. 318 to 342.
(*r*) Id. 337.
(*s*) As to these, see ante, 228, Absorbents.
(*t*) Coop. Dict. tit, Parotid Duct.
(*u*) El. Blum. 391.
(*v*) Id. ibid.
(*w*) Ante, 145 to 147.
(*x*) 5 Good, 192.
(*y*) Id. 191.
(*z*) Id. 191.
(*a*) Id. 172; El. Elum. 400; 2 Bost. 318; supra, notes (*p*) and (*q*.)

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entirely suspended.(b) In hysterics, the flow of urine is greatly augmented, while the absorption of bile seems diminished, and hence the discharge is nearly colourless. In violent agitation of the mind, the juices of the stomach become more acid than natural, and sometimes those of the larger intestines are stimulated into increased action when colliquative perspiration, or looseness, or both, exist.(c) Fright will suppress the secretion of milk.(d) The whole surface of the skin may become bedewed with drops of sweat, and even of blood, by a sudden paroxysm; grief fills the eyes with tears; fear is well known to be a powerful stimulant to the kidneys, and very generally to the alvine canal; anger gives an additional flow, perhaps an additional acrimony, to the bile, and, if urged to violence, even renders the saliva noxious; and disappointed hope destroys the digestion, and alters the qualities of the secreted fluids of the stomach;(e) and the disturbance of these secreting functions will, also, influence the healthy state of the blood.(f)

The secretions themselves and their enumeration.

The Secretions themselves.—It has been observed, that the secretions and excretions are more simple, that is, consist of fewer atoms than the albumen and fibrin of the blood from which they are formed.(g) We have seen that the secretions are divisible into those which are separated for certain nutritious purposes, and designed to remain in the frame at least for some time, such as the *gastric juice*, so essential in the stomach for digestion; the other class are the *excrementitious* and useless, and designed by nature to be immediately carried out of the system, such as principally urine and fæces.

Dr. Bostock has preferred a classification or arrangement of the secretions *themselves* under *eight* heads or classes, namely, the aqueous, the albuminous, the mucous, the gelatinous, the fibrinous, the oleaginous, the resinous, and the saline;(h) and he examines each of these with great perspicuity,(i) by—*First*, The *Aqueous* are perspiration and aqueous exhalation from the lungs:(k) *Secondly*, The *Albuminous* secretions are the fluid continually secreted from the surfaces of all the confined cavities of the body, as the thorax, abdomen, pericardium, the ventricles of the brain, and even the intestines of the cellular substance; and this fluid differs principally from the serum of the blood in containing a much smaller quantity of albumen:(l) *Thirdly*, The *Mucous* secretions are always found in those cavities or passages that have a communication with the atmosphere, such as the mouth, nose, œsophagus, stomach, alimentary canal, bladder, trachea, and the air vesicles of the lungs. These are distinguished by their viscidity or their capacity of being drawn out into threads, and by being, with difficulty soluble in water.(m) Of this description are the saliva, gastric juice, pancreatic juice, and, perhaps, tears and seminal fluid:(n) *Fourthly*, The *Gelatinous* secretions are so named, from their essential characters depending upon the jelly which they contain. This is found secreted in various interior parts of the body, and is supposed to be produced by albumen conveyed by the capillary arteries being united to a portion of oxygen, and thus converted into jelly:(o) *Fifthly*, The *Fibrinous* secretions are so named, from their resemblance to the fibrin of the blood, and from this being the probable source whence they are immediately derived, and they retain the peculiar fibrous texture from which they are produced.(p) Muscular fibre, of which muscles are

(b) 2 Bost. 323.
(c) 5 Good, 189.
(d) Copl. Dict. tit. Blood.
(e) 5 Good, 171.
(f) Copl. Dict. tit. Blood.
(g) Dr. Williams on Respiration, Edin. Med. Chir. Trans. 105.
(h) 2 Bost. 260.
(i) Id. 261 to 304; and see El. Blum. 394.
(k) 2 Bost. 261; see also, Brewster's Encyclopedia, tit. Anatomy.
(l) 2 Bost. 264.
(m) Id. 267.
(n) Id. 271.
(o) Id. 272.
(p) Id. 275.

composed, are of this description of secretion, and are supposed to have their fibrous appearances from their being discharged by the mouths of the capillary arteries. The fibrous new coats of arteries are secreted in this manner:(*n*) *Sixthly*, the *Oleaginous* secretions, composed of an *oily* ingredient, are a numerous and varied class, and under it are included all secretions containing much oil, such as fat, marrow, milk and cerebral matter, as brain:(*o*) *Seventhly*, The *Resinous* secretions, in their chemical properties, much resemble the last class, but are certainly distinguishable. *Bile* is of this class, and is a secretion from venous blood, and is by modern physiologists supposed to be immediately useful in promoting the process of digestion. (*p*) When the venous blood becomes loaded with inflammable matter, which cannot be discharged from the lungs, principally in consequence of the high temperature to which the animal is exposed, and when, from certain causes, one of which appears to be the increase of cutaneous perspiration, this excess of inflammable matter is not employed in the deposition of fat, the liver is the organ by which it is removed. In ordinary cases the quantity is small, probably no more than what is sufficient to preserve the liver itself in its healthy state, and to perform the secondary objects to which the function is subservient; but when from a conjunction of circumstances, there is an excess of inflammable matter, its dangerous accumulation is prevented by an increased discharge of bile.(*q*) *Urea*, or that substance which constitutes a peculiar or specific ingredient in the *urine*, is also of this class, and much resembling resin and bile; and this, operating upon the kidneys, is considered to be the outlet and occasion of the discharge of the excess of *nitrogen* or azote from the system. (*r*) *Cerumen*, or *ear wax*, is also classed under this head of resinous secretions:(*s*) *Eighthly*, The last class of secretions are the *Saline*, which are dispersed over every part of the system, and consist of acids, alkalies and neutral and earthy-salts, and are principally found in the bones. (*t*)

CHAP. VIII. SECT. III. OF SECRETION.

SECTION IV.—THE DISEASES IN THE SECRETORY ORGANS AND SECRETIONS IN GENERAL.

SECT. IV. THE DISEASES IN THE SECRETORY ORGANS AND SECRETIONS IN GENERAL.

The various *Dropsical fluids* are the result of *morbid action in secretion*. (*u*) They seem to have the same constitution with the serum of blood, except in the water which they contain, and it would appear that they are separated from the blood by mere transudation, through a membrane, a process analogous or very similar to filtration. (*x*)

SECTION V.—THE KIDNEYS AND ORGANS OF SECRETION OF URINE, AND RELATING TO THE SAME.

SECT. V. THE KIDNEYS AND ORGANS OF SECRETION OF URINE, AND RELATING TO THE SAME.

The *Kidneys* being organs for the secretion of *urine*, and of primary importance in the essential evacuation of that fluid from the system, demand our most particular and separate consideration.

The kidneys.

The *kidneys*, (renes νεφροι,) the organs of secretion of urine, and each measuring about four inches in length, and two in breadth, are situated on each side of and close to the vertebral column without, and behind the peritonæum, in the fat of the loins, and on a level with the last two dorsal and first two lumbar vertebræ, and in part immediately under the lowest por-

(*n*) 2 Bost. 276.
(*o*) Id. 277.
(*p*) Id. 288, ante, 213 to 216.
(*q*) Id. 292.
(*r*) Id. 292; see post, 235, 236, kidneys.
(*s*) 2 Bost. 298.
(*t*) 2 Bost. 300.
(*u*) The consequences of secretion going on too rapidly, Jackson, Prin. Med. 555, 556.
(*x*) 2 Bost. 257; and see Dr. Good, as to the Diseases of the Excernent Functions, and Dewees, Prac. Phys. 668 to 705.

CHAP. VIII. SECT. V. OF SECRETION.

tion of the diaphragm, and which connexion is the cause of the pain felt in respiration during inflammation in the kidney. The right kidney, however, is a little lower down than the left. Each is compressed and ovoid in its form, presenting two surfaces and two borders. The kidneys are invested, *i. e.* surrounded by a thin yet firm membrane, which turns over its concave border, and comes into contact with its pelvis, on which it is reflected, gradually degenerating into cellular tissue.(*y*) The *vessels*, and especially the arteries of the kidneys, are very irregular in their number and form. They contain *nerves*, but have but little sensibility, and consequently are seldom the seat of much pain or disease.(*z*) With respect to the minute structure it is very peculiar; the external and *cortical* part of the kidney is by all anatomists allowed to be the secreting or secerning part of the organ, and in or by which the urine is secreted; and all seem agreed that the internal substance, sometimes called *tubular* part, and the striæ, converging to the centre of the kidney, and taking a pyramidal shape, are the excretory ducts. Each part abounds in blood vessels; but the cortical portion has very minute colourless vessels, *which secrete* the urine; the medullary part contains those which *carry it off;* but it is concluded that there yet remains much to be done in investigating the minute structure of these glandular viscera.(*a*) The renal arteries of the kidney ramify in the cortical part of the organ, and there terminate in the tubuli uriniferi. Through these tubes the urine passes into the tubular or internal part, and become engaged in very fine tubes, which run through the papillæ or mamillary processes, of which there are about eight or ten in number. Through these the urine leaves the structure of the kidney, and descends along membranous canals, called infundibula, of which each has one papilla, and there unite in a general sac called the pelvis (or basin) of the kidney, capable of holding about half an ounce of fluid. From the pelvis of the kidney, the urine descends along the two ureters to the urinary bladder. The rapid secretion of the kidney has not been satisfactorily explained. Most physiologists believe that the whole of the fluid, of which urine is composed, is taken up by the lacteals, which transmit it into the thoracic duct, and thence to the circulation, from which it is poured out by the renal arteries: but others, on account of the almost incredible rapidity in which some odours are perceived to arise from urine, almost immediately after the food, from which the same proceeded, has passed into the stomach or small intestines, infer that there must be some unknown vessels, having more direct communication with the kidneys, than through the thoracic duct and organs of circulation.(*b*)

Function and utility of secreting and discharging the urine.

The sole use or function of the kidneys consists in separating from the blood the *Urine*, which contains superfluous matters, that are not required or adapted for nutrition, or which have already formed part of the body and been removed by absorption. The substances which in particular pass off by these two organs are *nitrogen*, in the form of highly azotised products, and various saline and earthy compounds.(*c*) In other words, the kidneys *secrete* the *urine*, and carry off the excess of urea and nitrogen, which is introduced into the system by the stomach and by respiration, for the purpose of forming, from such nitrogen, fibrin, as the source and origin of the muscles and the seat of their contractility;(*d*) and therefore

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(*y*) See full description, 2 Horn. Anat. 63 to 68; 3 Bell, 357, 358; El. Blum. 405.

(*z*) 3 Bell, 358, 359.

(*a*) Id. 360 to 369; El. Blum. 405, 406. 2 Dungl. Phy. 238.

(*b*) It is truly astonishing in how short a space of time the smell of certain articles will be perceived in the urine, (as in the instance of asparagus,) even within a few minutes after the same has been received into the stomach, ante 229, note.

(*c*) Dr. Turner's Chemistry, 570; 2 Dungl. Phy. 242.

(*d*) See 2 Bost. 293, 294.

forms the link between the viscera of the abdomen and those of the pelvis; and though lying in the abdomen, they are strictly connected with the parts of the pelvis.(*e*) Dr. Bostock observes, that when a larger quantity of fluid is received into the stomach than can be imbibed by the absorbents, the residue is carried off by the kidneys.(*f*) But *this drawing off* of the fluid from the system is not the sole object of the secretion; the water conveys away certain matters in solution; but as the urine contains more *saline matter* than any other secretion, it is supposed that the kidney is of use to *rid* the system of the superfluous saline substances. These principally consist of the muriatic salts, as the muriate of potash and soda; the phosphoric salts, as phosphate of soda, of lime and ammonia; the phosphoric and lithic acids, with animal extractive matter, and a gelatinous or albuminous matter. In short, chemists have declared that *eleven substances* are constantly present in the urine, and occasionally *others*, the product of morbid action, so that from the kidneys much both of the solid and fluid composition of the frame must be carried off in that circle of actions by which both the structure of the frame and the qualities of the living body are preserved.(*g*) It has been observed that the large proportion of *azote* in the urea, carried off in urine, leads to the conclusion that the kidneys are the great outlet for *azote*, as the lungs and liver are for *carbon*.(*h*)

Diseases of the kidneys.(*i*)

The kidneys are liable to various diseases, as *inflammation*,(*k*) suppuration and gradual wasting, and this even without indicating pain;(*l*) also to dropsy in the kidneys(*m*) and to renal calculi.(*n*)

Injuries to kidneys.

The appearance of the kidneys, although not generally an object of dissection, ought, it has been said, to be carefully observed in dissection, in case of suspicious death, as it is frequently connected with the exhibition of poison.(*o*) So, like the other solid viscera, the kidneys, although so deeply situated, may be ruptured by external violence, and several instances have been recorded of sudden death having been thus occasioned.(*o*)

Of the glands called the capsulæ renales.

The *capsulæ renales*, or *supra renal capsules*, are so named from their surmounting the kidneys. They are glandular bodies, in their natural healthy state of reddish yellow colour, one attached to each kidney. Each

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(*e*) 3 Bell, 337, 369; 2 Horner, Anat. 63; 2 Bost. 294; see the secretion of urea, ante, 235, and post.

(*f*) 2 Bost. 294.

(*g*) 2 Bell, 369; see post, 241, *Urine.*

(*h*) El. Blum. 410; 5 Good, 304.

(*i*) See, in general, Sir William Prout, on Diseases of the Urinary Organs. *Simcor and others* v. *Bignold*, tried on 30th March, A. D. 1832, was an action on life policy, for 3000*l.*, effected in 1827, with usual declaration that Bird was not affected with *any disease tending to shorten life.* Death, January, 1831. On a post mortem examination, it appeared that, although the right kidney was sound, except it appeared somewhat paler than usual, and weighed six ounces, yet there was, instead of the left kidney, a large fungous tumour, weighing two pounds four ounces, and of four times the dimensions of the other kidney. It consisted of various matter, retaining merely the external coating of the kidney. It was called by some of the witnesses a soft or bleeding cancer; and they were of opinion that it must have been of five or six years' growth, and that it was an *incurable organic disease.* Besides the kidneys, the bladder and some part of the neighbouring region were also diseased; but the rest of the body was in a healthy state. Mr. Bird had been medically treated for symptoms of this disease so far back as 1825 or 1826. The cause ended in a compromise by defendant's refunding the premiums received.

(*k*) 2 Good, 371; Dewees, Prac. Phy. 633.

(*l*) 3 Bell's Anat. 359.

(*m*) Dr. Bright's work; 5 Good, 246, 247; Copland's Dict. tit. Dropsy.

(*n*) 5 Good, 348, &c.; Coop. Dict. tit. Urinary Calculi; 2 Gibson, Surg. 370 to 374.

(*o*) 3 Paris & Fonb. 67.

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of these bodies is compressed and rather flat; the upper border is convex, and the lower excavated by a groove, which receives the extremity of the kidney.(*p*) The vessels sent to these bodies come from the renal or emulgent arteries and veins; from the cœliac branch of aorta, and the phrenic or diaphragmatic, or from the trunk of the aorta itself; and even from the lumbar arteries.(*q*) Mr. Bell observes, that every thing relating to the use of these bodies have hitherto eluded research, and that all is doubt and uncertain speculation; but suggests that it is useful in the fœtus, by deriving the blood from the kidney, that gland not then having undertaken its proper office of secreting the urine.(*r*)

The ureters.

The two *ureters*, one from each kidney, are the excreting ducts, carrying the urine from each of the kidneys into the bladder.(*s*) They are about twelve or fourteen inches in length, and about the diameter of a quill, and are composed of a fibrous and a mucous tunic.(*t*) These ureters descend along the lumbar region and over the margin of the pelvis, from whence they are directed towards the base of the *bladder*, in which they terminate about one inch from the orifice or commencement of the urethra.(*u*) They do not immediately open into the bladder, but perforate a short distance between its muscular and mucous coats, and finally open into its cavity by an oblique mouth, which peculiarity of structure prevents the urine from regurgitating into the ureters from the bladder.(*v*) The use or *function* of the ureters is to conduct the urine, which is incessantly gradually secreted in the kidneys, to the urinary bladder, where it can in general, except in certain disorders, be retained and discharged at a convenient time.(*w*)

The bladder.(*x*)

The urinary *bladder*, (vesica urinaria,) varying in shape according to sex and age, is a membranous or hollow viscus, bag or receptacle, into which the urine secreted in the kidneys slowly distils through the ureters, that it may be expelled at convenient season. It is nearly of a regular oval in the male, when moderately distended, the ends being obtuse; but flattened in the female.(*y*) It is a musculo membranous reservoir, placed deeply in the pelvis behind the symphysis pubis, and before the rectum. Its direction is oblique, being inclined somewhat forwards and upwards, from base to summit.(*z*) It is generally capable in the adult of conveniently containing about two pounds weight of urine, or one pint and a half;(*a*) and it is no sooner dilated, so as to contain two pints, than uneasy sensations are experienced.(*b*) The desire of discharging the water (termed micturition, from the Latin,) now becomes urgent; and if the inclination be not relieved, and the bladder suffered to be dilated beyond its natural state, it loses all power of contraction, and becomes in a degree paralytic; the desire indeed continues, and the effects are renewed in painful paroxysms; but the power is lost, and the bladder becomes more and more distended;(*c*) and unless relieved, notwithstanding con-

(*p*) 2 Horner, Anat. 69, 70; 3 Bell, 369.

(*q*) 3 Bell, 370.

(*r*) 2 Horner, Anat. 64, also admits the uncertainty respecting the supra renal capsules. See also, Dr. J. R. Coxe, Amer. Jour. Med. Sci. 40, for a full account of these bodies.

(*s*) Quain's El. 2d edit. 766; 3 Bell, 359; El. Blum. 406.

(*t*) Quain's El. 518; 2d edit. 767.

(*u*) Id. 519; 3 Bell, 359, 360.

(*v*) Id. 2d edit. 767; El. Blum. 406; 3 Bell, 378, 379.

(*w*) 3 Bell's Anat. 360.

(*x*) See, in general, Quain's El. 2d edit. 767 to 772; Coop. Dict. tit. Bladder, 226; tit. Catheter, 349.

(*y*) 3 Bell, 375, 376.

(*z*) Quain's El. 519 to 523; 2d edit. 767 to 772, where see a full description of the bladder.

(*a*) El. Blum. 406, 407.

(*b*) Coop. Dict. tit. Bladder, 226, where see the progress of the evil.

(*c*) Id. 226.

stant dribbling, after two or three days, terminates in the bladder sloughing, or in fever, inflammation and death; unless, indeed, a catheter can be introduced, or an operation by puncture be performed in due time.(*d*) The *fundus* of the bladder (which, in the fœtus, terminates in the urachus, a fibrous chord attached to the navel,) is covered behind by the peritonæum. The other coats correspond with those of the stomach. The *muscular* consists of interrupted bands of fleshy fibres, variously decussating, and surrounding the bladder, and so interwoven as to promote the contraction of this organ in every direction, and to diminish its size in all its dimensions.(*e*) These are usually called the *detrusor urinæ*. The fibres which imperfectly surround the neck of the bladder, and are inconstant in origin and figure, have received the appellation of sphincter. The *nervous* chiefly imparts tone to this membranous viscus. The *interior*, abounding in villiform follicles, is lined with mucus, principally about the cervix.(*f*)

Diseases of and injuries to the bladder.

As to the diseases of and connected with the bladder,(*g*) it is liable to inflammation from the lodgement of a calculus in it.(*h*) When there is a retention of urine in the bladder, the catheter is to be first tried, and afterwards puncture, which is performed through the walls of the abdomen, above the ossa pubis, or front ridge of the pelvis, or an inch and a half above the pubes. It is said, that the practice of opening the urethra behind the structure, instead of puncturing the bladder, has been successfully adopted and highly commended; but puncture from the rectum is not now in general practised.(*i*) Many cases have occurred of *rupture* of the bladder from blows or falls, followed by fatal extravasation of urine in the abdomen,(*j*) and perforating injuries to this organ, by gun-shot or sharp instruments, are frequently fatal.(*k*)

The urethra.

For the purpose of conveying off the urine from the bladder, and also for ejection of the seminal fluid, the *urethra* is provided, differing in form in the two sexes, as will be explained when we consider the organs of generation.(*l*) Its dimensions and other particulars have been fully described in a modern valuable work on anatomy.(*m*) The urine conveyed into the bladder gradually becomes unpleasant by its quantity, and urges its discharge through the urethra; and the urine is evacuated through this tube, from the contraction of the sphincter being overcome both by the actions of the muscular fibres of the *destrusor urinæ*, above described, and by the pressure of the abdomen. To these, in men, is superadded the action of the *acceleratores urinæ*, which force out even the drops of urine remaining in the bulb of the urethra, also presently described.(*n*) Mr. Charles Bell has further described two long muscles running from the back of the prostate gland to the orifices of the ureters entering the bladder, the action of which is not only to assist in emptying the bladder, but to pull down the orifices of the ureters, thus assisting to preserve that obliquity of insertion which the ureters have a ten-

(*d*) It is well known that a celebrated architect lost his life in consequence of retention of urine, whilst travelling with one of our kings. Many individuals have suffered from mauvaise honte, when too long confined in the company of superiors, who, consequently, should always afford opportunities to their companions for relief.

(*e*) 2 Dungl. Phy. 235; El. Blum. 407.

(*f*) El. Blum. 407; 2 Horn. Anat. 72, 73.

(*g*) See Coop. Dict. tit. Bladder, and id. Preface, p. v. tit. Bladder, id. tit. *Urine*, Retention of.

(*h*) 2 Good, 373.

(*i*) Coop. Dict. tit. Bladder.

(*j*) Id.

(*k*) Id. Gun-shot wounds; 2 Gibson, Surg. 146.

(*l*) El. Blum. 407; Coop. Dict. tit. Penis; see a full description, 3 Bell, 382 to 390; 1 Horn. Anat. 80, 81.

(*m*) 2 Horn. Anat. 80, 81.

(*n*) El. Blum. 407.

CHAP. VIII. SECT. V. OF SECRETION.

dency to lose in proportion as the bladder is depleted,(*o*) still more evident as it approaches towards the external orifice. The fasciculi are united together by an elastic substance, of the consistence of *mucus*. Immediately beyond the muscular portion of the urethra is the cellular structure of the corpus spongiosum.(*p*) This tube is subject to various diseases and disorders, as strictures,(*q*) fistula in perinæo,(*r*) and numerous others hereafter noticed.

Of the prostate gland.

The *Prostate Gland* is part of the canal of the urethra, and has been compared to a truncated cone compressed from above downwards. It is situate below, and in that part of the urethra which first projects from the bottom of the bladder. This body is a gland nearly of the size and figure of a chesnut, situate on the neck of the bladder, and surrounding an inch of the beginning of the urethra.(*s*) It is an observation made by Mr. Hunter, that the use of this gland is not sufficiently known to enable us to judge of the bad consequences of its diseased state abstracted from swelling. Its situation is such, that the bad effects of its being swelled must be evident, as it may be said to make part of the canal of the urethra, and, therefore, when it is so diseased, as its shape and size are altered, it must obstruct the passage of the urine.(*t*)

Of the scrotum.

The *Scrotum* in the male is the purse, membrane or bag which encloses the testicles, and is suspended under the urethra.(*u*) Before the beginning of the sixth month of the fœtal state, the testicle is situated near the kidney, when it receives a covering from the peritonæum, just like the other abdominal viscera. Between the beginning of the sixth month and the end of the seventh, the testicle has either descended so low as just above the abdominal ring, or else is passing through it, or arrived a little below it. When the testicle passes through the abdominal ring into the scrotum; it is received into a production of the peritonæum, which afterwards constitutes the *tunica vaginalis*, while that peritoneal investment which was given to the testicle in the loins is closely adherent to this body, and immediately covers the fibrous coat of the *tunica albuginea*. After the descent of the testicle into the scrotum, the communication between the cavity of the tunica vaginalis and that of the abdomen *commonly* becomes obliterated, which latter event is usually effected before birth, but sometimes not till afterwards, and, in a few subjects, even as late as the adult state;(*x*) and, sometimes, in consequence of the opening not being closed, the viscera protrude, and constitute what is termed *congenital hernia*.(*x*) The scrotum is sometimes affected with cancer, vulgarly called the chimney sweeper's cancer, or the soot wart: also to sarcomatous thickening and enlargement;(*y*) also to tumour or hydrocele of the tunica vaginalis,(*z*) but this is more properly a disease of the proper membrane of the testicle. In consequence of the natural sympathy between the urethra and testicles, the latter organs are apt to swell in cases of stricture of the former.(*a*)

(*o*) Med. Chir. Trans. vol. iii; El. Blum. 408, note A.

(*p*) Coop. Dict. tit. Urethra; 2 Horn. Anat. 80.

(*q*) Id. and tit. Bougie, and tit. Catheter.

(*r*) Id. tit. Fistula in Perinæo, and post, Diseases of Urine.

(*s*) 3 Bell, 380, where see a full description; 2 Horn. Anat. 82, 84. where see a full description of this gland.

(*t*) Coop. Dict. tit. Prostate Gland.

(*u*) Id. tit. Scrotum; and see a full description of the scrotum and testicles, 3 Bell's Anat. 390 to 415, and post; 2 Horn. Anat. 85 to 93.

(*x*) Coop. Dict. tit. Hernia.

(*y*) Id. note. (*a*.)

(*z*) Id. tit. Hydrocele; 5 Good, 291; 2 Gibson, Surg. 332.

(*a*) Coop. Dict. tit. Urethra.

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Of urine, and the importance of its due secretion and discharge.

The *due secretion of Urine* is of the greatest importance. The most essential principle which it seems to carry off from the constitution is the *urea*, or that of the uric acid; and as this is the most azotised of all the animal principles, the secretion of urine appears to have for its object a separation of the excess of *azote* (also termed nitrogen) from the blood, as respiration separates from it the excess of carbon.(*b*) The *nature* of the urine varies infinitely from age, season of the year, and especially from the length of the period since food or drink was last taken, and also from the quality of the ingesta;(*c*) and the specific quality of some ingesta manifest themselves in the urine, at least with respect to the smell, very rapidly after the food has been received in the stomach.(*d*)

The *urinary secretion* in a state of health, made after a tranquil repose, is generally a watery fluid, of a peculiar smell, and lemon colour.(*e*) It is one of the most compound fluids of the animal system, consisting of water, various acids, and alkalies, the former however bearing a preponderance, with a certain proportion of calcareous earth and other materials.(*f*) These, in a diseased state, sometimes become gravel or stone.(*g*) *Healthy urine* contains water, urea, lithic acid, lactic acid, and its accompanying animal matters, sulphuric acid, phosphoric acid, muriatic acid, fluoric acid, potash, soda, ammonia, lime, magnesia, silex, and mucus of the bladder. *Diseased* urine contains albumen, fibrine, red particles, and various other ingredients, differing from those of the healthy state.(*h*) The deviations from a due secretion and discharge of urine are several, attributable to an affection of the kidneys, bladder, or the urine, as 1st. destitution of urine; 2dly, stoppage of urine; 3dly, strangury; 4thly, saccharine urine; 5thly, incontinence of urine; 6thly, unassimilated urine; and lastly, erratic urine;(*i*) and to these are to be added the formation of urinary sand, gravel, stone, &c.(*k*)

Diseases of urine.

It is said that in disease no urine has sometimes been secreted for twenty-two weeks; and Dr. Richardson mentions the case of a lad of seventeen who had never made any, and yet felt no inconvenience; and an instance has been named of a girl who never discharged urine through the regular passage, but only from the breast.(*l*) But these are extraordinary instances; and in general if urine has not been discharged in the regular way before the termination of the third day, the use of a catheter, or a more serious operation must be performed, or fatal consequences will ensue.(*m*) Indeed, it is insisted that in the above ex-

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(*b*) Ante, 236, 237; El. Blum. 410; 5 Good, 304; Coop. Dict. tit. Wounds, and titles Urinary Fistulæ, and Urine, Incontinence and Retention of. Dr. Prout has established that urea consists of

Hydrogen,	266
Carbon,	799
Azote,	1866
Oxygen,	1066
	4000

El. Blum. 409; Dr. Turner's Chemistry, 569.

(*c*) El. Blum. 407; Dr. Turner's Chemistry, 569.

(*d*) El. Blum. 407. note (*m*,) 408, note (B,) ante, 236, note (*b*.)

(*e*) Id. 407, 408; but see id. 409, note C; Dr. Turner's Chemistry, 570.

(*f*) According to Berzelius, out of 1000 pints of urine 993 are water, 30 urea, and the rest other enumerated materials; El. Blum. 409; 5 Good, 346; and see Turner's Chemistry, 570, 571; 2 Dungl. Phy. 241, 242.

(*g*) 5 Good, 346, 347. See Sir W. Prout on Urinary Diseases.

(*h*) Sir W. Prout on Diseases of Urinary Organs; 5 Good, 347, 348; El. Blum. 408, 409, note C.

(*i*) 5 Good, 302 to 346; and see Coop. Dict. supra.

(*k*) 5 Good, 346, &c.; Coop. Dict. tit. Urinary Calculi.

(*l*) El. Blum. 410, 308, note (*m*;) 5 Good, 304. See an extraordinary case in 1 Amer. Jour. Med. Sci. 49.

(*m*) Coop. Dict. tit. Bladder: Bougie; *Catheter;* Fistulæ in Perinæo; *Prostate Gland;* Urethra; Urinary Abscesses; Urinary *Calculi; Urinary Fistulæ; Urine, Incontinence of;* Urine, Retention of; Wilson on Male Urinary and Generative Organs; Howship's Practical Treatise on the most

CHAP. VIII. Sect. V. Of Secretion.

traordinary cases the discharge of urine must have been supplied by the bowels, or by the skin.(*n*) The effects that usually result from a retention of the urinary elements in the system are a loss of energy, and a growing torpitude in every function, proving that the sensorium is directly debilitated and rendered incapable of producing the nervous influence. It is hence to be expected that the brain will evince torpitude in a greater degree than any other organ, and become oppressed and comatose as though in a state of apoplexy. Nor is it difficult to account for these effects, since they naturally follow from the blood being surcharged with that excess of azote which, as we have observed, it appears to be the office of the *urine* to carry off.(*o*)

important complaints affecting the Secretion and Excretion of Urine; and as to Inflammation of the Bladder, and Gibson's Surg. under the heads above mentioned, see 2 Good, 373.

(*n*) 5 Good, 304.

(*o*) Id. 304.

CHAPTER IX.

THE NERVOUS FUNCTION—THE EXTERNAL SENSES, &C.—THE PASSIONS, EMOTIONS, &C.—THE MIND AND INTELLECTUAL FACULTIES—CONCIENCE AND SOUL; WITH THE SEVERAL ORGANS AND PARTS.

SECTION I.—SUBJECTS OF THIS CHAPTER AND PROPOSED ARRANGEMENT.

The subjects of this chapter and proposed arrangement.

The *Nervous* Function; the External *Senses;* the Passions, Emotions and Affections; the Mind or *Intellectual Faculties;* and whatever relates to *Concience* and the *Soul,* as pre-eminently raising us above the brute creation, command our utmost attention, whether as regards the *Healthy* or the *Diseased* state. Without the former, man would be a mere automaton, devoid of sensation and motion; without the mind, he would be bereft of all those high enjoyments with which he has been endowed beyond the mere sensual gratification of animals; whilst the monitions of *Conscience*, the conviction that our *Souls* are *immortal,* and that life here is but a probationary state, preparatory to *life everlasting*, excite and stimulate us to virtuous actions, and restrain us from evil, far more powerfully than mere moral considerations; all verify that "God created man in *his own* image."(*a*) These are interesting not only philosophically, but practically, since it is well established, that although some diseases may originate in the *vascular* system, yet more frequently they are attributable to some deviation from the due performance of the *Nervous Function*, and are greatly influenced by the passions, mental faculties, and still more by a troubled concience.(*b*) Upon the state of the *Brain* and the *Nerves* depends the extent of our *mental faculties,* the degree of enjoyment of the several senses, our *temperament*, whether tonic or deviating into sanguine, phlegmatic, choleric, melancholic, or nervous, and our *tempers.*(*c*) The nerves, which arise partly from the brain and partly from its spinal continuation, are distributed by minute branches to every sensible part of the body, and constitute the immediate organs of two principal functions, *Sensation* and *Volition*. They convey, with the rapidity of electricity, impressions made upon any part of the body *to* the sensorium commune of the brain, and *from* that organ they transmit the

(*a*) Genesis, chap. i.; and see Shakspeare: Hamlet, act ii. sc. 2: "How noble in reason! How infinite in faculties! in form and moving how express and admirable! In action how like an angel! In apprehension how like a God! The beauty of the world! The paragon of animals!" El. Blum. 544. We might add with Milton, in his description of Eve and woman, "Grace was in every step, Heaven in her eye; in every gesture dignity and love."

(*b*) Mason on Self Knowledge; Cogan on the Passions; Fletcher on the Influence of the troubled Mind on Health; Copl. Dict. Prac. Med. tit. Disease; and ante, 47, 48; Rush on the Mind.

(*c*) As to these, see ante, 49 to 51; and post.

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nervous influence to every sensible part of the body. The important subjects of this chapter will therefore principally be, the *Nervous Function;* the several *External Senses;* the *Passions, Emotions and Affections;* and the *Mind* or *Intellectual Faculties;* with some examination of *Conscience* and the *Soul.* The *organs and parts* from which these spring, or where they are supposed to be situate, with their supporting or protecting organs or parts, will also be necessarily considered. Pursuing the same arrangement as adopted in the preceding parts, we will first examine the organs of each function, with some explanatory plates, and then proceed to the functions themselves.

SECTION II.—THE NERVOUS FUNCTION AND ITS ORGANS IN GENERAL.

First Definition and enumeration of all the Organs and Parts of the Nervous Function.

Secondly. The Head, comprising the Cranium and the Face, and its several Parts.

1. Of the Head, Face, and Countenance *generally*, and how far the Dimensions, Shape or Appearance assist in determining the degree of Intellect, Character, &c.
   - The Cranium or Skull.
   - The Face or Countenance.
     - Plates of Camper's Facial Angle.
   - Of Craniology; Cranioscopy, or Phrenology.
     - Plates of Phrenology, Ancient and Modern.
     - Of Physiognomy.
     - The Five Regions of the Skull.
     - The Symptomatology of the Countenance, medically considered.
     - Inadmissibility of these in judicial Inquiries.

Particular Parts of the Head.
- The Hair, Skin, and Pericranium.
- The Bones and Membranes of the Skull.
  - General observations on the *Bones* of the Skull.

Secondly. The Head, &c.
- The *Sutures* between the Bones.
- The particular Bones.
- The Frontal Bone.
- Two Parietal Bones.
- Two Temporal Bones.
- The Occipital Bone.
- Sphenoid and Œthmoid Bones.
- The Dura Mater.
- The Tunica Arachnoidea.
- The Pia Mater.
- The Falx and Tentorium.

Thirdly. The organs of the Nervous System.
- The Brain.
  1. Composition.
  2. Weight and Size of.
  3. Form of.
  4. Parts of.
     1. Cerebrum.
     2. Cerebellum.
     3. Falx and Tentorium.
     4. Medulla Oblongata.
     5. Sensorium.
- Spinal Cord.
- The Nerves, *Cerebral, Spinal, or Vertebral.*
  - The Nerves and their Compositions.
  - The Sympathetic Nerve and other Nerves.
  - The Plexuses.
  - The Ganglia.
- Properties and conjoint Actions of the Brain, Nerves, and Nervous System.
- The Uses of the Nervous System.
- Connexion between the Muscular and Nervous Systems.
- Diseases and Injuries to Brain and Nervous System in general.

First. Definition and enumeration of all the organs and parts of the *Nervous* Function or system.

The consideration of the *Nervous Function* is technically termed *Neurology* (from the Greek νευρον, a nerve, and λογος, a discourse, Latin *nervus*, and French *systeme nerveux*,) (*d*) and includes the description of the Brain, Spinal Cord, Nerves, and Organs of Sense, and whenever the terms "Nervous System," "Nervous Matter," or "Nervous Power," are employed without addition or restriction, they are to be understood in a general sense, as including or referring to the brain, spinal cord,

(*d*) Ante, 52.

nerves, plexuses, and ganglia,(*e*) and, according to some authors, also the organs of sense.(*f*) *Neuralgia* (from νευρον, a nerve, and αχγος, pain,) imports a painful affection of the nerve,(*g*) whilst under the term *Neurotica*, have been classed all disorders connected with the nervous function.(*h*) Although *Sensation* and *Motion*, (the results of the nervous system,) have been treated as *vital*, (and certainly life would cease if the nervous functions were either wholly interrupted, or even locally affected in *certain parts*,) yet, in other parts, although they may be essential to *perfection*, they are not absolutely indispensable for the continuance of life, and such parts may, in the absence as well of sensation as of motion, maintain a *degree* of existence; as in the instance of a paralyzed arm or leg, or even an entire side, which, although it will become gradually *wasted* and *reduced* in *temperature*, yet, nevertheless, will not die in the strict sense of that term, and the rest of the frame may continue in perfect health and activity.(*i*)

First, Enumeration of organs and parts.(*j*)

The principal sources of the Nerves are placed within the cranium and the spinal canal. The organs themselves are the Brain and the Spinal Cord, being its continuation. The *Brain* again is composed of or divided into the cerebrum, cerebellum, tuber annulare, and medulla oblongata, parts which differ so much in their structure and organization, as to render it highly probable that they exercise different functions.(*k*) The Spinal Cord descends from the brain nearly to the sacrum of the pelvis, and through it the body as well as the mind may be stimulated to exertion.

Through the *Nerves*, *Plexuses*, and *Ganglia*, the sensations are conveyed from their sentient extremities to the sensorium; and the dictates of the mind are, also, by the former, transmitted to every part of the frame, occasioning muscular motion. The brain is the seat of the *Intellectual Faculties*, the source of thought. *Sensorium* is a general term applicable to any source of nervous power; and the whole brain is called the sensorium, though sometimes used as the supposed part where the mental faculties are more particularly seated;(*l*) and it is to the defect in or imperfect performance of the nervous function, that most of the corporeal as well as mental diseases and deviations from healthy action, are confessedly attributable.(*m*) We will examine all these in their natural order, and observe the like arrangement as in treating of the other functions, namely, first considering the several organs and parts, and then the function, or their combined operation.

Secondly, Of the head in general.

The cranium and

The *Head* is the cavity containing most of the organs of the Nervous System, and of the Senses, and of the Intellectual Faculties. It is composed of two principal parts, namely, the *Cranium* and the *Face*. The *Cranium* is the upper part above and behind the bony fabric of the face, and protecting the Brain, and is generally of uniform thickness throughout;(*n*) whilst the bones of the *Face* are designed to enclose, protect,

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(*e*) 1 Dungl. Phy. 41; 1 Bost. 175 to 263.

(*f*) 2 Bell, 365.

(*g*) Coop. Dict. tit. Tic Douloureux; Cyclop. Prac. Med. tit. Neuralgia.

(*h*) Good's Stud. Med. *per. tot.*

(*i*) Soemmering, Corp. Hum. Fab. tom. iv. s. 87; and see 1 Bost. 268, note; id. 192, &c.; 1 Dungl. Phy. 66, 67; ante, 32; Dewees, Prac. Phys. tit. Paralysis.

(*j*) See division, ante, 244; and see the very useful Plates of the Viscera of the Cranium, namely, the Membranes and the Brain, and of the Nerves, arising as well from the Brain as from the Spinal Marrow and Cauda Equina, published by Messrs. Burgess & Hill, London; and see 3 Greg. Econ. Nat. 266 to 301.

(*k*) 3 Bost. 293; Jackson, Prin. Med. 127 to 132.

(*l*) 4 Good, 1; 2 Bell, 365; Jackson, Prin. Med. 127; Brouss. Phy. 122, &c.

(*m*) Ante, 151, 166, Brouss. Phy. 203, &c.

(*n*) As to the Head in general, and In-

CHAP. IX. Sect. II. Nervous Function and its Organs.

face in general, their proper dimensions, shape, &c.

and support the muscles and the organs of sense, excepting those of touch and motion, namely, those of sight, hearing, smell, and taste, and parts of the organs of mastication.(*o*) The natural and proper size of the entire head is, with reference to the rest of the body, one-eighth,(*p*) whilst the cranium, when in due proportion, is almost four times larger than the face, without including the lower jaw.(*q*) Dr. Elliotson observes, that, although in the European, the *vertical* section is almost four times larger than that of the *face* (not including the lower jaw,) *yet that the faculties do not depend upon this proportion*, because men of great genius, as Leo, Montaigne, Leibnitz, Haller, and Mirabeau, had very large faces.(*r*) He further remarks, that the correspondence of *Camper's Facial Angle* with the above scale in Europeans, is not to be regarded as an exact measure of the *understanding*, for persons of great intellect may have a prominent mouth; and that it shows merely the projection of the *forehead*, while the cranium and brain *may* vary greatly in size in *other* parts.(*s*) The *head* of a European is, in general, extremely symmetrical, although rather globular, the forehead moderately expanded, the cheek-bone narrow, not prominent, directed downwards from the malar process of the superior maxillary bone, the alveolar edge round; the front teeth of each jaw placed perpendicularly; the face oval and nearly straight, its parts moderately distinct, the nose narrow, and slightly aquiline, or at least its dorsum rather prominent: the mouth small, the lips, especially the lower, rather turned out, the chin full and round, and somewhat prominent; in short, the countenance of that style which has been generally considered most beautiful;(*t*) whilst, in *cretinism* and idiots, the cranium is obviously imperfectly formed or developed, and mental imbecility is the incident.(*u*) The *Cranium* of Europeans, in comparison of the face, is generally very capacious; the area of the face, without including the lower jaw, bearing to that of the cranium, in proportion of only about *one* to *four*, and projects but little, if at all, at the lower parts; and hence Dr. Elliotson has observed, that the intellectual faculties of its individuals are susceptible of the highest cultivation, while the senses of smelling, hearing, and seeing, are much less acute than in the dark nations; the circumference, diameter, and vertical arch of whose cranium being *smaller* than Europeans, and the *forehead*, particularly, being *narrowed*, and falling back in a more arched form, consequently, their *brain*, in general, and particularly those parts which are the organs of *intellect*, properly so called, must be of inferior size; whereas, on the contrary, the orbits and the olfactory, and gustatory, or rather masticatory organs, being more amply developed, the area of the *face* bears a greater proportion to the area of the skull as *one and one-half* to *four*.(*x*)

It is insisted that in general the more the organ of smell and taste are developed, the greater is the size of the *face*, and the greater its relative proportion to the cranium; that, on the contrary, the larger the brain, the greater must be the capacity of the *skull*, and the greater its proportion to the face. On this principle, a large cranium and a small face, it is said, indicate a large brain, with a restricted development of the *sense* of *smell* and *taste*. The character and nature of different animals is determined by the degree of energy with which their different functions are per-

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juries to the same, Coop. Dict. tit. Head; and tit. Trephine; 1 Bost. 215; El. Blum. 188 to 263; 2 Bell, 365; 3 id. 235; 4 Good, *per tot.*; 1 Horn. Anat. 126 to 143; 2 Horn. Anat. 350 to 401; as to *Brain*, 3 Bost. 289 to 292.

(*o*) 1 Horn. Anat. 143 to 155; 1 Bell, 36.

(*p*) Copl. Dict. tit. Cretinism, n. where see, in general, the deformities exhibited in Cretinism; and C. Bell's Essays, 159, 160.

(*q*) El. Blum. 550.

(*r*) Id.; see, also, 3 Bost. 304.

(*s*) El. Blum. 550; and see post, 247, 248, as to Camper's Facial Angle.

(*t*) El. Blum. 551, 553, where see a comparative view of the different inhabitants of the globe; see, also, 3 Bost. 225 to 229.

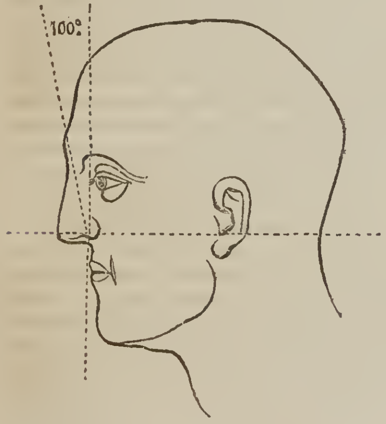
(*u*) Copl. Dict. tit. Cretinism.

(*x*) El. Blum. 557 to 559.

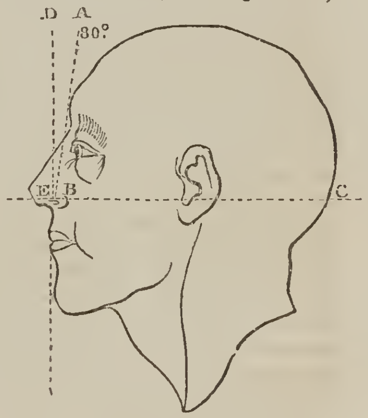
formed. They are guided and impelled by some leading propensity or disposition; and that as the cranium and face bear to the brain and organs of sense the relation of *containing* and *contained* parts, the study of their relative proportions is one of the greatest interest to the naturalist, inasmuch as they serve as indices of the faculties, instincts and capabilities of different individuals as well as of classes.(*y*)

Several modes of ascertaining the proportions of the cranium to the face have been suggested; that of Camper and his facial angle has been considered the simplest and best.(*z*) He drew two straight lines, the one horizontal, passing through the external *meatus auditorius*, and the bottom of the nostrils; the other running perpendicularly from the convexity of the forehead to the most prominent part of the upper jaw.(*b*) The angle, which the latter makes with the former, being the proper facial angle, is greatest in the human subject, from the comparative *smallness* of the brain, and the great development of the mouth and nose, in brutes. In the human adult this angle is about from 65° to 85°; in the ourang outang about from 55° to 65°; in some quadrupeds 20°; and in the lower classes of vertebral animals it entirely disappears.(*c*) Camper gives the following relative proportions of the facial angle, namely, the European, 80° or 90°; the Chinese, 75°; the Negro, 70°; the ourang outang, 58°; and the monkey, 42°.(*d*) It has, however, been justly observed, that Camper wrote rather to depict characters of countenances, as belonging to *different nations*, and even animals, than to connect those characters with any particular *comparative mental qualification*, though to a certain degree that may be the *effect* of his system;(*e*) and in Bell's Essays on the Anatomy and Philosophy of Expression, some defects in Camper's and Blumenbach's systems appear to be established.(*f*) The following sketches may assist in explanation. A B is the *facial* line; B C is the *horizontal* line; and A B C is the *angle* formed by their intersection, or the *facial angle*. In this case the *perpendicular line* D E and the angle D E C being therefore a right angle, or angle of 90°, it is clear that the angle A B C is a little less; it is 80°.

No. 1. Ancient Grecian.



No. 2. European (Englishman.)



(*y*) 1 Dungl. Phy. 234.

(*z*) Id. 256; and see the clear explanation in El. Blum. 550; and the scales as in El. Blum. 559.

(*b*) See his interesting work translated by Dr. Cogan, and with explanatory plates published, A.D. 1794.

(*c*) El. Blum. 550.

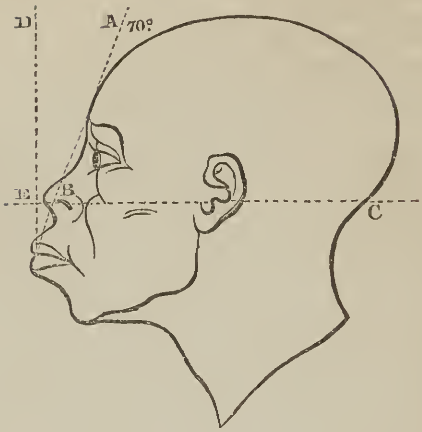
(*d*) Id. 559, note (*h*), where the scale appears rather to differ.

(*e*) 1 Convers. An. Econ. 56, 57; and El. Blum. 550.

(*f*) C. Bell's Essays, &c. 159, 160, 167 to 178, 217, 218, plates.

CHAP. IX.
SECT. II.
NERVOUS FUNCTION AND ITS ORGANS.

No. 3. Negro.



With respect to the size of the head, most physiologists agree that in general the extent of the faculties depends upon its largeness. Gall(*f*) observes that the integrant parts of the brain augment in number and development as we pass from a less perfect to a more perfect animal, till we arrive at the brain of man, who, in the internal superior, and in the superior region of the frontal bone, possesses several parts of which other animals are deprived, and by means of which he is endowed with the most eminent qualities and faculties, with powers of reasoning.(*g*) Magendie says that the dimensions of the brain are proportioned to those of the head; and the volume of the brain is generally in direct proportion to the capacity of the mind; and it is rarely found that a man distinguished by his mental faculties has not a *large head*.(*h*) The defective conformation of the brain is a source of idiotcy, and its disease the cause of insanity.(*i*)

When the *head* is from 21 to 22 inches in circumference, measuring nearly horizontally round the forehead and fullest part of the occipital bone, man obtains the height of intelligence; but when it is only 13 or 14 inches, there is idiotcy, or great imbecility; when from 14 to 17 inches in circumference, and about 10 to 12 from the root of the nose to the foramen occipitale, there is more or less stupidity, or more or less incapacity to fix the attention upon one object, uncertain and transitory feelings and passions, and confusion of ideas. Heads of 18 to 18½ inches in circumference, though too small, may nevertheless permit a regular exercise of the faculties; but they possess a sad mediocrity of talent, a spirit of servile imitation, and an extreme deficiency in comprehending the relation between the cause and effect; a want of self-government, and often few desires. Still some qualities or faculties may be considerable, because particular organs may be greatly developed, forming a striking contrast with the mediocrity of the rest.(*k*) One *practical utility* of this discovery

(*f*) 2 Gall, 364; El. Blum. 67, 549.

(*g*) Gall, book c. tom. ii. 364; El. Blum. 67, 549; it is even there supposed that this capacity predisposes to *religion*, El. Blum. 6, note 9; but perhaps that conclusion is without adequate premises.

(*h*) Dr. Magendie, Précis de Physiologie, vol. i. 184; El, Blum. 68.

(*i*) Dr. Marshall, Morbid Anatomy of the Brain by Saurey, A. D. 1815; El. Blum. 68, note (*p*;) in Copl. Dict. tit. Cranium, it is shown that the skulls of insane persons frequently differ from those who are sane; and post, note (*p*.)

(*k*) Gall, book c. vol. i. 196; vol. ii. 322; El. Blum. 68.

is, that too many attainments should not be crowded on a mind of such limited powers, and that the particular faculty, which is the strongest, should be peculiarly cultivated. Dr. Elliotson mentions an instance of the head of a male idiot, aged eighteen years, measuring only 16 inches in circumference, and $7\frac{3}{4}$ inches from ear to ear over the vertex, whose cerebrum weighed but 1lb. $7\frac{1}{2}$ oz., and the cerebellum but 4 oz.; whilst the hemispheres were united as far back as the vertex, and no falx existed, except for about two inches from the anterior part of the tentorium.(*l*)

Of cranioscopy or craniology, or phrenology and of physiognomy in general.(*m*)

Besides this established rule, that the larger the brain in the aggregate, the higher will in general be the intellectual capacity, many very eminent anatomists and physiologists have insisted that the extent and degrees of certain *particular departments* of mental capacity and of talented or amiable, or evil predispositions, may be ascertained by two descriptions of examination, the one usually termed *phrenology* (but from its connexion with the bones of the cranium, more properly *cranioscopy*, or craniology,) and the other termed *physiognomy;* the former, founded on the principles of Phrenology and the appearance of certain bones and parts, and the other on those of Physiognomy, relying upon the expression of the *muscles, eye and countenance.*(*m*) Certainly it is clearly established that the brain is formed, as well in size as in shape, *before* the bones; and in general, instead of the bones regulating the dimension of the brain, they subsequently grow, and unless interrupted in their natural course, conform to the shape of the brain; so that the external appearance of the bones and head may be the indices of the *natural* size as well as *shape* of the brain.(*n*) But the natural and congenital size and shape of the brain may, after birth, be affected by several causes; as by the deficient powers of the constitution, in which the growth of the brain itself or the process of ossification either generally or locally may participate; the bones of the cranium may thereby be insufficiently evolved and impede its relative growth, and such bones may then appear unnaturally small, as is sometimes observed in idiots and epileptics;(*o*) so the bones of the skull may become *too thick*, and which may proceed even from laborious employments, physical and mental,(*d*) though a small depression in the bones of the cranium may have no influence on mental capacity.(*q*) Man possesses, not absolutely the largest brain, but the largest brain in comparison with the nerves arising from it; (*r*) and as the size of the brain generally governs the size of the head, it has been generally assumed that the extent of mental faculties, as well as some peculiarities, may be ascertained from external observation; and this is the reason that the artists of ancient

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(*l*) El. Blum. 199.

(*m*) See as to *phrenology* and *physiognomy* in general, the authorities and arguments in 3 Bost. 209 to 218; 1 Bost. 218, note; and in particular, Combes's Essays on Phrenology, who very powerfully advocates the doctrine; De Ville's Manual of Phrenology is one of the most recent publications on the subject of *phrenology;* Dr. Elliotson and Sir Edward Home, and other distinguished authorities, saction the doctrine of cranioscopy in the most explicit terms; see Phil. Trans. for A. D. 1821; 1 Bost. 218, note; whilst Dr. Bostock, after referring to several authorities, disputes it; see 3 Bost. 213; as to the preference of the name *cranioscopy*, see 3 Bost. 211, note; see 1 Dungl. Phy. 261 to 281.

(*n*) 2 Bell, 384; 1 Bell, 36; 1 Dungl. Phy. 266; Copl. Dict. tit. Cranium; and Cretinism.

(*o*) See several causes of idiotcy or weakness of intellect, Copl. Dict. tit. Cranium; 1 Beck, Med. Jur. 347.

(*p*) Id. ib., where it is established that 151 out of 196, and 410 out of 500 insane persons had the bones of the skull *too thick*, thereby either pressing upon the brain or at least confining the same within too narrow limits. Probably this is the origin of the common expression, "*thick-headed*," as denoting *stupidity;* and see 3 Bost. 209.

(*q*) Copl. Dict. tit. Cranium, 441.

(*r*) El. Blum. 549; 4 Good, 9.

CHAP. IX. SECT. II. NERVOUS FUNCTION AND ITS ORGANS.

Greece, whether sculptors or painters, usually complimented their celebrated characters as well in size as with a *projection* in the forehead of even 100°, as being their ideal standard of the highest mental intelligence and sublimity, and which elevation and projection of the forehead was always supposed to indicate a greater than ordinary fulness and capacity of brain. The antique head was also with the same view represented as much *broader* than we now find to be usual or natural.(*s*)

Sir Everard Home, Dr. Elliotson, and many other eminent physiologists (following some distinguished continental physiologists(*t*) have strongly advocated the doctrine that different parts of the brain have different offices, and that the particular faculties, sentiments and propensities of each individual, may be ascertained whilst living, by *external examination* of the cranium, and generally that *phrenology* or *craniology* is a science that may be studied with great practical utility.(*u*) Dr. Elliotson observes that Gall had the immortal honour of having *discovered* and *proved* that particular parts of the brain are the seat of different faculties, sentiments and propensities;(*x*) that the exact situation of the organs can be learnt only from drawings or marked heads; but that independently of them, certain remarks may be made, namely, *First*, That the organs of the faculties, or qualities common to man and brutes, are placed in parts of the brain, common as well to man as brutes, namely; at the posterior inferior, and the anterior inferior parts of the brain, that is, of the instinct of propagation, the love of offspring, the instinct of self-defence, of appropriating, of stratagem, &c.: *Secondly*, Those which belong to *man exclusively*, and which form the barrier between man and brutes, are placed in parts of the brain not possessed by brutes, namely, the posterior *superior*, and superior of the front, that is, of comparative sagacity, causality, wit, poetic talent, and the disposition to religious feelings; and, *Thirdly*, That the more indispensable a quality or faculty, the nearer are its organs to the base of the brain or median line.(*y*) In A. D. 1562, we find a plate of the head, showing the supposed situation of some of the principal faculties,(*z*) which much resembles the more modern doctrine.(*a*)

The following *Sketches* and *Explanations* will sufficiently show the different organs and their situation upon which phrenologists rely.

(*s*) Conversat Animal Economy, 59, 60; and see the sketch, post, 251; and 3 Bost. 209 to 218; but see Bell's Essays, 159, 160, 167 to 178, 217, 218, and plate of the outline of the Head of Mercury.

(*t*) See the ancient plate, post, 251; observations and authorities, 1 Bost. 218, note; 3 id. 209 to 218; also, 1 Dungl. Phy. 261, &c.

(*u*) El. Blum. 196; and Dr. Elliotson, note 1, 204 to 227; 1 Bost. 218, note 9; and 2 Bost. 209 to 222, where Dr. Bostock appears to deny cranioscopy, and qualifies even physiognomy.

(*x*) El. Blum. 204, 206; see further Dr. Gall's octavo work, Sur les Fonctions du Cerveau, and his work De la Physiologie du Systeme Nerveux; also, Dr. Spurzheim and Mr. G. Combes's works.

(*y*) See further El. Blum. 222.

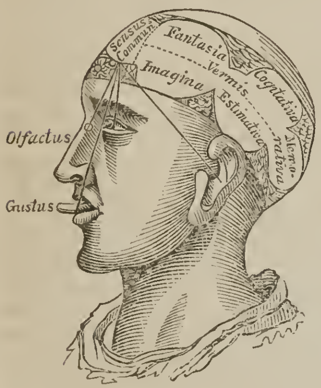
(*z*) See the plate, post, 251; and El. Blum. 205.

(*a*) See the Sketch from El. Blum. 205; and other sketches, post, 251.

PLATES ILLUSTRATIVE OF PHRENOLOGY OR CRANIOSCOPY.

No. 1.

Head given by Dolce, A. D. 1562.



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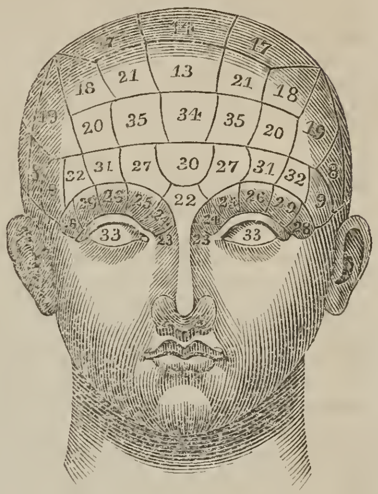

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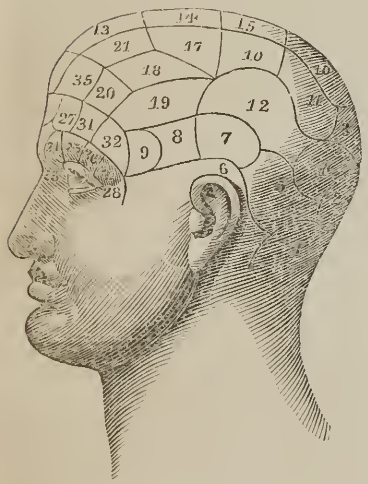

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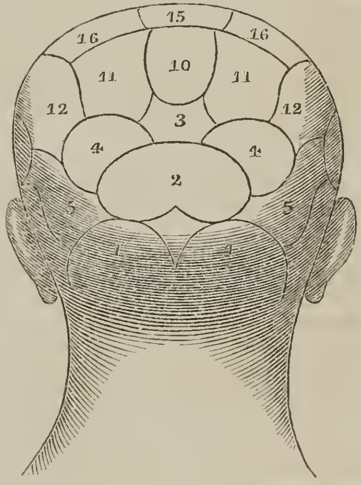

Names of Organs or Propensities as numbered in the above Plates, 2, 3, 4.

1. Amativeness.
2. Philoprogenitiveness.
3. Inhabitiveness.
4. Adhesiveness or Attachment.
5. Combativeness.
6. Destructiveness.
7. Secretiveness.
8. Acquisitiveness.
9. Constructiveness.
10. Self-Esteem.
11. Love of Approbation or Notoriety.
12. Cautiousness.
13. Benevolence.

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14. Veneration.
15. Firmness.
16. Conscientiousness or Justice.
17. Hope.
18. Marvellousness.
19. Ideality.
20. Gaiety or Wit.
21. Imitation.
22. Individuality.
23. Form.
24. Size.
25. Weight and Resistance.
26. Colour.
27. Locality.
28. Numeration.
29. Order.
30. Eventuality.
31. Time.
32. Melody or Tune.
33. Language.
34. Comparison.
35. Causality.

In the Manual of Phrenology, one of the latest explanations on the subject,(*b*) the following analysis of the fuller description of the supposed situation of these parts is given. The first nine faculties, it is said, give merely *desire*, and may be properly called *propensities*. Every head, except that of an idiot, has the thirty-five organs; but professed phrenologists do not attempt to say that they are *all* largely developed and active in any one individual; but that by observations on a few persons, every organ in one or the other will be found *fully* developed,(*b*) that is to say, in a *few* individuals; and that those who will pay attention to the manner a practical phrenologist proceeds when speaking of actions, will find that he does not attempt to point out or give more than *five to nine or ten prominent points* of character, except in very extraordinary cases.(*b*) Hence the phrenologist does not attempt to give more than a few of the prominent parts of the head, the rest being small and moderately developed, taking the same part in the character as their size manifest.(*b*) The following extract will show the outline of the doctrine.

"In making observations on the organs, it will be found they take different forms, according to their state of activity: the greater part of those in the posterior part of the head, when very active, present *round or oval appearances*, most of them *round*. Some of those in the anterior part of the head partake of the same configurations; while others, particularly those near and round the eye-brows, only present a *fulness* at their situations. We, therefore, consider a few observations on their more general forms, when very active, will give facilities in taking a view of the science. It will also be necessary to observe, that when two or more are found active adjoining each other, (when so,) some difficulty will be presented, but which a little practice and study of the general configurations will soon remove. No. 1. Amativeness, when large, gives a fulness to the back part of the neck, (*but care must be observed in making observations on persons inclined to be lusty*,) between the mastoid processes and the occipital protuberance. In the skull it is more easily observed by the fulness at the same parts. No. 2. Philoprogenitiveness, when large, will be found at times round, but its more general form is an oval, extending outwards towards the ears, giving in the head a drooping appearance, and in the skull a projection, when large, not easily mistaken. It is more generally developed in the female than the male, to which it gives an elongated appearance to that part of the head, in which care must be taken in observing the proportions before and behind the

(*b*) Manual of Phrenology, page 113 to 120, published by Mr. De Ville, Strand, London, A. D. 1828, where may also be obtained a small illustrative bust. The most scientific phrenologists have informed the author that they practically find that any peculiarity in either of the thirty-five enumerated propensities is *but rarely developed;* and that, in general, when an evil propensity is plainly discovered, some other counteracting propensity is to be found developed, which by due education may adequately restrain the former from becoming banefully active.

line often spoken of. No. 3. Inhabitiveness, when large, presents an appearance of a continuation upwards of the former: it is often to be observed in combination with it, presenting one general full configuration, like the inverted end of the figure of a heart rounded. No. 4. Adhesiveness or Attachment is on each side of inhabitiveness; when large, and Philoprogenitiveness also, it presents a round appearance; but when that is not very large, it then presents an oval appearance, inclining up and downward: this will also be its form when Combativeness and Destructiveness are fully developed. No. 5. Combativeness, when large, presents, in general, a round appearance, but at times, it will be observed of rather an oval form up and downward, when inhabitiveness, philoprogenitiveness, and destructiveness, are very large. No. 6. Destructiveness, when large, gives a fulness to the head about half an inch above the upper part of the ear, and a little forward and backward of it, at times causing the upper part of the ear to project outwards; if the nail on the finger was touched with colour, so as to leave its mark, and draw it round the ear, from the middle of the back part to about three-quarters of an inch forward of it, keeping the fleshy part of the finger to the ear, it would readily describe its situation. In the skull it presents an elongated form over the orifice of the ear, and occupies a large portion of the middle lobe of the brain. No. 7. Secretiveness, when large, and if the last organ and cautiousness are large, it gives a fulness to the part between them; when cautiousness is moderate it gives a round or oval appearance to the part. No. 8. Acquisitiveness, when large, presents sometimes round and other times oval appearances, more often the latter: it is easily discovered when active, giving to that part of the side of the head a fulness. No. 9. Constructiveness, when large, gives a fulness to the part where its seat is. Great care should be taken by beginners in speaking to the manifestations of this organ, particularly when melody is very large; they are then so blended together, it becomes quite difficult for the good practical phrenologist to separate them. I am not aware of any two organs, when both are large, presenting more difficulty than the two last mentioned. *Care should also be taken with the three last, namely, secretiveness, acquisitiveness, and constructiveness, as they will be found to range backward and forward on that line of the head: when so, constructiveness has often been taken as small, when it is large.* No. 10. Self-esteem: this organ, in general, takes an oval form up and downward. No. 11. Love of approbation or notoriety: this also takes an oval form, being seldom seen otherwise. No. 12. Cautiousness is of an elongated form on the upper part of secretiveness, round part of destructiveness; and when very large gives a squareness to that part of the head. No. 13. Benevolence: this also takes an elongated form; but at times, when very large, it appears of an oval form, particularly when imitation is also large, the two then forming one large oval, forward and backward on the middle of the upper part of the forehead. No. 14. Veneration, when large, takes a round form in general; but when those around it are fully developed, it then appears only full at the part, without any particular figure. This organ is often considered as small, when benevolence and firmness are large: it then appears a little hollow at veneration, which upon due consideration will not be found so. *These observations apply to most of the organs where those on each side of it are large.* No. 15. Firmness, when large, in general, appears round, giving to that part a prominent appearance; when conscientiousness or justice is also large, they give one round appearance to that part of the head. No. 16. Conscientiousness or justice, when very large, takes a round appearance, and when in combination with firmness appears the same as the last; and when cautiousness is large, in combination with the two last, it gives to that part of the head a large and full appearance. No. 17. Hope: this

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organ, when large, takes no particular shape, giving only a fulness to that part of the head. No. 18. Marvellousness, when large, takes an elongated form, presenting a full appearance at that part of the head. No. 19. Ideality also takes an elongated form, on the side of the head over constructiveness and acquisitiveness; and when the three are large, they give a full appearance to that part of the head; but the muscle referred to in another page, must not be lost sight of, when making observations on those organs. No. 20. Gaiety or wit, when largely developed, presents a round appearance, but when causality and ideality are also large, it then gives a fulness to that part of the forehead. No. 21. Imitation takes an elongated form, in the same manner as described in benevolence. No. 22. Individuality, when large, gives a full appearance to that part of the forehead between the eyes. No. 23. Form: this organ, when very large, gives a thick and heavy appearance to the upper part of the nose between the eyes, extending them outwards and wide apart. No. 24. Size: this organ requires care in giving judgment on it, giving to that part of the brow, when large, a heavy appearance; it is on the side of individuality, and under locality. No. 25. Weight: this, like the last, requires care in judging of it; it is on the outer side of size, and when large, and size also, they give a heavy over-hanging appearance to that part of the brow. *The last four organs require care in making observations on them; for when a frontal sinus exists, they then present some difficulty, but not so much as supposed; a little experience will give the power of judging the state of the sinus, if any exists. The sceptics and doubters, who represent these as obstacles, if they will take the trouble, as we have done, may gratify their sight by finding great numbers without.* No. 26. Colour, when large, gives an arched form to the eye-brow, and a fulness to the part when weight and order are also fully developed. No. 27. Locality, when large, presents a fulness on the middle line of the forehead, somewhat like a pear or egg shape, with the small end downward; and if individuality be moderate, it then presents a figure similar to what is given of the heart on the centre of the lower part of the forehead. No. 28. Numeration, when large, at times gives a heavy fulness to the outer lateral part of the eyebrow, and at other times it gives length to the same part. No. 29. Order, when large, gives a squareness of form to the brow, at times producing a heavy appearance, with a roundness; at other times, a more acute angle at that part of the brow, producing a squareness of form on that line. No. 30. Eventuality, when fully developed, gives a fulness to that part of the forehead on the middle line immediately above individuality and under comparison, which, when large, produces a fulness on the middle line upwards of the forehead. No. 31. Time, when large, takes a round form, and if gaiety, order, and melody, are also large, they then produce a fulness of that part without either of them giving separately a determined figure. No. 32. Melody or Tune: this organ, when large, gives a round figure; but like the last, when in the same combination, it is at times difficult to separate it and constructiveness. It becomes necessary to attend to the observations on it and constructiveness as given at No. 9. No. 33. Language: this is also an organ that requires care in judging of its activity. We find by practice that there appear to be three ways in which it denotes language; one, and the most general, is by the large full eye; another is by a very large orbit coming low down; and the other by a very heavy and full eyebrow. In this case the eye, will, at times, appear somewhat sunken, particularly if the whole of the perceptive faculties are largely developed. No. 34. Comparison, when large, presents a round appearance, and when eventuality and causality are also large, it then presents fulness of that part of the forehead. No. 35. Causality, like the last, is in general observed round when large, particularly when comparison is moderate; but when it and eventuality are large in combination, the appearance of the forehead is as in the last, producing a fulness on that part of the forehead, and is more generally found so than otherwise."(*a*)

One of the most distinguished and experienced surgeons of the present day has thus happily admitted the force of physiogomy, but at the same time expressed his decided opinion against the doctrine of cranioscopy, "We all acknowledge the influence of *physiognomy*, from the symmetrical features of a beautiful woman to the lowering countenance of the assassin; but as to *phrenology*, it never can arrive to science, for the most irregular and important parts of the brain *are entirely concealed from our view* at the basis of the skull. Yet the phrenologists have given all the qualities, mental and moral, to the bumps upon the upper and lateral surfaces of the brain, thus leaving nothing for the numerous inequalities of the basis." But the phrenologists answer these objections by insisting that the mental faculties are situated in the *superior* and towards the *external* parts of the head, although they converge towards the centre, and are therefore capable of examination externally in the manner for which they contend.(*b*)

With respect to the *practical utility* of phrenology, Dr. Elliotson insists that certain organs are perceptible in the construction of the head, developing different faculties, sentiments, and propensities to different talents, virtue, or vice in different individuals, and that the study and knowledge of these is not only calculated to assist parents and others in *education and the choice of occupation or professions of their children*, but also in checking and counteracting certain obvious *bad propensities*.(*c*) And he even contends that phrenology may be of the highest use when in alleged criminals there may be suspicion of idiotism or insanity, for that idiotism often depends on deficiency of cerebral developments, and many idiots have been executed for crimes when it was not exactly proved that they were idiotic enough to be unfit for punishment, but whose cranial development might have settled the point at once. That many persons have been executed who should have been considered madmen, because, although the fact of illusion was not distinctly made out, yet the extreme preponderance of the development of the organs of the propensities over that of the moral sentiments and intellect, proved that they were deserving of restraint rather than punishment; and Dr. Elliotson instances that the skull of Bellingham, the murderer of Mr. Percival, proved him to have been insane; and it is insisted that by phrenology the true mental faculties have principally been discovered, and that if it teach the true nature of man, its importance in medicine, education, jurisprudence, and every thing relating to society and conduct, must be at once apparent.(*d*) But other eminent physiologists, and in particular Dr. Bostock, entirely object to cranioscopy, and insist that it is not well founded on principle, and that the facts hitherto adduced are altogether inadequate to establish the doctrine.(*e*) Certainly the doctrine of cranioscopy is not as yet admitted in the practice of the law, for under the defence of insanity evidence only of acts, expressions or conduct of the prisoner, is regarded, without, as yet, admitting any evidence, medical or otherwise, as to the precise construction of the head or cranium.

(*a*) Manual of Phrenology. Dr. Spurzheim's Anatomy of the Brain contains a similar enumeration of the supposed thirty-five organs; and see 3 Bost. 216, note.

(*b*) See Mr. Combes's works, in which the doctrine of phrenology is strikingly and powerfully advocated.

(*c*) El. Blum. 213, 214.

(*d*) Id. 214, 215; and Mr. Combes's System and Essay on the Constitution of Man, and the works of Gall and Dr. Spurzheim.

(*e*) 3 Bost. 217.

CHAP. IX. Sect. II. Nervous Function and its Organs.

Of physiognomy.

As regards the science of *physiognomy*, it differs from cranioscopy in this respect, that the latter professes to judge of the character by the *shape* of the head, and especially by certain *projections or eminences in certain parts;* whilst physiognomy makes use of the form of the features, and the general aspect and expression of the muscles and countenance, as denoting the otherwise secret disposition and operation of the mind.(*f*) Physiognomy is a science of very early date, and was strongly insisted on by many of the ancients, and in more modern times was revived and cultivated by Lavater.(*g*) Dr. Bostock observes that it must be admitted as a matter of fact that there are few persons of any observation and reflection, or of any knowledge of human nature, who do not almost involuntarily exercise their judgment on the physiognomy of every new face that is presented to them; and that, without regard to any physiological speculation or controverted opinion, we, as it were, instinctively attach the idea of a certain disposition to a certain countenance, and regard one set of features as an index of wit, and another of stupidity. Nor does this idea want the support of plausible hypothesis.(*h*) The great instruments of expressing the human passions and feelings are the nerves and the muscles of the face; and when any passion is strongly marked, and frequently repeated, the *muscles* acquire a tendency to maintain this position even when the corresponding feeling ceases to exist; and by the frequent and powerful contraction of certain muscles, even the very shape of the neighbouring parts may be affected, the tendons may be permanently extended or contracted, and even the bones of the face may be somewhat altered in their form.(*i*) A succession of happy or unhappy events, or the indulgence of morose or degrading feelings, will permanently influence the countenance of the young, and occasion a character of gaiety, melancholy, or morosity that may endure through life. Dr. Bostock concludes his remarks by observing that the object, whether real or imaginary, of the science of cranioscopy and physiognomy is to distinguish between the *mental* faculties or dispositions of different individuals, and that whatever may be our opinion respecting the origin of these differences, whether innate or

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(*f*) 3 Bost. 218 to 222; Johnson, Dict. tit. Physiognomy.

(*g*) Id. 218; and see Hunter's Translation of Lavater, with Holloway's engravings, and C. Bell's Essays, 35, 36, as to Eyebrows; and see id. 43, 44, 58, 61, 62, 67 to 69, &c., which are beautifully illustrative as regards the expressions of passions, emotions, &c.; and see Camper, translated by Dr. Cogan, 125, A. D. 1794, where also see quoted the observations of Cicero and Pliny.

(*h*) We also watch the countenance to ascertain the present temper of the companion. It will be observed that a degree of this faculty is even extended to animals, and that the dog, especially the spaniel, more frequently the companion of man, will watch his eye and countenance to ascertain whether he may venture to caress or approach his master. If he merely frown, without other expression of anger, the dog will with fear approach or retrograde.

(*i*) 3 Bost. 219; and see C. Bell's Essays, &c. 36; but as there are no *tendons*, strictly speaking, in the *face*, this position can only correctly apply to the *muscles* in the face. Children, especially females, who have continuously been cultivated in the higher circles, are usually taught to place their mouths and other parts of the face, forehead, and countenance, as well as their whole frame, in the most placid and becoming position or attitude, and thus they habitually acquire the appearance or semblance of a character of courtesy and amiability which may not really exist; whilst the dropped or pouting lip and semblance of a vacant countenance in inferior ranks frequently indicate the absence of cultivation, or of the uncontrolled indulgence of bad or ill-regulated propensities. The countenance of persons habitually *cunning*, and pluming themselves upon their ideal quickness of perception and fancied peculiar acuteness, generally portray their absurdity; and persons addicted to lascivious indulgence and demeanour, invariably betray their vicious propensities. So, numerous other vices or tempers are readily demonstrated by the countenance or eye.

acquired, and whatever may be our means of ascertaining them, no one can doubt of their existence, even at a very early period of life. What may be called the mechanism of the human mind ought to form a very principal object of attention with the moralist and the public instructer, and more particularly with those engaged in the education of youth.(*k*)

Five regions of the skull, and *three* of the face.

To facilitate the description of the numerous *eminences*, *depressions*, *cavities*, and *foramina* of the *Skull*, anatomists and phrenologists examine successively its *external* and *internal* surface, and consider that the former is divisible into *five regions;* three being somewhat of an oval figure, and situated one superiorly, another at the base, and the third in front, including the face. The others comprise the lateral parts, which are somewhat flat and triangular.(*l*) Ancient physiologists, especially Lavater, also made ideal divisions of the *face* into three regions, the upper part being that of the intellectual life, the middle of the moral, and the lower of the animal life; these are supposed to be analogous to the head, chest, and abdomen, and are considered by them respectively to be the seats of three corresponding classes of faculties.(*m*) But we will postpone the consideration of these regions of the head, until we take a combined view of all these artificial regions throughout the frame.(*n*)

Of symptomatology, and the study of the countenance by physicians to ascertain the cause and state of disease.

Perhaps in the whole art of medicine there is not any department in which the experienced physician can more evince his talent and discernment than in the study of the countenance, expression and attitude of his patient, since it is well established that in innumerable instances he may thereby discover as well the seat as the cause of the disease, whether bodily or mental, and be enabled to apply the appropriate remedy. It has been correctly observed that this subject is not in general sufficiently regarded. Celsus remarks, "Medicus neque in tenebris neque a capite ægri debet residere; sed illustri loco adversus eum, ut omnes notas ex vultu quoque cubantis, perspiciat."(*p*)

Inadmissibility of cranioscopy and physiology in judicial investigations.

If the sciences of cranioscopy and craniology could be brought to any *certain and unvarying result*, it is obvious that they would be of the highest importance, not only as regards the varying descriptions of *education* to be applied to the thereby discovered capacities of children, but they might also materially influence the law and its administration, especially in its application to alleged criminals, towards whom, (independently of express evidence of mental imbecility or aberration,) yet if it were clearly proved that they had been strongly *predisposed* by natural construction to particular crime or outrage, some indulgence or mitigation might perhaps be justly extended. But at present, especially as regards *cranioscopy and small deviations* in the appearance of the skull from its perfect form and shape, not absolutely denoting insanity, there appears to be too much uncertainty to induce any practical application of the doctrine.(*q*) Perhaps we are wisely kept in uncertainty, as much misery might result from the anticipation of certain evil or good, and by the comparative irresponsibility for many of our actions, which we should be apt to infer we were predestined to perform, and would in vain endeavour to pre-

(*k*) 3 Bost. 222.

(*l*) Quain's El. 128 to 134.

(*m*) 3 Bost. 220.

(*n*) See post, Part II.

(*o*) See a valuable article by Dr. Gregory, Cyclop. Prac. Med. tit. Symptomatology.

(*p*) Lib. iii. cap. 6. Hippocrates and Celsus even enjoin attention to the attitudes of patients, Celsus, lib. ii. cap. 3, 4, 6. With respect to the discovery of mental depressions and affections, see Cogan on the Passions, 2d ed. and Fletcher's work; and see the beautiful illustrations in C. Bell's Essays.

(*q*) See the conclusion of Dr. Bostock, vol. iii. 217.

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vent. Practically we know from history that the greatest depravity and moral delinquency have been concealed under the most amiable appearance, whilst the best internal feeling, disposition and character may present a most forbidding countenance and demeanour. As "Man is practised in disguise, and cheats the most discerning eyes," it may be inferred that witnesses and prisoners will exhibit the most amiable appearance they can assume, and, therefore, it would be absurd to draw *favourable* conclusions from external appearances;(r) and, on the other hand, it is the duty of all to struggle against admitting the slightest prejudice, bias, or suspicion in respect of any assumed knowledge, either of cranioscopy or physiognomy, and to judge alone from the evidence and probabilities of each particular case. It has been remarked that the study of phrenology is too apt to encourage a conceitedness in superior powers of perception and sagacity, and, at least in courts of justice, would be a dangerous attendant.

Of particular parts of the head, especially the cranium and membranes.

We will now proceed to examine the parts of the cranium and other coverings of the brain in the order of the several successive layers of different descriptions, namely, *first*, the *hair*, and *skin*, or scalp; *secondly*, the *pericranium; thirdly*, the *plates* of the bones of the skull, as the outer plate, the *diploe*, and the inner plate, called the *vitreous; fourthly;* the dura mater; *fifthly*, the arachnoid, or, more technically, the tunica arachnoidea; and, *sixthly*, the pia mater, immediately within which lie the brain and its vessels.

The *Hair, Skin, or Scalp, and Pericranium*.—These may be termed the envelopes of the cranium. The hair and skin will be necessarily considered when we treat of the *Integuments* in general.(u) But with reference to some diseases and wounds of the head, these require particular local treatment, and have occupied the attention of the most eminent surgeons of the present time.(x) The *Pericranium* (from the Greek περι, about, and κρανιον, the skull or helmet,) sometimes called the aponeurosis, covers the bones of the skull, and resembles and corresponds with and performs the office of the *periosteum* of other bones, being the external covering immediately over the external plate of the bones of the skull, and between the same and the scalp.(y) Blood vessels pass in the same, and into and through the external plate of the bone, and into the diploe between the two plates,(z) and this membrane is subject to the same *changes* as the periosteum in other parts of the body, and especially inflammation(a) simple and rheumatic.(b)

(r) The guarded countenance is here alluded to; the instances of the sudden effect of shame or conscience will be considered towards the close of this chapter.

(u) Post, chapter xi.

(x) 1 Gibson, Surg. 122; Coop. Dict. tit. Head, as to the *Scalp* in particular.

(y) Lizars, 31; G. Smith, 263; Coop. Dict. tit. Head; Copl. Dict. tit. Cranium; see explanation in describing affections of the scalp and pericranium, Copl. Dict. tit. Brain, and Cranium; Cyclop. Prac. Med. tit. Headach.

(z) 1 Bell, 36, 37; 1 Horn. Anat. 164.

(a) Copl. Dict. tit. Cranium.

(b) Cyclop. Prac. Med. tit. Headach.

1. 1. Are parts of the *Frontal* bone forming the forehead. In general, the central division in the frontal bone does not exist like that in the particular skull here represented. The skull, however, usually has the appearance of an original division in the centre or along the mesial line, by a suture extending downwards to the root of the nose. At the lower and front part, two flat surfaces extend inwards, forming the roofs of the bony orbits. [*a*, *a*]

2. Is the left *Parietal* bone, forming the chief part of the lateral wall of the cranium or skull, and connected to the frontal bone by the coronal suture, and to its fellow along the mesial line, by the sagittal suture.

3. Is the *Occipital* bone or hind head, which is curved forwards below, forming a part of the base of the skull, in which it presents a large opening for the spinal marrow. It is connected to the two parietal bones by the lambdoidal suture.

4. The *Temporal* bone or temple, which contains the internal ear, divided into the tympanum and labyrinth. Its upper edge is thin and scaly, overlapping the edge of the parietal and sphenoid bones 6, forming the squamous suture. It has a long process [*a*] extending nearly horizontally forwards to meet the malar bone 8, which, with it, forms an arch or yoke, and underneath which the temporal muscle plays, and is the glenoid cavity for the head of the lower jaw and [*d*] the auditory canal.

5. The *Œthmoid* bone, of a spongy texture, entering largely into the structure of the nose, and its flattened sides bounding the orbit internally.

6. The *Sphenoid* bone, so called from its wedging in all the other bones of the cranium with all of which it is articulated, extends across and forms the middle part of the base of the skull, and is perforated by many holes for the transmission of a large number of the *nerves* of the brain, and gives attachment to some of the muscles of mastication.

7. The *Superior Maxillary* bone or upper jaw. It sends a process upwards [*a*] to form a part of the side of the nose. It forms the floor of the orbit[*b*,] and the half of the bony palate or roof of the mouth, along the mesial line of which it joins its fellow. [*c*] Its infra orbitary foramen, for the second division of the fifth pair of nerves, distributed to the muscles of the face. Along its lower border eight teeth are inserted into the alveoli or sockets. The bone itself is hollow.

8. The *Malar* or *Cheek* bone, forming the projection of the cheek, and likewise entering into the composition of the orbit. It participates with the temporal bone in the formation of the bony arch under which the temporal muscle plays. [*a*]

9. The upper extremity of a small irregularly shaped bone called the *Palate* bone, which is placed between the sphenoid and superior maxillary, and enters into the composition of the orbit and of the bony palate. The soft palate and Uvula are attached to it.

10. The *Os Unguis,* so called from its resemblance to a finger nail. It forms a part of the orbit, and is grooved with the corresponding surface of the superior maxillary for the nasal duct, which conveys the tears from the eye downwards into the nose.

11. The *two Nasal* bones. These form the upper part of the projection of the nose; they are articulated with the frontal bone above, and the cartilage of the nose below.

12. The *Inferior Maxillary* bone, or *Lower Jaw,*(*s*) shaped somewhat like a horse-

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(*s*) See description of lower jaw, ante, 69; and El. Blum. 313, 314, 317; 1 Horner, Anat. 152 to 155.

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shoe; *a*, *a*, is its base, *d* its angle. From the angle, a process of the bone mounts upwards, called the Rumus, which terminate in two processes, the posterior [*b*] is the rounded head, long in the transverse direction, and which rests in the socket [*c*] of the temporal bone. [4] The front process [*c*] affords insertion for the temporal muscle, and is called the *coronoid process*. It contains in the sockets or alveoli sixteen teeth in the adult.

e. The mental foramen, from which emerges a branch of the inferior maxillary nerve, to be distributed to the muscles on the *lower* jaw.

General description and distribution of these bones in certain parts of the entire head.

The bones of the *Cranium*, forming the parietes or walls for the Brain, are the frontal, two parietal, occipital, two temporal, Œthmoid and Sphenoid. The bones entering into the composition of the *Face* are, the Frontal, two Nasal, two Superior Maxillary, two Malar, and lower Jaw. The *orbit* is formed by the Frontal, Lachrymal or Unguis, Œthmoid, Superior Maxillary, Palate, Sphenoid, and Malar. The *thickness* of the cranial bones varies in different subjects from that of the tenth part to that of one-third of an inch. The average is about one-fifth part of an inch. The occipital bone is generally the thickest, and the temporal (the squamous portion of it) the thinnest, where it is covered by the temporal muscle. (*t*)

Bones of the skull in general. (*c*)

The Bones of the Head and Skull.—It has been observed, that the anatomy of the *skull* is important, not in itself only, but that it provides for a more accurate knowledge of the brain, explains in some degree the organs of sense, instructs us in all those accidents of the head which are so often fatal, and so often require the boldest of all surgical operations. The marks which we take of the skull, record the *entrance* of arteries, the *exit* of veins and nerves, the places and uses of those muscles which move the jaws, the throat, the spine; indeed, in all the human body, there is not found so complicated and difficult a study as the anatomy of the head.(*d*)

Of the bones of the skull in general, namely, outer plate, diploe, and inner plate or vitrea. (*e*)

The bones of *the cranium* or *skull cap* in general are *broad* and *flat*, and form the covering of the brain, and consist of *two tables*, thin plates, or layers, and an intermediate *diploe*, which answers to the cancelli of other bones: these tables are of the thickness of about one-tenth of an inch each: the external is rather thicker, more spongy, and less easily broken; the inner table is dense, thin, brittle, and more easily broken, and is sometimes fractured, although the external table remains entire; thence it is named *tabula vitrea*, or the *glassy table*.(*f*) These tables are parted from each other by the distance of a few lines (each the twelfth part of an inch,) and the intervening space is filled up with such *diploe*, cancelli or lattice work, which is a set of bony fibres covered with vessels, for nourishing the bone;(*g*) and by the dura mater (presently described,) adhering to the internal surface, and sending in arteries, which enter the cancelli by passing through the substance of the bone, and by the *pericranium* covering the external plate, and giving vessels from without, which also enter into the bone, the whole is connected into one system of vessels, and the aggregate is about the thickness of a quarter of an inch. The *pericranium*, *dura mater*, and *skull*, depend so entirely one upon the other, and are so truly parts of the same system, that an injury of the pericranium may affect the bone, separate the dura mater, and cause effusion upon the brain; whilst a separation of the dura mater may in like manner be followed by separation of the pericranium, which had been sound and

(*t*) But see 3 Bost. 210, 211, ante, 245, where it is said, that in the same subject, the cranium is in all its parts of uniform thickness, and that thence, by its external surface, the means of acquiring an accurate knowledge of the convolutions that are subjoined to it are afforded.

(*c*) Ante, 69; as to the bones of the head in general, see 1 Bell, 35 to 101; 2 Bell, 365; Coop. Dict. tit. Head; Copl. Dict, tit. Cranium; 1 Horner, Anat. 126 to 190.

(*d*) 1 Bell, 35, 36.

(*e*) See, in general, Coop. Dict. tit. Head; and Copl. Dict. tit. Cranium; 1 Horner, Anat. 156 to 178.

(*f*) See as to the bones of the cranium, ante, 69.

(*g*) As to the softened state of the diploe in diseases, see Copl. Dict. tit. Cranium.

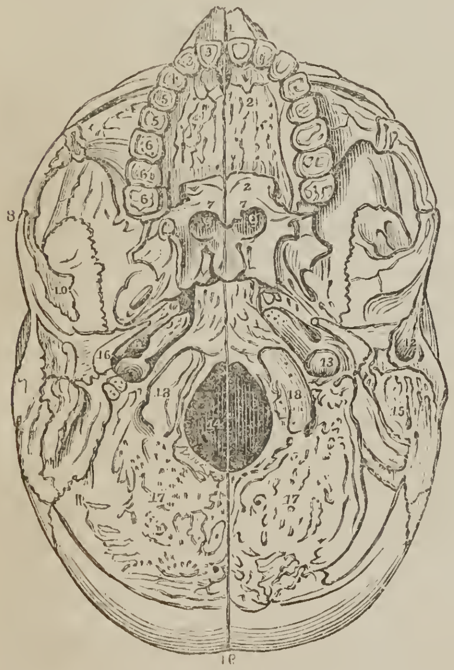
unhurt; and every disease of the cancelli or substance of a bone is communicated both ways, inwards to the brain, so as to occasion very imminent danger, and outwards towards the integuments, and warn us that there is disorder within. The general thickness of the skull, and the natural order of the two tables, and an intermediate diploe, is *very regular*, in all the upper parts of the head. Idiotism is sometimes to be attributed to an original malformation of the cranium, sometimes in respect of acquired thickness, but more frequently in respect of shape; by each of which the internal cavity, and consequently the capacity of the brain, are unduly diminished.(*h*)

Sutures.

Sutures.—All these external bones of the skull are joined together, or as it is technically termed, *articulated*, by *seams*, which, from their indented or dove-tailed appearance, are named *Sutures*. Suture is a common term for the line of contact of the flat bones. It is a mode of union, admitting of no motion, and is somewhat varied according to the degree of pressure to be sustained.(*i*) This mode of junction was providentially designed to facilitate birth.(*i*)

Number of the bones of the head.

In the adult *head*, including the cranium and face, there are *thirty* bones and *thirty-two* teeth.(*j*) These several bones have been enumerated in a preceding table,(*k*) and shown *in situ* in the antecedent plates;(*l*) those in page 54 give the frontal and posterior views of all the skeleton; that in page 259 is an exact representation of the bones of the head, disarticulated or separated for more convenient examination by students.(*m*) The following plate is a representation of the bones at the base of the skull.



1. Bony Cavity of the Nose.
2. Bony Palate, forming the Roof of the Mouth.
3. The Two Incisor Teeth of the Right Side.
4. The Canine Tooth.
5. The Two Bicuspid Teeth.
6. The Three Molar or Double Teeth.
7. The End of the Bony Palate, to which the Soft Palate is attached.
8. The Zygomatic Process, formed partly by the Temporal and partly by the Malar Bone.
9. The posterior openings of the Nose, communicating with the Pharynx.
10. The Glenoid Cavity for the Head, or Condyle of the Lower Jaw.
11. The Carotid Canal, by which the Carotid Artery enters the Skull.
12. The Meatus Auditorius Externus, or Orifice of the Ear.
13. The Foramen Jugulare, at which the Internal Jugular Vein leaves the Skull.

(*h*) 4 Good, 137; and see Copl. Dict. tit. Cranium, and tit. Cretinism.

(*i*) See a valuable note, 1 Bell, 40; and 1 Horn. Anat. 156 to 163; Dewees, Midwif. 41 to 44; and as to the course of the growth of bone and of sutures, ante, 38, 39, 69.

(*j*) 1 Bell, 39.

(*k*) Ante, 68.

(*l*) See plates, ante.

(*m*) See ante.

14. The Foramen Magnum, or Great Occipital Foramen, for the Passage of the Spinal Cord.
15. The Mastoid Process of the Temporal Bone, for the Attachment of Muscles which move the Head on the Spine.
16. The Styloid Process, for the Attachment of some Muscles of the Os Hyoides, Tongue, and Pharynx.
17. The Occipital Bone: all its inferior Surface gives Attachment for Muscles, which maintain the Head in the upright Position.
18. The Condyles of the Occipital Bone, on which the Head revolves on the First Vertebra or Atlas.
19. Mesial Line, or Centre of the Skull.

Os frontis.

Os Frontis.(*n*)—This bone is situate in the front part of the skull and superior part of the face. It has been compared in shape to a clam shell; for it is of a semicircular shape, and hollowed like a shell. It is marked on the inside by a spine or prominent line, which divides the hollow of the bone into two equal parts, and gives rise to a membranous partition called the falx, which perpendicularly divides and supports the hemispheres of the brain; and in some skulls this bone is divided in the centre by a distinct sutural line, and as represented in the plate, ante, 259. It is marked on the external surface by those high ridges on which the eyebrows are placed, and by two prominences, which are hollow caverns, named the *sinus* or cavities of the frontal bone. For a full description of every particular bone, the student is referred to Bell's Anatomy,(*o*) and, for the more modern view of the subject, to Dr. Quain's excellent work, [and 1 Horn. Anat. 128 to 143.](*p*.)

The two parietal bones.

The *Ossa Parietalia.*—The two parietal bones form the roof of the skull; they are *situated*, as appears in the plates, ante, 54 and 259. They are convex externally, concave internally, and present two surfaces and four borders. The external surface rises towards its middle, where it presents the parietal prominences; below which is an oblique line, bounding a flat surface, which forms a part of the temporal fossa. The internal surface is marked by branching lines, corresponding with the course of the middle meningeal artery, by depressions for the convolutions of the brain; and along the superior border is a slight groove, corresponding with the longitudinal sinus. The superior border is straight, and articulated with its fellow by a series of dentations; the inferior concave, and levelled off at its margin, is overlapped by the squamous portion of the temporal bone. The anterior unites with the frontal bone, and the posterior with the occipital. The anterior inferior angle dips down to the sphenoid, and is marked internally by the meningeal artery; the posterior inferior angle articulates with the mastoid part of the temporal bone, and presents internally a part of the groove which lodges the lateral sinus.(*q*) The two parietal bones form much the greater share of the cranium; they are more exposed than any others, are the most frequently broken and the most easily trepanned. The square form of the bone produces four angles, and surgeons speak of the frontal, occipital, mastoidean and temporal angles of the parietal bone.(*r*)

The two temporal bones.

The *Ossa Temporalia.*—On each side are *two* in the infant, but in adults become ossified into one *temporal bone.* But it has been observed, that the temporal bones are divided into two only, by regarding the bony ring of the meatus auditorius as a distinct bone. These are situated at the lateral and inferior part of the skull. They close the cranium upon

(*n*) See 1 Bell, 51; 1 Horn. Anat. 128 to 130.
(*o*) 1 Bell, 51 to 59.
(*p*) Quain's El. 106 to 108.
(*q*) 1 Horn. Anat. 131, 132.
(*r*) 1 Bell, 59 to 61.

the lower and lateral part, and each is *considered* under three portions, viz., the pars squamosa, pars petrosa, and the mastoid portion, and its processes are considered under numerous subdivisions.(*s*)

The occipital bone.

The *Os Occipitis* has also the names of *os memoriæ* (from its anciently being supposed to be the situation of the memory(*t*) and *os nervosum*. This is *situate* immediately at the back part of the head. It is the thickest of the cranial bones; but it is the least regular in its thickness, being nearly transparent in some places, and in others swelling into ridges of very firm bone. It gives origin and insertion to many of the great muscles, which move the head and neck. It supports the *back part* of the brain, contains the cerebellum or lesser brain, transmits the spinal marrow, and is marked with the conflux of the chief sinuses or great veins of the brain.(*u*)

The sphenoid and œthmoid bones.

We have seen that there are two *intermediate* bones considered to belong as well to the face as to the cranium, viz., the sphenoid bone and the œthmoid bone. The *sphenoid* bone is situated towards the centre of the base of the skull, and is articulated with *all* the bones of the cranium, and *several* of those of the face. Its form has been likened to that of a bat, and the resemblance is very close. Like other irregular bones it may be divided into a body, and processes or wings.(*x*) The *æthmoid* bone is common to the cranium, orbit and nasal fossæ, and is of a cuboid figure; presents six surfaces, and is divided into two equal lateral parts by a perpendicular lamella; the superior part of which projects into the skull in the form of a cock's comb; the inferior descends into the nares, forming part of the septum. It has been considered as one of the most curious bones of the human body. It appears almost a cube, not of solid bone, but is exceedingly light, spongy, and consisting of many convoluted plates, which form a net-work like honeycomb. It is curiously enclosed in the os frontis, between the orbitary processes of that bone.(*y*)

Of malformation or defects, and diseases of bones of the head in general.

The bones of the cranium may be originally malformed, or may undergo morbid changes, either by enlargement, deficient deposite of bone, or imperfect ossification; or the bones may be insufficiently evolved, and either deformed congenitally, or become thickened or enlarged by subsequent circumstances; they may become ulcerated, carious, or dead, or may have funguses or tumours, or be perforated, depressed or fractured.(*z*)

(*s*) 1 Bell, 64 to 72; 1 Horner, Anat. 135 to 138.

(*t*) See ancient sketch, ante, 251.

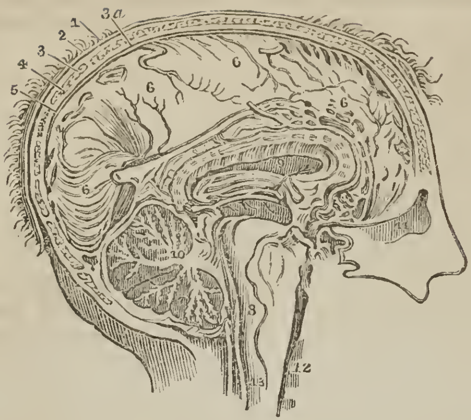
(*u*) 1 Bell, 61; 1 Horner, Anat. 132 to 134.

(*x*) 1 Horner, Anat. 138, 141; 1 Bell, 76.

(*y*) 1 Horner, Anat. 141 to 143; 1 Bell, 72.

(*z*) See these disorders and injuries, and their remedies considered, Copl. Dict. tit. Cranium and Cretinism; Coop. Dict. tit. Head, and tit. Trephine; 2 Gibson, Surg. 122 to 130; Am. Cyclop. Prac. Med. tit. Acephalous and Anoncephalous.

CHAP. IX. Sect. II. Nervous Function and its Organs.



1. Hairy Scalp.
2. Pericranium.
3. Outer Plate.
4. Diploe.
3. (*a*) Inner Plate.
5. Dura Mater.
6. The Falx Cerebri, which divides the left hemisphere of the Cerebrum from the right hemisphere, which has been removed to show the central perpendicular division.
7. Cerebellum, or little Brain.
8. Medulla Oblongata.
9. The Lateral Ventricles.
10. The Arbor Vitæ of the Cerebellum.
11. Cavity of the Nose.
12. The Medulla Spinalis.

Membranes of brain.

Besides the bony cranium, which we have thus considered, there is an inner and *threefold covering* afforded to the brain, namely, the *dura mater*, the arachnoid (or *tunica arachnoidea*) and the *pia mater*,(*a*) termed the Membranes of the Brain.

Dura mater.

These *membranes* of the brain have the name of *mater*, either because they defend the brain and protect its tender substance; or, according to others, because they were supposed to be the *source* of all other membranes of the body.(*b*) The dura mater, so termed from its hardness, may be considered as the *internal pericranium*.(*c*) It lines the inside of the bones of the cranium, and may be considered their internal periosteum, and is a firm and somewhat opaque membrane of about the thickness of a finger nail.(*d*) When the skull cap has been torn off, and the dura mater has been cleared from the blood, which escapes from the ruptured vessels, it is seen marbled with azure and rosy colours. Its outer surface is rough, from the adhesion to the bone being torn up; but on the inner surface it is smooth, shining, and of a pearl colour.(*e*)

The falx and tentorium.

The dura mater forms various processes or *septa* (Latin for *fences*,) which, by being extended *across* from the internal surface of the cranium, support the brain in sudden motions of the body, and prevent the mutual gravitation of its parts, and are also useful in retaining the sinuses or large venous trunks in the brain, in their triangular form.(*f*) These large processes are termed the *falx* and *tentorium*. By the *Falx* the hemispheres of the cerebrum and cerebellum are divided *perpendicularly* from the top and centre of the cranium downwards towards its base, and from the front to the back, and appears to serve the like office as the mediastinum in the thorax, which we may remember passes perpendicularly through the thorax from the front to the back, and divides the right and left parts of the lungs;(*g*) whilst the *Tentorium* passes *horizontally* at the bottom of the cerebrum, and supports its posterior lobes, and prevents

(*a*) El. Blum. 189; see the plate above.
(*b*) See, in general, 2 Bell, 385; Coop. Dict. tit. *Dura Mater*, and tit. *Head*, Copl. Dict. 202, 203.
(*c*) 2 Bell, 385; Coop. Dict. tit. Dura Mater; 2 Horner, Anat. 351.
(*d*) 2 Bell, 485; Coop. Dict. tit. Dura Mater; 2 Horner, Anat. 352.
(*e*) 2 Bell, 386; 2 Horner, Anat. 351.
(*f*) Id. 390 to 392; 2 Horner, Anat. 352.
(*g*) Ante, 99.

their pressure upon the subjacent cerebellum. In the various duplicatures of the falx and tentorium, they contain and support the *venous sinuses*, and prevent their two great local pressure on each other.

The *dura mater* is considered as insensible of pain, and consequently is not so much the seat or organ of many diseases as has been supposed.(*h*) On each side of the dura mater, there are from ten to fifteen *glands*, chiefly lateral to the course of the longitudinal sinus, and from these issues a fluid.(*i*) The dura mater is supplied with numerous arteries, which sometimes become aneurismal and distended, sometimes though rarely, causing epilepsy.(*k*) When the skull has been opened by a wound, it has been found that the dura mater will still protect the brain, resisting inflammation and giving it the necessary and uniform support. But when the dura mater is lacerated by the trephine or punctured, or worn by pulsation against the edge of the bone, there may be sudden hernia of part of the brain, from coughing, or a rapid and diseased growth from the pia mater forming a fungus.(*l*)

The arachnoid.

Arachnoid (or, perhaps, more technically, *tunica arachnoidea*,) so named from its thinness, it being like a spider's web, lying between the dura mater and pia mater, and it is said that its use is not exactly known, but in some respects it resembles in office that of the pleura of the lungs, or the peritonæum of the abdomen. It is exceedingly delicate, perfectly transparent, and so intimately adherent to the dura mater, except at the base of the brain, as to admit with difficulty of separation from it.(*m*) It is described by some anatomists as destitute of blood vessels, and extended, like the dura mater, merely over the surface of the brain, without following the course of its furrows and prominences.(*n*) Some anatomists consider the arachnoid coat as the external lamella of the pia mater, and only a reduplication.(*o*) Indeed, it was formerly considered the same as the pia mater; but the contrary has been clearly established; and it has been observed that this membrane is in nature, office and disease, a close sac, affording, as the peritonæum does to the abdominal viscera, a double covering to the brain and spinal marrow and the nerves, before their departure through the foramina of the dura mater, and, according to Bichat, lining the ventricle, insulating the organs on which it lies, and affording them great facility of movement, and liable to the affections or diseases incident to other serous membranes.(*p*)

The pia mater.

The *pia mater* is closely attached to the brain, and passes into its inmost recesses, following the course of its furrows and prominences. It is of the thickness of thin paper, and while the dura mater is firm and opaque, and not prone to inflammation, the pia mater is delicate, transparent, extremely vascular, and peculiar in being easily inflamed. Like the dura mater, it is not itself endowed with sensibility, but it is of great strength considering its apparent delicacy.(*q*) It is composed of the finest cellular

(*h*) El. Blum. 189; 2 Bell, 386, 387; but see Copl. Dict. tit. Cranium and tit. Brain; and Cyclop. tit. Headach.

(*i*) 2 Bell, 387, 388; 2 Horner, Anat. 355.

(*k*) Id. 389, 390; 2 Horner, Anat. 354.

(*l*) Id. 395; 2 Gibson, Surg. 140.

(*m*) See this noticed, Copl. Dict. tit. *Brain*; 2 Horner, Anat. 358, 359.

(*n*) El. Blum. 189, 190; 2 Bell, 396; 2 Horner, Anat. 358; Lizars, 179; see disease of the brain, Cyclop. tit. Brain; Copl. Dict. tit. Brain.

(*o*) 2 Bell, 295, note H; Copl. Dict. tit. Brain; Park's Inquiry, 8.

(*p*) El. Blum. 199, note B. 2 Horn. Anat. 359.

(*q*) 2 Bell, 395 to 399; 2 Horner, Anat. 360; see description of the pia mater and diseases, Copl. Dict. tit. Brain.

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tissue, for the purpose of conveying blood vessels to the surface of the brain in all its convolutions.

The diseases of the cranium.(r)

As to the *Diseases* and *Injuries* to the *head*, independently of the brain and nerves, they are various, and will be considered in the next part.(r)

Of the face.

The *Face* contains and encloses all the *organs of sense*, excepting those of touch and motion, viz. the organs of sight, hearing, smell, and taste, and part of the organs of mastication, deglutition, and of voice.(s) The great instruments of expressing the human passions and feelings are the *muscles of the face*, and when any passion is strongly marked and frequently repeated, these muscles acquire a tendency to continue in the same position, even when the corresponding feeling ceases to exist; and, by the frequent and powerful contraction of certain muscles, the shape of the neighbouring parts will be affected, and may be permanently extended or contracted, and even the bones of the face themselves may be somewhat altered in their form.(t) It is in respect of those consequences that physiognomists draw their conclusions respecting characters, but which we have seen ought not to be allowed any weight in judicial inquiries.(u)

Thirdly, Organs of the nervous system.(v)

Having thus considered the organs and parts of the cranium and face, which protect or support the sources of the nervous function, we are now to proceed to the parts of that function itself, namely, the *brain*, the *spinal cord*, the *nerves*, their *plexuses*, and the *ganglia*, each of which must be examined separately.(w)

The brain.

The *Brain* is defined to be that soft mass contained within the cranium, from the lower part of which the cerebral nerves, which are essential to the organs of sense, and some of the nerves of sensation and motion, arise, spring, or are propagated.(x) It is considered as the *centre* to which the affections of the nervous system are to be referred.(y) With respect to the relation which the different parts bear to each other, it has been generally supposed that *the brain is the centre of the nervous system*, or that part to which all the others are subservient, and that the nerves receive impressions from external objects, and transmit such impressions to the brain, where they become sensible to the mind, constituting perceptions;(z) and it is universally agreed that the brain is the instrument of the intellectual powers, and as well the source of the sensific as of motionary power.(a)

Construction and composition of the brain.

The *Brain*(b) is a body of a pulpy consistence, resembling a *soft coagulum*, filling the hollow bone called the skull, which gives the form to the head. It is of an oval but extremely irregular figure, having a number of projections and depressions, corresponding partly to the irregularities of the skull (or more correctly, to which the skull, in its growth and ossification,

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(r) Coop. Dict. tit. *Head;* and title, *Trephine;* and see Copl. Dict. tit. *Cranium;* and Cyclop. tit. *Headach.*

(s) 1 Horn. Anat. 143; 1 Bell, 36. Proper *proportion* of face, see Sir C. Bell's Essays, 159, 160.

(t) 3 Bost. 219; ante, 256; and see Sir C. Bell's Essays, &c. *per tot.;* 1 Dungl. Phy. 399 to 413.

(u) Ante, 257.

(v) See division, ante, 244.

(w) 1 Bost. 176; 1 Dungl. Phy. 41.

(x) 2 Bell, 365; Park's Inquiry, 8; 2 Horner, Anat. 350.

(y) 1 Bost. 181.

(z) 1 Bost. 196, 197; 4 Good, 1, 2.

(a) 4 Good, 1, 2.

(b) See, in general, 2 Bell, 377; 1 Bost. 176; very fully in Copl. Dict. tit. Brain; Cyclop. Prac. Med. tit. Brain; tit. Insanity; Coop. Dict. tit. Head; 2 Horner, Anat. 350 to 401.

has conformed,) (*c*) and partly produced by convolutions and cavities in the brain itself;(*d*) for its substance is composed of six lobes or divisions, two of which project anteriorly, two laterally, and two posteriorly.(*e*) We have examined its several *coverings* and *membranes*. It has internal cavities, which are called *ventricles*, and are lined with a serous membrane secreting an albuminous *fluid*, which, in the healthy state of the organ, is removed by absorption as rapidly as it is produced, but which is occasionally collected in considerable quantity, giving rise to the formidable disease of *hydrocephalus* or water on the brain.(*f*) The brain is composed of two substances differing in their situation, colour and consistence. The substance of the brain is of a peculiar nature, and cannot be easily described; the part towards the edges or outside is termed, from its situation, *cortical*, or from its *grayish* colour *cineritious*) from *cinis*, wood ash,) whilst that part in and nearest the centre is *white*, of the colour and consistence of blancmange, and termed *medullary*.(*f*) The *cortical* part is sometimes described as of a reddish brown colour; it is of softer consistence than the medullary and has numerous blood vessels without fibrous appearance.(*g*) This more external portion of the brain may be pierced or cut, or even large masses of it may be removed, without any very material effect being produced upon the perceptive faculties; and Dr. Bostock observes, that frequently large abscesses are formed in it, or tumours and excrescences of various kinds, which, if they do not compress the remaining or medullary part of the brain, seem to produce little injury to its functions.(*h*) The *medullary* part is generally considered as constituting the nervous substance in its most perfect state, and Drs. Gall and Spurzheim have conjectured that the use of the cortical or cineritious part is to form or secrete the medullary part;(*i*) but even different parts of this medulla of the brain have been destroyed and yet the nervous powers have remained nearly in their ordinary state.(*k*) It is, moreover, established, that the medullary matter is in general more sensible than the cortical; and its sensibility increases as it approaches the *centre* of the brain, where is found a much more elaborate system of organization, and a much greater variety of separate parts, all of which we may fairly conclude serve some appropriate purpose connected with the nervous power.(*l*) The *medullary* part of the brain is composed of proper fibres with furrows between them; and which furrows or striæ are for the most part placed in such a direction as to converge towards the base of the brain, and it has been a question whether these fibres merely unite, forming what are termed commissures, or whether they actually cross each other and pass on the opposite sides of the body. Dr. Bostock, from observation, is of opinion that only a few of these fibres so cross each other.(*m*) It is, however, admitted, that it generally happens that an injury inflicted on one side of the brain exhibits its effect on the opposite side of the body, proving, at all events, the transmission of the nervous influence in that particular direction, whatever may be the physical structure of the organ.(*n*) Of late it has been discovered, that the brain is really composed of a pulp, containing a

Ventricles of the brain.

Cortical or cineritious, and medullary.

(*c*) 3 Bost. 211; 1 Dungl. Phy. 266.
(*d*) 1 Bost. 177; 4 Good, 3.
(*e*) Park's Inquiry, 7; and see plate and explanations.
(*f*) Dewees, Prac. Phys. 673 to 688; Coop. Dict. tit. Hydrocephalus.
(*f*) Park's Inquiry, 8; 1 Dungl. Phy. 60.
(*g*) 1 Bost. 178; 2 Bell, 377; 4 Good, 3; 1 Dungl. Phy. 60.
(*h*) 1 Bost. 217. In the second part will be found a report of the very important and interesting case of an insurance upon the life of the Duke de Saxe Gotha, who, for years, had a cyst, or tumour, on the right hemisphere of his brain, which caused his death; where, also, see Dr. Gooch's opinion, and others valuable as regards this subject.
(*i*) 1 Bost. 178, note; 2 Bell, 377.
(*k*) 1 Bost. 217.
(*l*) Id. 216.
(*m*) Id. 185, note; 4 Good, 3.
(*n*) 1 Bost. 186.

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number of small globules or rounded particles, the pulp itself appearing to consist of floculi, likewise formed of globules connected together by fine cellular substance, the ultimate globules being of a tolerably firm consistence, and about eight times less than the red particles of the blood; which globules are disposed in lines, and give the brain its *fibrous appearance*, and they are both larger and in greater proportion in the medullary than in the cortical part of the brain.(*o*) Sir Edward Home states, that these globules are connected together by a peculiar gelatinous substance, which he conceives to act a very important part in the animal economy. He goes so far as to state "*there can be no doubt that the communication of sensation and volition more or less depends upon it*," and he even regards it as the very essence of life.(*p*)

Chemical composition of the nervous matter of the brain.

With respect to the *chemical composition* of the brain, it has been stated that the general result of experiments is, that the *medullary matter* is of a peculiar chemical compound, unlike any other constituents of the body, and that in some respects it resembles a saponaceous substance. It contains two species of adipose, or rather adipocerous matter, which are soluble in alcohol; likewise the peculiar animal principle, which is called osmazome,(*q*) together with a quantity of albumen, a small quantity of phosphorus, and some salts, which, however, seems to be less than in many other of the components of the body, it consists principally of the phosphate of lime, soda, and ammonia.(*r*) It has been observed, that, comparatively, this cerebral matter has little tendency to undergo decomposition, though in comparison with the nerves it is otherwise.(*s*)

Blood vessels in brain.

The *Arteries* and *Veins* in the head and brain are very numerous, and, in proportion to the rest of the frame, *more blood* circulates through the head and brain than in any other part. Haller calculated, that one-fifth of all the blood sent out of the left ventricle of the heart is carried to the head, although he considered that the weight of the brain is not more than one-fortieth of that of the body; but Dr. Bostock observes that such calculation is erroneous, and that the quantity of the blood sent to the head is not equal to one-tenth.(*t*) However, the quantity is so great that the failure of the regular supply of *duly atmospherized* blood from the aorta, after it has been exposed to the air in the lungs, and the consequent accumulation of venous blood in the head, produces apoplexy, &c. He further observes that there are many curious contrivances connected with the circulation through the head, as by the falx and tentorium, &c. for preventing this great quantity of blood from producing any injurious effects upon the brain by any particular local pressure or its unequal distribution, or in consequence of its stagnating in the vessels, or being too violently propelled through them.(*u*) One use of the ventricles in the head, as well as of the various internal convolutions of the brain, is to afford a more extended surface, by which the blood vessels may enter its substance at a greater number of points, and consequently in small quantity at any one part, while, at the same time, they are more firmly supported in their passage by the greater quantity of investing membrane.(*x*)

Progress of the brain towards maturity and decay.

The brain itself is developed in succession until the age of from twenty to forty, when it has attained its full growth relatively in each individual. The cerebellum (or smaller brain below the cerebrum) is

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(*o*) Id. 186; 4 Good, 3, 4.
(*p*) 1 Bost. 187.
(*q*) As to this, see ante, 26, and Turner's Chemistry, 578.
(*r*) 1 Bost. 191.
(*s*) Thouret, Journ. de Physique, tom. xxxviii. p. 334; 1 Bost. 190, note; but see 2 Bell, 367; post, 270, note (*i*.)
(*t*) 1 Bost. 183; 4 Good, 29; 2 Bell, 409.
(*u*) 1 Bost. 183, 184.
(*x*) Id. 184.

developed and perfectly formed towards the age of from eighteen to twenty. From thirty to forty the cerebrum and cerebellum remain nearly stationary, till the fiftieth or seventieth year, according to individual constitution. Certain parts of the brain, however, especially those in the anterior inferior region of the forehead, have at this time already begun to diminish, the memory is less faithful and the imagination less ardent, and intimate the approach of old age and the decline of our faculties.(*y*)

Weight of the brain.

We have seen that it is the general opinion, that the extent of human intellect greatly depends on the size and conformation of the brain, and that man has in general, of all the animal creation, the largest brain, or at least it is so, with reference to the nerves proceeding from it.(*z*) Soemmering observes, that the smaller the *other* nerves (that is, the nerves from the spinal column) (*a*) are, compared with the sensorial nerves, (that is, the cerebral nerves from the base of the brain,) the greater is the development of the mental faculties, and in this sense man has the largest brain of all animated beings, if its bulk be compared with that of the nerves arising from it, but by no means so if its weight be compared with that of the whole body. According to some authors, the weight of the brain at the time of birth is equal to the sixth or seventh part of the entire frame. In the full grown man it is not usually more than a thirty-fifth part,(*b*) and the weight of the entire brain is from three to four pounds in the adult,(*b*) though by gradual depression, instances have occurred (as in the case of the Duke de Saxe Gotha) of a person living many years, though with impaired faculties, with a brain weighing only two and a half pounds.(*c*)

Form of the brain.

Form of the Brain.—But besides the power of the brain depending on the *size* and *weight*, it is supposed by many able physiologists, that the powers of the nervous system depend as much at least upon the perfection of its organization as upon its bulk, and also upon the proportion between the size of its different parts.(*d*) Indeed, the doctrine of phrenology appears much to depend on such proportions.(*e*)

The brain, how far essential to life.

The brain, it has been insisted, is necessary to life, only because the muscles of respiration owe their action to its influence.(*f*) The function of the brain in general intermits in sound sleep, whereas that of the heart

(*y*) El. Blum. 69, 70, in notes; Copl. Dict. tit. Brain.

(*z*) Ante; El. Blum. 549; 1 Bost. 229, 230; 1 Dungl. Phy. 254 to 256; 4 Good, 9.

(*a*) See explanation of these nerves, post.

(*b*) Cloquet's Anat. translated by Knox, 403; Copland's Observations on the Spine; Meckel's Anat. by Jourdan and Breschet, vol. ii. 682; 1 Bost. 228. It has been stated that in man the weight of the brain to that of the whole body is 1-28th, 1 Bost. 229. Haller and Dr. Bostock appear to have considered that the weight of the brain in the human subject is not more than one-fortieth part of that of the whole body, Haller, El. Phys. 5, 20; 1 Bost. 229; 4 Good, 9. But, supposing the weight of the entire body to be 11 stone, or 154 lbs. and the brain to weigh a fortieth part, then it would weigh upwards of 3¾ lbs. But that appears to be above the ordinary weight, for, in A. D. 1832, it was considered that there was an extraordinary development of the brain in the late Baron Cuvier, and Mr. Berard, Professor of the Ecole de Medicine, compared it with several of the most voluminous brains he could find, and ascertained that its weight was 3 lbs. 13½ oz., while none of the others exceeded 2 lbs. 12½ oz. If that account be correct, then the brain is not in general equal to the fiftieth part of the weight of the body, and somewhat under 3 pounds' weight. But Soemmering states that the smallest brain he had met with in an adult man was 2 lbs. 5½ oz., 4 Good, 9. Dr. Good says that the weight of the brain to that of the body is from 1-22d to 1-33d part of the weight of the entire frame, (see 4 Good, 9;) but even the latter is too *large* a proportion. It is from about 1-40th to 1-50th part, 1 Dungl. Phy. 254 to 256.

(*c*) Dr. Gooch's opinion, post, Part II.

(*d*) 1 Bost. 231.

(*e*) Ante, 249 to 255.

(*f*) 2 Par. & Fonb. 20.

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has no repose or cessation.(*g*) It may be conjectured that the brain, or rather more comprehensively, all the intellectual organs may be strengthened and improved, if not even actually enlarged in children, by proper mental exercise of their functions;(*h*) but that is a subject to be considered when we examine the intellectual faculties. After death the brain putrifies very soon, compared with the nerves, which retain their adhesive powers, and remain white among the putrid parts.(*i*)

Diseases and maladies of the brain. (*k*)

For the full consideration of the diseases of the brain we must refer to the second part; they are unhappily numerous,(*k*) and may affect the whole or a part, and the part may be either wholly animal or wholly intellectual.(*l*) Idiotism is generally the result of an original malformation of the cranium, sometimes in respect of a subsequent thickening, but more frequently in respect to shape; both of which diminish the internal cavity and consequently lessen the volume or capacity of the brain.(*m*) Insanity, or mania, may, therefore, arise from the state of the cranium or the diseased state of the brain, or of the nerves, or of the three or two concurring.(*n*)

Injuries to brain.

Injuries to the head and brain have occupied the attention of more authors, than, perhaps, any other medical subject.(*o*) Several ounces of the brain have been lost in consequence of wounds without death, or loss of memory or intellect.(*p*) There is a very marked distinction between puncturing, cutting, or even burning the surface of the brain and *pressing* it; from the first there may be little or no effect, or even pain; but in the latter there is stupor, pain, or convulsion. The reason is, that in the first it is principally a local irritation in a part which has little if any feeling; while, in the latter, the effect of the pressure spreads extensively.(*q*) The flow of venous blood to the brain,(*r*) and concussion of brain, may be more fatal than even wounds.(*s*) Considering the brain as the *centre* of perception, it necessarily follows that any serious injury to this organ will be attended with a diminution or loss of sensation to the *whole* system, although each of the organs of sense and motion may individually and in themselves be in a sound state. This is proved by our daily experience of the effects of external violence upon or concussion of the brain, and of various diseased states, either of the nervous matter itself, or of other bodies in its vicinity; such as tumours of the skull, thickening of its membranes, or effused fluids of any kind pressing upon the surface of the brain, or contained within its cavities. One of the most frequent causes of the loss of nervous power is *pressure*, and this may take place without any permanent injury to the part compressed, for we frequently observe

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(*g*) El. Blum. 60.

(*h*) See post.

(*i*) 2 Bell, 367. But see 1 Bost. 190, note; ante, 268, note (*s*.)

(*k*) See, in general, ante, 48; Brodie on Diseases of the Brain, *per tot.*; Copl. Dict. tit. Brain; Coop. Dict. tit. Head; Abercrombie's Pathological Researches into Diseases of the Brain, *per tot.*

(*l*) El. Blum. 71; Epilepsy, a disorder of the Brain, id.; Coop. Dict. tit. Hernia Cerebri; Hernia of the Brain, Inflammation of Brain, 2 Gibson, Surg. 140.

(*m*) 4 Good, 137; Copl. Dict. tit. Cranium; 2 Par. & Fonb. 22.

(*n*) A Crichton on Mental Derangement, vol. i. 138; 4 Good, 57; as to the examination of the Brain in cases of Insanity, see 1 Paris & Fonb. 327; 2 id. 20.

(*o*) See Copl. Dict. tit. Brain; Brodie on Diseases of the Head, Med. Chirurg. Trans. vol. xiv. 330, 394; and see as to Apoplexy, Amer. Cyclop. Prac. Med. A. Cooper's Dictionary, tit. Head; and tit. Trephine, for injuries in general; and Abernethy on Diseases of Head.

(*p*) 2 Bell, 404.

(*q*) Id. 409; see post, chapter on Injuries, &c., and interesting instances in Mr. Erskine's Speech in defence of Hadfield, vol. v. 28 to 32.

(*r*) G. Smith, 34.

(*s*) Id. 270; 2 Paris & Fonb. 23, 121; and 23, 389, as to the action of opium upon the brain; and as to the mode of dissecting the brain, 3 Paris & Fonb. 46.

that immediately the pressure is removed, the organ resumes its ordinary functions.(*t*)

Cerebrum and cerebellum, and their hemispheres.

The brain consists of three principal general divisions, namely, the *Cerebrum*, *Cerebellum*, and *Medulla Oblongata.*(*u*) The *cerebrum*, or brain properly so called, is the uppermost and largest, and the *cerebellum*, or lesser brain, (the central part of which, from its beautiful white arborescent appearance and importance, is sometimes termed *arbor vitæ,*) lies below and behind. Each of these are again divided into two hemispheres, namely, the *falx*, or falciform process, divides the upper part of the brain perpendicularly, and the *tentorium* horizontally divides the upper from the lower part, or the cerebrum from the cerebellum, and the *falx cerebelli*, being a continuation of the upper falx, divides one-half of the cerebellum from the other; so that there are four distinct parts of the brain, besides the medulla oblongata, which lies below the cerebellum.(*v*) The *cerebrum* is much larger than the cerebellum, being in adults five or six times, or, according to others, eight times, and others even nine times larger than the cerebellum, which weighs only about a sixth or seventh part of the whole brain.(*x*) It has been asserted that the proportion of the cerebrum to the cerebellum is greater in man than in any other animal;(*y*) and it has been supposed that the cerebellum is the seat of sexual desire, and that before puberty it is small, but that its proportion in size to the cerebrum is at birth from 1-9th to 1-20th part, or even less; and that in the adult it is as 1-5th, or at least as 1-7th, and acquires its full development between the 18th and 26th years, and that the breadth and prominence of the occiput are proportional.(*z*) But the supposition that the cerebellum is immediately connected with the generative faculty, has been of late denied by Desmoulins and others.(*a*) It has, however, been observed, that the cerebellum is larger in males than females.(*b*) It is generally considered that the cerebrum, or upper part, is more immediately concerned in the function of the *mind*, and the cerebellum, medulla oblongata, and spinal marrow, in that of *voluntary motion.*(*c*)

The falx and tentorium.

The proper cerebrum of the brain occupies the whole of the upper part of the head, and is separated from the lesser brain by the dense though thin membrane called the *tentorium* before-mentioned,(*d*) except at the common basis of both, where they are united. Whilst the dense membrane, called the *falx*, passing from the centre of the os frontis and top of the cranium *perpendicularly* downwards to a considerable depth from the upper part of the skull, that is, about half through it, and extending from the fore to the back part of the head, divides the *cerebrum* into two hemispheres, as they have been called, and performs an office in that respect resembling the mediastinum.(*e*) The cerebellum is likewise divided by a similar membrane, called the *falx cerebelli*, in two hemispheres.(*f*)

Medulla oblongata.

Immediately at the base of the skull, and connected with it, is the *medulla oblongata*,(*g*) which is the prolongation of the substance of the

(*t*) 1 Bost. 211, 212; as to pressure of the brain, see 2 Paris & Fonb. 22.

(*u*) 4 Good, 3, 4; see a very clear description in Park's Inquiry, 6 to 9; and the vertical section of the cranium and contents, ante, 264; also, 2 Horn. Anat. 351.

(*v*) 1 Bost. 177, 178; 2 Bell, 377.

(*x*) 2 Bell, 383, 461; Meckel's Anat. by Jourdan and Breschet, vol. ii. 682; 1 Bost. 287.

(*y*) 1 Bost. 230.

(*z*) El. Blum. 532; see Dungl. Phy. 256.

(*a*) See observations, 3 Bost. 308.

(*b*) El. Blum. 533.

(*c*) Park's Inq. 8.

(*d*) Ante, 264.

(*e*) Ante, 100, 264, as to the falx; and see Park's Inq. 7. The falx frequently confines disease of the brain to one side or hemisphere.

(*f*) 1 Bost. 178; 2 Horner, Anat. 353.

(*g*) 1 Bost. 179; 4 Good, 3.

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crura cerebri and cerebelli from the pons varolii.(*h*) It is considered that the constant superiority of the human subject over the rest of the animal creation, depends greatly upon the proportionate size of the cerebellum to the medulla oblongata.(*i*) The *Medulla Spinalis* is its continuation through the vertebral column.(*j*)

Sensorium. (*k*)

It has been observed that the general result of our experience establishes that there is a *common centre of perception*, and that in the human species it exists exclusively in the *brain;* but it is further observed that the term is here employed in its most extensive sense to signify *all the parts* of the nervous system except the nerves themselves and the spinal cord, without settling whether any and what particular part of the brain is the seat of this peculiar power. Thus it is generally considered, that as regards the sense of *sight*, it is conveyed to the retina, and from thence by the optic nerve to the sensorium commune.(*l*) So the sense of *hearing* consists in the communication of the external part of the ear through the tympanum, the Eustachian tube, and the auditory nerve, communicating with the sensorium.(*m*) In short, the sensorium seems to be considered to be the part where all the perceptions *are assembled.* Dr. Bostock observes, that there is some reason to suppose that the *medulla oblongata* is more immediately essential to certain nervous operations than either the cerebrum or cerebellum.(*m*) But he states that there is no satisfactory proof of any hypothesis upon this subject. Formerly an opinion prevailed that the seat of the perception is not in the brain itself but in its investing membrane.(*n*) Others have considered that the *Pineal gland* (which is a small projection in the centre of the brain, and a small mass of gray substance of a conical shape,) is the seat of perception, but that notion also is equally erroneous with the former.(*o*) Attempts have been made to ascertain the seat of the sensorium, by endeavouring to trace up the nerves of the different organs of sense to one spot within the brain, which might be considered as their origin, but this attempt has proved unsuccessful, though some nerves have been traced up to the base of the brain, or to some part immediately connected with the medulla oblongata, and it has been admitted that *no anatomical centre* of this kind has yet been discovered.(*p*) Dr. Bostock observes, that there are some circumstances which lead us to *doubt whether there be any central organ of this kind;* but that different portions of the brain are subservient to different offices, and that some are more peculiarly connected with the organs of sense, some with the voluntary motions, and others with the different vital functions.(*q*) He, however, adds, that still there are certain considerations which may lead us to suspect that this appropriation to a central organ may actually exist, though as yet undiscovered;(*r*) and referring to some modern experiments, showing that certain parts of the cerebrum, and cerebellum, and medulla oblongata and its appendages, are the more immediate seat of perception and of the intellectual faculties, and that other parts of the cerebellum are more concerned in voluntary motion, as proved by the experiment of the effect of removing the cerebellum, which immediately destroyed the voluntary power over the muscles, though the animal appeared to retain its volition, but had lost the capacity of exercising it, Dr. Bostock concludes by saying *possibly* we may go so far as to conjecture that

Pineal gland.

(*h*) 2 Bell, 467; 4 Good, 7.
(*i*) 1 Bost. 231.
(*j*) See the site of, ante, 264, No. 12.
(*k*) Ante, 245.
(*l*) 1 Dungl. Phy. 140, &c.
(*m*) Id. 126, &c.; 1 Bost. 209, note.
(*n*) Id. 214.
(*o*) Id. 215; and see 2 Horner, Anat. 381.
(*p*) 1 Bost. 219, 220.
(*q*) Id. 220.
(*r*) Id. 221.

while the *perceptive faculties* have their common centre in the *medulla oblongata*, or its appendages, volition has a more extended connexion with the brain.(*s*)

Spinal cord.(*t*)

To the base of the skull, and connected with the brain by the intervention of the *medulla oblongata* just considered, is a prolongation of the brain (or rather as the spinal cord is *first* formed in the fœtus, the brain is a prolongation of the spinal cord,) extending down a small canal in the back bone, hence termed the *Medulla Spinalis*, or vulgo *Spinal Marrow*,(*u*) though correctly it should be termed the *Spinal Brain*, or *Spinal Cord*.(*x*) Indeed, according to Sir Charles Bell and others, it is a *Double Cord*.(*x*) Like the brain it is enclosed in membranes, it possesses both cineritious and medullary matter, although their respective position is reversed; it has a longitudinal furrow, dividing it imperfectly into two halves, analogous to the hemispheres of the brain.(*y*) The spinal cord, as well as the brain, possesses a fibrous texture, although, as it would appear, less distinct than the brain, and it differs from the brain in the effects resulting from disease or injury, which are generally observed to produce paralysis on the same side of the body with that on which the injury has been inflicted.(*z*) The spinal cord is to be regarded as a common centre, for the greatest part of the nerves that supply the muscles of voluntary motion. When it is compressed or divided in any part, the limbs that are supplied with nerves, which branch off from it *below* the injury, are paralyzed. If the injury take place near the lower extremity of the spine, the lower limbs alone become insensible, and as none of the functions essential to life are affected, the patient lives with all his faculties and powers unimpaired, except that of locomotion. The nearer to the head the injury is situate, so much more extensive is the derangement of the different functions; and there have been many cases where, after a dislocation or fracture of some of the cervical vertebræ, all power has been lost over the voluntary muscles, and the functions of the abdominal and thoracic viscera have been nearly suspended; yet for the short time that life was capable of being continued under these circumstances, the cerebral function and the mental faculties remained in a sound state.(*a*) The spine, or medulla in the vertebræ, is subject to peculiar diseases.(*b*)

(*s*) Id. 221, 223.

(*t*) See, in general, Copland, Diseases of Spine; Coop. Dict. title, Vertebræ; and see Brodie on Diseases of the Joints, *per tot.*; and ante, 54, 70, as to *Spine*.

(*u*) Park's Inq. 7. It is certainly very distinguishable from the *marrow* of bone, as to which see ante, 61.

(*x*) 4 Good, 7, 21; 2 Bell, 468; 2 Horn. Anat. 339, &c.

(*y*) 1 Bost. 179; 2 Bell, 468.

(*z*) 1 Bost. 186.

(*a*) 1 Bost. 211.

(*b*) Coop. Dict. tit. Vertebræ.

CHAP. IX. SECT. II. NERVOUS FUNCTION AND ITS ORGANS.

Of the nerves.(*c*)

The Nerves themselves in particular.

The nerves in general. (*d*)

As most diseases, whether mental or affecting the body, are attributable to the influence of the nervous system,(*e*) the study of the nature and influence of the nerves, in a medical view, is of most essential importance; and as regards physiognomy, and the art of depicting the countenance and the passions in drawing and painting, Professor Camper, and Sir Charles Bell in his elegant Essays, have established how important is the study of the nerves;(*f*) and they even show how each nerve is concerned in the principal passions of the human mind when they are in operation, with plates, happily delineating the various states of the countenance.(*f*) The nerves, as distinct white cords or threads, are perhaps more discernible throughout the entire frame than even the muscles. Some nerves communicate from the most extreme parts the feeling of touch, pain, and other sensations *to* the sensorium of the brain, whilst in return *others* communicate from the sensorium the volition of the mind, so as to move even the remotest muscles and excite them to motion in various directions; and without such nerves man and animals would be a mere automaton, and wholly insensible and incapable of locomotion, however perfect his muscular power and the bones and joints; and yet some are so delicate as to be scarcely discernible: thus it is said to have been established, by microscopic observation, that each fibre in the retina of the eye, or expanded optic nerve, does not exceed in diameter the thirty-two thousandth part of a hair; and that the whole aggregate of the nerves, if they were conjoined, would not make a cord of an inch diameter.(*g*)

The nerves are defined to be long, white, or whitish cords, threads, or strings, of a pulpy nature, and as being bundles of fibres, constituting cords, visible in the dissected body, as distributed directly from the brain itself, or mediately through the intervention of the spinal marrow,

(*c*) See divisions, ante, 244.

(*d*) See the general compact description, El. Blum. 183 to 227; Park's Inquiry, 9; Cyclop. Prac. Med. tit. Neuralgia; 2 Horner, Anat. 476 to 537. As regarding nerves, see Cyclop. Prac. Med. tit. Galvanism. Sir C. Bell's Essays on the Anatomy and Philosophy of Expression will be found particularly interesting and instructive. See a plate of all the nerves, 1 Dungl. Phy. 56, and a plate of nerves of expression, Sir C. Bell's Essays, 11, and 12; but see Mr. Earle's attempt to refute the doctrine of Sir C. Bell, A. D. 1834.

(*e*) Copl. Dict. tit. Disease.

(*f*) See Camper's View of the Connexion between the Science of Anatomy and the Arts of Drawing, Painting, and Statuary, translated from the Dutch by Cogan, M. D., A. D. 1794, p. 123 to 138. In page 132, &c., Camper states which pair of nerves is concerned in each passion or feeling of the mind. And see C. Bell's Essays, 2d ed. *per tot.*

(*g*) Gregory's Econ. Nat. vol. iii. p. 280.

and as passing into all parts designed to have sensation, and are instruments of two descriptions, namely, of *sensation* and *volition:*(h) and it is supposed by some that the same nerve is subservient to different purposes, or that different nerves serve the same purpose,(i) whilst others contend that the nerves which transmit sensation are different from those which transmit volition.(k) All the nerves originate from, or at least are connected with two distinct sources, and pass into different parts of the frame, some from the base of the *brain* itself, or rather from the *medulla oblongata*, and pass to the organs of the external senses; and others originate from the spinal cord, and pass from thence to the muscular parts, and on that account and in respect of their different influence are arranged under two classes, namely, those apparently springing from the *brain*, but rather connected with than produced from it,(l) are called *Sensorial* or *Cerebral*, and those springing from the spinal cord are called the *Spinal* or *Vertebral* nerves. The *sensorial* or cerebral serve *more directly* as the connexion between the organs of sense and the faculties of the mind.(m) Both these classes of nerves, however, equally operate as conductors,(n) and one set at least we have seen are supposed to excite the muscles to motion by contact and a species of electricity.(o) They are disposed in *pairs*, and proceed in corresponding directions to the sides of the body. At the commencement of those springing from the brain, and as exhibited in a succeeding plate,(p) anatomists generally reckon *nine pair* of the sensorial or cerebral nerves, and some ten pair, but they include the accessory, which are a part of the eighth pair, and termed accessory, from their partaking of both descriptions of nerves. These are chiefly, though not wholly, appropriated to the four local organs of sense.(q) The spinal nerves are thirty pair (or, according to some, *thirty-one* pair), and these spring from the spinal cord; and soon after their commencements ramify and divide into numerous branches, which are distributed into and through most parts of the body.(r) The nerves, as they pass from the brain and spinal marrow, are invested and collected into firm cords by the continuation of the pia mater; the arachnoid, however, is soon reflected back, but the pia mater accompanies them through all their ramifications, and is supposed to be only thrown aside where they terminate in their sentient extremities.(s) When the nerves arrive near to their ultimate destination, they generally ramify into still smaller branches, gradually more and more minute, until they seem at length to become a kind of pulp, and are no longer visible to the eye.(t) It has been observed, that as the medullary fibres are observed to *decussate*, or cross or intersect each other at acute or unequal angles in different parts of the brain, and as injuries of one side of the head have often been observed to produce a palsy of the opposite side of the body, it has been supposed that all the nerves originate

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(*h*) 2 Bell, 366, 367; 4 Good. 4; Gregory's Econ. Nat. vol. iii. p. 279; and see 1 Bost. 225 to 227; 1 Dungl. Phy. 52, &c.

(*i*) 4 Good, 5.

(*k*) 1 Bost. 224; post, 277, n. (*e*,) (*f*.)

(*l*) 3 Gregory's Econ. Nat. 279 to 291.

(*m*) 1 Bost. 182, 222; 1 Bell, 384; 2 id. 366, 463, 466, 469; 1 Dungl. Phy. 52, &c.; 4 Good, 10; but see id. note,* in which it is said that the present doctrine is that the nerves are not a production of the brain.

(*n*) 2 Bell, 369.

(*o*) Ante, 87, 89.

(*p*) See the plate post, 278, of the base of the brain turned up, and the numbers, stating the supposed origin of the nine pairs of cerebral nerves; and see 1 Dungl. Phy. 48. The tenth pair of the head is by some anatomists considered the first of the vertebral, id.

(*q*) 4 Good, 7.

(*r*) 1 Bost. 179, 180; 2 Bell, 366; 4 Good, 4, 7; 2 Horn. Anat. 343, &c.

(*s*) See 2 Horner, Anat. 330.

(*t*) 1 Bost. 180. See description of Neuralgia and Tic Douloureux by Dr. Elliotson, Cyclop. tit. Neuralgia. But some modern anatomists deny the *pulpy* appearance.

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from the side of the brain opposite to that at which they come out. But this opinion is far from being established, because a decussation in some parts is by no means a proof that it obtains universally; and though there are instances of the injuries of the head which have produced a palsy of the opposite side, there are others in which the injury and palsy were both on the same side.(*u*)

Composition and structure of nerves.

The *fibrous* structure of the nerves, it is said, is more obvious than that of the medulla of the brain. It is probable they are composed of a series of twisted fibres and very simple cylinders, enclosed in a membranous sheath, analogous to those of the muscles.(*x*) They appear, from microscopical examination, as a number of longitudinal *cylinders*, connected together by cellular substance, which, like the muscular fibres, may be divided into portions that are more and more minute, until at length we arrive at the primitive or ultimate nervous filament, which is about twelve times greater than the fleshy fibre, and may be easily distinguished from it by its texture and size. It is of a waved or tortuous form, and is composed of a cylindrical canal, containing a viscid pulpy matter, evidently different from the substance of the canal itself. They are of a *conical form*, the apex or small point being at the part where they are sent off from the brain, and they gradually increase in diameter as they proceed from their origin to the organs for which they are destined.(*y*) With respect to the general structure of the nerves, the sympathetic nerve and the par vagum differ from the other nerves in the disposition of their fibres, which, instead of being straight and parallel, are irregularly connected to each other, and twisted together.(*z*) The *ultimate nervous* fibre is smaller than the fibres composing the substance of the brain. They differ from each other in thickness, from that of a small pencil, but more usually of a hair, to the finest fibre of silk; and these filaments are each of them enclosed in a delicate sheath, called *neurilema*, and in their course down the nerve they divide, subdivide, and unite again in the most varied manner, producing a perfect connexion among themselves in every part. A number of these filaments forms a larger bundle or *fasciculus*, which is always enclosed in its sheath; and the fasciculi divide and unite in the same way with the primitive filaments. Most of the nerves consist of several of these fasciculi, though some contain only one. The different filaments, as well as the fasciculi, are tied together by the substance which forms their sheaths, and the same body seems to compose the general covering of the whole nerve, presenting altogether a structure which is considerably analogous to that of the muscle.(*a*)

Nerves are of different *forms*, sometimes *flat*, as the *ischiatic* nerve, or *round*, as the nerve of the eye, or *irregular*. They are bound up in firm membranes, and blood vessels accompany them, or run in their centre. Each nerve consists of many fibriles, and the cellular texture of the blood vessels are interwoven with their fibriles. The matter of the nerve is soluble in alkali, so that the white and opaque matter of the nerve may be washed away, leaving the cellular texture. It is in consistence something between fluid and solid.(*b*) There are three distinct membranes which belong to a nerve; 1st, an outer sheath; 2dly, a fine dense

(*u*) 3 Gregory's Econ. Nat. 279, 280.

(*x*) 1 Bost. 18; 1 Dungl. Phy. 25. See further as to globules; and see Edwards, and also M. Dutrochet on Elementary Structure of the Body, as commented upon in 3 Bost. 273 to 280; and as to M. Desmoulins on the Nervous System, and Mayo and Hooper on Brain, see 3 Bost. 304 to 312.

(*y*) 1 Bost. 188.

(*z*) Wilson's Lecture on the Skeleton, 7; 1 Bost. 189.

(*a*) 1 Bost. 189.

(*b*) 2 Bell, 366, 367. As to the *chemical* composition of nerves, see Turner's Chemistry, 578.

strong membrane; and 3dly, a soft delicate and vascular membrane, which invests the proper matter of the nerve, and follows it in its minute subdivision, conveying the blood vessels to it, and nourishing it, and in this respect it is equivalent to the pia mater of the brain.

With respect to the *distribution* of the nerves, it has been further remarked, that the greater part of the nervous matter is sent to the organs of sense and of voluntary motion; that the viscera are much more sparingly supplied with nerves, the glands have still fewer, while some of the membranous parts appear to be entirely without them.(*c*) Generally speaking, the nerves which supply the organs of *sense* proceed immediately from the base of the brain, or rather from the medulla oblongata, while the *muscles* receive their nerves from the spinal cord, but there are some exceptions from that rule.(*c*) There is much more irregularity with respect to the *course* of the nerves that go to the *viscera;* they generally take their immediate origin from some of the ganglia and plexuses that form part of the *visceral* system, and they are connected with each other in a great variety of ways, apparently for the *purpose of producing a direct nervous communication between all the viscera as well* as between each viscus and the other parts of the body.(*d*) We have seen that the term nervous system generally includes the brain, the spinal cord, and all their ramifications; and it is so disposed, that if the body could be divided into two lateral halves by a plane passing perpendicularly through its centre, the nerves of the two parts would be almost, if not exactly, similar to each other, while at the same time they are so united by plexuses and anastomoses, or communications with each other of various kinds, as to ensure a complete connexion between the two parts, and an entire correspondence of their sensations.(*d*)

Dr. Bostock observes, that the plausible conjecture of some physiologists, that the transmission of the two powers of perception and volition from the extremities to the brain, and from the brain to the extremities, is effected by *different nerves*, or at least by different nervous filaments, has of late been confirmed;(*e*) and again, that each nerve serves different functions in the animal economy.(*f*)

It has been considered that the nerves and spinal cord possess all the properties of the brain, but in a less powerful degree than the aggregate of that organ, and that they are capable for a limited time of performing all its functions, and moreover that they also possess a power independent of the brain.(*g*)

In all parts of the body it is found that the *sensibility* of the nerves resides principally if not entirely in their *extremities*, where they are divided into extremely minute filaments, or spread out into thin expansions.(*h*)

The particular nerves.

It would be beyond the scope of this summary to enter into a detailed description of all the nerves, and it must suffice to name the principal, and refer to the works where they are fully considered. An accurate knowledge of the nerves in general is, however, of essential importance to every surgeon in many of his operations, for otherwise he might either tie up, wound, divide, injure, or destroy an important nerve, and occasion total deprivation of sensation, or serious, if not permanent, injury.(*i*)

(*c*) 1 Bost. 179; Haller's El. Phys. x. 6, 9; Soemmering, Corp. Hum. Fab. tom. ii. p. 131; 2 Horn. Anat. 329, 330.

(*d*) 1 Bost. 182, 183.

(*e*) Id. 224, 3 id. 72, note; Bell, Phil. Trans. for A. D. 1826, p. 163.

(*f*) Id. 225, and see id. p. 227, note 6; and ante, 275, n. (*i*,) (*k*.)

(*g*) 1 Bost. 236.

(*h*) 1 Bost. 67; 4 Good, 265; 1 Dungl. Phy. 66, &c.

(*i*) 3 Gregory, 291.

The including a large nerve in a ligature intended to be applied only to an artery, may occasion tetanus.(*k*) And if in bleeding in the bend of the right arm from the median basilic vein, as explained in the second part, a surgeon should materially prick the *median nerve*, which passes down the arm near that vein, the consequence might be the total extinction of sensation and power of motion of the three centre fingers.(*l*) So if unscientifically a ligature should, in an operation to prevent hæmorrhage, or otherwise, include or divide the trunk of a nerve, the due performance of the nervous function in the part would at least be suspended: and the division of some nerves even near the extremities may occasion tetanus or lock-jaw.(*m*)

Anatomists always describe the nerves as some proceeding from the encephalon, and the others from the spinal marrow.(*n*) The former *cerebral or sensorial nerves* are enumerated as below.(*o*) With respect to arrangement, anatomists mention them in the order in which they present themselves to view when the brain is lifted from the cranium, and turned up, as in the following plate:—

First, Names of the Parts of the Brain, &c. at Base.

A. Anterior Lobes of Cerebrum.
B. Middle Lobes.
C. Posterior Lobes.
D. Cerebellum.
E. The Tuber Annulare, or Pons Varolii.
F. The Medulla Oblongata.
G. Crura Cerebri.
H. Crura Cerebelli.
I. Fissura Silvii.
K. Corpora Albicantia.
L. Infundibulum for the Pituitary Gland.
M. Corpora Pyramidalia.
N. Corpora Olivaria.
O. Three Roots of Olfactory Nerves.

Secondly, Origins of the Cerebral Nerves.

1. 1. First pair.—Olfactory Nerves.
2. 2. Second Pair.—Optic Nerves.
3. 3. Third Pair.—Nerves Motores Occulorum, to the Muscles moving the Eyes.
4. 4. Fourth Pair.—Patheticus, to a Muscle moving the Eye.
5. 5. Fifth Pair.—Trigemini, leading to parts about the Eyes, Upper Jaw, Face, Lower Jaw, and Tongue.
6. 6. Sixth Pair.—Abducentes, passing to a Muscle of the Eye.
7. 7. Seventh Pair.—Portio Mollis and Portio Dura.
 The Auditory Nerve and Facial Nerve, to the Muscles of the Face, the Agent of Motion.
8. 8. Eighth Pair.—Glossopharyngeus, leading to the Fauces, Tongue, and Pharynx.
 The Par Vagum, to the Lungs, and terminating in the Stomach.
 The Spinal Accessory Nerve.
9. 9. Ninth Pair.—Lingual Nerve, to the Muscles moving the Tongue.

(*k*) Coop. Dict. tit. Tetanus; 4 Good, 254, 256; Dewees, Prac. Phys. 293.

(*l*) See the case, post. part ii. and 1 Dorsey, Surg. 105.

(*m*) 4 Good, 254; Coop. Dict. tit. Tetanus. Dewees, Prac. Phys. 294, note.

(*n*) 1 Dungl. Phy. 53.

(*o*) 2 Bell, 470 to 512; and see 4 Good, 19, &c.; 2 Horner, Anat. 475 to 500.

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Those which come from the anterior part of the cerebellum are therefore placed before those which arise lower down from the cerebellum and medulla oblongata.(*p*) From the olfactory nerve to that which passes out betwixt the cranium and first vertebræ there are *nine* pair of nerves, namely:

1st pair. Olfactory nerves, to organ of smelling.

2d pair. Optic nerves, to organ of sight.

3d pair. Motores occulorum, to the muscles moving the eyes.

4th pair. The trochelearis or pathetic nerve, to a muscle moving the eye.

5th pair. The trigemini, leading to the eye, upper jaw, face, lower jaw, and tongue.

6th pair. The abductores, passing to a muscle of the eye.

7th pair. The auditory nerve and *facial* nerve, to the muscles of the face, the agent of motion.

8th pair. Glosso pharyngeus, leading to the fauces, tongue, and pharynx.

The par vagum, to the lungs, and terminating in the stomach; and

The spinal accessory nerve, passing amongst the muscles of the shoulder, and connecting the par vagum and spine and shoulder.

9th pair. Lingual nerve, to the muscles moving the tongue.

10th pair. Suboccipital nerve, but which is perhaps more properly the first spinal or first cervical nerve,(*q*) and sometimes called the *accessory nerves.*

The spinal nerves, viz. cervical, dorsal, lumbar, and sacral.

The *Spinal* nerves are those which proceed from the spinal cord, and are the cervical, dorsal, lumbar, and sacral, and are thirty pair, one issuing between each joining formed by the pieces of vertebræ that compose the back bone. Those proceeding from the upper part, from their situation termed *cervical,* are seven pair, and supply the upper extremities; and from filaments given off by the third, fourth, and fifth pairs, is formed what is called the phrenic or diaphragmatic nerve, subservient to the function of respiration. The nerves of the back, called *dorsal,* are twelve, going chiefly to the trunk of the body, and administer to the muscles that give it motion. The *lumbar* nerves consist of five pair, and the *sacral* also of five pair; and these, with their numerous ramifications, proceed chiefly to the lower extremities, and are subservient to the function of motion.(*r*)

Great *sympathetic* or *visceral* nerve.(*s*)

Then is to be considered the *great Sympathetic* or *Visceral* nerve, with its various ramifications. This nerve appears in the upper part of the neck, in the form of an oblong body, about an inch long, called the superior cervical ganglion, and it communicates with various smaller ganglia about the base of the skull. It is defined to be a tract of medullary matter passing through and *connecting* the head and neck, and the viscera of the thorax, abdomen, and pelvis into one whole. Those

(*p*) See plate, and 3 Gregory's Econ. Nat. 282; 2 Bell, 470, 488. See a plate of the nerves occasioning the various *expressions in the face,* C. Bell's Essays, 11, 12.

(*q*) 2 Bell, 512; 2 Horn. Anat. 514.

(*r*) 2 Bell, 512 to 519; Park's Inq. 9 to 12; 2 Horner, Anat. 343; 3 Gregory's Econ. Nat. 288, 292 to 301. In the last work there is an enumeration of each nerve, with a plate of the whole, but it is, perhaps, too minute to be of practical service. The representation of the median nerve in the plate in the second part, connected with an action for the supposed cutting of such nerve in unskilful bleeding, will sufficiently illustrate; and see the plate of nerves in C. Bell's Essays, &c 11 and 12; and 1 Dungl. Phy. 55, 56.

(*s*) See, in general, 2 Horn. Anat. 501 to 513; C. Bell's Essays, 3 and 4. The *sympathetic* nerve is also by some termed *intercostal,* see 1 Bost. 180, n.; 3 Gregory, 277; but the latter term is not now generally used by practical anatomists; and see 281 as to intercostal nerves properly so termed.

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viscera to which it is distributed are entirely independent of the will, and have functions to perform too essential to life to be left under the influence of volition. The sympathetic nerve is thus, as it were, a system within itself, having operations to perform, of which the mind is never conscious, while the extent of its connexions occasion during disease sympathetic affections not easily traced.(*t*) With respect to this *sympathetic nerve* Dr. Bostock observes, that besides the two classes of nerves, the cerebral and spinal, there is one nerve, or rather a set of nerves, that appear to hold an intermediate relation between the two, or to have a direct connexion with both the brain and spinal cord; this is the sympathetic nerve, by him termed intercostal. Some *nervous* twigs, that descend from the brain, *unite* with the branches that are sent off from the spinal cord; these form a series of *ganglia* on each side of the spine, from which numerous nerves proceed that are distributed over all the thoracic and abdominal viscera. From the way in which the intercostal nerve is composed it would seem adapted to *combine the influence of all the parts of the nervous system*, and to afford a supply of this influence to each individual organ, which in this way have a direct communication; and it is from this circumstance that its popular name of *sympathetic* is derived.(*u*) We have seen that the structure of this nerve and the *par vagum* differs from the nerves in the disposition of the fibres, which, instead of being straight and parallel, are irregularly connected to each other, and twisted together.(*x*)

The phrenic or diaphragmatic nerve.

The *phrenic* or *diaphragmatic* nerve is a branch from the third and fourth *cervical* pair of nerves, descending in the neck along the fore part of the *scalenius anticus muscle*, and entering the thorax between the subclavian artery and vein, passing over the root of the lungs adhering to the pericardium and to the diaphragm, upon which muscle its branches are distributed.(*y*)

The nerves whose influence is principally connected with the function of *respiration* are the *phrenic and par vagum*.(*z*) If the spinal cord be divided above the origin of the phrenic nerves, respiration suddenly ceases, but the action of the heart remains without any immediate change. If the same nerves be cut through in a living animal, the diaphragm becomes paralytic, and respiration is only imperfectly carried on by means of the muscles which raise and depress the ribs; but when the *nervi vagi* are divided in the middle of the neck, the breathing is instantly impeded, and death soon follows.(*a*)

Axillary and other nerves.

Next are to be examined the *axillary or brachial plexus*, which are the nerves proceeding from the spine, and accompanying the blood vessels to the muscles, glands, and integuments, in the thorax, arms, hands, and fingers. This plexus is formed of five of the spinal nerves, namely, the fifth, sixth, seventh, and eighth cervical nerves, and first dorsal, counting the suboccipital as the first cervical nerve. The plexus extends from above the clavicle to the edge of the tendon of the latissimus dorsi.(*b*) From this axillary plexus proceed no less than nine different nerves.(*c*)

(*t*) 2 Bell, 485, 499, 519 to 530; 1 Dungl. Phy. 57 to 59; 1 Bost. 180, n.

(*u*) 1 Bost. 180, n.; 4 Good, 257.

(*x*) 1 Bost. 189. The act of *blushing* is attributed to the distribution of the sympathetic nerve, and which has been considered as a provision for that power possessed by the imagination, or rather that uncontrollable connexion which exists between the feelings and the action of the vessels in blushing, and in the expression of the passions, 2 Bell, 521; but see 1 Bost. 305, where blushing is attributed to the distribution of the nerves of the heart.

(*y*) 2 Bell, 530 to 533; 2 Horner, Anat. 518.

(*z*) Ante, 102.

(*a*) 1 Good, 352; Jackson, Prin. Med. 416, 417.

(*b*) 2 Bell, 533; 2 Horner, Anat. 519 to 526.

(*c*) 2 Bell, 534; 2 Horner, Anat. 520.

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The branches given off from the spine opposite the thorax, form the *intercostal nerves*, of which there are eleven or twelve, which run between each rib to the intercostal muscles.

The other principal nerves are those of the thigh, leg, and foot, and about the pelvis; the pudic nerve, and those of the lower extremity, as the anterior crural nerve; the obturator nerve; the ischiatic, the tibial, the plantar, fibular, and the metatarsal nerves. It has been observed, that the nerves of the lower extremity have the same connexion with the visceral nerves in the system of the sympathetic that the nerves of the arm have, and which is proved by various sympathies; namely, the influence of cold feet on the bowels, the effect of cold water dashed on the legs to promote the action of a purgative, the spasms of the legs in cholera, and pains in the knees preceding a fit of the bile.(*d*)

Of plexuses.

The nerves, in the course of their passage, frequently anastomose, or in other words communicate with each other, and these communications are sometimes so numerous and intricate as to form a complete net-work, to which the name of *plexus* has been applied. These are chiefly found at the branchings off of the nerves of the upper and lower extremities. From these plexuses new nerves originate, which seem to be independent of those which produced them.(*e*)

Of ganglia (*f*)

Ganglia are small oblong reddish knots or masses of nervous matter, larger than the nerves which form them, and also of a firmer consistence, and are situated along the course of the nerves, generally where two or three of them form an angle, and especially in the different parts of the thorax and abdomen: they are composed of a mixture of two substances, which appear analogous to the cineritious (from the Latin *Cinis*, wood-ash coloured,) and the medullary matter of the brain: they are of a redder colour, and are more copiously supplied with arteries than other nerves. Anatomists are generally agreed that the nerves which proceed from a ganglion, are larger than those which enter into it, as if in their passage through it they had received an additional quantity of matter, and hence some physiologists have supposed ganglia to be small brains, whence the nerves acquire new power and energy: their texture, however, is fundamentally the same as the nerves.(*g*) Mr. Bell's second division of nerves, *the irregular*, are considered as not capable of communicating either perception or volition, but merely serve to transmit the nervous influence from one part to another; it includes what he names the respiratory nerves and sympathetic system, and is connected in an indirect manner only with the brain, while it is principally to these nerves that the *ganglia* are attached. Dr. Bostock suggests, that it is probable that besides their ordinary office, these nerves, on certain occasions, are capable of conveying perceptions, and that the *ganglia* are the parts to which the perceptions are referred, for example, the perceptions of internal diseases.(*h*) It has been observed by Dr. M. Good, that it is remarkable that the nerves of touch have ganglions near their origin.(*i*)

With respect to the appropriate office of the *ganglia*, Dr. Bostock observes, that from the mode in which they are composed, it would appear a natural conclusion that one office which they perform is to produce a more complete connexion and sympathy between the sensation of dif-

(*d*) 2 Bell, 540 to 552; 2 Horner, Anat. 526 to 537.

(*e*) 1 Bost. 180; 2 Bell, 469 to 552; 4 Good, 4; 2 Horner, Anat. 331.

(*f*) See, in general, Park's Inquiry, &c. 38 to 42; 2 Bell, 373, 469 to 552, 524; 4 Good, 4; 2 Horner, Anat. 331. As to the difference between these ganglia and other nerves, Copl. Dict.

(*g*) 1 Bost. 182; 2 Bell, 373; 4 Good, 4.

(*h*) 1 Bost. 227, n.; 250, n.

(*i*) 4 Good, 206.

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ferent parts. Some have supposed them to be small brains or independent sources of nervous power, and central spots to which perceptions are referred; and others have conjectured that their office is to recruit the nerves that pass through them, or to add to their substance, in the same manner that the cortical part of the brain has been conceived to generate the medulla: but Dr. Bostock concludes, that upon the whole we must acknowledge that the specific office of the ganglia has not been discovered.(*k*)

Power of nerves to reunite.

The nerves, like the other parts of the frame, are capable not only of being repaired, but even reproduced after an injury, and after a nerve has been completely divided, and its functions totally suspended, it may gradually resume its power, and like a severed muscle or tendon, the ends may become again connected by the formation of a new substance. It has been observed, that we should not have previously suspected that a part possessed of such delicate functions could have been so easily restored, or that the newly formed portion, which is obviously different from other parts of the nerve, would have proved adequate to perform the office of the organ in its original state.(*l*)

Diseases in the nerves.

The diseases or disorders of the nerves are termed *neuralgies* or *neuralgia*(*m*) (from the Greek νευρον, a nerve, and αλγος, or Latin *dolor*, pain.) (*m*) The diseases affecting the nervous functions in general are classed by Dr. Good under the term *neurotica*.(*n*) Of these, the tic douloureux, perhaps, is the most acute;(*p*) but there are an infinite variety of disorders affecting the nerves, which will hereafter be enumerated and considered. The sensation of pain is essentially connected with the operation of the nervous system.(*q*) Abernethy, in his lectures, expressed his conviction that in tetanus and *all nervous* affections, it is a most material point to operate on the brain through the medium of the *digestive* organs, and that the production of secretions from the alimentary canal has a more beneficial effect than any other means.(*r*)

Injuries to the nerves, and remedies.(*s*)

Blindness may be occasioned by the pricking of the frontal nerve of the *ophthalmic* branch of the fifth pair;(*t*) and if the infra orbital nerve be wounded, serious consequences may ensue.(*u*) In the case of tumours in the neck, there may be loss of voice, and when, if the recurrent nerves be cut, the voice, it is said, has been restored.(*x*) When the ninth pair of cerebral nerves is injured, the motion of the tongue may be lost, but the sense of taste may remain unimpaired.(*y*) With respect to the anterior crural nerve, the two nerves which are closely connected with the femoral artery in the middle of the thigh, have not unfrequently been taken up with the extremity of the artery in amputation, which has occasioned twitching in the stump, and much distress.(*z*) In bleeding in the ankle the nerve has been pricked, occasioning great pain, &c.(*a*)

(*k*) 1 Bost. 231, 232; Park's Inquiry, &c. 38 to 42.

(*l*) Dr. Haighton's experiments; see Phil. Trans. for A. D. 1795, p. 190; 1 Bost. 190, n.; Dr. Philip, vol. i. p. 254; vol. ii. p. 409.

(*m*) Coop. Dic. tit. Tic Douloureux, and 4 Good, 212, 223.

(*n*) 4 Good. See also, Cyclop. Prac. Med. tit. Paralysis; Dewees, Prac. Phys. 258, 268.

(*p*) Coop. Dict. tit. Tic Douloureux, 2 Bell, 494, 495; 4 Good, 212 to 223; as to the dividing the infra orbital nerve, 2 Bell, 495; and see Cyclop. Prac. Med. tit. Neuralgia.

(*q*) Jackson, Prin. Med. 175.

(*r*) Coop. Dict. tit. Tetanus; 4 Good, 255; but see Cyclop. Prac. Med. tit. Neuralgia; Dewees, Prac. Phys. 287.

(*s*) See, in general, Coop. Dict. tit. Tetanus.

(*t*) 2 Bell, 489; 2 Gibson, Surg. 198.

(*u*) Id. 495.

(*x*) Id. 506, 507.

(*y*) Id. 511, where see other instances of the consequences of injuries.

(*z*) 2 Bell, 544.

(*a*) Id.

and the nerve passing over the tibia is subject to be bruised, and from thence tetanus has ensued.(*b*) Wounds of the eighth pair of nerves are generally considered fatal, though some doubts begin to be entertained on the point. Indeed, Klein positively states that such an injury is not fatal. However, if the wound of one of these nerves be not absolutely fatal, there can be no doubt of its being highly perilous, and that it should be most cautiously avoided in operation.(*c*)

A partial division of a nerve has been suspected as a cause of tetanus, but this is disputed;(*d*) and it is denied that the including a nerve in *ligatures* applied to arteries, will occasion that disorder, though it is considered blameable to include them.(*d*) *Presssure* on the nerves of the neck may materially injure them, though such pressure may not produce immediate death.(*e*) It has been established that the division of a nerve does not in all cases *necessarily* prevent transmission of the nervous power.(*f*)

Properties and action of the brain and nerves, and nervous system.(*g*)

Of the two specific powers that distinguish living from dead matter, spontaneous motion and *sensation* or sensibility, the latter is confined to the brain and nerves. It is the office of the nervous system to produce sensation.(*h*) The office of the nerves is twofold, namely, first, to excite motion in other parts, especially in the voluntary muscles; and secondly, to convey impressions made upon the organs of sense to the brain, and there to excite perception, or by means of sympathies to give occasion to reaction.(*k*) But it is admitted, that the way in which this is accomplished, or the succession of changes by which it is immediately preceded, is extremely difficult to ascertain,(*l*) and as yet not thoroughly established, and that all questions respecting the *action* of the nervous system are involved in much obscurity, which in some measure attaches to the nature of the subject. We know that physiologically, sensibility is properly defined to be the power which the nervous system possesses of receiving and transmitting certain impressions, and producing corresponding changes in the sensorium, and we further know, that the nerves are the media by which external impressions are conveyed to the brain; but we are at a loss to account for the *manner* in which the conveyance is effected.(*m*) We know *that the brain, or rather the phrenic nerve, is influenced by it, and causing the motion of the diaphragm in respiration* through the medium of the phrenic nerve, is immediately necessary to life, only because the muscles of respiration owe their action to its influence.(*n*) Assuming it as an established fact, that the brain is the primary seat of sensibility, we are to endeavour to ascertain the *mode* by which this faculty *operates*.(*o*) The operation is of two kinds, the first depending upon the *action* of external bodies on the nervous system; the second upon the *reaction* of the nervous system itself on some of the corporeal organs.

First, As to the Action.—The body is furnished with certain instruments, denominated *organs of sense*, consisting essentially of two parts, first, a peculiar conformation of an organized substance, which is specifically adapted to receive and *modify* certain impressions; and secondly, a quantity of nervous matter suitably disposed for the reception of the

(*b*) 2 Bell, 544.
(*c*) Coop. Dict. tit. Throat.
(*d*) Id. tit. Tetanus; 4 Good, 249, and id. 6.
(*e*) 2 Par. & Fonb. 44.
(*f*) Dr. Philip, vol. i. p. 254; and vol. ii. p. 409.
(*g*) See division, ante, 244.
(*h*) 1 Bost. 193.
(*k*) Jackson, Prin. Med. 604, &c.; see further and fully, 4 Good, 7, 8.
(*l*) 1 Bost. 193.
(*m*) 1 Bost. 194; 2 Par. & Fonb. 20.
(*n*) 2 Par. & Fonb. 20.
(*o*) 1 Bost. 196.

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impressions after they have been thus modified. The nervous matter that belongs to the organs of sense, is connected by nerves with the brain, and these nerves possess the power of *conveying* the impression along their course to this organ, where they produce *perceptions*. In this operation there are obviously three distinct stages; first, the original impression on the sentient nervous extremities; secondly, the transmission of the sensation along the trunk of the nerve; and, thirdly, the reception of it by the brain; and it has been justly observed to be an established point that an external impression cannot be perceived by the mind without going through these successive steps of this process.(*p*) Thus one of the most important of the external senses is the *touch;* it is extended over a great part of the surface of the body; but its most delicate seat is the points of the fingers; when a substance presses upon the finger, some peculiar change is induced upon the expansion of nervous matter, which is connected with the cutis, a certain effect is immediately propagated along the nerves that lead from the hand to the brain; and a third change is then produced in the brain itself. That these three successive changes are all concerned in the operation, is proved by daily experience, in which we find that if either the organ itself be injured, or the nerve be interrupted in its course, or the brain be in any way deranged, the proper effect does not follow from the application of the impression.(*q*) The same facts and principles apply to the other organs of the senses.(*q*)

Secondly, The Reaction.—The second mode in which the nervous system operates, is by its *reaction* on some of the organs of the body, an operation which, with respect to the succession of events, is the reverse of that which we have just considered. Of the action of this description, one of the most important to our existence, and the most frequently exercised, is the faculty of *voluntary motion*. Here the affection originates in the *brain*, in which some change takes place; this is *trasmitted down* the nerves into the muscle, where an effect is produced on the muscular fibre, which causes it to contract or elongate; and in this, as in the former case, all the three stages are equally essential.(*r*) If the nerve be divided in its course, we may exert the volition, and produce the necessary change in the brain, but no motion will ensue in the muscle: and we can ascertain the point where the nerve is divided by irritating the nerve just below the point, which will occasion the muscle to contract in a degree, and by irritating the upper part of the nerve above the point of division, a sensation will be produced in the brain.(*s*)

With respect to the two modes of action and reaction, in which the power of sensibility operates, it will be observed that they are exactly the reverse of each other, and this has led to a modern doctrine, that these two powers or operations are not, as had been supposed, carried on by the same nervous fibres, but are actually exercised by different portions of nervous matter;(*t*) but Dr. Good observes, that doctrine is not yet settled in a manner altogether satisfactory.(*u*) So also Mr. C. Bell concludes that the functions of the nervous system are exercised by different descriptions of nerves; those of receiving external impressions, and producing voluntary motion by certain cerebral and spinal nerves, which pass directly from the brain or spinal cord to the organ which receives the impression; and those of uniting the different parts of the animal frame into one whole, by nerves which pass from one organ to another, including what he terms the superadded system of nerves.(*x*)

(*p*) 1 Bost. 197.
(*q*) Id. 197.
(*r*) 1 Bost. 198, 199; Jackson, Prin. Med. 591, &c.
(*s*) Id. 199.
(*t*) Id. 200, n.; Jackson, Prin. Med. 604 to 607.
(*u*) 4 Good, 19.
(*x*) 1 Bost. 206, n.; 4 Good, 21, 22.

Besides these *physical* functions of the nervous system, which belong as well to animals as to man, there are others which either belong to it, or are at least always connected with it, of an *intellectual or morbid kind*, which constitute the science of metaphysics,(*y*) and which will be presently concisely considered.

But in what manner is this action and reaction effected? The question, says Dr. Bostock, may be thus stated in direct terms. When an impression made upon an organ of sense is transmitted by a nerve to the brain, or when the exercise of volition is communicated to the nerves, so as to produce the corresponding effect upon the muscle, what change does the nerve experience, or in what way is it acted upon so as to admit of this transmission?(*z*) What is it that occasions such rapid and harmonious succession of movements of the fingers, so remote from the brain, on the flute or piano, or other musical finger instrument, according to the volition and dictate of the mind; and what it is that so rapidly conveys from the toes or fingers to the brain the sense of pain, and as rapidly conveys from the brain to the muscles of the same extremities, the mandates of the brain, to withdraw from the external object that occasions the pain? Three hypotheses have prevailed at times upon this subject. Some have supposed that the brain and nerves are provided with a certain *fluid*, called the animal spirit, which serves as the medium of communication between the different parts of the nervous system; *secondly*, others have supposed that this transmission is effected by means of the *vibrations* or oscillations of the particles of the nervous matter itself; while, *thirdly*, others ascribe the action of the nerves to the operation of *electricity*.(*a*) We have seen that the latter doctrine is considered as at least plausible.(*b*) Dr. Bostock dissents from the first and second of these hypotheses, and considers the last as at present insufficiently proved.(*c*) The matter of a nerve does not seem capable of any kind of *contraction*.(*d*) They are merely *conductors*, and in that capacity minister to the brain and to the organs of sense, and to the muscular power.(*e*) Dr. Bostock observes, that the result of our observation upon the nervous system and its functions, is, that it has two distinct powers, that of *receiving* and *transmitting* impressions, which is exercised by the nerves and spinal cord, and that of *perception* and *volition*, which is more immediately exercised by the brain. Upon this principle Blumenbach has arranged the organs of these functions into the two classes of *sensorial* (comprehending the brain and its immediate appendages,) and the *nervous*, properly so called, including the nerves, the plexuses, and the ganglia. The *sensorial* organs are the exclusive seat of the powers of *perception* and *volition* and of the *intellectual faculties*, while the office of the nerves is to serve as *media* of communication between the common centre and organs of sense and motion.(*f*)

The uses of the nervous system.(*g*)

The endowment of sensation and the power of putting the muscular machine into action, are the primary attributes of the nervous system, which, we have seen, includes the brain, nerves, and organs of sense; the nerves convey the feeling from the extremities to the brain; and volition from the brain to the extremities;(*h*) they operate as *conductors*.(*i*)

(*y*) 1 Bost. 200.
(*z*) Id. 200; 4 Good, 18, 19.
(*a*) 1 Bost. 201; 4 Good, 18 to 19; and see El. Blum. 226, n. L. 1 Dungl. Phy. 68 to 70.
(*b*) Ante, 86, 87.
(*c*) 1 Bost. 200 to 205; and see 4 Good, 17 to 32, notes of editor; 3 Bell, 2, 3.
(*d*) 2 Bell, 368.
(*e*) Id. 369.
(*f*) 1 Bost. 227.
(*g*) See division, ante, 244; and see, in general, 1 Bell, 384 to 393; 2 Id. 364; 2 Horner, Anat. 332 to 335.
(*h*) 2 Bell, 365, 366; 2 Horn. Anat. 332.
(*i*) 2 Bell, 369.

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Their uses are twofold; *first*, to maintain our connexion with the external world, by receiving external impressions, and producing voluntary motion; and *secondly*, to unite the different parts of the animal frame into one whole.

With respect to the *first*, it has been observed, that man could not long exist if deprived of connexion with external objects, which recruit the corporeal frame as well as the mental faculties.(*k*) By the communication through the nerves, we receive pleasure and pain and all the motives to action, whilst by the will returned through the nerves, all voluntary motions ensue. Thus are the nerves internuncii betwixt the external impressions and the moving power.(*l*)

The *second* use is equally important. The different functions which depend upon contractility, such as respiration, circulation, and digestion, have all a necessary connexion with each other. The circulation could not be carried on unless the digestion produced the material of which the blood is composed; respiration must cease unless the heart propelled the blood through the lungs; and digestion can only be performed by the blood being conveyed to the minute arteries of the stomach, after it has received its proper action in the lungs. But still the dependence of these functions upon each other, is of a mechanical nature.(*m*) Dr. Bostock observes, that without these uses connecting man with external objects, and each part of the frame with the other, he would be no more than a species of automaton, without homogeneity, and destitute of consciousness. The nerves, on the contrary, pervade every part, and give to the whole sets of organs and functions a necessary vital dependence upon each other, so as to bestow upon the animal the feeling of individuality, and to connect all its operations, without any visible change in its structure and composition. A great part of the sciences of medicine and of pathology, consists in tracing the operation of this nervous connexion between the different parts of the body, and observing the effects which are propagated to distant organs or functions by the affection of any single organ or function; and this connexion is not of that kind which we may denominate physical, where the change is extended to remote parts in consequence of an alteration in the mechanical or chemical constituents of the body, but it is to be referred to that *sympathetic* connexion between the parts which can be accounted for upon no other principle but the operation of the *nervous* energy.(*n*)

Sir C. Bell observes, that by the knowledge of the nervous system, the *Physician* is informed how the viscera are united, and how the disease of one is sometimes like a disease of the whole, or sometimes affects a single and remote part. Through a knowledge of the nerves he is enabled to discover diseases by their symptoms; for example, internal disorders, by the outward pains and motions they give rise to through the connexion of nerves. In the same way, by knowing the distribution of the nerves, and the sympathies they occasion, the *Surgeon* can trace the course of the wounds through the great cavities, by the pains or motions they produce in the limbs and outward parts.(*o*)

Connexion between the muscular and nervous system.

It has long been a subject of controversy whether muscular contractility is a faculty which exists independently of nervous sensibility, as Haller and others have contended, or whether the contractility of the muscles is not *in all cases* necessarily accompanied by sensation, and through the medium of a nerve, as the Neurologists contend.(*p*) The

(*k*) 1 Bost. 205.
(*l*) 1 Bell, 384.
(*m*) 1 Bost. 206, 207.
(*n*) 1 Bost. 207, 208; 2 Bell, 257.
(*o*) 2 Bell, 365.
(*p*) 1 Bost. 232 to 252; 4 Good, 250 to 253.

CHAP. IX. SECT. II. NERVOUS FUNCTION AND ITS ORGANS.

conclusion seems to be, that whenever *volition* is necessary to put a muscle in motion, as in all *voluntary* motions, then as volition is propagated from the brain, down the nerve, to the muscle, in all these cases the action of the nerve is an essential part of the process. But a great number of the most important internal motions of the body are performed in consequence of the direct application of stimulants to the part that is to be moved, as the food in the stomach, and the blood in the ventricles of the heart and arteries; and in these cases the muscular fibres contract without the intervention of any nerve.(*q*) The *voluntary* muscles are put in motion solely or principally by the act of volition communicated to the muscle by the medium of the nerve; whereas the *involuntary* are put in motion by immediate internal stimulants, without the aid of nerves of *volition* from the brain.(*r*) But although these contract without nerves communicating *directly* with the brain, they nevertheless all have *sympathetic* nerves.

Dr. Good, when speaking of vertigo or dizziness, with a fear of falling, states that the nervous power which supplies the muscular fibres, is communicated, not, strictly speaking, in a continuous tenor, but in minute and successive jets, so that the course of it is alternately broken and renewed by a series of fine and imperceptible oscillations; and that in a state of health and vigour, this succession of influx and pause is perfectly regular and uniform: but as soon as (in the absence of strength and health) the harmonious alteration through which the nervous power is thus supplied, is interfered with, the oscillations become manifest, and the uniform current is converted into a tremulous undulation, and the muscular exertion to which it gives rise, instead of being seemingly one and undivided, is sensibly multiplied into hundreds; and that any person may convince himself of this, by observing a strong and healthy arm extended for a few minutes with a small weight at the end of the fingers, and on the contrary, an arm reduced in strength by fever, or any previous labour; when the first will maintain an even and uniform line, but the second will be broken into tremors and undulations, and unless supported, will drop much sooner than the former.(*s*)

Diseases of and injuries to the nervous system in general.(*t*)

With respect to the *Diseases* affecting the nervous system in general, we must reserve the consideration of the subject to the succeeding part.(*u*)

Independently of wounds and blows, and other visible injuries, all acts that affect the mind and passions may be baneful in their consequences upon the nervous system. Surprise, fright, terror, anger, and indignation, are not unfrequently productive of apoplexy, paralysis, epilepsy, convulsions, syncope, and almost innumerable other maladies, bodily as well as mental.(*x*) So the working on fancy may occasion death, and yet, however malignant or diabolical, our law does not treat such death as felonious.(*y*) Injuries to the passions and the mental faculties, which affect the nervous system, will be presently considered.(*z*) For some pains in the nerves, such as a species of rheumatism, termed rheumatic neuralgia, the utility of acupuncture has been recommended.(*a*)

(*q*) 1 Bost. 249.
(*r*) Id. 250, note.
(*s*) 4 Good, 369.
(*t*) See division of subject, ante, 244.
(*u*) See, in general, 4 Good; Dr. Cook on Nervous Disorders, vol. i. p. 217, Copl. Dict. tit. Disease; and in particular, id. 568, 569, as to consequences of injuries to the nerves.
(*x*) Copl. Dict. tit. Diseases.
(*y*) Hale, 420; Jackson, Prin. Med. 251 to 260.
(*z*) Post; and see Park's Inquiry, 216 to 256.
(*a*) Amer. Cyclop. Prac. Med. tit. Acupuncture; 4 Good, 218.

CHAP. IX. Sect. III. External Senses, &c.

Sect. III.—Of the External Senses, their Organs and Parts.

Of the external Senses, in general.
Their importance, medically and legally.
Enumeration of the External Senses.
Consequences of the Loss or Injury to one or more of these.
Consideration of each external Sense, medically and legally.
1. Sight.
2. Hearing.
3. Smell.
4. Taste.
5. Touch.
6. Motion.
7. Speech and Voice.
Of Instinct and Habit, as they affect Evidence.
Sensations.

Of the external senses in general.(*b*)

The *External Senses* (as distinguished from the *Mental*) are those faculties of the *body* which enable the *mind*, or the *internal senses*, to have communication with external objects, and are the *media* through which we receive simple sensations, which are the first elements of our thoughts, and the means of developing all the powers of the understanding. They exist, more or less, as well in animals as in man, and sometimes even superiorly in the former, though, upon the aggregate, man, by the additional power of communicating his ideas with his fellow creatures, by the intervention of speech, and by his superior mental faculties, can in general *better apply* each external sense.(*c*) It has been justly observed, that the agency of the senses, the intercourse between the mind and external matter, and the influence of the mental will over the body, are mysterious; and notwithstanding all the seeming confidence of those who have written upon the subject, seem still to be inexplicable phenomena.(*d*)

Importance of the knowledge of the external senses, as well *legally* as *medically*.

Next in importance to the intellectual powers of the mind, the knowledge of the external senses claim the most interested attention; because it is now clearly established, that the mind can only exercise its powers through and by means of the external senses, for all our *acquired mental perceptions* are originally derived from impressions made on our *external* senses, and from thence conveyed to the Sensorium, or at least to some part of the brain; and when we abstract or generalize our ideas, we do so by comparing and combining the knowledge we have derived from such *external* senses.(*e*) Bereft of the organs of hearing and speech, it will be found that the knowledge and attainments of individuals would be lamentably limited;(*f*) and if *all* the external senses should be destroyed or rendered inactive during infancy, or before ideas of external objects have been impressed upon the mind, there would be *no mental intelligence whatever*. It is needless to enlarge upon the necessity for an accurate knowledge of the external senses to the practising physician;(*g*) and it has been justly observed, that a knowledge of the nature of the union between the mind and body, is of the greatest practical importance in the administration of justice, especially as regards evidence, and as the

(*b*) See division of the subject, ante, 243. We have seen that the nervous system or function embraces the external organs of sense, ante, 244, 245; and see 2 Bell, 364; 2 Par. & Fonb. 25 to 31; G. Smith, 33, 34, 219; 4 Good, 1 to 32; 1 Dungl. Phy. 73 to 225.

(*c*) See, in general, 4 Good, 1, 9, 13 to 17.

(*d*) See Amer. Cyclop. Prac. Med. tit. Age; 3 Bell, 2; 4 Good, 39; 3 Bost. 147 to 160.

(*e*) See Locke and Berkeley, and other authorities; 3 Bost. 147 to 160; Stewart's Elements, vol. 1, sect. 4, p. 99; 1 Dungl. Phy. 247 to 281.

(*f*) Post.

(*g*) Dr. Gregory on Duties of a Physician, 93; and 3 Bost. 145.

following observations and the numerous cases relative to the *identity* of persons and evidence in general will establish.(*h*)

CHAP. IX. SECT. III. EXTERNAL SENSES, &c.

Enumeration of the external senses, viz. sight, hearing, smell, taste, touch, motion, speech, and voice.

These external bodily senses, as distinguished from the mental or internal, are Sight, Hearing, Smell, Taste, and Touch.(*i*) Four of these are situate in the head, and some of the cerebral nerves, already considered, constitute parts or the instruments of those senses. The fifth sense (touch) is situate nearly every where in the external parts of the frame, though by the habitual use of the fingers, the sensation is in them more acute, delicate, and perfect, than in other parts of the frame.(*k*) To these *five* senses it has been suggested that a *sixth* might be added, namely, the sense of *Motion*, for it is by a sense of motion that we know many of the qualities of outward things, as their distance, shape, resistance, and weight; and *speech* and *voice* have been treated as a *seventh* sense,(*l*) but they are rather modes of *relating*, *communicating*, or receiving ideas of *other* senses, than as constituting in themselves a distinct sense. It has been observed, that the existing causes of all external senses act by what may be regarded as a species of *touch*, for the rays of light strike the retina of the eye, the undulations of the air, constituting sounds, communicate their motions to and vibrate in the interior of the ear, the sense of smell is produced by particles emitted from the odorous body, and carried by the air to the nose, while taste is immediately caused by the contact of the sapid body with the papillæ of the tongue.(*m*)

Internal senses.

The office of the nerves, which we have considered, is to convey the impressions of the *external* senses to the sensorium of the brain, where, by a process as yet not satisfactorily established, representations are made to the mind. We know little further than that by the operation of the mental perceptions and powers, new thoughts are excited in the mind.(*n*) With respect to the *Internal* senses, being those of the *Mind*, they are usually enumerated as perception, memory, association, comparison, imagination, reason, and judgment,(*o*) to which several others may be added. All sensations *originate* in the *external* senses or organs receiving the impressions of *outward* bodies. When this change influences the mind, we call it *Perception; Memory* is the power of recalling these sensations; and *Imagination* is the power of suggesting new combined ideas, and termed the mother of *Invention*. They are powers of the *mind*, which by the constitution of our nature are gradually acquired and increased by due *exercise*. In infancy the perceptions are simple and transitory; *Memory* is only perfected by degrees, whilst by the accumulated store of ideas, the *imagination* is invigorated, but still it is kept limited to the *ideas* received, not from, but in consequence of the operation of the external senses.(*p*) *Strength of Mind* and *Judgment* are, however, acquired, not so much by an accumulation of new ideas, as by reflection upon and *comparison* of those ideas which we have already attained.(*q*)

(*h*) See post, and 1 Beck, Med. Jur. 324 to 233.

(*i*) 4 Good, 42; 3 Bell, 1 to 235; 1 Dungl. Phy. 71.

(*k*) 3 Bell, 1 to 10. By a change of habit, the sense, as well as muscular power, may be transferred to another part, as in the well-known instance of the female, who, having lost her arms, has cut out, most dexterously, watch papers, and made lace, by the use of her toes.

(*l*) 3 Bell, 6, *sed quære*. In Com. Dig. Idiot. (B.) it is supposed that if a person lose the *sense of speech* by apoplexy, a commission of lunacy may issue against him, although, in other respects, he show signs of sense; but if he be competent to manage his own affairs, such a doctrine cannot be sustained. See Dungl. Phy. 225, &c.

(*m*) 3 Bost. 126, &c.

(*n*) 3 Bell, 3.

(*o*) 4 Good, 42; and see post.

(*p*) 3 Bell, 4 to 9; but see post, as to Mind.

(*q*) Wynn's Eunomus.

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Consequence of the loss or absence of the use of one or more of the external senses.

It has been observed, that *individually* no one of the external organs of sense, by itself, conveys much information to the mind,(*r*) and that the *loss* of one of the senses after it has been fully exercised, at least in *early* life, will sometimes be providentially, in a considerable degree, compensated by the others becoming stronger and more acute.(*s*) But with the exception that if a person be *born totally deaf*, it follows that he must be also necessarily *dumb* (or rather his power of articulation will be *suspended* whilst he continues dumb,) because as he could never have *heard* any *sound*, he could not, by articulation, *imitate* the language of others, which is the only source of speech.(*t*) Whilst, on the other hand, the loss of *one* or more of these senses in *later* life, after a long exercise of the whole, will leave the individual in full enjoyment of many faculties of the mind, and especially those of memory and imagination, although he may be incapable of *increasing* the store of images and ideas. It has been observed, that where one of the senses is deficient, and especially when *naturally* so, the rest have very frequently been found in a more than ordinary degree of vigour and acuteness, as though the sensorial power were primarily derived from a common source, and the proportion belonging to the organ whose outlet has become destroyed or imperfect, were distributed amongst the other organs.(*u*) But it has been judiciously remarked, that whether that principle be true or not, it is more certain that another principle is generally concerned, resolvable into *attention*, *habit*, or *practice*. Thus a blind man, whose eyes cannot apprize him of danger, or convey to him any kind of information, is habitually all attention with his ears, just as the organ of touch in a deaf and dumb person is, from necessity, continually exerted and brought by habit to acquire a more exquisite power of feeling and discrimination far superior to what is enjoyed by the generality of mankind.(*x*) But it is supposed that perfect quickness of perception and mental intelligence can only be attained by the possession of all the five senses, because it is by *comparison* and *combination* of all the several simple and original affections or feelings conveyed to the sensorium, and by their being associated and combined to infinity, that they administer to the memory and imagination, to taste, reasoning, and moral perception, and every active power of the mind.(*y*) And it has been observed, that if an individual were, from his birth, deprived of the use of *all* his external senses, possessing no faculty of seeing, hearing, tasting, smelling, or discrimina-

(*r*) 3 Bell, 10, 105, 106, 128.

(*s*) 4 Good, 159; 3 Bost. 129, as to the singular delicacy of touch, and still more of smell, in persons born deaf, and consequently dumb.

(*t*) 1 Par & Fonb. 371, where see the detection of an imposture by applying this rule. M. Sicard, it is said, succeeded in detecting a most accomplished impostor, who pretended to have been born deaf, and therefore, dumb, by requiring him to answer a number of queries in writing; when the Abbé soon found that he *spelt* several words in compliance with their *sound*, instead of according to their established orthography; as by substituting, for instance, the c for the q, which at once enabled the Abbé to declare that it was impossible that he should have been deaf and dumb from his *birth*, because he wrote as we *hear*, and not as in the case of the real deaf and dumb, *sed quære*, he might have been taught to write by an illiterate person, and, therefore, spelt incorrectly, without *ever* hearing. If Milton, who wrote so feelingly of his own loss of vision, had been *born* blind, he could not have described and pictured so luxuriantly the beauties of creation, particularly the sun, nor described woman in the person of Eve. "On she came; grace was in every step; Heaven in her eye; in every gesture, dignity and love."

(*u*) 4 Good, 139; G. Smith, 437 to 439.

(*x*) 4 Good, 139, in note; G. Smith, 437; and see an interesting case, Coop. Surg. Dict. 337, of a deaf and dumb girl discovering the opening of a distant door, merely by the tremulous effect upon the chair in which she sat.

(*y*) 3 Bell, 10.

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tion by touch, he would perhaps amount to no more than a growing mass of organized matter as respected his relative situation in life, in short, a mere automaton; though if having *fully exercised* those faculties for a time, he should *afterwards* lose the power, his intellectual vigour and experience might in all probability enable him to carry on his social functions, at least in some degree.(*z*)

If a person be *born deaf*, it is considered that he must of necessity be *dumb;* but there is not necessarily, on account of deafness, any *defect* in the organs of speech, but the power of exercising it is merely *suspended* during the continuance of the deafness, by the circumstance of the individual never having *heard* sounds, and consequently being unable to imitate them; and speech is merely the imitation of certain tones and words previously uttered by others. If the sense of hearing were established, then immediately the *power* of speech might be exercised; yet the law has erroneously supposed that a man who is born deaf, dumb, and blind, must be in the same state with an idiot, and he is supposed incapable of any understanding, as wanting all those senses which furnish the human mind with ideas.(*a*) It has, however, been decided in more modern times, that a person deaf and dumb is not on that account incompetent, but if he have sufficient understanding, may give evidence by signs, with the assistance of an interpreter;(*b*) and the astonishing intelligence evinced by persons who have been under the care of the Philanthrophic Deaf and Dumb Asylum, fully proves that although some of the organs of *external* sense may be suspended, or even destroyed, yet the mind is still capable of very considerable cultivation.(*c*) We shall, in a following section, consider the practical application of this subject.

Considerations of this nature are not only important to medical practitioners, but essential as regards every department of medical jurisprudence, especially that branch termed Medical Police, and indeed as regards every member of society, in all questions of disabilities or disqualification or evidence.(*d*) Thus in legislating or prescribing punishment or compensation for any injury to one or more of the organs of sense, legislators, judges, barristers, and juries ought to be well informed of and be able justly to appreciate the ultimate consequences to the suffering individual; and though the absurd lex talionis does not prevail in this country,(*d*) yet as the practice of the judge's increasing damages for wounds and injuries super visum vulneris, is not in use,(*e*) it has become of essential importance that all concerned in the administration of justice should be able accurately to anticipate and estimate the actual and probable final consequences of all injuries to these organs of sense.(*f*)

The several senses separately considered.

The several *external senses* and their organs are usually thus arranged: 1st, *Sight;* 2dly, *Hearing;* 3dly, *Smell;* 4thly, *Taste;* 5thly, *Touch* and

(*z*) G. Smith, 137.

(*a*) Co. Lit. 42; Fleta, lib. 6, c. 40; 1 Bla. Com. 304; post.

(*b*) *Ruston's case*, 1 Leach's R. 408; post.

(*c*) See Ency. Brit. vol. iii. Supplement, tit. Deaf and Dumb; and Stew. Phil. vol. iii. 401; also, Hoffbauer, Med. Legale.

(*d*) G. Smith, 437 to 439; see 4 Bla. Com. 13, cites Pott's Ant. b. 1, c. 26, where, in speaking of the lex talionis, it is observed, that the law of the Locrians, which demanded an eye for an eye, was judiciously altered, by decreeing that he who struck out the eye of a one-eyed man should lose both his own.

(*e*) 1 Ld. Raym. 176; 3 Salk. 115; Barnes, 153; 1 Wils. 5; 2 Wils. 248; 1 Rol. Abr. 572, 573; Sayer on Damages, chap. xxviii.; *Hoare* v. *Crozier*, E. 22 G. 3. K. B. Tidd's Prac. 9th ed. 856.

(*f*) Thus, supposing upon the trial of an action for a battery, in consequence of which the eyes or ears are, at the time of the trial, in an imperfect state, if the jury should be satisfied that the plaintiff will, probably, *never* recover the use of his eyes, should not the damages be greatly enhanced?

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Feeling. To these, as we have seen, many may be added, 6thly, The sense of *motion*;(*g*) and 7thly, the sense of *speech* and *voice*.(*h*) These several senses have been either collectively or separately the subject of very numerous interesting works.(*i*) We shall here only notice the leading points most important in medical jurisprudence, with a few explanatory plates.

First, Of sight and its organs, the eyes.

The eye is an optical instrument, so constructed as to convey the impressions of objects placed in front of it to the retina, or expansion of the optic nerve at the posterior part and sides of the eye, and by which they are carried to the sensorium. By a simple and well understood principle of optics, the rays of light, reflected from any object which they carry to the eye, when the eyelid is raised or open, first impinge or fall upon the cornea, which extends in front of the iris and pupil, and are refracted by it in such a manner as to diminish the circle which they form in front; and in which contracted state they pass through the pupil, which is merely the opening of the iris, and which is enlarged by the radiated, or contracted by the circular fibres, in proportion to the intensity of the light required by the retina. Having passed through the pupil, the rays of light are received on the crystalline lens or humour, which resembles in colour the brightest glass, and in shape is similar to a double convex glass or optician's lens, and by which they are drawn to a point or focus, at a certain appropriate distance behind it, and at that distance is placed the retina. In traversing the eye, some of the rays are scattered in various directions, and these are absorbed by the dark pigment or black coloured fluid which is secreted by the choroid membrane surrounding the inner part of the eye. The object is delineated on the retina, (in concert and sympathy with which the iris acts,) and its impression is transmitted by the optic nerve to the brain, which is thus rendered sensible of the existence of the object upon the retina. In consequence of the decussation of the rays within the eye, all objects are inverted on the retina. But as the retina possesses the power of determining direction as well as distance, and as the mechanical condition of the function stops at the retina, and the transmission of the object along the optic nerve, is a vital not a mechanical phenomenon, it would be idle to argue against the opinion now obsolete, that habit alone enables us to overcome the visual defect.(*i*)

The following figures will assist in explaining, though they are not minutely accurate.(*j*)

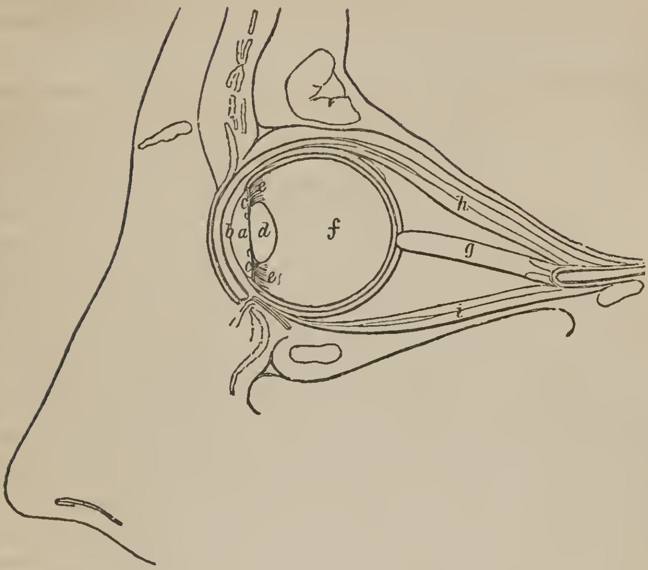
(*g*) 3 Bell, 10.

(*h*) 3 Bell, 6; quære, see ante, 287, note (*k*.)

(*i*) See, in general, 3 Bell, 1 to 235; 4 Good, 1 to 32; id. 197 to 323; 138 to 212; and the observations of Dr. Bostock, vol. iii. 61 to 136; 1 Dungl. Phy. 70 to 228; Jackson, Prin. Med. 143 to 171; Brous. Phy. 66 to 91; see, further, Newton's Optics; and 1 Dungl. Phy. 182, &c.

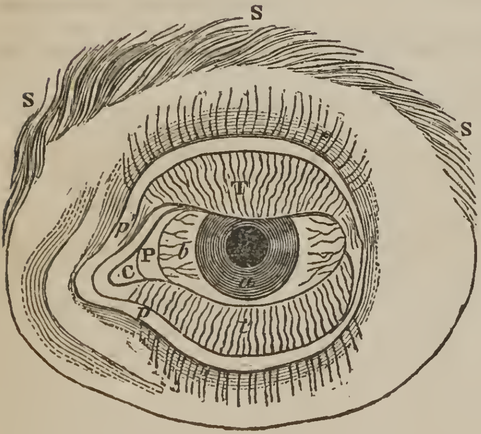
(*j*) A diagram on a large scale, with explanation, may be purchased of Messrs. Carey & Hart, &c.

FIG. 1.



a. Aqueous humour.
b. Cornea.
c. Iris.
d. Crystalline lens.
e. Ciliary processes.
f. Vitreous humour.
g. Optic nerve.
h. i. Muscles.

FIG. 2.



a. Iris.
b. White of eye, or sclerotica.
P. Plica semilunaris.
C. Caruncula lachrymalis.
S S S. Supercilium.
T. Under surface of upper eyelid.
t. Under surface of lower eyelid.
p. Punctum lachrymale in the tarsus of each eyelid.

Fig. 3.

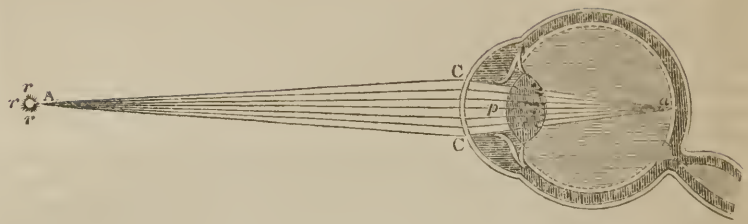
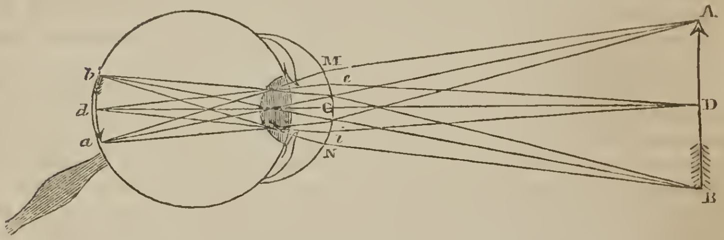


Fig. 4.



General observations.(*k*)

Sight is one of the most important and interesting subjects of medical skill and care, and as regards jurisprudence, especially the testimony of witnesses upon what they allege they have seen, perhaps, requires more attention than any other organ of sense. As parts connected with physiognomy, it must be admitted that not only the eye of an observer, but still more those of the observed, enable us to perceive the temper and disposition, the passions and affections of a fellow creature; and whilst his tongue may most artfully lie and dissemble, his hypocrisy may not unfrequently be discovered in the countenance, which often enables us to detect what is crooked in the mind.(*l*) The ancients uniformly considered the eyes as most expressive of the internal emotions. Pliny, that proficient in all polite arts, says, " the mind dwells in the eye;" and observes that even the motion of the eye-brows contributes a considerable share to the ostensive effects.(*m*) Again, as regards the testimony of witnesses upon the subject of identity, or what they saw of a transaction, it may become a question whether it were possible to identify a person under particular circumstances, or the discrepancy in the testimony may be reconciled; in all which questions an accurate knowledge of the principles of vision may be most important.(*n*) In the instance

(*k*) See 3 Bost. 61. The student should examine 2 Horner, Anat. 414 to 453; and 3 Bell's Anat. 11 to 126, for an anatomical description of the eye and its appendages, and the secretion of tears; and see Dr. Bostock's Phys. vol. iii. 61 to 112, for a *philosophical* view of the subject. In the latter the best works on the subject will be found considered. For a *pathological* and *surgical* view of the diseases and injuries affecting the eyes, see 5 Good's Index, titles, Eyes and Sight; and, in particular, the able articles in Coop. Surg. Dict. titles *Cataract, Cornea, Exopthalmia, Eye, Gutta Serena, Hydropthalmia, Iris, Lacrymal Organs, Leucomra, Ophthalmia, Pupil, Sight, defect of*, 2 Gibson, Surg. 155 to 212; Dewees, Prac. Phys. 318 to 376; Amer. Cyclop. Prac. Med. tit. Amaurosis, &c.

(*l*) 3 Bell, 105.

(*m*) Camper, translated by Dr. Cogan, A. D. 1794, p. 125; and see ante, 256, n. (*g*.)

(*n*) 3 Par. & Fonb. 142 to 167; index, Identity, and notes; and as to family likeness and identity, id. vol. i. p. 201; 2 Collect. Juri. 402, mistakes of identity by of supposed poison, it has been established that there may be an optical fallacy, which will induce an erroneous supposition of its presence, and to avoid which, therefore, there should in general be a repetition of the experiment on white paper, and the results should be examined by daylight, and viewed by reflected and not by transmitted light.(*o*) To this may be added the power of detecting impostors, who have falsely assumed maladies, and who may be discovered by the application of the principles incident to the several organs of sense, but more especially that of sight.(*p*)

General description of the eyes.

Sight, and its organs the eyes, may be considered with reference, *first*, to the organs of sight themselves, and the communication with the sensorium; and *secondly*, as regards their appendages. With respect to the eye itself, it might suffice to state that the rays of light pass from the external part to what is termed the *retina*, placed at the back or bottom of the eye, and which is considered the primary seat of sight,(*q*) and are from thence conveyed by the *optic nerve* to the sensorium, where the sense of sight is perfected; but this interesting subject requires more particular description.

From every point of a visible object the rays or rather pencils of light are emitted or reflected in every direction; but to produce vision it is necessary that they should be concentrated or converged to such a point as to make a forcible impression on the retina. Thus, it will be observed, that in the preceding plate, page 292, from the luminous body A, (fig. 3,) the rays *r*, *r*, *r*, are sent in various directions. Those which fall upon the transparent *cornea*, C, C, are there refracted in such a manner as to enter the *pupil* at *p*, and in passing the *crystalline lens* and vitreous humour, they suffer a second refraction, and are converged to a point or focus at the point *a* on the retina. Now, it is evident that if the rays could have passed the humours of the eye in their natural direction, that is, in the direction of the cone or pyramid C, A, C, they would have made upon the retina a wide and extensive but very feeble impression, such as we know by experience could not produce distinct vision; to obviate this, it is appointed by the all-wise Author of our existence, that, by force of the refraction which they suffer in the eye, they should form another cone opposed to the first at its base, and the apex of which is at *a*, and thus an impression sufficiently forcible to produce distinct vision is made on the retina.(*r*)

In the preceding instance the luminous body A was considered as a point, and what has been said of it will apply to *every point* of a visible object which is capable of transmitting or reflecting to the eye a pencil or collection of rays. Thus, we may easily suppose that from every point of the arrow, A, D, B, in fig. 4, pencils of light may be transmitted; these, like all pencils or collections of rays coming from a point, will diverge, and will fall upon the eye in the form of cones or pyramids, such as A, M, C, from the point A; D, *e*, *i*, from the point D; and B, C, N, from the point B. If the eye, therefore, is in a proper state, the divergent rays proceeding from the point D will be united together into one pencil or mass, such as they were when they first proceeded from the object at

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a witness of impaired faculties; 1 Par. & Fonb. 440; G. Smith's For. Med. 502 to 509, 520 to 525; 1 Beck, Med. Jur. 324 to 333, and several singular instances how many persons will perceive a resemblance of children to their parents or parent which others do not perceive. This is attributable to a different construction in the lens or retina.

(*o*) 2 Par. & Fonb. 246 to 248, 250, and Fodcré Medicine Légale, vol. iv. p. 137; 2 Beck, Med. Jur. 205.

(*p*) See instances, 1 Par. & Fonb. 370 to 372, as regards pretended blindness, and how detected. 1 Beck, Med. Jur. 22, 23.

(*q*) 3 Bost. 88.

(*r*) Gregory's Econ. of Nat. vol. iii. 393, 395; and 1 Dungl. Phy. 166.

the point *d* upon the retina; the divergent rays, which fall more obliquely from the point A, will be united on the retina at the point *a;* and those which proceeded from B will, by the same rule, be converged and meet at *b*. Hence, it is evident that by means of this *refraction* there are certain points at which the rays of light, after passing the pupil, cross each other, and the image which is formed on the retina is consequently *inverted.*

The deviations from perfect sight giving occasion for the use of varying glasses in spectacles thus arise. If the humours of the eye, through age or weakness, have shrunk or decayed, the *cornea* will then be *too flat,* and the rays not being sufficiently bent or refracted, arrive at the retina before they are united in a focus, and would meet, if not intercepted in some place, behind it. They, therefore, (unless influenced by artificial means) do not make an impression sufficiently correct and forcible, but form an indistinct picture on the bottom of the eye, and exhibit the object in a confused and imperfect manner. This defect of the eye is, therefore, remedied by a double *convex lens,* such as the common spectacle glasses, which, by causing the rays to converge *sooner* than they otherwise would, afford that aid to this defect of nature which the circumstances of the case may require, the convexity of the glass being always proportioned to the deficiency in vision.

If, on the contrary, the *cornea is too convex,* the rays will unite in a focus before their arrival at the retina, and the image will also be indistinct. This defect is remedied by *concave glasses,* which cause the rays to diverge, and consequently by being properly adapted to the case, will enable the eye to form the image in its proper place.

As the direction in which the rays cross each other bears a due proportion to the angle in which they are transmitted from the object to the eye, it is evident that the image formed upon the retina will be proportioned to the apparent magnitude, and thus we have our first ideas of the size and distance of bodies, which, however, in many cases are corrected by experience. The nearer any object is to the eye the larger is the angle by which it will appear in the eye, and therefore the greater will be the seeming magnitude of that body.

The mechanism, structure, and composition of the eye.

The parts of the eye itself are formed on the principle that rays of light must be so concentrated as to be impinged (or struck) strongly on the retina(*s*) at the bottom of the eye, so that the picture of the external object may be there perfectly formed in miniature, and conveyed from thence to the *sensorium commune.* Now, as an optician's lens (viz. a *double convex* glass) is necessary so to concentrate the rays of light proceeding from an object as to form a small image of it, so on the same principle an essential part of the eye is the crystalline lens which brings the rays of light to a focus; and in order that the lens may make the rays proceeding from an object converge into an accurate focus, and thereby form a distinct image on the retina of the eye, the *vitreous* humour is interposed between the lens and the surface of the retina. The anatomical parts of the eye are very numerous, and we can here only enumerate the principal.

The globe or ball.

The *Globe* or *Ball* of the eye, which is of nearly a spherical form, is composed of three *transparent* parts, called (though not with strict propriety) *humours,* namely, the *Aqueous,* the *Lens* or *Crystalline,* and the *Vitreous* humours.

The aqueous humour.(*t*)

The *Aqueous Humour* fills a space immediately behind the transpa-

(*s*) Sounded as if spelt re-te-na.

(*t*) See observations, 3 Bell, 15, 17, 77, 78; 3 Bost. 66, 67; 2 Horner, Anat. 450 to 452.

rent cornea, presently described, and between such cornea and the lens. This humour distends the anterior and pellucid part of the eye so as to increase the sphere of vision. That part of this space which is in front of the iris, presently described, is termed the *anterior* chamber, and that part behind the iris, and which is the smallest, is termed the *posterior* chamber. This humour is perfectly fluid and of a watery consistence, that it may allow free motion to the iris. It holds in solution a small quantity of saline matter with some albumen, and is the only part of the eye that is properly termed humour. The quantity of the aqueous humour in the adult is supposed to be five grains. It is again rapidly secreted after having been discharged by puncture in the cornea.

Lens or crystalline humour.

The *Crystalline Humour*, which constitutes the *lens*, as before alluded to, is placed immediately behind the *perforation* in the *iris*, and which *perforation* is called the *Pupil*, and there is not, as might be supposed, in fact, any globular or other body in the centre, but the appearance is attributable to the aperture in the iris. This crystalline lens is a body of considerable density and firmness, having the form of a double convex lens, and which is placed horizontally behind the aperture of the iris. In its natural state it has a glazy appearance, like glass, and is of the consistence of strong jelly; but when boiled it is white, precisely similar to the appearance of the eye of a boiled fish. This lens is of great power, collects the rays of light like a double convex glass, or optician's lens, so as to concentrate them and make a more forcible but very minute image of the retina at the bottom of the eye, and all rays of light must necessarily pass through this crystalline.(u)

The vitreous humour.(x)

The *Vitreous Humour* lies behind the lens. It distends the general ball of the eye into a regular sphere, that it may move easily in the orbit, and its diameter in the axis of the eye is so proportioned to the focal distance of the lens, that the image of an object is formed accurately on the surface of the retina.(x)

While these humours have each its distinct character, and all are in a degree transparent, they possess, in proportion to their density, different powers of refracting the rays of light. This, it has been observed, has the still further good effect of correcting the aberration of the rays, and giving the truest colours as well as the most correct image of the object presented to the eye.(z)

The retina.

The *Retina* (the principal seat of sight,) (a) is placed on the sides and at the bottom of the eye, beyond the vitreous humour, and is considered by the most modern physiologists, not as part of the coats of the eye, nor strictly an expansion of the optic nerve, but rather as *an expansion of nervous matter connected with the optic nerve*, and as being the principal organ by which the sensation of sight is received and conveyed to the sensorium commune.(b) As regards the other parts of the eye, the retina is concave; but with reference to the head it is convex. Upon the retina the external object is pictured, though in so small a shape that it has been said that the sail of a windmill will be depicted on the retina so small as about the 66th part of the thickness of a common hair.(c)

When the impression has been received upon the retina, it is transmitted, by means of the *optic nerve*, to the sensorium commune, an effect

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(u) 3 Bell, 17, and fuller id. 80; 3 Bost. 65, 66; and see id. 78 to 87, as to the use of the crystalline lens. 2 Horner, Anat. 448 to 450.

(x) 3 Bell, 17, 79, 80. 2 Horner, Anat. 446, 447; 1 Dungl. Phy. 155.

(z) 3 Bell, 18; 1 Dungl. Phy. 170.

(a) 3 Bost. 70; 2 Horner, Anat. 443.

(b) Id. 70; see 3 Bell, 49, 51 to 55.

(c) 3 Bell, 21, 22.

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which the older physiologists ascribed to the agency of some supposed unknown animal spirit, but which was afterwards referred to a vibration propagated along the part, and still more recently to the operation of electric fluid.(*d*)

The following parts, though assisting and essential to regulate the admission of light, and duly conveying the impressions, are rather *accessory* to, than the direct organs of sight.

The cornea.

The *Cornea* (from *cornu*, a horn,) is so called from being firm like horn, transparent, and composed of laminæ. Some anatomists have considered this as the same, and forming part of the opaque white sclerotic coat of the eye, and which surrounds the retina externally. It is the pellucid circle in the front part of the eye, which has the appearance of being variegated with colours, though that is a deception, owing to its perfect transparency: the circle of the cornea is, however, far from being regular; its margin is flat towards the nose. The fulness of the cornea, with the perfect transparency of the subjacent aqueous fluid, gives a brilliancy to the eye, and is a sign of health; the reverse dims the eye, and, with the fallen features, accompanies ill-health.(*e*)

The iris.

The *Iris* is the coloured circle which surrounds the pupil, and which we see through the transparent cornea of the eye, and which gives the *colour* of the eye. It is a membrane before the crystalline lens, placed in the aqueous humour, and dividing the anterior from the posterior chamber.(*f*) It contains two sets of fibres, one circular and one radiated; by these it possesses the peculiar powers of contracting or expanding, so as to regulate the quantity of light that shall enter the pupil. It contracts in a bright or strong light, and expands when the light is feeble, and hence the pupil has the appearance of being small in the first case, and large in the latter.(*g*)

The pupil. (*h*)

The *Pupil* of the eye is not, as commonly supposed, a distinct round body of itself; but is merely formed by the central perforation in the iris, by which the interior is perceptible, and through which alone the rays perforate towards the retina, and, therefore, when we hear of the dilatation and contraction of the *pupil*, we are to understand only the action of the iris, which, by possessing the power of contracting and relaxing, holds a control over the quantity of light transmitted to the bottom of the eye; for by the extension of the iris the diameter of the pupil is diminished, and vice versâ, and this is often an index to the surgeon of the state of the nerve, and the probability of giving relief by operation.

The optic nerve.

The *Optic Nerve* of each eye, as appears from the plate, ante, 292, is situate at the posterior part of the globe, and towards the nose, and communicates, as it will be observed, with the retina; and there is a ganglion formed by the third and fifth pairs of nerves, which may influence the iris, and thus modify the quantity of rays which are received by the retina, and transmitted by the optic nerve to the sensorium(*i*) but the mode of communication with the internal senses of the mind seems wholly conjectural.(*k*)

Although when both the eyes are perfect there are two retinas, and two

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(*d*) 3 Bost. 88.

(*e*) 3 Bell, 29 to 33; Coop. Surg. Dict. tit. Cornea; 2 Horner, Anat. 434.

(*f*) 3 Bell, 41; 2 Horner, Anat. 440.

(*g*) 3 Bost. 73 to 75; see Coop. Surg. Dict. tit. Pupil, and tit. Iris; 3 Bell, 22, 41 to 49; 1 Dungl. Phy. 156.

(*h*) 3 Bost. 78 to 75; 3 Bell, 32, 41, 42; Coop. Surg. Dict. tit. Pupil, 1 Dungl. Phy. 156.

(*i*) 3 Bost. 77, 78.

(*k*) As to the optic nerve, see 2 Horn. Anat. 432; 1 Dungl. Phy. 157 to 159; 3

conductors of the optic nerves leading from each, yet the two latter unite and their filaments decussate, and consequently, although there are two retinas, yet there is only a *single* vision with the two eyes.(*l*)

The appendages of the eyes.

The *Appendages* of the eyes are the eyebrows (*supercilia*,) (*m*) eyelids (*palpebræ*,) tarsal cartilages (*tarsi*,) eyelashes (*cilia*,) glandulæ Meibomii, caruncula larchrymalis, and lachrymal apparatus, (consisting of the lachrymal gland, puncta, and ducts, and the lachrymal sac and its duct,) the lachrymal sac and the nasal duct with the *bones*, called the os unguis, the superior maxilla, and the inferior turbinated bones, together forming a complete canal;(*n*) and to these are to be added the numerous muscles, blood vessels, glands, and nerves. Of these, some of the principal are the *tunica conjunctiva*, which is the inflection of the internal skin of the eyelids, and is vascular, and liable to inflammation, and is the common seat of ophthalmia.(*o*) The *meibomian glands*, so called from their discoverer, lie under the inner membrane of the eyelids, and exude a white sebaceous matter, which defends the edge of the eyelid from the acrid tears; this also is subject to inflammation, and is the seat of ophthalmia tarsi.(*p*)

Lachrymal gland and tears.

The *Lachrymal Gland*, by which *tears* are secreted, is situate in a small depression of the os frontis, under the anterior part of the upper eyelid, and near the external angle of the eye. It is of the conglomerate class, and is provided with a number of excretory ducts, which gradually discharge the fluid over the surface of the cornea. The superfluous part of the tears is carried off by the puncta lachrymalia, and conveyed along the ducts of the nostrils.(*q*) When the eye is irritated by an extraneous substance the tears are discharged in a greater quantity, and thus serve as a defence to this tender organ, and sometimes wash away the cause of irritation or facilitate its removal. Affections of the mind occasion an increased flow of tears, singularly varying in different persons; but the efficient cause of which affection cannot be traced.(*r*)

Muscles and nerves of the eyes.

The *Muscles*, which are attached as well to the globe as to the eyelids, are numerous, to enable us to move the eyes and the eyelids in various directions; and the branches of the *nerves* give such muscles the power of voluntary motion, and assist in the various functions of the eyes.(*s*)

Power of ascertaining distances.(*t*)

The errors and discrepancies in testimony respecting the relative distances between objects evince the great importance of the ability to correct evidence in this respect. Although in general these will arise from a want of due attention to intervening objects, and a general carelessness of mind, it may be attributable to the state of the retina and varying construction of the eyes of different persons. Witnesses will repeatedly differ most materially in the supposed distance, size, and other circumstances in the perceived object, and hence the discrepancy of their different evidence.(*u*) An accurate knowledge and power of describing distances and objects in general will arise from an habitual attention to

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Bost. 72, 73, &c.; id. n.; Jackson, Prin. Med. 160.

(*l*) 3 Bost. 103, 104.

(*m*) As to the effect of the eyebrows, see ante, 256, n. (*q*;) 2 Horn. Anat. 415.

(*n*) 2 Horner, Anat. 421 to 427.

(*o*) 3 Bell, 120; Dewees, Prac. Phys. 319.

(*p*) 3 Bell, 121; 3 Bost. 76; 2 Horner, Anat. 418.

(*q*) 3 Bost. 76; 3 Bell, 122 to 125; see full description of the lachrymal gland, 2 Horner, Anat. 421, and Coop. Surg. Dict. tit. Lachrymal Organs.

(*r*) Dr. Gregory's Econ. Nat. vol. iii. 385, 386; 2 Dungl. Phy. 222.

(*s*) 3 Bost. 77, 78; 2 Horner, Anat. 418.

(*t*) See Coop. Surg. Dict. and see further, as to distances, under the head Hearing, post.

(*u*) 3 Bost. 80 to 102; see fully Gregory's Econ. Nat. 400 to 403; 1 Dungl. Phy. 192 to 199.

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SECT. III.
EXTERNAL SENSES, &c.

what are the dimensions of a known object at the distance of a measured mile on level ground, and what are the usual appearances of fixed intervening objects, size of fields, &c. Persons who have frequently seen objects, and observed them with attention, can judge of the distance, magnitude, and position of such objects entirely by experience and association,(*x*) or by what is termed audible distances, which will be presently considered;(*y*) and the sense of touch is frequently exceedingly exquisite in a blind person, so as to perceive even the difference in suits of playing cards.

Short and long sightedness.

The occasion of *near* and *short sightedness*, and the consequent inability accurately to see distant objects, and the reverse, *long sightedness*, or the incapacity of accurately distinguishing near objects, is attributable to the excessive convexity of the cornea of the eye, or its converse flatness, and has already been adverted to. If the lens of the eye have *too great* a convexity, or if the lucid anterior part of the eye be formed too *prominent*, or if the size of the ball of the eye and the diameter of the vitreous humour be unusually great, then the person does not see distinctly, and he is what is termed *near sighted* or *short sighted*.(*z*) The effect of old age is gradually to reduce the eye to a less prominent state, and consequently to bring it to the *reverse* of the near sighted eye, and the defect is to be aided by a different description of glass.(*a*) Near sighted or short sighted persons cannot see distinctly when at a distance, when *e converso*, old people cannot distinctly see objects when near, and old age corrects short sightedness by gradually reducing the convexity of the eye, thereby enabling a person to see objects further removed, until by degrees he comes to see perfectly at the distance most convenient for the common affairs of life.(*b*) Dr. Bostock considers it to be established that short sightedness is *hereditary*, and is more frequent amongst the higher classes, and attributable to studious and some other habits,(*c*) whilst *long* sightedness may be acquired by habit, as by sailors, and countrymen, residing in very open countries.(*d*)

Squinting.

In squinting both the eyes are not used at the same time, nor do they see objects double, and on looking attentively at any object only one eye is in fact used, and the immediate cause of the other eye not being directed to the object, or rather being drawn away from it, appears to depend upon its vision being imperfect, so that if it were directed to the object together with the sound eye it would produce a confused impression, and it is to prevent this defect that the habit of turning the eye aside is unconsciously acquired.(*e*) So that the former notion that squinting is the want of correspondence between the different parts of the two retina is now exploded.(*f*) It has been suggested that the cure of squinting is to endeavour to strengthen the weak eye by use and by covering and suspending the use of the sound eye,(*g*) as also by tonics and gentle stimulants.(*h*)

(*x*) 3 Bost. 94 to 102.
(*y*) 3 Bost. 113.
(*z*) 3 Bell, 18, 19, 104; and see how the defect may be aided by glasses, and why, id. 26; see also 3 Bost. 86, 87.
(*a*) Id. 87.
(*b*) 3 Bell, 20; 3 Bost. 87.
(*c*) 3 Bost. 87.
(*d*) 1 Dungl. Phy. 199.
(*e*) 3 Bost. 111; 3 Bell, 108, 112 to 119. Squinting is occasionally caused by a blow, &c. id. 115; see also 1 Dungl. Phy. 204, 205.
(*f*) 3 Bost. 112. But it has been observed, that probably in squinting the *axis* of the defective eye will be found *permanently fixed* in a different direction to the other, and the individual, therefore, if he would use that eye, is compelled to turn his *head* or the *object*, and cannot turn the defective or misplaced eye.
(*g*) 3 Bell, 116 to 119; 4 Good, 179 to 183.
(*h*) 4 Good, 182; see full directions how to use the eye in particular, id.;

Adams in his Essay on Vision, has prescribed the following rules for the preservation of sight.(*i*) 1st. Never sit for any length of time in absolute gloom, nor, on the other hand, exposed to a blaze of light. From this rule may be deduced the impropriety of going hastily from one extreme to the other, whether of darkness or of light, and it may be inferred that a southern aspect is improper for those whose sight is weak and tender. 2dly. Avoid reading a small print. 3dly. Do not read in the dusk, nor, if the eyes are disordered, by candle light. 4thly. The eye should not be permitted to dwell on glaring objects, more particularly on the first waking in the morning. 5thly. The long sighted should accustom themselves to read with rather less light, and somewhat nearer to the eye than usual, while those who are short sighted should use themselves to read with the book as far off as possible.(*k*)

Essentials to preserve sight.

Dr. Bostock collects and observes upon instances whereby in a peculiar state of the retina, persons of sound mind, or at least not insane, may have either formed an erroneous perception of colours, or may have had presented fallacious images even of supernatural appearances; and that in certain diseased states of the nervous system the retina is more than usually disposed to retain the impressions which imagination may have presented, and the spectrum will still remain visible; and the same causes which tend to weaken the nervous system, frequently also produce a similarly debilitating influence over the mental powers, so as to render them peculiarly susceptible of being affected by credulity;(*l*) and, it is added, that we are by this means not unfrequently enabled to explain certain supposed supernatural appearances, the evidence of which is too direct for us to doubt of their actual occurrence without setting aside all human testimony;(*l*) and Dr. Bostock states an instance in himself of a similar illusion.(*m*) This fact is most important, as well in a pathological as in a judicial view; for it establishes that the assertion of having seen such spectrum does not by any means evince either delirium or absolute aberration of the mind, and that the assertion is not to be contradicted, but treated as a bodily defect, with appropriate remedies, or at most a *weakness* of intellect, perhaps only temporary, and not as evidence of insanity;(*n*) and this truth may occasionally explain transactions in courts of justice.

The supposed existence and appearance of spectres accounted for.

The eyes and their appendages are subject to a melancholy list of diseases and injuries. The seat of many of the diseases is the retina. But as vision is the combined operation of the external organ, nerve, and brain, the destruction of or injury to the function may be produced by disease of the retina, or of the optic nerves, or of the brain.(*o*) The connexion and sympathy between the retina and the viscera of the abdomen is also very particular, and the disorder of the stomach will have an immediate effect on the sensibility of the retina.(*p*) No affection is

Diseases of the eyes.

Phil. Trans. vol. lxviii. 86, 89; see also Gregory's Econ. Nat. vol. iii. 400.

(*i*) Gregory's Econ. Nat. vol. iii. 403. These rules may, no doubt, be practically useful, but the detailed enumeration reminds us of a gentleman who plumed himself on his power of drinking much wine without occasioning intoxication, and as a favour would to a *very particular* friend communicate, what he termed, his three *golden* rules, 1st. Never to sit with his face towards the light; 2ndly, Never to drink malt liquor; 3dly, Never to open his mouth excepting for the purpose of eating or drinking. What an agreeable companion!!!

(*k*) 3 Gregory's Econ. Nat. 403.

(*l*) 3 Bost. 90, 91, 160, n.; Dr. Alderson's Essay on Apparitions. Brewster, Natural Magic.

(*m*) 3 Bost. 161, 163.

(*n*) See post "Imagination."

(*o*) 3 Bell, 59, 60; Amer. Cyclop. Prac. Med. tit. Amaurosis.

(*p*) 3 Bell, 61; Ibid.

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more lamentable than that of *cataract*, (from the Greek καταρασσω, to confound or disturb,) and which as its very name denotes, signifies a disease which obstructs, confounds, or destroys vision, but which is capable of depression or dispersion by *couching*. It is more particularly defined to be an impediment to sight produced by *opacity* of the *crystalline lens* or its capsule.(*q*) It would be in vain to enumerate in this summary all the diseases of the eyes. They will be found enumerated and considered with their appropriate remedies in the works referred to in the notes.(*r*)

Injuries—expulsion of eyes from socket, &c.

One of the injuries to the eye may be that of its being forced, either totally or in a considerable degree, from its orbit. When this has occurred only in a degree, and, indeed, sometimes even when entirely, it has been replaced, and sight has been restored, though after a total evulsion, this can scarcely be expected, unless perhaps when the eye has been immediately replaced.(*s*)

Defects in the eyes, and effects upon sight and evidence.

It is supposed that persons who have been *born blind*, judge of the distance, magnitude, and position of objects, entirely by experience and association; and it is remarkable what precision they acquire in this respect without any assistance from the sight, the sense of which, under ordinary circumstances, we almost exclusively employ:(*t*) but it is impossible, if they have never seen, that they can adequately describe external objects; whilst those who have originally seen for a time, will, from memory and association, retain the power of description according to the degree of perfection at the time sight was lost. If a person born blind have the obstruction removed, he will, for a considerable time, lose his previous power of distinguishing by sound and other circumstances, unless he purposely close his eyes, and he will be at a loss to use his eyes with accurate *effect*.(*u*) The circumstance of a person being *blind*, will not in the least affect his power of speech or conversation, if his hearing be perfect so as to enable him to *hear* and appreciate the extent of sounds.(*x*) If the use of one of the eyes be lost, the individual judges less accurately of distances and other objects, than when he had the use of both.(*y*) As regards *evidence*, it has recently been decided at Nisi Prius, on the authority of other decisions, but doubting the principle, that if an attesting witness become blind after the deed was executed, it may be read in evidence, on proof of his handwriting and that he has become blind, without calling him as a witness, although it was objected that he was still competent to give evidence respecting what passed at the time of his signature, and therefore ought to have been called.(*z*)

1. Blindness.

Identity and likeness.

The variations in the accuracy of sight, and the discrepancy of testimony on the subject of *identity*, very frequently form an interesting subject of consideration in judicial inquiry, but these will be more properly examined in a subsequent part of the work.(*a*)

(*q*) Coop. Surg. Dict. tit. *Cataract* and *Couching*, where see a full description of the disease and couching and other remedies; see also 2 Gibson, 187 to 197; 4 Good, 158 to 169; Dewees, Prac. Phys.

(*r*) Ante, 292, n. (*k*.)

(*s*) See Coop. Surg. Dict. tit. Exophthalmia.

(*t*) 3 Bost. 129, 130.

(*u*) See Mark, chap. viii. verse 22 to 24.

(*x*) 3 Bost. 174.

(*y*) 1 Dungl. Phy. 201.

(*z*) *Pedler* v. *Paige*, Mood. & Rob. Rep. 258, on authority of *Wood* v. *Drury*, 1 Ld. Raym. 734; but Park, J. doubting; and on principle this decision seems erroneous.

(*a*) See, in general, 1 Par. & Fonb. 219, 220; 3 id. 142, 143; id. index, tit. Identity; Dr. G. Smith's Med. Juris. 502 to 505, 520 to 525; Cyclop. tit. Identity; 1 Beck, Med. Jur. 327 to 333.

1. The pavilion.
2. Meatus auditorius externus.
3. Membrana tympani.
4. Malleus,
5. Incus,
6. Stapes,
Os orbiculare between the incus and stapes,
} Small bones of the ear.

7. Cavity of the tympanum.
8. Eustachian tube.
9. Meatus auditorius internus.
10. 11. 12. Labyrinth.
10. Vestibule.
11. Semilunar canals.
12. Cochlea.
13. Stapedius muscle.

Secondly, Hearing and its organs, the ears.(b)

It has been observed from the above sketch, that the *Ears* (the organs of *hearing*,) are of an elaborate complicated structure; which is less understood even than that of the eyes.(c) No sound can be produced but with perceptible blast and concussion of the air, and with some resistance of the air percussed, and the vibrations or tremors excited in the air by such percussion, continue for a short time to move from the place of percussion in concentric spheres to great distances.(d) The ears are so constructed as to embrace, collect, and convey *sounds* to the sensorium commune of the brain where their principal effect is produced, and sound like light is capable of being reflected from a body at a definite angle,

Sounds.

(b) See a valuable article, Coop. Surg. Dict. tit. Ear, 420; 1 Dungl. Phy. 113 to 140; and Curtis on the Ear.

(c) See the above plate, and 1 Arnott, El. Ph. 418. The supposition that the tyrant Dionysius constructed a cave, with an aperture, so as to operate perfectly as an ear, seems scarcely credible: "Dionysius made a subterraneous cave in a rock, in the form of a human ear, which measured eighty feet in height, and 250 in length. It was called the Ear of Dionysius. The sounds of this subterraneous cave were all necessarily directed to one common tympanum, which had a communication with an adjoining room, where Dionysius spent the greatest part of his time, to hear whatever was said by those whom his suspicion and cruelty had confined in the apartments above. The artists that had been employed in making this cave, were all put to death by order of the tyrant, for fear of their revealing to what purposes a work of such uncommon construction was to be appropriated;" Plutarch's Lives; 1 Arnott's El. Phy. 416; and authorities referred to in Lempriere's Classical Dict.

(d) Newton's Optics, 1 Arnott's El. Ph. 288, &c. The radia of sound proceed from the spot where it originated, similar to the circles in water from the spot where it was stricken, 1 Arnott's El. Ph. 388, &c.

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Echoes.

and concentrated into a focus; and upon that principle it is that *echoes* are produced, and that the vibrations which constitute sound are increased by speaking trumpets, domes, and whispering galleries, which, it has been observed, may be regarded as analogous in their operation to convex lenses or mirrors. (*e*) But as regards musical sounds, and what is termed a *musical* ear, it is confessed that we are quite ignorant on what the faculty depends. (*f*)

The ear has been usually considered under three orders or parts; *first*, the outward or external part; *secondly*, the cavity in the temporal bone, called the tympanum, containing also minute ossicles or bones; and *thirdly*, the tube and nerves conveying the sensation to the sensorium, and these several parts are described in the antecedent plate. (*f*)

The external part of the ear is composed of cartilaginous folds of singular form, and which, from their elastic nature, without having the appearance of a regular apparatus, as in the case of the ear trumpet, nevertheless most effectually receive and collect sounds, and increase their vibrations,(*g*) and transmit them into the meatus auditorius externus,(*h*) which is a tube about eleven lines or near an inch long, conveying such sounds into and upon the membrane called *membrana tympani*, which is stretched across the cavity of the ear, and separates the external parts from the cavity of the temporal bone, where are placed all the parts of the *tympanum*, or vulgarly the *drum* of the ear, from its resemblance to one description of that instrument, as well in figure as effect.(*i*) The latter contains several small ossicles and bones, which vibrate and modify the vibrations of sound, and also serve to communicate with the nervous expansion of or near to the auditory nerve similar in office to the retina of the eye.(*j*) The auditory nerve conveys the sense of hearing to the sensorium;(*k*) and it has been conjectured, that the medium by which the undulations of the air are ultimately conveyed to the auditory nerve, is a fluid enclosed in a membrane, which enables it to retain its form, and prevents it from being diffused in the cavity in which it is lodged,(*l*) as in complete deafness this auditory nerve is, in general, the only organ appearing defective, it may be reasonably supposed that the hearing principally depends on the perfection of that nerve.(*m*) The *Eustachian* tube, so named from the anatomist its describer, is a passage extending from the back part of the tympanum into that part of the mouth called the fauces, and which, as will be seen in the plate, is an open passage leading from the tympanum into the fauces, so as to enable the air contained within the drum to have full communication with the external air through the mouth. This is essential to the perfect function of the ear, and if materially obstructed or injured, the sense of hearing will be greatly diminished or destroyed.(*n*) There are two sets of nerves appropriated

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(*e*) 3 Bost. 114, 115.

(*f*) Id. 122 to 125; but see id. 118, n. It is singular to observe, that some are indescribably elated or depressed by varying music, others not in the least affected, and others disgusted, whilst the dog will howl at the most cheerful music, as if he "bayed the moon."

(*f*) 3 Bost. 115, &c.; 3 Horner, Anat. 453 to 474; and 1 Arnott, El. Ph. 418.

(*g*) Instances are recorded of the whole of the external ear having been cut or carried off by a cannon ball, and yet *hearing* has been still continued; Coop. Surg. Dict. tit. Ear.

(*h*) As to the meatus auditorius and its imperfections, see Coop. Surg. Dict. tit. Ear.

(*i*) As to the tympanum, see Coop. Surg. Dict. tit. Ear; 2 Horner, Anat. 458.

(*j*) As to the ossicles, see 3 Bost. 117; and Coop. Surg. Dict. tit. Ear; 2 Horner, Anat. 461, 462.

(*k*) 3 Bost. 121, n.

(*l*) Id. 114, n. 119; end of note; 2 Horn. Anat. 468.

(*m*) Coop. Surg. Dict. tit. Ear. See also description of ear in 1 Arnott's El. Ph. 417 to 419; 2 Horner, Anat. 471.

(*n*) 3 Bost. 120; Coop. Surg. Dict. tit. Ear; and see a particularly clear explanation in 1 Arnott's El. Ph. 417 to 419.

to the ear, one for the immediate purpose of receiving the impression of sound, and the other for the general purposes of the nervous influence. The first is termed the *portio mollis* of the seventh pair of the cerebral nerves; its fibres are dispersed over the internal parts of the organ, and more especially through the bony canals which communicate with the tympanum, constituting the immediate seat of the sense of hearing. The general nerves are derived from the fifth pair, and are principally dispersed over the muscles of the ear, of which there are many.(*o*)

Distances.

With respect to audible ideas of distances, they are, it is supposed, acquired by persons who have become *blind* after having for some time fully exercised the power of vision, by comparing the strength of impressions of sound with a *previous* knowledge of the space which exists between the ear and the sounding body;(*p*) and, with respect to those who were *born* blind, their audible ideas of magnitude are principally applied in acquiring a knowledge of apartments, which blind persons are often able to estimate with considerable correctness.(*p*) This they acquire either by attending to the force of the reverberation which is produced from the walls, or by being told the size of the apartments they usually inhabit, and using a certain short pace, that is, one foot, to prevent risk of injury in stepping across it, and also ascertaining the ordinary sound of a voice speaking in the usual pitch, at the entrance or extreme end of the room, and then comparing the effects thus produced upon the ear with that in the case immediately under consideration, and their previous experience, in similar circumstances, will lead to a just conclusion.(*p*)

Of deafness and dumbness.

If a person be *born deaf*, that is, as it is termed, afflicted with *congenital* deafness, it follows, that as long as the loss of the faculty continues, he will, also, for the reasons before stated, continue dumb, or, rather, his power of speech will continne *suspended*.(*q*) If, after having been so born deaf, he should afterwards, as at the age of nine, be cured of the defect, and hear perfectly, he will have great difficulty, and will occupy much time in obtaining a knowledge of the position of sounding bodies, and still more of imitating articulate sounds; and, in a recorded instance, even after an interval of some months, his powers in this respect were very limited.(*r*)

It appears to have been formerly supposed to be a necessary conclusion, that, if a person be *born deaf*, he must be dumb, and that, as a further consequence, it is probable he would not *write* words according to their *accent* or *sound*, but merely by imitation of letters and figures;(*s*) and that if born deaf and dumb, he must, necessarily, be an idiot;(*t*) and, although the law has since changed, and a person in this melancholy state of privation *may* evince understanding, and, therefore, may inherit; and, also, on attaining twenty-one, and evincing adequate mind, may manage his property,(*u*) may contract marriage,(*x*) and give

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(*o*) 3 Bost. 120, 121; Coop. Surg. Dict. tit. Ear; 2 Horn. Anat. 471.

(*p*) 3 Bost. 122.

(*q*) Ante, 288, 289.

(*r*) M. Magendie's Journ. vol. v. p. 487; 3 Bost. 122.

(*s*) Ante, 288, note, (*t*,) citing 1 Par. & Fonb. 371; *sed quære* whether the experiment of M. Sicard, there narrated, might not be fallacious. If the alleged impostor could write at all, might he not have been taught to imitate the *bad spelling* by some instructer in writing without *ever hearing*.

(*t*) 1 Bla. Com. 304; and see post.

(*u*) *Dickenson v. Blisset*, Dicken's Rep. 268, where a lady born deaf and dumb, on attaining twenty-one, claimed possession of her estate, and the Lord Chancellor having put questions to her in writing, to which she wrote sensible answers, gave effect to her claim; and see authorities, 1 Par. & Fonb. 171, 292; and post.

(*x*) Coop. Surg. Dict. tit. ear; and see tit. Deaf and Dumb, vol. iii. Supplement

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evidence by writing or signs, and with the assistance of an interpreter:(*y*) yet the *presumption* of idiotcy prevails; and able physiologists suppose, that dumbness must exist when the deafness was congenital; but the supposition seems erroneous: it is true, that a person born deaf, inasmuch as he cannot *hear* sounds, or the articulation of words in any language, cannot, unless duly instructed, *imitate;* and his faculty of *speech* being *suspended,* he is incapable of voice to express his ideas, but he is, nevertheless, *capable* of uttering *sounds;* and the use of the tongue, as regards speech, seems merely torpid, and if deafness be cured, as at the age of nine years, the individual will, gradually, though with difficulty, be able to imitate words, and, in the course of a few months, be able to speak:(*a*) and, it is now clearly established, that speech and articulation may be taught, notwithstanding congenital weakness continues;(*b*) and persons from their nativity deaf and dumb, may (unless otherwise defective in intellectual powers, which is not, by any means, a necessary result,) by proper care and instruction, and the aid of touch and smell, acquire considerable knowledge and intelligence, and even the power of speaking, although to an incumbered and limited extent.(*c*) With respect to a mere local or particular injury, it is a well-known fact, that those persons who have lost the use of one of the ears, are less able to judge correctly of the position of sounding bodies than those who retain the use of both.(*d*)

Diseases and injuries of ear, &c.

The diseases and injuries of the ear are numerous, such as ear-ache, which, with its treatment, has been ably considered,(*e*) and the diseases and injuries, and their remedies, have been also pointed out.(*f*) Sudden, unexpected, loud vibrating sounds and noises, may occasion death.(*g*)

Hearing, as regards affirmative evidence, weighing against negative evidence.

As the accuracy of hearing, when the organs are perfect, like that of sight, depends on the degree of attention, and the propinquity to the speaker or the sound, and other circumstances, great discrepancy will sometimes ensue in the evidence of different persons with regard to what they may suppose they have heard or not heard. Hence, it is a common observation, and, in practice, may be considered a rule, that the affirmative testimony of one witness, whose credit is not, in other respects, impeached, that he *did hear* a particular expression or sound, is to be given effect to in preference to the negative testimony even of twenty witnesses, who swear that they did *not* hear the same. Any *difficulty* of hearing, as it constitutes a natural impediment to the necessary *quickness of perception,* ought always to constitute an insuperable objection to a juryman; but this is too frequently disregarded in the administration of justice.

Thirdly, Sense of smell.

The *third sense is Smell,* which, however useful and contributing to

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to Ency. Brit. and Stew. Phil. vol. iii. 401; and, as to marriage, see Swinburn on Marriage, s. 15.

(*y*) *Ruston's case,* Leach, Cr. C. 455; 1 Phil. Ev. 18; Peake, Ev. 127. *Writing* is preferable, *Morrison* v. *Lennard,* 3 C. & P. 127.

(*a*) M. Magendie's Journ. vol. v. p. 223; 3 Bost. 122; and see 1 Good, 378 to 381; G. Smith's Hints, Ev. 113, 114.

(*b*) 1 Good, 378, 379; ante, 289.

(*c*) 1 Good, 377.

(*d*) 3 Bost. 123.

(*e*) 2 Good, 298.

(*f*) Coop. Surg. Dict. tit. Ear; 4 Good, 184 to 194; 2 Gibson, Surg. 143 to 144.

(*g*) The father of two children, one aged two years and the other four, in the neighbourhood of Horsham, in Sussex, recently took them to the top of his house, and the sudden ringing of the dinner bell occasioned concussion of the brain, and their death, in a very short time afterwards.

full enjoyment of life, is, certainly, not essential to man's existence,(h) though, in some animals, the sense is so peculiarly powerful, as to enable them to secure their prey, as well known in the instance of sporting dogs. The immediate organ of *smell* is the mucous membrane called *Schneiderian*, after the anatomist who first accurately described it, and which lines the internal parts of the nostrils, and, especially, the turbinated bones. This membrane is supplied very plentifully with blood vessels and nerves, the latter from two distinct sources, namely, from the first pair, called the olfactory, and from some branches of the fifth pair, and upon the latter of which the irritation is produced, which excites sneezing. The *olfactory nerve* does not, however, like the optic and auditory nerves, terminate in a filamentous texture, but is reduced to a pulpy substance, which is, as it were, incorporated with the mucous membrane for which it is destined.(h) Desmoulins insists that the branches of the fifth pair of nerves are the only, or at least the principal nerves of smell.(i)

The sense of smell will frequently become more delicate by repeated exercise, when the senses of vision and hearing have been suspended, and so as to enable the individual to discover the nature and presence of surrounding bodies.(k) It may be important in judicial inquiries to remember that the effect of habit will, frequently, as regards the sense of smell, reconcile and even attach individuals to the most offensive effluvia; so that in a prosecution or action, it will be found that the evidence of numerous witnesses of undoubted credit, that they have experienced no unpleasant sensation, will endanger a verdict, whilst the *contrary* evidence of others, who only, occasionally, have passed near to the nuisance, will clearly establish that to them it was intolerable.(l) In these cases, if the nuisance be near to a highway, along which *all* persons have a right to pass, the affirmative evidence of only one or two witnesses of credit ought to be given effect to, and the concurrent testimony of the others wholly laid aside, because habit may have reconciled the nuisance to them; but the individuals of the public who may not live in the neighbourhood have a right to continue and use the public way without such annoyance.(m) As connected with medical jurisprudence, we may observe, that it is laid down that a person might be indicted for murder by laying noisome and poisonous filth at a man's door, to the intent by a poisonous air to destroy him.(n) But it has been observed that we are

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(h) See Sneezing, ante, 116; respiration, ante, 116; and see a description of the organ, 4 Good, 195, 196; 3 Bost. 131 to 133; 2 Horner, Anat. 403 to 414; 1 Dungl. Phy. 97 to 112.

(h) 3 Bost. 131 to 133.

(i) 3 Bost. 310.

(k) Id. 130.

(l) Id. 171.

(m) Sittings at Westminster, before Lord Tenterden, A. D.——MS. *The King* v. *Neil*, indictment for a nuisance in boiling bones, &c. near Maiden Lane, leading to Highgate, Mr. Green, in support of the prosecution, swore that the stench was so overpowering, that it was, frequently, with difficulty, and not without spurring, that he could urge his horse to pass the premises, and in certain directions of wind when he approached, the horse would actually turn round rather than proceed. Another witness also proved, that the effluvia was intolerable to him when passing, and caused nausea, &c. Twenty healthy well looking persons, living actually on the premises, and constantly exposed to the effluvia, swore that they never experienced the slightest inconvenience or nausea. Lord Tenterden, adverting to the frequent recurrence of similar evidence, directed the jury that the testimony of the twenty might be perfectly true, on account of habit having reconciled them to the nuisance; but that, as it affected passengers, there must be a verdict for the prosecutor, followed by abatement or cessation of the nuisance; 2 Car. & P. 485, S. C. but that point is not reported.

(n) Dalton, J. chap. xciii. out of Mr. Cook's reading; 2 Par. & Fonb. 111.

CHAP. IX. Sect. III. External Senses, &c.

not aware of the existence of any poisonous filth so noxious as to destroy by merely inhaling its stench.(o)

Fourthly, Sense of taste and tasting.(p)

The sense of *Taste* is subservient rather to our gratification and enjoyment than to our existence.(q) It is principally seated in the extreme part of the tongue, though partly in the fauces and gullet.(r) It is said by high authority that, *generally* speaking, no aliment of an agreeable taste is unhealthy, and that nothing fit for the food of man is ill-tasted, and that, therefore, *in general*, the taste serves as an instructer to man what he may venture to eat and drink, but this is a very questionable position.(s) The tongue, with its gustatory and other nerves, as auxiliary to the sense of taste, has already been considered when examining the organs of digestion.(x) But, though the chief organ of taste is the tongue, it is not the only organ, and the sense of taste may continue, although it be lost.(y)

Dr. Bostock observes, that the senses of smell and taste are, in many respects, very intimately connected with each other, and the one frequently mistaken for the other; but that, unquestionably, the nerves of the tongue do receive impressions quite unconnected with smell.(z) It seems, however, that there is at least considerable association between the nerves of smell and taste; for if that of smell be lost, the sense of taste will also be absent,(a) especially when the utter want of smell was congenital.(b) The curious fact of the sense or appetite of taste being more highly acute by habit and refinement, is observed upon by the same able author.(c)

Diseases and injuries to taste.

The diseases and injuries to taste are named *parageusis*, or morbid taste, where the sense of taste is vitiated or lost, and are of three species, 1st, Acute taste; 2dly, Obtuse taste; and 3dly, Want of taste;(d) and their defects are capable of being relieved by various enumerated remedies.(d)

Fifthly, Sense of touch, and of external feeling.(e)

Touching, or the sense of *touch*, or external feeling, is universally classed as one of the five senses,(f) and we shall find, when enumerating the diseases connected with this subject, that under this sense are included, not only the sensation of propinquity and contact with a *foreign substance*, but also the feeling of external soreness, itching, tickling, or titillation, tingling, and pricking, heat, coldness, numbness, fidgets, &c. &c.(g) which, when spontaneous, are in truth rather symptoms of approaching fever or inflammation, or other disease, or their sequels, than actually existing diseases or real local affections.(g) But other physiologists treat these, or, at least, heat and cold, under another head, and as *sensations* of a specific nature, giving rise to *perceptions* that are specifically distinct from those of either of the five organs of sense,

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(o) 2 Par. & Fonb. 111.

(p) See, in general, El. Blum.; 3 Bost. 134 to 136; 4 Good, 200 to 205; 1 Dungl. Phy. 87 to 97.

(q) 3 Bost. 131.

(r) Id. 134.

(s) 4 Good, 202; but as the very position admits exceptions, no man should rely alone on the flavour of an unknown substance or liquid.

(x) Ante, 174.

(y) 4 Good, 200.

(z) 3 Bost. 134, 135.

(a) 4 Good, 200.

(b) Id. 205.

(c) 3 Bost. 136.

(d) 4 Good, 200 to 205.

(e) See, in general, El. Blum. 227; 3 Bost. 126 to 131; 4 Good, 205; and see 1 Dungl. Phy. 73 to 87.

(f) 3 Bell, 10; 3 Bost. 126.

(g) See 4 Good, 205 to 212.

though the sensations of heat and cold are referred in a great measure to the surface of the body, where is also the sense of *touch*,(h) and they insist that the impressions of heat and cold are received by *different nerves* to those of the sense of touch.(i) The organ or seat of touch, in its healthy action, is the skin and the extreme sensitive branches of the nerves leading, not only to the fingers and toes, but to the surface in almost every part of the body, and it is remarkable that the nerves of touch have ganglions near their origin.(k) It is certain, however, that independently of constant use properly assisting in causing the fingers to be most susceptible of the sense of touch, there are at the extremities very fine papillæ, or small elevations, into or immediately under which nerves communicate, and these are the seat of touch.(l) It has been observed, that if our sources of information were confined to the sense of touch, our ideas would be very limited,(m) but that one great use of touch is to correct the impression that we derive from the other senses, and, therefore, when we have it in our power to apply the organ of touch to a body under examination, it is had recourse to as the mode which enables us to acquire the most satisfactory information respecting it;(n) and it has been urged that if a person born blind were to recover his sight, he could not, without the assistance of touch, ascertain the difference between a globe and a cube;(o) and a singular case is mentioned where the exceedingly fine sense of touch which dumb persons are sometimes gifted with, is apt to be mistaken for the faculty of hearing,(p) and where even the most gentle shutting of a door was perceived merely by the very small *tremulous motion* communicating across the room to and up the legs of the chair upon which the deaf and dumb person sat, and which she perceived by the tremulous effect on her legs and back. It is a sense that may be greatly improved by habit, and therefore, though in general we use the fingers, yet, if they be lost, the faculty may be acquired by the toes or other parts in nearly an equal degree of sensibility, and there does not appear to be any perceptible peculiar organization in the fingers for the purpose of touch, though from habit they have become more susceptible.(q) Nevertheless, as the thumb and finger are the only natural organs adapted to the cocking a gun and pulling the trigger, it is well known that the loss of them is a disqualification for the army, as it is not anticipated that their loss can be readily, or, at least, with facility, supplied, and the consequence of an injury to them not unfrequently become the subject of judicial inquiry;(r) and the well known habit of a particular person using the left instead of the right, or proof of the converse, and that the act must have been effected by the left hand, may frequently assist in the discovery of a criminal.(s)

Diseases or defects and

The *diseases* and *defects* in the organ or sense of touch are termed *parapsis*, or morbid touch, where the sense of touch or general feeling is

(h) 3 Bost. 136 to 138.
(i) Id. 138.
(k) Mayo's Outlines Human Physiology, 2d ed. 402; 4 Good, 206.
(l) 1 Dungl. Phy. 79.
(m) 3 Bost. 128.
(n) El. Blum. 227, 230, where see a full description of touch in general; and see 3 Bost. 126 to 131; 4 Good, 205; Coop. Surg. Dict. tit. Ear. See the fraud practised by Jacob on Isaac and Esau, Genesis, c. xxvii. v. 22.
(o) 3 Bost. 129, n.
(p) Coop. Surg. Dict. 432; ante, 290, n. (x.)
(q) 3 Bost. 128; but see 4 Good, 206, 207, as to the ganglia of the nerves at the extremities of the fingers.

(r) Instances of individuals cutting off or mutilating fingers to avoid serving in the army or militia frequently occur, G. Smith, 440; and as to the discovery by marks impressed by fingers whether death was by self-destruction or a third person, see 3 Par. & F. 33, 34; ante, 37, n. (n.)

(s) Patch's case, 3 Par. & F. 34, n. (a;) and *Rex* v. ——, Harg. State Trials, App. 29; 3 Par. & F. 33, 34.

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vitiated or lost, and Dr. Good classes these under three species, 1st, Where there is an acute sense of touch or general feeling; 2dly, An insensibility of touch or general feeling; and, 3dly, Where there is an illusory sense of touch or general feeling; and each of these is capable of being relieved or diminished by appropriate remedies.(*t*)

injuries affecting sense of touch.

Sixthly, MOTION.

We have seen that some anatomists and physiologists add a *sixth* sense, that of *motion*,(*u*) which it is admitted is quite distinct from the nerves of touch. There is, it is considered, a set of nerves appropriated to the sensitive faculty of the muscles, and also distinct from those nerves which give them the power of motion.(*x*)

Seventhly, SPEECH and VOICE.

The faculty of *Speech* or Voice has also, we have seen, been considered a *seventh* sense,(*y*) though more properly it is rather a mode of relating or communicating ideas of other senses than in itself a sense. In examining the organs of respiration we in due order considered the principal organ of voice, namely, the *larynx*, and we there saw that the voice itself is the sound of the air propelled through and striking against the sides of the glottis, or aperture into the mouth; and the shrillness or roughness of the voice depends on the natural or assumed internal diameter of the glottis, its elasticity, mobility, and lubricity, and the force with which the air is propelled,(*z*) and it has been observed that a very minute variation in the capacity of the glottis, as even not exceeding the 54th part of a silk worm's thread, or one-three hundred and fifty-fourth part of a hair, will occasion a sensible difference of tone.(*a*) *Speech* is the modification of the voice into distinct articulations in the cavity of the glottis itself, or in that of the mouth or the nostrils,(*b*) acquired by successive imitations of others. These have already been sufficiently described.(*c*)

The defects, diseases, and injuries affecting speech.(*d*)

The defects and diseases affecting speech are numerous, and of three generic divisions, each of which is again divisible into different species. The *first* genus is *aphonia, dumbness, or speechlessness*, or inability of speech, and which also is of three species; 1st, elingual dumbness, or speechlessness from destitution of a tongue, either congenital or subsequently,(*e*) but which is not always a necessary consequence of the absence of the tongue;(*f*) the second species is atonic dumbness, arising from the loss of the use of the tongue by injury to the *nerves*, sudden shock, &c.;(*g*) the third species is *deaf dumbness*, or speechlessness from deafness, congenital or produced during early infancy.(*h*) This we have seen is usually considered a necessary incident of congenital deafness; but, as suggested, it may then, in reality, only constitute a *suspension* of the power of speech, and may be restored if deafness be removed.(*i*) The *second genus* is merely *dissonant* VOICE, where the sound of the voice is imperfect or depraved, and which is of three species, as, 1st, a whispering voice; 2d, a voice of puberty; or, 3d, an unmelodious voice.(*k*)

(*t*) 4 Good, 205 to 212; as to the sensations of heat and cold, see 3 Bost. 136, &c. and post.

(*u*) Ante, 286; 3 Bell, 10.

(*x*) See Mr. Bell's observations, Phil. Trans. for A. D. 1826, p. 163; 3 Bost. 139.

(*y*) Ante, 287; 3 Bell, 6.

(*z*) Ante, 95, 96.

(*a*) 1 Good, 382.

(*b*) Id. 341; 1 Dungl. Phy. 386.

(*c*) Ante, 95, 96; and 1 Good, 339 to 347; Jackson's Prin. Med. 287 to 292.

(*d*) See, in general, 1 Good, 369 to 396; Amer. Cyclop. Prac. Med. tit. Aphonia, Copl. Dict. Prac. Med. tit. Voice.

(*e*) 1 Good, 370.

(*f*) Id. 346; but see ante, 175.

(*g*) 1 Good, 373.

(*h*) Id. 375.

(*i*) Ante, 289; and G. Smith's Hints for Examination of Witnesses, 113, 114.

(*k*) 1 Good, 381 to 386.

The *third genus* is *dissonant* SPEECH, where the articulation is imperfect or depraved, and is of two species; 1, *Stammering*, where the flow of the articulation is disturbed by irregular intermissions or snatches, and is of two descriptions, hesitation or stuttering,(*l*) and either of these has been considered as constituting a disability to continue an officer in the army, since a hesitation or stuttering in the timely giving of the word "halt," or other word of command, might expose a whole company or line to destruction. These defects are capable by attention of being alleviated if not entirely overcome. (*m*) And, 2dly, misenunciation, where the sounds are freely articulated, but inaccurately enunciated. (*n*)

Speech as regards evidence.

Speech, as well regarding particular words as tones of voice, may become exceedingly important in the administration of justice. The unguarded adoption of a particular local pronunciation, phraseology, or articulation, may justly lead to a conclusion that a party is a native of, or has been long resident in, a particular district; and the use of a slang or vulgar term known to be peculiar to a particular individual, or set of persons, may, like the proof of a particular habit, sufficiently identify the person who used it, to have been the individual who also did some other illegal act.(*o*) But as regards the proof of the identity of a person merely by a witness swearing to a knowledge of a peculiarity in his voice, and having heard the voice of a supposed offender on a dark night, has been considered too uncertain to be relied upon, as many members of the same family frequently have the same peculiarity.(*p*)

Of instincts and habits.

We will here merely allude to *Instincts* and *Habits*, so singularly and mysteriously superior in some animals, and the knowledge of which will not unfrequently lead to the discovery of truth.(*q*) These, as they may affect evidence, will be considered in the third part of this work, and are here only alluded to as in some degree connected with the organs of sense. (*r*)

(*l*) 1 Good, 386.

(*m*) 1 Good, 387; Dr. Cormac on Hesitation of Speech, A. D. 1828; and see Philosophy of the Human Voice, by J. Rush, M. D.

(*n*) 1 Good, 389, where there is an interesting consideration of different languages.

(*o*) In *Blake* v. *Pinfold*, tried on the Western Circuit, A. D. 1832, before Taunton, J., after the trial the juror stated that the jury came to a conclusion that the plaintiff had used certain low and coarse expressions towards the defendant's wife, notwithstanding the evidence was in other respects uncertain, merely on account of the singularity of the terms, and its having been proved that the plaintiff, on other occasions, was in the habit of using the same whenever he was in an ill humour.

(*p*) Per Denman, C. J., in *Rex* v. *Clarke*, 27th March, 1834, at Norwich, and the jury acquitted the prisoner.

(*q*) See the next note.

(*r*) See 3 Bost. 180 to 185. As regards *instinct* the powers of pigeons and of dogs when placed in an unknown and distant country, of immediately discovering and proceeding back, in a direct line, to the place of their usual resort, may be instanced. M. Serres makes a curious remark upon the relation which the faculty of instinct bears to the development of the fifth pair of cerebral nerves; namely, in man, these nerves are peculiarly, small, whilst in the bee they are remarkably large, so as to afford some ground for the opinion, that instinct differs from *rational* faculty as well in its seat as in the mode of its operation. See 3 Bost. 303. As regards *habits*, the result of a recent trial established the importance of attending to them. Thirty-two witnesses positively, and it is believed conscientiously, swore to the *identity* of a cow, for which an action of trover was depending, in order to establish that the same belonged to the plaintiff, most of them also relying on their knowledge of the particular breed, and the circumstance of all the *cows* being, as it was termed, *bull-headed*, whilst two witnesses, to the satisfaction of the jury, proved that the cow belonged to the defendant, by swearing that whilst the plaintiff's drover was driving the cow with others along a high-way, the cow, on approaching the defendant's farm, suddenly and impetuously rushed from the herd

CHAP. IX. SECT. III. OF SENSATIONS.

Besides the *tangible* and actually *discernible* organs of the nervous system, and those belonging to the external senses, there are certain *corporeal sensations* and *feelings*, which, although of a specific nature, yet cannot be traced or attributed to any particular *known organ* or part, or bodily faculty, that has been *discovered*, such as the *sensations* of heat and cold, of muscular motion, of hunger, and thirst, and of the sexual organs. Those of heat and cold are generally referred to the surface of the body, and seem naturally to be felt nearly in equal degree in every part. These we know are not in exact proportion to the degrees of external heat or cold or clothing, but rather depend upon the state of the temperature of the particular individual, and perhaps principally the state of circulation of the blood; one familiar instance is the slight shivering or chill frequently experienced by healthy persons after eating a hearty meal, and which is attributable to the progress of assimilation of the chyle with the blood, or probably whilst passing from the thoracic duct into the subclavian vein, and the succeeding heat indicating subsequent relaxation of the capillaries.(*s*) Mental impressions of various kinds also have the effect of almost instantaneously increasing or diminishing as well the actual temperature as the sensation of it; Dr. Bostock supposes that the seat of these sensations is the same as that of touch, and that, like touch, they may be referred to the nerves that are distributed over the cutis;(*t*) but to this there are certainly exceptions, as illustrated by the above familiar instance. The sensation of *Motion* is of a specific kind, and completely different from that of touch, strictly so called, and is to be referred to the contraction of the muscles producing certain impressions, which are conveyed to the sensorium, and excite corresponding perceptions.(*u*) The sensation of hunger and thirst, previously noticed,(*x*) and of the sexes, considered in the next chapter, are styled *appetites*, and consist in uneasy sensations, which seem to be produced by a peculiar condition of certain secreting organs, and which are removed by a change in the condition of such organs.(*y*) Whether or not there are nerves appropriated to these several sensations seems to rest on conjecture, but as in every part of the body which is provided with nerves, we possess a degree of feeling which seems to be independent of external impressions, and all such parts, from the operation of various circumstances, both internal and external, become the seat of *pain*, there seems to be no doubt that there are nerves which convey every sensation to the sensorium commune, where it becomes perceptible.(*z*)

SECT. IV.—OF TEMPER, PASSIONS, EMOTIONS, AFFECTIONS, AND FEELINGS.

First, OF TEMPER.

As distinguishable from temperament and temperature, which we have seen more immediately affect the *corporeal* state of man.(*a*) *Temper* or *Disposition* is that particular cast of *mind* which affects the *mental* parts of the frame or intellectual faculties, and renders the perception of certain qualities capable of making a more prompt or a more durable im-

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through intricate lanes until she stopped at her accustomed cow-house, where she had been born and bred, and where she could not have been for two years. Such was the effect of evidence of habit. We have also seen that the proof of a person from habit being left-handed may tend to his conviction of a crime, ante, 37, n. (*n*,) and 307, n. (*s*;) and Patch's case, 3 Par. & Fon. 34, n. (*a*.)

(*s*) Park's Inquiry, 192, 193; 3 Bost. 136.

(*t*) 3 Bost. 138.

(*u*) Id. 138.

(*x*) Ante, 196.

(*y*) 3 Bost. 140, 141; Jackson's Prin. Med. 370 to 375.

(*z*) *Semble*, 3 Bost. 143.

(*a*) Ante, 49, 50.

pression upon one person than another, and it may be termed the *temperament* of the *mind*, as distinguishable from that of the *body*, although probably attributable to the same or similar circumstances in the structure of the whole frame. We deem that man of *irascible temper* who is *always disposed* to be angry at trifles, and him we praise as *humane* who is *uniformerly disposed* to commiserate sufferings.(*b*) But even these mental qualifications are generally much influenced by the particular state of the body; a fact which we all practically know, and frequently watch in others.(*c*) These qualifications of the *mind*, however, are much more under the influence of careful education, than the temperaments of the *body* can be affected by pathological or medical care. Hence the importance of the earliest moral and religious precepts, encouraged by example, so as on the one hand to rouse and stimulate an *unfeeling temper* or mind to works of charity and benevolence, and to restrain and limit the *too liberal* or humane temper, and render it more cautious and discriminate in works of charity and humanity, lest the naturally amiable temper should become prodigal, and ultimately distress and sour the mind, from the inability to continue its generous propensity.(*d*) We are taught by the laws of morality, and still more by revealed religion and heavenly example, so to modify our tempers as to become prone towards good, and restrained from evil actions; and hence it is no excuse in law, if any undue propensity be indulged, so as to become injurious either to ourselves or to society.(*d*) But, even in the *administration* of the law, the circumstance of a person being unhappily of an irascible temper, yet laudably endeavouring to curb and restrain its indulgence, may occasion mitigation of punishment for an injury committed by him under a strong and malevolent excitement, purposely occasioned by another who knew of such disposition. We practically know that what is commonly termed *good temper*, *good nature*, or *good humour*, powerfully affects the bodily functions, and generally occasions composure, fatness and good health, whilst the sour, peevish, and fretful temper in general induces an excess in the secretion of bile, and irregular health and spare habit.(*e*)

CHAP. IX. SECT. IV. PASSIONS, EMOTIONS, &c.

Perhaps, next to the organs of external sense and sensation, in the ascending scale towards the highest mental faculties, are those *Passions*, *Emotions*, and *Affections* which more or less influence man as well as animals. The study of the passions has been regarded by some as exclusively belonging to the department of morals or metaphysics; but this is much too limited a view, for they are very nearly related to our corporeal organization, and have a most important influence over it, so as to occasion health or disease, and gradual or even sudden death:(*f*) and even

Secondly, OF PASSIONS, EMOTIONS, AFFECTIONS, and MENTAL FEELINGS, and how

(*b*) Cogan on Passions, 11, 12.

(*c*) The temper is greatly affected by indigestion, Dr. Johnson on Indigestion, 31, 32; Lord Chesterfield advised, "Before asking a favour of a lord, take care to ascertain from his valet whether he has had a copious evacuation, for if he be in a state of indigestion, he will be sure to refuse. It is frequently important to watch the time and season when the temper may be more particularly disposed to generous acts."

(*d*) See a beautiful illustration in Parnel's Hermit.

(*d*) *Rex* v. *Treagle*, Old Bailey, 11th Sept. 1833, *cor.* Patterson, J., and Gurney B. The defence for stabbing prosecutor was, that prisoner was known to be of an irascible temper, and prosecutor entered his room and provoked him. Per judges. The circumstance of a party being of a violent temper constitutes no excuse, as every one is bound to restrain such temper, or there would be no security for life. The prisoner was convicted, but recommended to mercy.

(*e*) 5 Good, 199 to 200, *sed quære.* Modern physiologists deny the result as to bile.

(*f*) Cyclop. Prac. Med. tit. Antiphlogistic Regimen; 3 Bost. 202 to 208; and see 4 Good, 66 &c.; anger, why injurious,

CHAP. IX. SECT. IV. PASSIONS, EMOTIONS, &c.

far they are the objects of *medical* or *legal* interference.

those physiologists who deny the materiality of the mind, admit that the operations of mind and body are so intimately connected, and the one part of our frame has so much power over the other, that no system of physiology can be perfect in which the passions and mental faculties are entirely disregarded;(*g*) and the *intellectual functions*, although not so *direct* an object of physiology as those considered in the preceding chapters, yet many of them are so closely connected with the physical change of the body, as to require considerable attention in any system which professes to give an entire view of the animal economy; and whatever hypothesis may be adopted upon the subject of materialism, it is obvious that the passions, emotions, and intellectual faculties, possess the power of acting upon matter, and actually do exercise a very extensive influence over the animal body; and for this reason discreet physicians frequently forbear to communicate to their patients any apprehension of their being in a dangerous or precarious state.(*h*)

It is therefore essential to investigate the nature of passions and emotions, and to trace their effects; though unhappily the investigation will evince that too frequently the mind is weak and selfish, and that almost in every one, more or less, they are not adequately restrained by moral or religious precepts. Why is it so frequent that man will be stimulated by the passion or emotion of *pride* even to self destruction, rushing, though *unprepared*, criminally into the presence of his Creator, merely because he has, perhaps by an absurd speculation or gambling transaction, become unable to pay his bills, or satisfy what he terms a debt of honour; when he can bear, with comparative composure, the sudden discovery of the infidelity of his wife, the seduction of his daughter, or the dishonour of his son? The diversities in the effects of these passions are truly mysterious.

The beneficial or injurious effects of passions, emotions, and affections on the body as well as mind.

We will first consider the effect of passions, emotions, and affections upon the mind and body, with some allusions to the remedies, and then examine how far the *law* has interfered upon these subjects. We have seen that there is scarcely an organ or function of the human frame that may not be directly affected and disordered by the indulgence or influence of one or more of the *Passions*. Dr. Copland, in his excellent work, practically demonstrates how many diseases are attributable to sentiments and passions, and how greatly they may be modified as well by medical as by mental regimen,(*i*) and he adduces many interesting instances, which will be more properly enumerated in the second part of this work, evincing how much more the passions and emotions should be attended to as well by physicians as in the administration of the law, than has hitherto been observed. Dr. Barlow, in a valuable article upon antiphlogistic regimen, speaking generally upon the effect of excitement upon an already diseased person, observes, that mental excitement is capable of disturbing all the bodily functions, and of exasperating every symptom of fever; of ordinary exertion of mind, the febrile patient is soon rendered incapable by the effects of disease, which speedily hebetate the mental energies. The morbid excitement of the brain, which results from its special derangement, is itself a symptom of disease, and as such is the proper province of the medical attendant, who should direct the appropriate treatment; all ordinary excitement of mind of which the patient may be susceptible, should be carefully restrained, or permitted only with

B. Rush, Med. Inq. &c. on Diseases of the Mind, 334.

(*g*) 1 Bost. 262, 263.

(*h*) G. Smith, 537; 2 Bell, 98; Sir Henry Halford, Med. Gaz. 600 to 603, where see the exceptions, in order that relations may prepare the patient for death.

(*i*) Copl. Prac. Dict. Med. tit. Disease; and see the effect of passion on the blood Copl. Dict.; and on Deglutition; Jackson, Princ. Med. 251 to 260.

extreme caution; perfect quiescence, both of body and mind, being that state which will best second the medical treatment. Indeed it is the same principle which applies to mental as to bodily rest; for though in referring to *mind*, the remarks are applied to the manifestations, the reasoning is really directed, not to these but to the physical state of the *brain*, on which they depend, and which, under fever, is sensibly disturbed by whatever gives rise to such mental emotion; and consequently the moral treatment of the invalid is no unimportant part of antiphlogistic regimen;(*k*) and Dr. Roget, in his interesting article upon Age, observes, that the most frequent predisposing cause of climacteric disease is *mental anxiety and suffering, the corroding influence of which will eventually sap the foundations of the most robust constitution.*(*l*) Dr. Good observes, that a sober, quiet, and regular habit of life, with a due attention to the ingesta and egesta, *and particularly to a tranquillized state of mind*, will often enable the valitudinarian, although dangerously predisposed to sudden death, to reach even his threescore and tenth year with cheerfulness and content;(*m*) whilst the death of a consumptive person will be accelerated by numerous passions, as mortified ambition, disappointed love, and even home-longing, when at a remote distance from friends and country;(*n*) and it was well established in the instance of Marinus de Caballis, ambassador at Paris from the Venetian States, that his palpitation of heart and intermitting pulse was attributable to nervous affection, occasioned entirely by the great charge of important state matters, which pressed heavy upon his mind, increased by dejection, in consequence of his physician having indiscreetly prognosticated his death, and which was prevented by other more judicious advice, avoiding the exciting cause, by temporary retirement, and taking cordial medicines, accompanied with the assurance of recovery.(*o*) Mental emotions particularly affect the secreting organs. It has been said that the whole surface of the skin has been bedewed with drops of sweat and even of blood, by a sudden paroxysm of agony of mind; grief fills the eyes with tears; fear is well known to be a powerful stimulant to the kidney, and very generally to the alvine canal; anger gives an additional flow, and perhaps additional acrimony, to the bile; and if urged to violence, even renders the saliva poisonous; and disappointed hope destroys the digestion and alters the qualities of the secreted fluids of the stomach, and they become more acid.(*p*) Even the unsatiated appetites of hunger or thirst may be suspended by mental emotions, especially by the sudden communication of news that overwhelms us with grief or disappointment;(*q*) and sudden passion or commotion of mind will frequently occasion diarrhœa or looseness, or in other words, hasty and unnatural, crude, loose, and too frequent evacuations,(*r*) or feculent looseness,(*s*) and bilious cholera may be occasioned by a sudden fright or any other rapid exhaustion of the sensorial power.(*t*) Dr. Elliotson remarks that Bichat regards the passions as directly influencing the organic functions only, and springing from the state of the organs of that class, but that here he is perfectly unintelligible. *Vexation*, indeed, disturbs the stomach, and *fear* augments the quantity of urine; but does not vexation equally and as directly disturb the *mind*, confuse the understanding, and occasion heat and pain in the forehead? Are not, in fact,

(*k*) Amer. Cyclop. Prac. Med. tit. Antiphlogistics.
(*l*) Cyclop. Prac. Med. tit Age; also Amer. Cyclop. Prac. Med. tit. Ages.
(*m*) 4 Good, 304.
(*n*) R. Hamilton, in Duncan's Med. Com. xi. p. 343; 3 Good, 186.
(*o*) 2 Bell, 90.
(*p*) 5 Good, 171 to 173; Brous. Phy. 213, &c.
(*q*) 1 Good, 97.
(*r*) Id. 190.
(*s*) Id. 191.
(*t*) Id. 205; cites Phil. Trans. 1667; Henrici Dissert. de Cholera Morbo, 1740.

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the passions a part of the mind?—a part of the animal functions? They powerfully affect it is true, the organic or vital function; but this shows the close connexion merely between the two classes of functions.(*u*) Camper, in his valuable work upon the connexion between the science of anatomy and the arts of drawing, painting, and statuary, shows practically how each passion operates upon the brain, nerves and muscles, in deranging or modifying their action; and the interesting work of Dr. Cogan on the Passions,(*x*) [Rush on diseases of the mind,] Park's Inquiry into the Laws of Animal life,(*y*) and Fletcher on the influence of the troubled Mind on the health,(*z*) powerfully illustrate how the indulgence or control over each passion and emotion, *medically* and *mentally* influences our bodily as well as our mental health and happiness. Dr. Bostock also has made some valuable observations on the subject.(*a*) These should be studied by all who wish to enlarge the scale of their own and their fellow creatures happiness. In them will be found ably considered the effect of mental attention, abstraction, memory, association, imagination, and judgment, joy, love, hope, and fortitude, shame, anxiety, fear, disappointment, surprise, alarm, terror, pride, pity, sorrow, grief, despair, jealousy, hatred, anger, and rage, and all other passions and emotions, and their happy or baneful consequences upon the bodily and mental health and happiness.(*a*)

The passions and emotions, with reference to their *physical* influence on the body, may, it is said, properly be arranged under two heads, 1st, those which stimulate and excite; and 2dly, those which depress.(*b*) Each of them has a particular effect upon the several functions, *first*, *directly* on the brain and nerves; and *secondarily* upon the other functions, and especially the circulation. *Anger* stimulates and *increases* the action of the heart; whilst in *fear* the circulation of the blood is depressed, and the blood is not transferred with the usual force through the different parts of the sanguiniferous system.(*b*) The effects of fear are especially manifested upon the heart and arteries, the pulse becomes irregular, throbbing violently, or being nearly suspended, according to the degree of the emotion or the mental feeling immediately connected with it. The extent to which this action may proceed is absolutely indefinite; and we have numerous examples in which the effects produced upon the circulation by mental excitement, have remained during life; and to such a dangerous extent has this excitement been occasionally carried, as to have caused instant dissolution.(*c*) So, sudden intelligence of death may occasion permanent insanity;(*d*) and very frequently the unguarded communication of a depressing event has occasioned immediate death, espe-

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(*u*) El. Blum. 56.

(*x*) Cogan on Medical Influence of the Passions, 278 to 325.

(*y*) Park's Inquiry, 216 to 255, where the physical influence of moral impressions, passions, and emotions, are fully considered.

(*z*) Fletcher's Sketches, &c. published 1833.

(*a*) 3 Bost. 202 to 208; all young people should also read Mason's Self Knowledge, as the best instructer for regulating and controlling the passions. Young artists should study Camper's work, with plates; and Sir C. Bell's Treatise on the anatomy and philosophy of expressions; and see Le Brun's work.

(*b*) 3 Bost. 206 to 207; and see the influence of the nervous function on secretions, ante, 233. See also Jackson, Princ. Med. 251 to 260.

(*c*) Ante, 233, 234; 3 Bost. 203.

(*d*) A gentleman, on the point of marriage, left his intended bride for a short time; he usually travelled in the stage coach to the place of her abode; the last journey he took to her was the last of his life. Anxiously expecting his return, she went to meet the vehicle: an old friend suddenly announced to her the death of her lover: she uttered an involuntary scream and piteous exclamation—"He is dead." From that fatal moment, for fifty years, this unfortunate female, daily and in all seasons, traversed the distance of a few miles to the spot where she expected her future husband to alight from the coach, uttering in a plaintive tone—"He cially of a previously enfeebled body.(*e*) Indulgence of the passion of anger will affect the secretion of milk.(*f*) The depressing passion of distress will even instantly change the colour of the hair from dark to gray;(*g*) and fright will bring on cholera.(*h*) The terror and fear of death from a gunshot wound may actually produce it, unless the tender and sympathizing manner of the surgeon, and his assurance of safety, should instantly relieve the mind:(*i*) and it is supposed that not only may the function of a particular organ be separately suspended or affected for a time, but by the continuance of any passion, even the structure of such organ itself may be injured.(*k*)

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Effects of each *particular* passion, emotion, and affection, on the body as well as the mind.

Having thus shown *in general* the influence of passions, emotions and affections on health, we will, even at the risk of the imputation of repetition, in a few respects, attempt to show the peculiar local or general influence of each *particular* passion, emotion and affection.

The impressions and excitements to the *mind* are various; but all may be arranged under the terms *Passions*, *Emotions*, *Affections* and *feelings;* and are of two descriptions; as, *first*, those originating in *Self-Love;* and, *secondly*, those derived from the *Social Principle*. And each of these are again of two orders; *first*, those which are excited by the idea of *Good*, under which those connected with *self-love*, are joy, gladness, contentment, satisfaction, complacency, proper pride, desire and hope, and all their variations; and those of the *social principle* are all benevolent desires and dispositions, whether social affections or sympathetic affections, as gratitude, admiration, esteem, respect, veneration, and fondness; the prevalence and due indulgence of all which are *beneficial* as well to the *mind* as the *body; secondly*, those passions, emotions and affection, which are excited by the idea of *Evil*, and are always more or less injurious as well to the *mind* as to the *body;* of these also some are *selfish*, whilst others are connected with the *social principle;* of the *former*, are sorrow, grief, melancholy, and their variations, with their correctives, patience, resignation and humility;(*l*) doubt, suspicion, fear, surprise, fright, consternation, terror, horror, dread, anxiety, despair, anger, wrath, resentment, indignation, &c.; those connected with the *social principle*, are malevolent desires and dispositions, false pride, malignancy, envy, rancour, cruelty, rage, revenge, suspicion, jealousy, indignation, contempt, &c.

General influence of *good* passions, emotions and affections, and of those which are *evil*.

The lively yet temperate action of the vital influence of the *good passions*, emotions and affections, constitute an essential part of the perfection of health. The mind, undisturbed by any violent emotion, agitation or depression, is able to exercise its noblest powers, with a tranquil vigour. The body continues in the regular discharge of its proper functions, without the least sensation of difficulty or embarrassment.(*m*) But if influenced by one or more of the *evil passions* or emotions, all or some of the bodily functions become deranged, and the deviation from

is not come yet; I will return to-morrow." Uwins on Disorders of the Brain.

(*e*) The talented Readhead York died suddenly whilst entering the King's Bench Prison, in the act of honourably rendering to relieve his bail from liability, an event which the surgeons pronounced was entirely attributable to mental depression, incident to such an unhappy change of circumstances, without the probability of melioration.

(*f*) Ante, 234; see *Temple* v. *Prescott*, 1 Chitty's Gen. Prac. 76, n. (*q*;) Copl. Dict. tit. Blood, 189.

(*g*) 1 Dungl. Phy. 76; and see El. Blum. 56; post, 318, n. (*p*.)

(*h*) 1 Good, 205.

(*i*) Coop. Dict. tit. Wounds.

(*k*) 3 Bell, 262.

(*l*) Even such corrections, if indulged to excess, may become banefully injurious, as religious fanaticism, brought on by excessive contrition, and frequently terminating in mania; see 1 Paris & Fonb. 314, note (*a*,) 363, and post.

(*m*) Cogan on Passions, 280; and see ante, 311, as to effects of good temper in *causing* full and healthy appearance; and 5 Good, 199, 200.

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perfect bodily health will immediately or soon become lamentably apparent. We have seen that mental emotions will hasten if not occasion the death of consumptive individuals.(*n*)

It would be more pleasurable to examine the happy influence on the health of the body by the presence of the *good and amiable* passions, emotions and affections, especially of hope, joy and love, in their extensive signification;(*o*) but as more connected with the administration of law, we will only state the established influence and consequence of the *evil* passions and emotions, more especially those which may be excited and occasioned by the malevolent and malicious acts of third persons, and which ought to subject them to criminal punishment; for although a person might occasion the death of another, by the sudden indiscreet communication of joyful tidings, and deserve a degree of censure for his want of due caution, yet it would be in vain to contend that he ought to be *punished* for an event not occasioned by any *malicious* act, and therefore our observations will be principally directed to the influence of *evil* passions and emotions. These are principally the malevolently causing fear or terror, sorrow or grief, anger or revenge, jealousy, &c., in a third person, by any malicious invention and communication, occasioning the enumerated unhappy consequences, bodily as well as mental.

Injurious consequences of particular evil passions, emotions or affections, and how they operate on health.

The injurious and baneful influence of evil passions and emotions, are universally admitted, though *how* their effects are produced may not be precisely agreed. Physicians of the present day generally and correctly ascribe the *primary* change produced by beneficial or injurious *passions*, emotions or affections, to their influence upon the *brain* in particular, and from thence diffused throughout the *nervous* system, and by which animated bodies are rendered susceptible of infinite variety of impressions;(*p*) whilst others, though erroneously, have attributed the effects of the passions on the bodily economy to their stimulant or sedative influence, *altering the action of the heart;* and they have accordingly been divided into two classes, one of which is termed *exhilarating*, and the other *depressing*; the former being supposed to *increase*, and the latter to diminish the action of the *heart and arteries.*(*q*) But it has been shown that there is more reason to consider the *brain* as the primary seat of the passions, and to be *directly* influenced by them.(*r*)

In consequence of the influence of the passions, either the system in general or some particular organ is made to deviate from the exercise of those functions on which health depends, or is restored to its pristine office after such deviations have taken place.(*s*) The influence may either be general or local and particular, and when a particular organ, as the heart, may have been previously diseased, the consequence of a less degree of emotion may be more suddenly fatal than if it were in a healthy state.(*t*) Indeed it is a disputed point, whether in any case *sudden death* can be occasioned by the influence of a passion or emotion, as the rupture of the heart or aorta, unless the particular organ were previously in a diseased or a disordered state.(*u*)

Effects of *fear*, consternation, terror, hor-

Fear and Fright, (defined to be surprised fear) *and Terror.*—The changes instantly induced upon the body by *abject fear* have been thus described. The universal rigour, the contracted and pallid countenance,

(*n*) Ante, 119, 313, n. (*n.*)
(*o*) See illustration, Cogan on Passions, 280 to 288.
(*p*) Cogan on Passions, 279; Park's Inq. 231 to 235.
(*q*) Park's Inq. &c. 226, &c.; but where some of the usual conclusions are denied.
(*r*) Park's Inq. 231 to 235; and see Cogan, 279; and ante, 266.
(*s*) Cogan on the Passions, 278, 279.
(*t*) Park's Inq. 231.
(*u*) See post, and authorities collected 2 Paris & Fonb. 26 to 30, and 110; Cogan on Passions, 285, and id. 363, note T.

the deep sunk eye, the quivering lip, the chilliness, torpor, prostration of strength, and insufferable anxiety about the region of the heart, are so perfectly analogous to the morbid influence of excessive cold, to the symptoms of typhus, and the first stage of intermittent fevers, that no one can doubt of the pernicious influence of this passion in predisposing the body to the like diseases, and in aggravating their symptoms; the surface becomes constricted and bedewed with a cold sweat; an oppression is felt at the breast, and often violent beating at the heart; urine and fæces are sometimes passed unconsciously;(*x*) syncope, and, in extreme cases, sudden death has occurred. It is peculiarly dangerous in every species of contagion. It has changed the complexion of wounds, and rendered them fatal.(*y*) It has occasioned gangrenes, indurations of the glands, epilepsies, and the suppression of natural or beneficial secretions; it has induced a permanent stupor in the brain, and the first horrors of the imagination have in some cases made too deep an impression to be effaced by the most favourable change of circumstances. Even joy, though in its nature so pleasing, and in its general effect so salutary, has frequently proved the cause of sudden death;(*z*) it is therefore not difficult to admit that the effects of fear may be able to paralyze the grand organ of circulation, and, like some pestilential diseases, occasion the torpor of death.(*a*) Numerous instances are on record of the attempt of nocturnal house-breaking having induced so powerful an effect upon the nerves of the most sensible and healthy females, as to occasion continued sleeplessness and anxious nights for months, and even decline, if not speedily removed. And parents would do well carefully to provide against the risk of attendants frightening their children, lest their minds should be permanently affected.

ror, surprise, anxiety or dread.(*v*)

Terror is defined to be the *agitation* of *fear;* sometimes producing effects upon the body, common to agitation simply. In some cases it rouses the energy of the system to an unusual degree; and in others, it produces the irregular and convulsive action of the muscular system. Hence it is said to have *caused* in some instances, and in others to have *cured* the attacks of epilepsy and other spasmodic disorders.(*b*) Dr. Frank has given an interesting case of violent carditis or inflammation of the heart, a rare affection, brought on by terror in a prisoner condemned capitally, and it proved fatal; dissection ascertained it to be confined to the heart;(*c*) and terror may so powerfully act upon the mind of a pregnant woman as to produce abortion and death.(*d*)

Effects of anxiety,

The powerful influence of *Sorrow* and the other depressing passions upon the brain and nervous system, will be obvious to every one who

(*v*) See, in general, Cogan on Passions, 291 to 294; Park's Inq. 226 to 235; Fletcher on Troubled Mind, &c. 241 to 244, 250; G. Smith's For. Med. 38; 2 Paris & Fonb. 26 to 30, 110; id vol. i. 127; vol. iii. 14, 145.

(*x*) Park's Inq. 230; Cervantes, in his Don Quixote, when describing Sancho's state, when in a dark night near the fulling mills, facetiously alludes to the natural effects of fear on a low and cowardly mind.

(*y*) Cogan on Passions, 291, 292. The fear and terror incident to a limb having been carried off or shattered by a cannon ball, will frequently of itself occasion death, when the timely tenderness and assurance by the surgeon that the individual will recover, will save life, Coop. Surg. Dict. tit. Gunshot Wound.

(*z*) Cogan on Passions, 285, 286, 292, 363, 364; G. Smith's For. Med. 38; see several instances establishing the necessity for a cautious manner of communicating even joyful tidings. Pliny informs us that Chilo, the Lacedemonian, died upon hearing that his son had gained a prize in the Olympic games. "Cum victore filio Olympiæ expirasset gaudio." Plin. Mag. lib. vii. sect. 7, and there collected other instances; and 2 Paris & Fomb. 27 to 30, and 110.

(*a*) Cogan, 293; Park's Inq. 226 to 235.

(*b*) Cogan, 293.

(*c*) 2 Good, 344.

(*d*) 2 Paris & Fonb. 110. Amer. Cyclop. Prac. Med. tit. Abortion.

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sorrow, melancholy or despair. (*e*)

has experienced or witnessed the stupefaction and horror with which the sufferer is sometimes seized upon the sudden communication of evil tidings; the agitation that immediately succeeds introducing subsequent languor and debility, and the deep melancholy into which the mind subsides after the first conflicts are passed. Excessive sorrow has been the frequent cause of rupture of the heart and sudden death (as occured to Philip V., who died suddenly upon being told that the Spaniards had been defeated, and whose heart, on being examined, was found ruptured,) or of confirmed or permanent melancholy, loss of memory, imbecility of mind, or nervous fevers, and of hypochondriac complaints. (*f*) It renders the body peculiarly susceptible of contagious disorders, occasions the loss of appetite, perpetual *watchfulness*, confirmed apathy to every thing social and exhilarating; and the attention may be immutably fixed upon the cause of its distress, introducing or occasioning the most lamentable diseases, and hastening the dissolution of the sufferer. (*g*) The anxiety and dejection of mind, which usually accompany the scene of misery where illness prevails in a distressed poor family, are sure to influence contagion in typhus fevers. (*h*) Where sudden communication of a distressing event has occasioned death, it is probable that, as in abrupt communication of joyful events, it operates like a stroke of electricity indiscreetly directed; and the violent percussion probably produces a paralysis of the heart by the excess of the stimulus. (*i*) It has, however, been conjectured, that in cases of sudden death by abrupt communications, occasioning either joy, sorrow or fear, the heart and arteries have *previously* been placed in an opposite state by a converse passion. Thus, that in case of death from excessive joy, the subject was either previously decayed, or at the instant deeply oppressed with the opposite passions of fear and anxiety, by which the natural and salutary action of the heart and arteries were greatly impeded, and that this will, of consequence, create a resistance to the impulse of joy, and render it more liable to destroy the tone of that sensible organ; and that in most of the instances recorded, the persons who have fallen a sacrifice to the excess of joy were in that particular situation; nor was there an opportunity given to soften the agony of fear, by a cautious manner of communicating the tidings. (*k*) The effect of mental affliction upon the body as well as mind has also been ably illustrated by Dr. Fletcher in his work, and by Dr. Park. (*l*) Pity is regarded as *sympathetic* grief, and like it may exercise a powerful physical influence over the mind. (*m*) The depressing passions will induce fever; (*n*) and in pregnant women all mental anxieties and miseries increase the danger of miscarriage; (*o*) and Dr. Good observes, that a plump widow has, by weeping, become a skeleton in a month or two. (*p*)

The effect of displea-

Anger and its variations.—As regards *anger*, it rouses all the powers of nature into the most violent exertions; and therefore it is not surprising

(*e*) See, in general, as to the effects of grief. Park's Inq. 237. Jackson, Princ. Med. 252, 253.

(*f*) Cogan on Passions, 284, 285; 2 Paris & Fonb. 26, 27, note (*a*.) See Brous. Phy. 220.

(*g*) Cogan, 290, 291.

(*h*) 2 Good, 171.

(*i*) Cogan on Passions, 284, 285.

(*k*) Cogan on Passions, 285; see other instances, 2 Paris & Fonb. 26 to 30, and 110; where see the apposite authorities.

(*l*) Park's Inq. &c. 237 to 244.

(*m*) Id. 250.

(*n*) Jackson, Princ. Med. 253.

(*o*) Copl. Dict. tit. Catalepsy; and tit. Hysterics. See Dewees, Dis. Females, 451, &c.

(*p*) 5 Good, 200. The effects of passion of the mind on the body, and especially on the countenance, have been thus feelingly described:—

"Danger, long travel, want or *wo*
Soon change the form that best we know;
For deadly fear can time outgo,
And blanch at once the hair;
Hard toil can roughen form and face,
And want can quench the eye's bright grace;
Nor does old age a wrinkle trace
More deeply than *despair*."

Marmion, Canto I.

that its pathological effects should be numerous and severe. Inflammatory and bilious fever, hemorrhage, apoplexy, inflammation of the brain, and mania, have arisen from the increased impetuosity it has given to the vascular system; as also sudden death, either from ruptured vessels (especially when previously disordered) or the excess of its stimulating power upon the vital organs, particularly in plethoric and sanguineous temperaments. Palsy, epilepsy, aphonia or loss of voice, diarrhœas, involution of the intestines, and those diseases which may be attributed to the excessive perturbation of the nervous system, and also to exhausted strength, have too frequently succeeded to its tremendous exertions. In short, as there is no passion so turbulent, so there is none so immediately dangerous as excessive anger. (r) It has been observed that there is little doubt that many persons have been convicted of murder, where the death of the individual in question was the *sole effect* of the high state of irritation in which he had been placed; and death in syncope and apoplexy, and other fatal diseases, may also in certain cases of predisposition result from the same powerful cause; and violent transports of the mind may likewise occasion the *return* of any particular disease to which the patient had been formerly subject, as epilepsy and other spasmodic diseases; they may likewise bring a chronic disease at once to a fatal crisis, as the bursting of an abcess in the liver into the cavity of the abdomen, in consequence of violent passion. (s) In advanced life, serious consequences often result from a violent paroxysm of rage, similar to those produced by excessive grief, such as effusion into the brain, the bursting of a blood vessel, an attack of mania or a fit of apoplexy. (t) *Hatred* is to be regarded as rooted and permanent anger; but its operations are not so violent or injurious to the frame as anger.

sure, resentment, indignation, *anger*, wrath, rage, hatred, rancour, and revenge. (q)

Jealousies are of two descriptions, but that which is most injurious to health is connected with love; and in the extreme contains a complication of the most tremendous passions that can agitate the human breast; and though it has love for its basis, yet it unites the torments of every painful emotion. It suspects equal danger in the most opposite appearances. Every token of innocence is interpreted into proofs of guilt, and every instance of affection as a mark of insulting hypocrisy; under the influence of this baneful passion, the mind becomes at intervals the sport of transporting hope and wild despair, is alternately tormented by fits of rage and the depth of contrition for excesses committed in its transports, uniting the extremes of dreadful hatred and passionate fondness. It entertains the most cruel suspicions of the object it most adores, and is even tempted to destroy that which it dreads to lose. (x) Independently of the melancholy and criminal excesses to which indulged jealousy may stimulate the unhappy victim of the passion as depicted in Shakspeare's Othello, the immediate baneful effects of the passion upon *health* are numerous, exciting to inflammatory fevers, and the whole train of evils proceeding from the excess of stimulus, which it will be needless to enumerate. It has, in consequence of that contrariety of emotions to which the passion of love is subject, occasioned the most dangerous and obstinate maladies, hysteria, epilepsy, hectic fevers, the rage of madness, or

Effects of suspicion, jealousy, &c. (u)

(q) As to the effects of anger, &c. see Park's Inq. &c. 244 to 250; 3 Paris & Fonb. 14. Brous. Phy. 220.

(r) Cogan on Passions, 288; Jackson, Princ. Med. 255, 256.

(s) 3 Paris & Fonb. 14, 15, where see several interesting instances; Dr. Cook on Nervous Disorders, vol. i. 217.

(t) Park's Inq. 246 to 250, where a narrative is stated, illustrating the fatal consequences resulting from the excess of grief and anger.

(u) See Park's Inq. 250 to 255, as to love, from which jealousy springs; Brous. Phy. 223.

(x) Cogan on Passions, 169, 170.

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the still more pitiable state of confirmed and wasting melancholy,(*y*) and not unfrequently even self-destruction.(*z*)

Moral conclusion as regards education and habitual indulgence of passions.

The knowledge of these consequences ought practically to induce every parent and preceptor by education to inform the young of the necessity for self-control, lest the undue indulgence of any passion, emotion or affection, should affect their health and happiness; and as regards the *social principle*, that to become amiable, they should habitually abstain from occasioning mental pain to others, when unhappily the too prevalent want of attention to that regimen encourages in youth so many selfish, morose and malevolent dispositions, dangerous to themselves as well as to the community.

Medical and other remedies.

The mental and medical remedies against the injurious consequences of passions, emotions and affections, would almost obviously be the *removal* of the exciting cause, or counteracting or mitigating its effects;(*a*) and for these purposes it is essential that the physician and the friends of the sufferer should be well acquainted with human nature, so as to suggest to his mind sources of comfort, which, however singularly, are yet known to have powerful influence; thus sometimes the moderate indulgence of a counter passion, even that of revenge by *legal* measures, and the suggestion of the recovery of large damages against a seducer, strangely console the mind of an injured husband; and perhaps an unhappy individual, almost excited to self-destruction by the apprehension of his concealed insolvency becoming known, may be saved by the very fact of its being generally communicated, and the spontaneous liberality of his creditors. The free communication to others of almost every description of grief, when met with sympathy instead of unfeeling opposition, will also almost invariably mitigate the dangerous effects, and unquestionably the administering of the least cordial aliment, recruiting the body, will gradually also influence the brain and mind.

The defective state of the *Law* as regards the punishment of injuries to the passions and emotions.

Although it will be admitted that the true object of law ought to be the security to individuals of the full enjoyment of those endowments with which the Almighty has blessed mankind, yet the English law is singularly defective in the protection of natural passions and feelings from injuries. It in general interferes only when there has been a *visible* bodily injury inflicted by *force* or *poison*, whilst it leaves almost entirely unprotected the whole class of the most malignant *mental injuries and sufferings*, unless in a few cases where, by descending to fiction, it sordidly supposes some pecuniary loss, and sometimes under that mask, indirectly and contrary to its own legal principle, affords compensation for wounded feelings. Thus a parent cannot, in *that character*, sue for an injury inflicted on his child and on his own domestic happiness; nor can he *punish* the vilest seducer of his daughter, occasioning his most agonizing mental sufferings *and her ruin;* nor can he compel the culprit to make even pecuniary compensation, unless the facts will sustain the allegation that the daughter was the *servant* of her father, and that by reason of the seduction he lost the benefit of her services. Nor is there any punishment for many *verbal slanders*, undermining the character of the person calumniated, and occasioning the most dangerous illness, or even death;(*b*) and even where a culprit, in the ab-

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(*y*) Id. 287, 288.

(*z*) See an amusing instance of the effect of jealousy in Fletcher on Influence of a Troubled Mind on Health, 267 to 271, where a wife of twenty was jealous of her husband of sixty, and the cure.

(*a*) See 2 Bell, 90; Cyclop. tit. Antiphlogistic Regimen; and see Copl. Dict. tit. Disease; Cogan on Passions; Fletcher on Influence of the Troubled Mind on Health, *per tot.* with instances; Rush on Diseases of Mind, 314 to 356.

(*b*) In the House of Commons, the Solicitor-General Pepys, on Tuesday, 18th March, 1834, mentioned a distressing instance of such existing defect in our law.

sence of her husband, threatened her that, unless she gave him money, he would charge her husband with the guilt of an unnatural crime, and in the agony of her alarm, induced her to part with her husband's money, it was held, that as the law only extends to extorting money from the *party himself*, to whom the threat was made, this culprit was dispunishable, and at most only compelled by action to return the money, even without interest.(*c*) It is true that our ecclesiastical law, pro salute animæ, punishes every description of unbrotherly or uncharitable calumny, as an offence to morals and religion of a public nature,(*d*) yet their censures and punishments are very inadequate to restrain such injuries, and afford no pecuniary compensation to the sufferer. Nor will the law punish criminally *verbal* imputations, even of the most infamous crime, however alarming and agonizing the consequent sensation, unless it be established that the culprit so acted with a view or intent to extort a chattel, money or valuable security.(*e*) The law in these cases absurdly supposes every one to be *vir fortis*, and incapable of being alarmed or affected by such injuries to the feelings.

Reason why the law has been defective in punishing injuries to passions and emotions, and instances.

Perhaps the reason why the law has been thus remiss in protecting the feelings from injury, is the difficulty of fixing any rule or scale by which to appreciate the injurious effects, for that mental injury which would almost destroy one individual would perhaps not even be felt by another; but when it has been ascertained by medical evidence, to the satisfaction of a jury, that a malevolent injury has been committed for the express purpose of affecting the passions or mental enjoyment of another, there seems to be no reason why the law should not punish the aggressor. It certainly, in a degree, admits the influence of natural passions and emotions as an *excuse* for some acts which would otherwise not be defensible; as if a parent or husband interfere and *beat* a stranger in protection of a child or wife, and use no dangerous weapon, such indulgence of a natural passion is excused,(*f*) although if such relationship had not existed, the act would have been illegal.(*f*) So a husband killing a person in the act of adultery with the wife, although an unnecessary violence, may amount only to manslaughter, in respect of such illegal excitement of his passions.(*g*) But the law does not sufficiently protect feelings and passions by punishing many malevolent acts which may occasion injury without personal violence; thus, the killing a person by fright or alarm is not a felonious murder, but at most is a misdemeanor.(*h*) Nor is the

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A young woman had in early life been seduced by a man of title; but after living with him for a certain time she became ashamed of the course of life she was pursuing, and taking the opportunity of escaping from it, she retired into a distant part of the country, where her seducer was unable to discover her. She obtained a situation, in which she conducted herself with so much propriety that she not only gained the good will of her employers, but was appointed to another situation in a public establishment. Several years after, her seducer discovered the place of her retreat, and having in vain made proposals for the renewal of their intercourse, he hit upon the expedient of depriving her of the means of subsistence, thinking that he should then succeed in his attempt to possess himself again of her person. He therefore published in the town where she resided the history of her early life. The consequence was that the unfortunate woman lost the esteem of the friends her good conduct had procured her, and she was deprived of the appointment by means of which she obtained her livelihood. Was not this woman entitled to compensation? Yet if she had brought an action against her persecutor, he would have justified, and she would have been turned out of court, with the aggravation to her misfortune of having incurred a useless expense." Unquestionably the law affords no compensation in such a case for the *malicious injury* to what might be termed her justly-acquired *recovered character*.

(*c*) *Rex* v. *Edward*, 1 Mood. & Rob. 257, on 7 & 8 Geo. 4, c. 29, s. 7 & 8.

(*d*) Law's Eccles. Law, 47.

(*e*) 7 & 8 Geo. 4, c. 29, s. 7 & 8; and see *Rex* v. *Edward*, 1 Mood. & Rob. 257, supra.

(*f*) 2 Rol. Ab. 546; 3 Bla. Com. 3; 1 Hale, 486; T. Raym. 212; Cro. Jac. 296.

(*g*) 1 Hale, 486; T. Raym. 212.

(*h*) 1 Chit. Gen. Prac. 43, n.; 4 Bla. Com. 197, 201, n. 25.

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most malevolent slander, actionable in a court of law unless it produce temporal injury, although the mental happiness of the party calumniated be most severely injured; and it would be scarcely believed, that if by fraud a party impose upon a wife, and have sexual intercourse with her under the false pretence of being her husband, the *criminal* courts will not take adequate cognizance of this injury to the feelings, because there is an absence of that actual criminal force in general essential to support an indictment for a rape;(*i*) and if a single individual, avoiding conspiracy with another, should diabolically fabricate such a verbal false tale of infidelity in a wife as to stimulate the husband by the mere influence of the passion of jealousy to destroy his wife or himself, it is apprehended that in the present defective state of our law such atrocious act would not be amenable to justice.

In point of *law* it is not murder to work on the *imagination* so that death ensue, or to call the feelings into so strong an exercise as to produce a fatal malady. (*k*) But the law, although imperfect in all that respects the protection of the mind, treats the act of assuming the semblance of a ghost, and terrifying persons, especially in a public highway, as an indictable nuisance and *misdemeanor*, though the unnecessary violence in shooting at and killing a person so guilty has been determined to be murder. (*l*) And the law at least so far regards the *fears* of mankind, when *many* individuals might reasonably be alarmed, that it is indictable as a nuisance at common law to keep large quantities of gunpowder near to the habitations of several individuals, or to a highway, although no actual injury has as yet arisen. (*m*) And it is clear that it is an indictable, and punishable misdemeanor to allow the indulgence of passion or emotion to such a degree as to attempt self-destruction, however stimulating the undergone misery may have been; and we know that if the act be perfected, it will be punished by the forfeiture of the goods and chattels of the felo de se.

With respect to occasioning death by *terror*, it has been observed, that although the proof of the crime may be difficult, yet its perpetration is far from impossible, and it has been suggested that to act upon the mind of a pregnant woman by extreme terror, and so produce abortion and death of malice prepense, would certainly, in a moral view, be murder in its most atrocious form, and that although it might require some ingenuity in framing the indictment, yet as our law is fertile in fictions on less worthy occasions it ought not to allow its just vengeance to be avoided. (*n*) But it is apprehended, that according to the existing law in such a case, no indictment for murder could be supported. (*n*) At least, admitting that there be no adequate scale in which *mere mental* injuries can be justly weighed, or compensation or punishment duly ascertained, yet in all the instances, when through the agency of the nerves, a *bodily injury has also been occasioned* and clearly proved, there seems no reason why the culprit, who has malevolently occasioned it, should go unpunished, and injuries of this nature might be safely left to a jury. The enactment to prevent the moral delinquency in *cruelty* to an *animal* by its owner, was at first ridiculed as an absurd regulation, because it attempted to take into consideration the sufferings of an *animal*;(*o*) but it was soon universally agreed that the enactment had a most salutary operation, not only in restraining cruelty towards an animal, but in repressing that

(*i*) *Rex* v. *Jackson*, Russ. & R. C. C. 487.

(*k*) 1 Hale, Pl. Cr. 429.

(*l*) *Rxe* v. *Smith*, 4 Bla. Com. 201, n. 25.

(*m*) *Rex* v. *Taylor*, 2 Stra. 1167, 1169; see also 1 Par. & Fonb. 352.

(*n*) 2 Par. & Fonb. 110, n. (*a*.) The case of murder by starvation is there referred to, but then there must have been a *legal duty* to provide food or an imprisonment by the delinquent, or he is dispunishable; *Rex* v. *Smith*, 2 Car. & P. 449; 1 Chitty's Gen. Pr. 34, 35.

(*o*) 3 Geo. 4, c. 71, called Mr. Martin's Act, but which of late has been held, does not extend to *bull* baiting, because, although cows and other animals are enumerated, *bulls* are not. *Ex parte Hill*, 3 C. & P. 225.

disposition which might extend its operation to mankind. Surely the same principle ought to be extended to repress all malevolent injuries to the *mind of man*, especially as it has been demonstrated that such injuries may and constantly do occasion most serious injury to the body itself, and frequently even death. Suppose a woman to be pregnant, it is notorious that all anxieties of mind increase the danger of miscarriage,(*p*) and ought not a person maliciously guilty of causing her mental anxiety, with intent to occasion her miscarriage, and succeeding in such attempt, to be equally punished as if he administered a noxious ingredient?(*q*)

If any doubt should exist in the mind of any one, whether our law be not defective in not *punishing corporeally* those who wilfully occasion *injuries to the passions, emotions, affections, or feelings of another*, let him read some of the able speeches of Mr. Erskine, especially those relating to the injuries of adultery and seduction,(*r*) and examine the French law, which is much preferable;(*s*) and consider the numerous instances in which persons who have been injudiciously only fined for an offence recognised by law, have with exultation instantly thrown down the money to the officer, and contemptuously left the court.(*s*)

Section V.—Of the Mind, or Intellectual Faculties.

According to the proposed plan of giving an outline of all the functions and organs, the aggregate of which constitutes *man*, it remains to consider the nature of *mind*, or the intellectual faculties, sometimes termed *soul*, Reasons for inquiring into

(*p*) Copl. Dict. See Rush on the Mind, 356.

(*q*) Id. Catalepsy and Hysterics.

(*r*) See, in particular, Mr. Erskine's speech for the Rev. Mr. Markham, vol. v. 177, 190, 191. And as to the mental sufferings from jealousy, of a seduced and deserted woman, id. 41. Also the debates in Parliament on the Adultery Bill, which was rejected in the Lord's, and so much discreditable levity evinced by some individuals on that occasion; an event which suggests the supposition that meliorations in the law, on these subjects, have been rejected from fear that the legislators themselves would become the first objects of castigation.

(*s*) See fully Palliet, Manuel de Droit Français, ed. A. D. 1818, p. 1115 to 1149, where every description of private injury, and even breach of confidence, by disclosing a secret, is punishable with six months' imprisonment, and in some cases even five years.

(*s*) See Erskine's Speeches, vol. v. 192, Mr. Erskine's observations. In a late instance of a profligate injury to a father by seduction and desertion of his daughter, the defendent insultingly sent the 1000*l.* damages awarded by the jury to the plaintiff by a livery servant, with his compliments, and he would with pleasure send him another 1000*l.* the next morning if he would send his second daughter to him for the intervening night, and he found her agreeable.

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the nature of mind, or intellectual faculties.

and at others, *understanding;* and which are so superior to the mere functions of the *body* and the external senses, passions, and emotions, that they can, and in *legal consideration ought*, so to control and regulate the former as to prevent them from becoming injurious to others, and even from attempting self-destruction. The influence of the *mind* over health, it will also be seen, is singularly powerful; and as questions upon *mental capacity* to dispose of property, and the sustaining a commission of lunacy, and the irresponsibility for crimes, and generally as regards the administration of justice, are of daily occurrence, an examination of this interesting subject appears essential in an outline of medical jurisprudence. It is true that it has been objected that the attempt to define the nature of mind or soul would be as vain and presumptuous as to try to find out by thought alone the nature of the Almighty, or whether he existed before time, or had himself a beginning.(*t*) Anatomists can explain most of the functions of the *body*, because each has its distinct visible organ; but as regards the *mind*, though the brain is considered its organ, yet no one has satisfactorily established in what particular part or by what means it operates; and many physiologists, as we shall presently see, even wholly deny the materialism of mind. All, however, agree, that, in order to our becoming acquainted with the existence of surrounding objects of an external world, three things are necessary; first, sound external senses; secondly, a due maintenance of the nervous and sensorial energy, apparently under different modifications, whereby they are made capable of being roused or excited by the different objects addressed to them; and, thirdly, an exercise of the faculty of attention to the impressions which are thus produced.(*u*) However difficult it may be to define the nature of mind, or this sensorial energy, we have more than once shown that it ought to be considered an indolent method of philosophizing to stop at whatever is not easily understood.(*x*) Besides, some definition and examination of the subject of mind is absolutely essential as regards *education* and all those *mental maladies* which so powerfully influence the body.(*y*) It has been well observed that many of the numerous instances of false sentimentalism, mental extravagance, hypochondriaism, low spirits, fanaticism, and various other mental weaknesses, are to be cured rather in colleges of general instruction than by medicine; for when *all* the faculties of the mind have been duly cultivated, and the social feelings and virtues are thus brought into action, the wild fire influencing persons in those states will burn in vain, and meet with little or no fuel to support its rage.(*z*) The knowledge of what constitutes mind in a healthy state, is also essential to an accurate understanding of what *in law* constitutes the aberration in idiotcy, lunacy, insanity, and incapacity to manage property. Questions upon every part of the subject unhappily are of frequent occurrence.

The nature of mind and intellectual faculties in general.

The term *Mind* (Latin *mens*) has had various definitions, as, the *soul*, the intelligent power, the intellectual capacity, the intellectual faculties, and the understanding. Mind is that within us which thinks, reasons, and is cognizant of sensations conveyed to us through the medium of the senses. It is the power by which we are enabled accurately to perceive and comprehend the visible or probable agreement or disagreement of ideas.(*a*)

(*t*) Shelford on Lunacy, Introd. xxvii. a work of great merit. It will be observed, however, that the learned author immediately after attempts, and with great ability, the very task he seems to decry. On the subject of this section, the student should read Brown's Philosophy of the Human Mind, a work of singular and original merit.

(*u*) 2 Good, 116.

(*x*) Ante, 19; Sir C. Bell's Essays, Pref. 2d edit. xii.; 1 Dungl. Phy. 232.

(*y*) See post, the consequences of excessive mental attention to one subject absolutely occasioning a thickening of the cranium and mental aberration.

(*z*) 4 Good, 106.

(*a*) Locke on Human Understanding; Stew. Phil. of Human Mind; Dr. Browne's Lectures; Id. Inquiries into Intellectual

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It has been well observed that the crowning science of *mind*, although in some respects independent of the sciences of *matter*, is nevertheless closely allied to them, for, at least, it is assumed that the faculties of the mind are originally awakened or called into activity solely by the impressions of matter, although from the poverty of our language all the terms used in speaking of mind and its operations are borrowed from matter;(*b*) besides, many mental emotions are entirely dependent on bodily conditions; and probably if all our external senses were from nativity suspended, the mind would have no actual attainment or intellectual power. The science of mind, therefore, cannot be studied until after or concurrently with the acquirement of knowledge of an external nature. As connected with our present and, still more, our future happiness, the knowledge which we are enabled to obtain of the laws of nature governing the operations of our own mind, must be regarded as the most important of all sciences. *External objects* first impress or operate upon the *outward senses*, which by means hitherto unexplained immediately impress or operate on the mind when in a sound state, or excite in it perceptions or ideas of the presence and qualities of objects.

Ideas or mental images.

The several intellectual faculties, the aggregate of which enables us to judge of the the state of the mind of an individual, and which are in constant though, generally, *unobserved operation*, though varying in strength and degree in different individuals, may be thus explained, The *five* external senses of sight, hearing, smell, taste, and touch, or some of them, convey certain images or ideas of *actual external* objects to the sensorium of the brain, where they are operated upon and rendered useful by the intellectual faculties, and present to the mind what Locke and others have termed *ideas* or *mental images;*(*c*) of these a *simple* effect in any *one* sense produces what is called a *simple idea;* the word idea here signifying an image or representation in the mind of an action or quality; thus, white and sweet are simple ideas. An idea *compounded* of *several* simple ideas is called a *complex*, or sometimes *compound* idea, as man, horse, tree, &c., which are evidently compounds of a number of simple ideas, viz. of figure, colour, solidity, &c.; and sometimes, for distinction's sake, when many complex ideas are compounded in one, the followers of Locke call it a *decomplex* idea, as homicide is a compound of man and killing. Again, impressions on the senses are often so *associated* together that the idea of one will not be recollected without that of the other; so ideas may associate with *impressions*, as if an impression be made on any of the senses while an idea is predominant in the mind.(*d*)

Enumeration of the principal mental faculties. (*e*)

The principal mental faculties are *attention*, *perception*, *memory*, *association*, *comparison*, *imagination*, *invention*, *reasoning*, and *judgment;*(*e*) to which might be added, numerous modifications and variations of these faculties known by different terms; all of which, when the bodily part of our frame, or rather the part termed brain, is itself in a healthy state, operate collectively so as to produce what is termed a *sound mind.* It will be found that these several terms are by no means synonymous, but that each named faculty of the mind differs from the other, though nearly connected with and *graduating into each* other; and one or more of these faculties may be defective in a greater or less degree, while the others remain

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Powers, by Abercrombie; Jackson, Princ. Med. 177 to 260; and all the works on Insanity, post.

(*b*) Thus we are obliged to use the word *taste* as well as regards the relish of food as *mental* taste, &c.

(*c*) Johnson's Dict. tit. Idea. But according to Reid's Inquiry, &c. the supposition that there are what were termed *innate* ideas, or ideas entirely originating in the mind, has been given up by philosophers since the time of Mr. Locke.

(*d*) See Dungl. Phy. 249 to 253.

(*e*) Ante, 287, n. (*o*,) (*p*,) (*q*,) 290, n. (*j*.)

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perfect in the individual;(*f*) but to constitute high intellect, all must exist and combine; and, at least till by repetition in the perception of the same or a similar object, it has become so well known as not to require so much attention, we ordinarily use all or such of the five external senses as can assist in establishing the presence of an object in order to perfect our accurate perception of the same; just as a child, and even a man will, until experience has rendered it unnecessary, extend his hand to *feel* an object, although he has the full use of his eyes.(*g*) All preceptors of youth, all medical practitioners, and all concerned in the administration of justice, who may have to decide on questions of idiotcy, lunacy, insanity, or mental imbecility, ought to examine each of the several mental faculties separately, and endeavour to discover the state of weakness or derangement, and which faculty in particular it affects, and the consequences, and the best physical and moral treatment.

Of attention.(*h*)

Attention, which may be considered as synonymous to *study*,(*i*) has been defined to be that faculty by which the mind *dwells* upon a perception so as to augment its consciousness of it.(*k*) It should precede as well as accompany perception.(*l*) It will be obvious that the accuracy of our knowledge of an external object or idea must depend on the *degree* of *attention* with which it is observed and *examined*, and that unless such object has been for some time not only perceived but *dwelt upon*, and impressed on the brain or in the mind, and there contemplated with interest and desire to retain it, in exclusion for a time of other objects, the image or idea will be no more than a mere passing shadow, or will be confused, leaving no *distinct impression* on the mind, and it will consequently be incapable of retention.(*m*) But when due attention has been evinced, the image or idea will then be sufficiently impressed, and will have become the subject of memory, of which *attention* must in all cases be the forerunner. Attention has a powerful physical effect upon the *body*(*n*) as well as the mind itself when in a diseased or enfeebled state; and as, on the one hand, excessive continued mental attention to any particular subject may actually occasion a thickening of the bones of the cranium and the disappearance of the diploe, and convert the external and internal plates or tables of the skull into one dense bone, and occasion mental derangement;(*o*) so, on the other hand, it is important to health and due mental enjoyment to keep up an habitual stimulus to an adequate production of this sensorial power; for if it do not sufficiently continue, the disorder may ensue which Sauvages termed *melancholia Anglica*, as particularly affecting the English, (although, in truth, the French are still more under its influence,) and which is a general listlessness and disgust, and an irksomeness and weariness of life, often without any specific reason, and sometimes occasioning self-destruction, if the appropriate physical and

(*f*) Per Sir J. Nicholl, in *Ingram* v. *Wyatt*, 2; 1 Hagg. Rep. 401, 402.

(*g*) 3 Greg. Econ. Nat. 421, 425. The application of this truth will frequently detect a fabricated story in giving evidence.

(*h*) See the effects of attention fully considered, Park's Inquiry, 220 to 226.

(*i*) To study is to consider *attentively*. Locke; 1 Dungl. Phy. 249.

(*k*) Park's Inquiry, 220; Greg. Econ. Nat. vol. iii. 423, 424.

(*l*) The term *attention*, as used in military operations, may illustrate the mental operations. Before it is used the soldier is technically termed "*standing at ease*," that is, not *disorderly*, but without any *precise arrangement*, and perhaps wholly indifferent to any particular object; but the instant the command is "*attention*," then he must immediately bend his mind to an *exact attention* to and observance of the operation to be performed. So, antecedent to any mental operation, the mind is "*standing at ease*," but when called to perform an operation it must in the first place observe *attention*.

(*m*) 3 Greg. Econ. Nat. 423, 424

(*n*) Thus it has been well established that close attention to a chess board will alleviate the pain of the gout, and any thing that engages attention, or excites an interest will afford the greatest relief in attacks of the asthma, Park's Inq. 224.

(*o*) Copl. Dict. Prac. Med. tit. Cranium.

moral remedies be not in due time applied.(*p*) Therefore as mental affliction and diseases are the subjects of medical as well as moral treatment, an acquaintance with the moral influence of *attention*, and the important share it has in the performance of the mental functions, is essential to the physician as well as to the moral philosopher, and when properly directed it lays the foundation for the improvement, as it, in fact, constitutes the basis, of every faculty of mind.(*q*)

Abstraction, though sometimes used to denote *inattention* or *absence of mind*, and sometimes the separation of ideas from each other, or of a part of one idea from the residue, also imports any operation which *withdraws the attention* of the mind from a particular idea, and which, as well in bodily as mental diseases, has powerful influence in diminishing those effects which would result from too long continued *attention* to the painful or injurious object. But, in truth, it cannot be justly regarded as a peculiar and distinct faculty, for we have no *direct* power of abstracting or diverting our attention from any idea or sensation, but the faculty of increasing our efforts of attention to *another object*, which operation, however, has indirectly the same effect as positive abstraction.(*r*)

From the defective construction or dimension of the brain of an *idiot*,(*s*) his powers of *attention* are so small that he cannot even *correctly perceive* or *acquire* a new idea, and consequently his memory or recollection of it will be comparatively defective. The legal definition of the term idiot, it is true, is not so limited, but imports a person *without understanding*, (mental judgment,) from his nativity, and whom the law, therefore, presumes never likely to attain any;(*t*) but the actual cause of the defect is his incapacity duly to *perceive*, or rather to *attend* to ideas presented by the external senses, on account of quickness, activity, and motion in the intellectual faculties, and it is rather as a consequence that he fails in memory and other mental faculties, for he can have no memory of what he never *perfectly knew;* and Locke observes, that it is only by *attention* that ideas offering themselves are *taken notice of*, and, as it were, *registered* in the memory; and Watts remarks, that attention is indispensable, because truth does not always strike the soul or mind at first sight, and it follows that he cannot *reason*, still less judge, for what can we reason but from what we know; and it has been justly observed that attention is the mother of memory. In short, the idiot, from *sterility* and natural hebetude, stops short on the very *threshold* of intellect, and therefore can never approach the throne of the mind. He is by nature *stupid*, sluggish or dull, and incapable sufficiently to *attend*. But this refers only to *complete* idiots, for in some idiots there may be considerable power of attention and perception, and a degree of memory, and some progress in knowledge, beyond mere infancy, may have been made by the help of a small degree of attention and by habit and careful education; for which reason, as objected by Lord Tenterden, the mere proof that a person after the age of puberty can count and multiply in an ordi-

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(*p*) See authorities, 4 Good, 107.

(*q*) See fully Park's Inquiry, 225, 226.

(*r*) Park's Inquiry. 223.

(*s*) From the Greek ιδιωτης, Latin *privatus*, signifying bereft or deprived; but still the books do not define of *what* deprived. Johnson's Dict. defines an idiot to be one without the powers of *reason;* but that may be only the result of his incapacity to *perceive*. It seems that ιδιωτης signified originally merely a person of no note, who had not obtained public distinction, one of inferior mind or talent, afterwards it was extended to a rude, ignorant or unenlightened mind, and, finally, it signified simple and foolish mind. It will be observed that idiots have, in general, a small or *compressed* brain, ante, 249, n. (*l*,) 270, 271, n. (*m;*) and hence, it will be found that they rarely even mentally *perceive* accurately, much less associate, compare, reason or judge, and this probably arises from the want of the power of *attention*.

(*t*) Co. Lit. 246, 247 a; 3 Mod. 44; 4 Coke, 126; 1 Bla. Com. 302.

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nary way, which may be acquired by education and habit, is not by any means decisive that he is not an idiot.(*u*) In short, after education, the difference between an idiot and one compos mentis will principally be found in the deficient powers of the former in *reasoning* and *judging* with any ordinary probability of a correct result.(*x*)

Inabilities sufficiently to *attend* to external objects are treated as mental maladies under different terms, as *revery*, which may consist in absence of mind, abstraction of mind, or what is termed brown study; in the first of these the attention is truant, and does not yield readily to the dictates of the will, and this is that absence or vacuity of mind too common in schools over tasks, and at *church* when hearing *sermons*, and is the reason why few profit much from what they read. In the second, the attention is riveted, at the instigation of the will itself, to some particular theme unconnected with the new object presented to the mind; and in the third, the attention has, as it were, the consent of the will to relax itself and be the sport of whatever train of ideas may successively be uppermost or most vivacious in the sensory, and there is no fixed attention to any one or more subjects, and consequently no progress in mental improvement.(*y*) These deviations from useful attention will sufficiently evince the importance of this faculty.

Perception.(*z*)

Supposing the brain to be in a sound state, the image or idea conveyed to it by the external senses, and there viewed with attention, will in general be *correctly perceived* by the mind, which is ever predisposed to accumulate new materials, as corporeally the body hungers after its appropriate food.(*z*) This faculty of the mind is termed *perception*, from the Latin *perceptio*, and defined to be the power of perceiving, or *that act of the mind by which it becomes conscious of any thing*.(*a*) The capacity of perception varies in degree from the idiot to the highest perfection of intellect, and may even in some idiots be greatly increased by the habitual exercise of attention, especially whilst young: some are exceedingly *quick* in perception, whilst others are termed *dull or slow;* but the former may or may not produce advantageous results, depending on the due strength of and due exercise of the other mental faculties. Hence we say, "he is *too* quick," that is, he perceives too hastily, without sufficient attention, or without associating, comparing, reasoning or judging; hence the danger of conceit, which habituates the individual too hastily, and without adequate attention and examination, to conclude that he has obtained a perfect knowledge of a subject.

Memory. (*b*)

Memory is the *third* mental operation, and is acquired only by *attention* to, and due *perception* of ideas at the time they were presented to the mind. Attention has been justly termed the art of Memory, because memory is the natural result of attention and of accurate previous per-

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(*u*) Locke's Essay on the Human Understanding, B. II. c. 12, s. 12 and 13; *Ingram* v. *Wyatt*, 1 Hagg. Rep. 402; post; *Ld. Portsmouth's case*, 3 Addams, 63; *Smith* v. *Smith*, id.; *Harford* v. *Morris*, 2 Hagg. Cons. Rep. 423; and *Bagster* v. *Newton*.

(*x*) *Bull* v. *Mannin*, 1 Dow, N. S. 392; 3 Bligh, N. S. 1.

(*y*) See Johnson's Dict. tit. Revery, referring to Locke. Revery is loose musing, or irregular thought; it exists when ideas *float* in our mind without any reflection or regard of the understanding; that is, when the current of ideas is allowed to pass through the mind, without any one being detained by the will. This is the case in dreams, when the will is suspended. See Dugald Stewart's Chap. on Dreams.

(*z*) See the use of the several organs of external sense, ante, 288, 289.

(*a*) Watts on Mind; Bacon's works; Park's Inq. 220; Dr. Stewart's Outline of Moral Philosophy, 21, 22; Johnson's Dict. tit. Perception. 1 Dungl. Phy. 248.

(*b*) See Greg. Econ. Nat. vol. iii. 436 to 441; Brous. Phy. 120.

ception of one or more ideas antecedently perceived by the mind, with adequate desire to retain it, so much so that in general when we say, "we do not remember," we should rather say that we did not originally attend nor ever *sufficiently perceive*. The art of memory is attention; and memory itself has been defined to be that faculty of the mind, which enables us to *treasure* up and *preserve* for *future use*, the knowledge we have acquired; or, according to Locke, it is "the power to revive again in our minds those ideas, which after imprinting have disappeared or have been laid aside out of sight;" a definition, however, which either evinces the poverty of our language or our inability sufficiently to explain the operations of the mind. We know by experience that it is that faculty, which is the great foundation of all intellectual improvement and accumulation of knowledge, and without which no advantage could be derived from the most rapid and extensive succession and accumulation of new ideas. It implies a capacity of retaining duly perceived knowledge impressed by attention, and a power of recalling it to our thoughts when we have occasion to apply it.(*c*) By the power of memory we are, as Addison observes, perpetually looking back when we have nothing present to entertain us, and in that case the mind resembles those repositories in some animals that are filled with stores of food, on which they ruminate when their present pasture fails; hence the well-known term *ruminating* has been adopted in its application to meditation or deep thought of a subject. Memory is as capable of cultivation and continuance by due exercise of the mental faculty, as the muscular power may be strengthened by its due exercise, hence the necessity of inuring the mind to action and study through every stage of life, by which the young originally *acquire* memory, and the old recruit and continue it, and retain their mental vigour and powers much longer than others.(*d*) As connected with evidence, and though attributable to a moral delinquency of inferior degree, yet as perhaps affording a legal excuse for primâ facie perjury, it is a well established fact that persons habitually telling falsehoods, or making what they would term embellishments, will by often repeating the same fabricated or highly-coloured story, at length be imposed upon themselves by the vivacity of the idea, so as to mistake it for an idea of *memory*, and swear to its existence, they then believing it to be true; and this well established fact might perhaps in some cases prevent such perjury from being deemed wilful, and, if clearly established, exempt from punishment. The consideration of this and all subjects illustrative of the faculty of memory, are highly interesting in a legal view, but a full examination in this part of the work would exceed our limits.(*e*)

So essential is the power of memory to the perfect mind, that in some of our older statutes the expression "*unsound memory*" or "*non-sane memory*" was used to denote as well an idiot and lunatic as every person incapable of managing himself or his affairs.(*f*) It must nevertheless be kept in view that the most superior memory frequently exists in many descriptions of *insanity*, though not so in idiotism, because in the latter the defect is in the *want* of capacity, whilst in insanity it is in its perversion.

But as these three faculties of attention, perception and memory, would of themselves only impress on the mind several single or simple ideas, in order to enable us to associate, compare, reason and judge, it will be found we are endowed with the following other faculties.

(*c*) Locke on the Human Understanding, B. 2, ch. 10.

(*d*) 3 Greg. Econ. Nat. 437.

(*e*) See several valuable observations, Greg. Econ. Nat. 436 to 441.

(*f*) See Lord Redesdale's observations on the words "*non sane memory*," used in the Irish act, 7 Geo. 2, c. 14, in *Carew* v. *Johnston*, 2 Schol. & Lef. 280; and see Lord Coke's observations on *unsound memory*, Co. Lit. 247 a; 4 Coke, 124 b.; and Sir J. Nicholl, in *Ingram* v. *Wyatt*, 1 Hagg. Ec. C. 401.

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Association and comparison.(*g*)

As regards *Association* and *Comparison*, the fourth and fifth faculties, it will be observed, that when a new image has been presented to the mind and duly observed, other new ideas may at the same time be presented, or memory may call to recollection previously perceived images and ideas, which may then be *associated* or viewed together, and *compared* with each other, and their nature and utility thereby better appreciated. The association and comparison of several ideas or images with each other are considered of the greatest importance in the ascending scale of intellect antecedent to reasoning and judgment; for the power of comparing the several properties and relations of material objects, and of reasoning analogically concerning them, and the power of abstraction and that reflex operation of the mind by which it is enabled to review its acquirements and to contemplate its own faculties and operations, which leading to the discovery, almost to an affinity, of new truths and probabilities, are the inexhaustible sources of the extension of knowledge. Locke observes, that "those who cannot distinguish, compare and abstract (that is separate) ideas, would hardly be able to understand and make use of language, or judge or reason to any tolerable degree;" and by selecting particular ideas and dwelling upon them, we are enabled to compare them and observe the relation between them, reason upon them and improve the judgment;(*h*) and it has been considered that by ideas happily thus associated and running together in trains, we lay our chief dependence in sowing the seeds of organized systematic education, and in acquiriug our entire stock of perceived ideas, and consequently a knowledge of sciences. But sometimes unfortunately some of our ideas may have been *erroneously associated*, and hence arise the frequent whims, prejudice and eccentricities, that occasionally cannot be readily overcome; and when the body has been enfeebled by diseases, these frequently become banefully influential.(*i*)

The observance of the operation of the faculty of *association*, as indeed of all the other faculties of the mind, separately and collectively, may be found of great practical utility to lawyers; it may enable them to detect imposition and fabricated tales; thus it is well known that from natural association of concurrent ideas, eye-witnesses, when describing the truth, naturally relate *in the due order of time* as the facts arose without any express study or design of doing so; whilst it is frequently otherwise in fabricated stories.(*k*) Therefore, if a witness of ordinary intelligence *reverse* the order of pretended events, or *afterwards* desire to interpolate a fact, it will be a fair inference that his tale is fabricated; and for the same

(*g*) As to *Association*, in general, 3 Greg. Econ. Nat. 429 to 436; 3 Bost. 165 to 169. The utility of *association*, as regards memory, is singular. If the recollection of one idea or event be exerted, it will usually follow in evidence that the recollection of the associated idea will also be revived; 1 Bost. 165. This truth is often practically illustrated in the examination of witnesses in courts of justice, where the just rule is that a counsel cannot put what is termed a *leading* question to his own witness, that is, the question must not be put to him in such a manner as directly to suggest a favourable answer; but it is allowed to suggest any association of ideas, and thus elicit a recollection of the principal fact desired to be proved. Starkie on Evidence.

(*h*) Park's Inq. 225.

(*i*) Park's Inq. 225; 4 Good, 45. The following quotation may illustrate. Thus, "He that has got the ideas of numbers, and hath taken the pains to *compare* one, two, and three to six, cannot choose (that is, fail) to know they are equal."—*Locke*. So, "if we rightly estimate what we call good and evil, we shall find it lies much in comparison."—*Locke*. "They, measuring themselves by *themselves*, and comparing themselves among *themselves* are not *wise*," 2 *Corinthians*, x. 12. Again: "No man can think it grievous, who considers the pleasure and sweetness of love, and the glorious victory of overcoming evil with good, and then *compares* these with the restless torment and perpetual tumults of a malicious and revengeful spirit."—*Tillotson*. Also, "I will hear Brutus speak, I will hear Cassius speak, and *compare* their reasons."—*Shakspeare*.

(*k*) Hartley on Man; 3 Greg. Econ. Nat. 434.

reason, when upon a witness being required to repeat his narrative, omits or transposes any material fact, suspicion of his veracity may be justly excited. These few established truths evince the importance to lawyers of some examination of mental operations.

Imagination, invention, and genius.(*l*)

Imagination, the sixth faculty, is purely intellectual; and yet its effects upon the body are powerful. Whilst *memory* is the actual recollection of some image antecedently in fact presented to the mind, imagination is the *invention* of the mind, of a supposed similar object, either the same or variously modified. When the mind has been stored with correct ideas, either obtained from the perception of external actual objects, or from the operations of its own powers, it can combine these ideas in various forms, and dispose them in *new trains*, and that operation constitutes what is termed *imagination*, which becomes the source of a new set of ideas and feelings, often more powerful than those immediately derived from the direct impressions of external objects. The term imagination, from the Latin *imaginatio*, is used in different senses, as "fancy, or the power of forming ideal pictures; or the power of representing things absent to one's self or others;" or "a conception or image in the mind, an idea;" and sometimes it imports "an unsolid or fanciful opinion." Glanville observes, that "our simple apprehension of corporeal objects, if *present*, is termed *sense;* if *absent*, *imagination;* and when we would perceive a material object, our fancies present us with its idea;" whilst Bacon defines imagination to be "*the representation of an individual thought;*" and to be of three kinds, namely, imagination joined with belief of that which is to come; joined with memory of that which is past; and of things present, or as if they were present; for I comprehend in this *imagination* feigned and at pleasure, as if one should imagine such a man to be in the vestments of a pope or to have wings."(*m*) After observing the apparent connexion between cause and effect, we learn by the aid of imagination, memory and attention, so to modify them as to produce new results, and thereby acquire the talent of *invention*.(*n*) It has been usual to suppose a great distinction between invention and judgment, as if they were distinct powers of the mind, and not the same power differently employed. But it has been correctly observed that the only two great distinctions in the human mind are *memory* and *genius*, which certainly do not always meet in the same person; and the assigned reason is that where there is *great memory* there is a kind of inertness in minds of that cast, which enables them to retain a great number of ideas, but disables them from separating, analyzing or making new combinations, so essential to imagination, invention and genius. This will account for persons of a very strong memory complaining that when they attempt to compose, they experience great difficulty, from being incumbered with the thoughts, sentiments, and even the exact language of other authors.(*o*) So long as imagination is controlled by the other faculties of reason and judgment, it is, perhaps, the most useful and ornamental faculty of man, since it leads to those *improvements* and *inventions* so advantageous to society; but if not so controlled, it withdraws the mind from sober and important pursuits of life, weakens the attention, and finally impairs, if not destroys, the judgment.(*p*) Imagination has been termed the mother of *invention*, or the discovery of something new, as the suggestion of the mind in imagination must necessarily precede the invention itself, as will be presently explained.

(*l*) See an entire chapter on Imagination and Invention, 3 Greg. Econ. Nat. 442 to 445; and Akenside's beautiful work on the Pleasures of Imagination, especially, "*Say, why was man, &c.*" 3 Bost. 186 to 189.

(*m*) And see Johnson's Dict. tit. Imagination; 1 Dungl. Phy. 250.

(*n*) Park's Inq. 225.

(*o*) 3 Greg. Econ. Nat. 441 to 445.

(*p*) Stewart's Phil. Human Mind, vol. i. ch. 7.

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The effect of imagination on the state of the body.

Although *imagination* is a faculty *purely* of an intellectual nature, yet its effects upon the body are so remarkable that it is properly a subject of a physiological as well as pathological nature,(q) and that many facts clearly prove that the imagination can affect not only the nervous system, but that it can act upon the circulation, respiration and digestion; in short, that imagination is one of the most important agents in the animal economy. In medical practice it presents at one time the most powerful obstacle, and at another the most active assistant to the exertions of the physician.(r) We may here observe, that the circumstance of a person supposing that he has seen an apparition or supernatural representation, is medically considered not to afford evidence of *insanity*, but at most of weak intellect or weakness attributable to fever or temporary causes.(s)

Reason.(t)

Next comes the power of *reasoning* (Latin *ratio*, and French *raison*,) upon all the ideas conveyed to or imagined in the mind; and reason is defined to be a chain of *subordinate* or *intermediate* judgments, following and depending upon one another, by which some *general conclusion* or *judgment* is attempted.(u) It is the ability by which we can distinguish truth from falsehood, and right from wrong, and by which we are enabled to suggest means for the attainment of a particular end, and reasoning is a chain of judgments founded one upon another.(x) It is defined to be the power by which man deduces one proposition from another, or proceeds from premises to consequences. But, as observed by Locke, *reason* is, in the English language, sometimes taken for true and clear *principles*, sometimes for clear and fair *deductions*, and sometimes for the cause, particularly the *final cause*. This power of reasoning is by far the most important of those faculties termed intellectual, for it is on the right use of this power that our success in the pursuit both of knowledge and of happiness depends, and it is by the exclusive possession of it, at least in degree, that man is distinguished in the most essential respects from the rest of the animated creation. It is indeed from their subserviency to the operation of reason, that the other mental faculties derive their chief value.(y) *False reasoning* will be found in general to depend upon a false or unnatural association of ideas;(z) it may also depend on a false judgment; and this state of the mental faculties is usually presented in insanity and in monomania, as regards the particu-

(q) Ante, 299; 3 Bost. 187; and as to the effect of imagination, as may regard medical agents, id.; and see Copl. Dict. tit. Diseases; Park's Inquiry, 225, 226; as to the physical effect of attention over bodily pains, id. 220 to 226; and as to illusions, 4 Good, 101.

(r) 3 Bost. 161 to 163, where see singular instances, and of one affecting the learned author himself in fever.

(s) *The King* v. *Llewellin Jones*, indicted for shooting at W. Miller, and dangerously wounding him with intent to murder, and found guilty, 21st March, A. D. 1834: Mr. Barnes, a surgeon, in answer to evidence that the prisoner had previously supposed that he had seen an apparition, deposed that "a belief of having seen apparitions is a proof of great *weakness* of mind, but not a proof of derangement; it arises from weakness of intellect." And see 3 Bost. 161 to 163, where he relates such a state of mind on himself, whilst labouring under a fever; and Dr. Ferriar, in his Theory of Apparitions, observes, "that partial affections of the brain may exist, which render the patient liable to *imaginary impressions*, either of sight or sound, without permanently disordering his memory or judgment. From which peculiar condition of the sensorium we conceive the best supposed stories of apparitions may be completely accounted for;" and see Sir W. Scott's letters on Witchcraft, &c., where some interesting cases are recorded.

(t) See 3 Greg. Econ. Nat. 447, 481 to 487; 1 Dungl. Phy. 250.

(u) 3 Greg. Econ. Nat. 447, 481; but I have ventured to introduce the words in italics; and see Hobbes' Leviathan, pt. i. c. 5.

(x) 3 Greg. Econ. Nat. 447.

(y) Stew. Phil. Human Mind, vol. ii.

(z) 3 Greg. Econ. Nat. 481.

lar subject of mental delusion.(*a*) The power of reasoning in the *idiot* is exceedingly limited, although he may, by education, acquire a habit of assuming the semblance of reasoning, even more frequently than the wise, but he either suddenly stops before he attempts to arrive at a conclusion, or comes to an erroneous conclusion: whereas in *insanity*, except as regards the particular subject of delusion, the power of reasoning frequently continues undiminished, and sometimes is very acute,(*a*) for which reason the more comprehensive term "*unsound mind*" has been preferred in law.

Judgment. (*b*)

Judgment (synonymous to opinion or decision) is the faculty or power of discerning the correct relations between one term or one proposition and another. It enables us, after having exercised all the preceding faculties, and reasoning upon certain established facts, to arrive at and pronounce a correct *decision* on the result, and upon the proper course to be observed, or, according to Locke, it is that faculty which God has given to supply the want of *certain* knowledge, and thereby the mind takes any proposition to be true or false without perceiving *demonstrative* evidence; while Watts observes, that *reason* ought to accompany the exercise of our senses whenever we would form a just judgment of things proposed to our inquiry. It has been justly observed, and as regards the *legal profession* should ever be kept in view, that errors in decision or judgment do not so often arise from any fault in the mental faculty of reason, but more frequently from the imperfect materials upon which the decision is founded, as either from a want of sufficient facts, or from a want of due attention to or comparison of them, or a too hasty examination of one or any number of them, or from not recollecting all the chain of analogies, or the different links of relation, by which the various parts of evidence or facts are connected with the general conclusion, or from the interference of unfounded belief, prejudices, or passions. Every person, even of the soundest mind is liable to be incorrect in judgment if he speak (as too many rashly do) upon subjects with which he is not sufficiently acquainted, or if he attempt to give an opinion on a point which requires for its decision more facts than are laid before him; for it is evident that the judgment in such cases is founded on a partial view of the subject, and many facts which are not examined may stand in opposition to the general conclusion or judgment he forms. The mind requires to be *habituated accurately to peruse and to dwell* on each fact which has relation to the question, and essential to be considered in forming a judgment, and then to associate, compare, and reason upon the aggregate. And such *system* of attention, examination, and contemplation ought to be pursued by *unvarying habit*, for otherwise the individual will eventually become hasty, rash, precipitate, and erroneous in judgment, and consequently not to be confided in. Goodness of memory of all sciences, rules, and data connected with the question upon which the judgment is to be given, will also be as essential as facts strictly so termed; for otherwise such technical rules may be forgotten, and judgment contravening them, will necessarily be erroneous, at least as regards practical utility. Judgment has been described as *a cool and slow faculty*,(*c*) hence in describing the converse, we use the terms "hot headed," and "hasty judg-

(*a*) See post, and the instances collected by Lord Erskine, in the defence of Hadfield, vol. v. of speeches.

(*b*) See 3 Greg. Econ. Nat. 432, 433, as to *common sense* being that judgment usually incident to all persons; and see an entire chapter on judgment, id. 445 to 448; and Locke on Human Understanding, B. 2, c. 33; 1 Dungl. Phy. 250.

(*c*) Judgment, a cool and slow faculty, attends not a man in the rapture of poetical composition. Dennis. See Brous. Phy. 120.

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ment," as a decision without due consideration. Even amongst persons allowed by law to be classed amongst those of *sound mind*, there are great variations in the *degrees* of judgment, from the highest pitch of excellence to that of a considerable degree of weakness; and hence Pope has observed. "'Tis with our judgment as our watches, none go just alike; yet each believes his own;" and although secretly each may know that he has neither correctly attended, perceived, remembered, associated, compared, or reasoned before he decided, yet from the fear of the imputation of slowness or indecision, he will venture to pronounce a judgment upon unknown premises.

The faculty of *judgment*, however, is generally supposed not to exist in either the idiot or the *wholly* insane, or in partial insanity, termed monomania, excepting in matters *not connected* with the particular illusion,(*d*) though his judgment for many other purposes may be perfect, and he may be legally liable to punishment for his crime not attributable to such particular defect, if the jury should believe that at the time he committed the act he knew he was committing an offence against the laws of God and nature;(*e*) and as *judgment* is essential to a perfect mind, it was held that a *non compos* ought not to sit as a judge when he is to decide on matters of fact, though he might, perhaps, act in some respects *ministerially*;(*f*) and for the same reason a *non compos* cannot act as an attorney or solicitor,(*g*) or as an arbitrator,(*h*) or as a guardian(*i*) or executor, for being unable to manage his own affairs, he is equally incompetent to manage those of others, still less to make an award, which requires not only mental perception but reason, and above all judgment.

Import of term common sense.

As a result of reasoning and judging upon *common* or ordinary objects, perceived nearly alike by *all* mankind, there is a degree of judgment termed *Common Sense*. As our judgments, opinions, or conclusions (terms which are synonymous,) are chiefly exercised in discerning and judging of the several relations of things, and as the perception of external objects are nearly alike in all men, there is also a similarity in the accuracy of their perceptions, though there are different degrees of vividness, depending upon difference of *attention*. Simple perceptions and their relations are, we have seen, the materials on which the intellects of men are alike exercised, and they are in mankind, though more or less in degree, laid up in all minds by association, and it is in following those associations that the mind brings back before it the relations of which it is to judge, and if the perception of relations be similar, so will those associations be in *common* with the *most part* of man; and though there may be great difference in the judgments of different men, yet there are so many circumstances of human life in *common* to *all* men, that there must be so much similarity as to establish a *common sense*, that is, perceptions, relations, associations, and judgment; in which *all agree;* and when any particular man differs from *all* others in these respects, he is said not to have *common sense* or not to be in his senses, or to be insane or *delirious*, a term then employed to denote *every* mode of error. *Delirium* has, therefore, been defined to be a *false judgment*, arising from *erroneous perception*, or from *false recollection*, and in general producing disproportionate emotions.(*k*)

(*d*) See post, 348; Lord Erskine, in his speech for Hadfield, Speeches, vol. v. appears to have assumed that the will of a monomania "is void; although it have no relation to the subject of illusion;" *sed quære*, see post, 348.

(*e*) *Rex* v. *Offord*, 5 Car. & P. 168; and *Bellingham's case*, Collinson on Lunacy, Addenda, 630.

(*f*) Bryd. 65, 85; Bro. Abr. 258 a.

(*g*) Bull, ch. 126.

(*h*) Bryd. 58.

(*i*) Co. Lit. 88 b; *Ex parte Brydges*, 2 Fonb. Treat. Equit. 249, n.

(*k*) Dr. Cullen's work, edit. by Dr. Caldwell; as to delirium, see *Brogden* v. *Brown*, 2 Addam's Rep. 441.

But the diseases of the mental faculties will be more properly considered in the next part.

The conjoint use of these faculties, and expediency of observing the operation of each.

It will be found, that each of these intellectual faculties, the aggregate of which constitute Mind, however apparently mysterious on account of there being no known part of the brain by which the operation is performed, as is the case with regard to the *corporeal* functions, are yet capable of explanation and illustration even to the mind of a child, and should unquestionably form a branch of education, as calculated to enlarge the understanding and impress the necessity for the *constant* and *systematic* exercise of each faculty in due order towards the completion of every mental operation.(*l*)

Full mental enjoyment the result.

Endowed with these intellectual faculties in full vigour, man, although imprisoned or in solitude, deserted by all, and even excluded from every new external object, may still greatly improve the active principle of his mind, and support a cheerful, and even useful existence of, perhaps, permanent benefit to mankind.(*m*) These enable man, after having enjoyed the advantages of education, and an acquired store of ideas, to cultivate and improve each moment of time, even more effectually than by acquiring new ideas, since strength of mind or intellect is better acquired by a *comparison* of and reasoning upon those ideas which we have already attained, than by an accumulation of new ideas.(*n*) These enabled Milton, when bereft of sight, so *luxuriantly* to describe the beauties of nature, and the beneficence of the Almighty.

The observations of some of the best authorities on mind and materialism.

This concise outline relative to the mind or intellectual faculties, in its *sound* state, might suffice, but as there have been diversities of opinion respecting the nature of Mind, and especially on the doctrine of Materialism, it may now be expedient to condense the observations of some of the best authors on the subject.

Blumenbach observes, that "*Animals* enjoy *mind* and possess *brain.*"(*o*)

(*l*) The invention of a chain, and afterwards of the chain cable, it is well known, was attributable to such a mental process. Thus, a man accidentally curved the forefingers of each of his hands, so as to make parts of a circle, and then placed one within the other, and pulled in opposite directions; he perceived, and then observed with *attention*, that whilst the fingers were retained in this position they formed an inseparable link or connexion to the two hands and arms; he then *remembered*, that two or more things, when connected or linked together, constitute a continuation of double or treble the length of each connected article; and he *desired* to *invent* some instrument enabling him to lower a bucket to a considerable depth, and draw up water to a height above. His experience then suggested that iron is constituted of tenacious materials, and, however hard, is yet capable, when heated, of being bent into the form of a ring; and then his *imagination* suggested that several distinct pieces of iron might be made and welded one within another, and form several rings or links in what is now termed a chain; and having reasoned upon and judged of the probability of success, he perfected his invention. Another individual observed that rope cables were frequently, by the chafing of a rocky shore, worn and separated, endangering the ships by which they were anchored. He tried the ordinary chain for the use of a ship, but he soon observed that the strain of a storm frequently elongated the circular links, and rendered them elliptic, and by such change in form destroyed the tenacity, and severed its parts, and, therefore the cable gave way; his imagination then suggested that such rupture might be prevented, if he, in the first instance, formed each link in an elliptic form, and placed a stay with broad ends in the centre, supporting the sides when strained; and he perfected such invention, obtained a patent, and realized a fortune. *Brunton* v. *Hawkes*, 4 B. & Ald. 541.

(*m*) Of these, in general, see Locke on the Human Understanding; and as a useful summary, 3 Greg. Econ. Nat. 416 to 448.

(*n*) Wynne's Eunomous; see also Dugald Stewart, *passim*.

(*o*) Thus, external objects are by them mentally perceived, and in a degree con-

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Extract from Blumenbach, translated and annotated by Dr. Elliotson.

But in respect of the intellectual and moral principles of *man*, our nature does not admit of *comparison* with that of any other inhabitant of the globe, the difference between our constitution and theirs being a difference not in *degree* but in *kind*.(*p*) In the external senses, of at least smelling, hearing, and seeing, man is surpassed, and many animals have a sense or instinct not possessed by or known to us.(*q*) But in the higher and mental faculties there is no comparison between the capacities of animals and man. A savage may in some manner seem little superior to an ourang-outang, but if instruction be offered to both, the former will gradually develop the mental powers of man in all their noble superiority, while the latter will still remain an ourang-outang. The excellence of man's mind demonstrates itself chiefly by his *powers of acquiring new ideas*, and by his voice and hands. Witness the infinite variety and the *depth* of thought expressed by means of words, his *great reasoning* powers, his *ingenuity*, his *taste*, his upright *religious* and benevolent feelings; his manufactories, his galleries of the fine arts, his halls of justice, his temples and his charitable establishments. Besides the qualities common to all animals, each of which he, like every animal, possesses in a degree peculiar to himself, and some, indeed, in a degree very far surpassing that in which any brute possesses them; for instance, benevolence, mechanical contrivance, the sense of music and language, and the general power of observation and inference respecting present circumstances, he appears exclusively gifted with at least feelings of religion and justice, with taste and wit, and with decided *reflecting* faculties of *comparing* and *reasoning* on causes which no animal possesses.(*r*) It has, however, been observed, that from the most ancient period down to the present day, no philosopher has been able to proceed beyond generalities, nor has any one made the least progress in the precise knowledge of the true nature of man, his inclinations and his talents. Hence, we have as many philosophies as *soi disant* philosophers, and hence the vacillation and uncertainty of our institutions, especially of those which relate to education and to criminal legislation.(*s*) In another part of the same excellent work, there is a section expressly upon the *mental faculties*, which deserves attentive consideration.(*t*)

Extract from Bell's Anatomy.

In another able work,(*u*) it is observed that "individually the several organs of *external* or bodily sense or sensation convey but little information to the *mind;* but by *comparison* and *combination*, the simple and original affections or feelings received from them are *associated* and *combined* to infinity, and administer to the *memory* and *imagination*, to *taste*, *reasoning*, and *moral perception*, to the *passions* and *affections*, and every active power of the *soul*.(*u*) The office of the nerves is to communicate, and of the brain to receive, the impressions of external bodies, by which corresponding changes and representations are made in the mind. We know nothing further than that by the operation of the external or bodily senses, *new thoughts* are excited in the mind. Between the sensation excited in the brain and that organ, there is an indissoluble though inexplicable connexion; the brain itself is not sensible, nor does the eye perceive, but both together give us the knowledge of outward things; but when the sensation is once received and communicated to the brain, it is *treasured* there, and may afterwards be excited independent of the external organ; hence comes the term *internal* senses. With respect to these *internal* senses, it

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sidered and stored in memory, so that if they have been punished for certain acts on one occasion, they will, on a subsequent occasion, recollect and endeavour to avoid similar punishment.

(*p*) El Blum. 541, 543.

(*q*) Id. 543, 545, where see an interesting instance of extraordinary instinct in a wasp.

(*r*) El. Blum. 546.

(*s*) Dr. Elliotson's note to El. Blum. 47.

(*t*) El. Blum. 40 to 50; and see 4 Good, 130; 1 Dungl. Phy. 230 to 281.

(*u*) 3 Bell's Anatomy, 10.

appears that all sensations originate in the *external* senses or organs, receiving the impressions of outward bodies. When this change influences the *mind*, we call it *perception; memory* is the power of *recalling* these sensations, and *imagination* is the power of *combining* them; these are powers of the *mind*, which by the constitution of our nature are gradually acquired to a certain extent by all persons, however uncultivated, and rapidly increased and enlarged by exercise and education. In infancy, the perceptions are simple and transitory, the memory is perfected by degrees, and with the store of ideas already acquired, the imagination is invigorated, but still it is kept limited to the ideas received, not, from, but in consequence of the operation of the external senses. (x) Hence, we have seen, that if a person be *born* deaf and dumb, or at all events deaf, dumb, and blind, he cannot, in general attain intellectual vigour, because he cannot *receive* and *compare* ideas; whereas a person, after he has been educated, having become deaf and dumb, will still continue perfect in mind, at least to a certain extent."(y)

Extract from Dr. J. M. Good, edited by Mr. Samuel Cooper.

Dr. John M. Good has taken a combined view of the principal medical and other authorities upon the subject of the mind and the intellectual faculties, and he "observes, that whatever be the nature of *mind*, it is clear that *the brain is the organ in which it holds its seat, and from whence it maintains an intercourse with the surrounding world.*(z) It is the instrument of communication between the *mind* and the *body*, as well as between the body and the objects by which the body is surrounded; and as a failure or irregular performance of its functions, in various ways, lays a foundation, for an extensive division of *corporeal* diseases, strictly so called; so a failure or irregularity of performance, in other ways, lays a foundation for as numerous a train of *mental maladies*. Of the nature of the *mind* or *soul* itself, we know little beyond what *revelation* has informed us; we have no chemical test that can reach its essence, no glasses that can trace its mode of union with the brain, no analogies that can illustrate the rapidity of its improvements; and hence the darkness which hung over the ancient philosophers, continues to this hour without abatement, and has equally resisted the labours of modern metaphysicians and physiologists. That the mind is an intelligent principle we know from *nature*, and that it is a principle endowed with immortality, and capable of existing after death, we learn by express *revelation* from the God of nature; and with such information we ought to rest satisfied, and, with suitable modesty, direct our investigations to those *lower* branches of this mysterious subject that lie within the grasp of our reason."(a)

"The *external* senses of the *body* just considered, and those of the *mind*, have been thus distinguished from each other; the former are the senses of sight, hearing, smell, taste, and touch, whilst those of the *mind* are the *internal* senses of intellectual *perception, attention, memory, association, reason, judgment, imagination, invention,* &c. as before enumerated. *External* objects first impress or operate upon the *outward senses*, which, by means hitherto unexplained, and perhaps altogether inexplicable, immediately impress or operate upon the mind when perfectly organized(b) and in a *healthy state*, or excite in it *perceptions or ideas* of the presence and qualities of such objects at the instant so presented; the word *idea* being here employed in its broad popular meaning, as importing whatever a man *observes* and is conscious to himself he has in his

(x) Id. 3, 4.

(y) Ante, 288, 289.

(z) 4 Good, 32 to 47; and see Locke on the Human Understanding, b. 2, c. 10; El. Blum. 65, 540; Stew. Phil. of Human Mind; Dr. Brown's Lectures on same subject; Brous. Phy. 119, &c.; 3 Bost. 158, 159.

(a) 4 Good, 32 to 47; Jackson, Prin. Med. 203.

(b) See objection to the expression mind organized, post, 338, n. (e.)

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mind. But the *mind* has various peculiar powers or faculties as well as the body; they are quite as active and lively in their respective functions, in consequence of which the ideas of external objects are not only thus *perceived*, but they are *retained* or remembered, and previous as well as present ideas are compared and associated, then *thought of, compounded, abstracted, doubted, believed, desired, received*, or *rejected;* and hence another fountain, of a very capacious flow, from which we also derive *ideas*, namely, a *reflex* act or consciousness of the mind's *own operations*, independently of *present* external objects, whence the ideas derived from this fountain are denominated ideas of *reflection*. The intelligent and *wise* man is he who having been corporeally duly formed, has industriously laid in and carefully assorted an extensive stock of *intellectual ideas*, as the idiot or *stupid* or ignorant man is he who from original or congenital defect, or from natural hebetude, or having had but few opportunities, has collected and arranged but a small number. The man who accurately discovers the natural relations of his ideas *quickly*, is a man of *sagacity*, and, in popular language, is said to possess a *quick* understanding or *sharp intellect;* the man, on the contrary, who discovers these relations *slowly*, we call *dull* or heavy; if he *rapidly* discover and put together relations that lie remote, and perhaps touch only on a few points, but those points most striking and pleasant, he is a man of *wit, genius*, or *brilliant fancy*, of agreeable allusion and metaphors; but if he intermix ideas of fancy with ideas of reality, those of reflection with those of sensation, and *mistake* the one for the other, however numerous his ideas may be, and whatever their order of succession, he is termed a *madman*, or at least of *confused* ideas or intellect, he reasons from false principles, and has no *judgment*. Finally, our ideas are very apt to *associate* or run together in trains: and, upon this peculiar and happy disposition of the mind, we lay our chief dependence in sowing the seeds of *education*. It often happens, however, that some of our ideas have been associated erroneously, and even in a state of early life, before education has commenced, and hence, from the difficulty of separating them, most of the sympathies and antipathies, the whims and prejudices, that occasionally haunt us to the latest period of old age."(*b*)

"Again, the *mind* has its *feelings* as well as the body, and it is the feelings of the mind which are called *passions;* and in that view *animals* have mind as well as man.(*c*) The feelings of the *body* are numerous and diversified, as those of simple ache or agonizing pain, hunger, thirst, heat, cold, and a multitude of others. Those of the *mind*, at least in man, are still more numerous and more diversified, for they comprise the multifarious train of *Grief, Joy, Love, Hatred, Avarice, Ambition, Conceit*, and, perhaps, hundreds more."(*d*)

"The *Mind*,(*e*) also, is subject to original *malformations and deviations* in structure, either itself or its surrounding cranium, from the highest standard of intellect in various degrees, from the *madman* down to *mere weakness* of understanding, each of them requiring peculiar medical treatment or regimen, and the latter capable, in some cases, by due instruction, of considerable improvement, especially in some particular branch of knowledge, although not in all."

"So the mind is subject to diseases of various kinds.(*e*) It may be-

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(*b*) 4 Good, 45.

(*c*) El. Blum. 541, 543.

(*d*) 4 Good, 46.

(*e*) 4 Good, 46. The term *mind*, instead of the *brain*, its organ, is here incorrectly used. Dr. Burrow, in his excellent Treatise on Insanity, has fully demonstrated the metaphysical absurdity of talking of a diseased or malformed *mind;* it is the *brain* not the *mind* which is diseased; however, this involves the disputed question, whether the mind is or not a *material* substance.

come enfeebled in all its powers, or only in a few of them, or in only a single one. The powers of perception and imagination are frequently disturbed without any excitement of the passions; the functions of the understanding, on the other hand, are often perfectly sound, while the man is driven by his *passions* to acts of turbulence and outrage; and these infirmities, whether of body or mind, may be constitutional and permanent, periodical or recurrent, or merely incidental and temporary. The *body* may be of a sanguineous temperament, of a plethoric temperament, of a nervous or irritable temperament; so the *mind* may occasion an overweening confidence and courage, or be characteristically dull and inactive, or be ever goaded on by restlessness and eager desire; it may be quick in apprehension and taste, but weak in memory, strong in judgment, but slow in imagination, or feeble in judgment, but rapid in imagination; its feelings or passions may be sluggish, or too susceptible, or some passion may be peculiarly energetic, while the rest remain at the temperate point.

"When the corporeal deviations from the standard of high health of the *body* are but slight, they are scarcely entitled to the name of diseases, but when severe or extreme, they become subjects of serious importance. It is the same with the different states of the *mind;* while several, or even all the *mental faculties* are *slightly* weak or sluggish, or inaccordant with the action of the rest, although they may require parental or friendly care, and the cultivation of the strongest parts of the faculties, they are scarcely subjects of *medical* treatment, for otherwise half the world would be daily consigned to a *straight waistcoat;* but, when the same changes become striking and strongly marked, they are *real diseases* of the intellect."

"It is also clear, that the mind and body have, in many cases, a *reciprocal influence* on each other, which is sometimes general and sometimes limited to particular faculties or functions; hence fever produces delirium, and vapours or low spirits dyspepsy."(*e*)

"Moreover, the mind is susceptible of innumerable injuries, as well those of a violent, tangible, or visible nature, directly affecting its organ, the brain, as by those which operate indirectly upon the passions and nervous system, and of which numerous instances will be adduced in the succeeding part."(*f*)

Inference that it is the province of medical professors, parents, &c. to study the mind.

It seems, therefore, clear, that it is an important part of the province of a physician to study the *passions* and the *mental* temperaments and characters of man, especially all the corporeal malconstructions, defects, and diseases, principally in the head and brain, which are the foundation of *mental maladies*, or of any deviation from the soundest and highest intellect, so as to avoid or mitigate or even cure *weakness of intellect* and *insanity* in all its degrees.

Many of the diseases of the mind have their origin and seat in a remote part of the frame, and may be relieved by *local* remedies applied to the latter; but, in general, mental deviations are attributable to the imperfect, or diseased, or oppressed state of the *brain itself*. All these and their remedies will be considered in another part of this work, especially in that relating to *insanity*.(*g*)

The practical application of the knowledge of the temperament, character, and passion of the *mind* and the *intellectual faculties*, is obviously of the highest importance, not only to the medical profession, but to parents, and those who have the education and care of persons of weak or imperfect understanding, and all concerned in the administration of

(*e*) 4 Good, 46. (*f*) Post, 350, 351.
(*g*) Jackson, Prin. Med. 230 to 245.

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justice. Due attention to regimen, and education adapted to that part of the intellect which is the strongest, may avert or mitigate many of the distressing consequences of mental malady.

Of the doctrine of *materialism.*

Before we quit this subject, it may be proper to advert to the disputed doctrine of *Materialism,* or the connexion of the mind or intellectual faculties with the body in this transitory state. It is agreed, that, the impressions made upon the external senses are carried to the brain and produce what are termed *perceptions,* and these constitute the origin of all our knowledge of the properties and qualities of bodies or substances; although we are ignorant of, or at least imperfectly acquainted with, the nature of the process by which this train of actions is produced; but it appears certain that some *permanent change or impression* is left in some part of the *brain;* because, when a clear perception has once existed, a state nearly resembling it may be produced *without the repetition* of the exciting cause, and the state thus produced constitutes what is called an *idea.* Whereas, in case of blindness from birth, no such idea can exist or be presented to the mind, however perfect the brain.(*h*) But the *cause of mental perception* is unknown, though it is considered certain, that the connexion between perception and ideas is through the intervention of the nervous system. It may be observed, that nothing but experience could teach us that rays of light entering the eye would excite ideas of *vision,* or that undulations of air would impress the ear with ideas of *sound,* and we are wholly unable to say *why* the reverse operations might not have taken place, though we are sufficiently convinced of the fact by uniform experience. From the want of *demonstrative* proof of the *reason* or *cause,* has arisen the great dispute between the *Materialists* and the *Antimaterialists,* and upon which difference in opinion it has been justly observed that the full comprehension of the subject will probably always elude the research of human faculties.(*h*) All that we venture to assume we know, is, that impressions made on our senses by external objects, furnish the occasions on which the *mind,* by the laws of its constitution, (*but what or how constituted we know not,*) is led to perceive the qualities of the external world, and to exert all the different modifications of *thought* of which it is capable.(*i*) Locke has shown that our *mental ideas* are primarily derived entirely from impressions made upon our *external senses,* and he arranged the objects of thought under two great divisions, which he termed ideas of *sensation* and ideas of *reflection;* the *first* comprehending the knowledge which we *immediately* derive from the impression of *external* objects; the second, the ideas which are produced by the operation of the *mind* upon the materials which it had already acquired from the impression made upon the senses.(*k*) The first may be termed *perceptive* ideas, and the second *intellectual* ideas. There is no question in the whole circle of the sciences, which has been more the subject of discussion than what respects the connexion between the *nervous system* and the *intellectual faculties.* Those who are termed *Antimaterialists* contend that the *mental powers,* although connected with the brain, are ultimately to be referred to *something independent of matter;*(*l*) while, on the contrary,

(*h*) This is proved by the circumstance of a person blind from nativity never even in a dream having an idea of what we term sight or of visible objects. But Dr. Bostock insists that new perceptions may be produced in the mind, which had never previously existed, as in case of supposed apparitions, 3 Bost. 157.

(*h*) 3 Bost. 151, 152; 4 Good, 32 to 39; and see Sir C. Bell's Essays, &c. 11, 15 to 29.

(*i*) Professor Stewart's Elements, sect. 4, vol. i. 99; 3 Bost. 148.

(*k*) 3 Bost. 149 to 150.

(*l*) What extent of mental power can exist, if there has been no use of the external senses?

other philosophers, termed *Materialists*, maintain that *the mind is actually seated in some part or parts of the brain, and which, during the present life, thinks and reasons, and is, necessarily, connected with matter*, and can never exist during life but in conjunction with it; and they assert that *thought* is no more than a property of a peculiar kind of *material* existence.(*m*) Dr. Bostock, after observing that the point in dispute has been seldom discussed with sufficient temper as merely philosophical, but as if connected with morals and religion, which it certainly is not,(*n*) sensibly and dispassionately examines the subject, arranging the arguments on each side.(*n*)

Arguments in favour of the materialists.

The *Materialists* contend that a certain part of the nervous system, viz. the *brain*, possesses a *set of properties* peculiar to itself, termed *mental;* that the same collectively constitute *mind*, and that *mind therefore is a faculty or set of faculties belonging to the brain, just as much as contraction is the property of the muscles*, though we know not how.(*o*) They contend that the enlargement and increased perfection of the powers of intellect in manhood, compared with those in infancy, are to be attributed to due *mental exercise* and employment, and not to any independent invisible agent; and that there is some part or parts in the brain actually influenced as well by substantial and tangible causes, as by emotions and passions, and that the mind therefore is not, as the ancient antimaterialists contended, a mere *ray of divinity* or secret unknown *independent* power; for otherwise, why should not the intellectual faculties be as strong and perfectly intelligent in infancy as in manhood, which, it is admitted, they, in general, are not? Mr. Belsham further clearly states that "when there is an organization, there is no perception; but, that, whenever such an organic structure as the brain exists in a healthy state, perception also exists; and that when such organization is *imperfect*, perception is imperfect; and where the organization is sound, vigorous and healthy, perception also is proportionably vigorous and clear; but when the organization is impaired, perception is enfeebled and obscured; and when the organization ceases, perception appears to cease.(*p*) And it has been urged, why should not the Author of Nature, who has endowed us with the external senses, also endow us bodily with the actual possession of the powers of mind as their result; and why is it that a person born blind, when an adult, though with the utmost as it were *latent powers* of intellect, has never experienced, even in a dream, any thing like what the sense of seeing is described to be?(*q*) So in many diseases, such as delirium, fatuity, and frequently in insanity, anatomists have discovered and perceived, though not invariably so, that the brain itself is affected or injured,(*r*) or that the bones of the cranium are in that disorder generally greatly *thickened*.(*s*) And it has on accurate premises been conjectured, that all kinds of madness are attended with some altered circulation or state of the brain or the nerves, and that marks of undue determination of blood to the small vessels of the brain have been visible on dissection in eighteen out of twenty cases;(*t*) and in other cases, although visible changes may not always have been discovered in vessels, which are too minute to admit ocular proof of their existence, yet there

(*m*) 3 Bost. 151, 152.
(*n*) Id. 150 to 155; and see to the same effect, 4 Good, 32.
(*o*) 3 Bost. 151, 152; Park's Inq. 324 to 326.
(*p*) Belsham's Elements, 333.
(*q*) 3 Gregory, 421.
(*r*) Post, 3 Bost; 157, note; see instances in Mr. Erskine's speech in defence of Hadfield for treason on firing at the king, Speeches, vol. v.
(*s*) Copl. Prac. Dic. Med. tit. Cranium, and tit. Cretinism.
(*t*) A. Chrichton on Mental Derangement, vol. i. 138; Park's Inq. 326; 4 Good, 55; 1 Paris & Fonb. 327; 18, 20.

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appears strong ground for believing that in most cases of madness or other deviation from strong intellectual powers, there exists a disorder in the brain itself, which occasions the malady, and changes may exist in the minute vessels of the brain that produce important derangement of function, yet elude the search of the dissector,(*u*) or that the bones of the cranium have too much compressed the brain,(*x*) and that, therefore, *really the brain is the seat and occasion of intellect and of its deviations.*(*y*) And it has been authenticated that Greding found the skull too thick in 151 out of 196 insane persons, and Georget observed it one-twentieth and upwards too thick in 480 out of 500 of the same class of patients.(*z*) The circumstance of *insanity* being hereditary, has also been attributed to a peculiar construction of the head, inducing, at least, a susceptibility or predisposition towards that malady in the successive offspring; and habitual excessive intoxication or indulgence of the passions, which accelerates the circulation, will cause undue determination to the head, predisposing to insanity and ultimately will produce it.(*a*)

When in some kinds of insanity the affection is confined to a particular class of ideas, the impaired tone of the vessels of the brain remaining, after the more active stage has subsided, may be insufficient to excite derangement from *ordinary* impressions, and only productive of injury when any *casual association* brings on the train of ideas connected with that class of moral feelings, whose influence is become too powerful.(*b*) Again, as the weakness of the small vessels of the brain, remaining after inflammation, is seldom to be removed by local applications, but requires constant care in avoiding a repetition of the exciting causes, until time has been allowed for nature to restore their tone; so neither can it be expected, by local applications to remove the morbid irritability of the more delicate and less accessible organ of the mind. Local applications may often be employed with advantage, as an adjunct to other means; but this alone can seldom effect a cure, without what may be termed *moral treatment* being required in addition, which consists chiefly in avoiding every cause likely to produce those feelings or associations, which make a powerful impression on the mind, and induce determination to the brain.(*c*)

The opposite doctrine of antimaterialism.

On the other hand, the *antimaterialists* insist that the mind or intellect and mental powers, although, in some degree, connected with the brain, are ultimately to be referred to something independent of matter, and, consequently, independent *of the brain or any substance in the head or elsewhere;* and they insist that the whole universe displays the most striking proofs of the existence and operation of intellect or mind in a state *separate from organization*, and under conditions which *preclude all reference to that origin*, and they treat the mind as an invisible unsubstantial endowment of the Almighty, unconnected with matter.(*d*)

Upon the whole of the arguments on each side, Dr. Bostock, who is a decided antimaterialist, observes, (but without reference to the numerous instances above collected to the contrary,) that as far as the light thrown upon the subject by *anatomical* examination can assist upon these questions, there have been many observations, and that he considers the result to be *that the greatest disproportion exists between the derangements of the brain and those of the mental powers;* and he insists that after the

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(*u*) Park's Inq. 326, 327.

(*x*) Copl. Dict. tit. Cranium; and id. tit. Brain; and enumeration of instances, ante, 261 (*h;*) and Cyclop. Prac. Med. tit. Neuralgia.

(*y*) Park's Inq. &c. 323 to 328, ante, 273.

(*z*) 4 Good, 55, 56; Cyclop. Pr. Med. tit. Neuralgia, 167.

(*a*) Park's Inq. 323, 324; 4 Good, 60.

(*b*) Park's Inq. 327.

(*c*) Id. 327, 328.

(*d*) Dr. Pritchard on the Nervous System, 52, 53; 3 Bost. 193, note 7; 1 Bost. 320, 328, 329.

most complete state of insanity it is *often* difficult to detect the smallest alteration in the structure of the brain; but that, on the contrary, the brain has not *unfrequently* been found very considerably disorganized, when no defect had been previously observed in the intellect;(*e*) and upon the whole he concludes that *mind* is not a property of the *brain*, or that, at least, it is not so in the same way that contractility is a property of the muscle, or sensibility of a nerve;(*f*) and that as far as we are to be guided in our conclusions by pathological and anatomical considerations in positive *insanity*, the disease of the *mind* is *frequently* independent of or antecedent to that of the *brain*. But he admits that in *delirium*, we may conceive that the primary disease is in the *brain*, and in *fatuity* the *brain* would appear to be imperfect, and incapable of performing its functions, and that there is another state in which the *brain* is *morbidly affected*, so as to convey false perceptions to the *mind*; but where, at the same time, the mind itself is sound, and the individual is consequently aware of the fallacy of his perceptions.(*g*) Upon the whole he denies that it is practicable to connect *particular* injuries of the brain with any corresponding injuries of *particular* mental faculties. The very terms, however, of these expressions(*h*) seem to admit a diffidence on the part of that learned physiologist, almost amounting to an admission of a contrary result, and, coupled with the preceding arguments of the materialists, and the certainty that the mental faculties are often injured by a local blow or other violence upon the head, and that when bones of the head are too thick, idiotcy usually is the result;(*i*) it seems upon the whole to afford just ground for inferring, that there is a specific *and substantial part situate within the head, constituting the organ or cause of intellectual faculties*, and that consequently, *physically* as well as *legally*, remedies and punishments for injuries, which may thus, as it were, corporeally affect the mind, ought to be prescribed. The student, desirous of extending his study upon this interesting subject, will find it discussed, at length, in the works referred to in the notes.(*k*)

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The supposed result.

Upon the whole we will assume that the mind, or intellectual faculties, or internal senses, usually enumerated to be *attention*, *perception*, *memory*, *reason*, *imagination* and *judgment*, (*l*) are actually seated in or proceed from the *brain*.(*m*) and are in that respect *properties of the body*;(*m*) and not, as the ancients supposed, seated in the *diaphragm*,(*n*) nor as in their view, *a ray of the Divinity*,(*o*) and that the extent of intellect or the height of the *capacity* for mental intelligence, actually depends on the size, form and structure of the brain, when not unduly pressed by the surrounding bones;(*p*) and that its actual attainment of perfection, when in a healthy

(*e*) 3 Bost. 157; and id. note 4; and Dr. Burrows on State of Brain in Insanity, 58.

(*f*) 3 Bost. 157; and see ante, 340; but see Park's Inq., &c. 326, 328, 329, as to the difficulty of discovering the altered state of the brain and vessels, although *in reality existing*.

(*g*) 3 Bost. 159, note 161 to 163, and he admits that the appearance to himself of the semblance of an apparition was attributable to the then state in fever of his own brain.

(*h*) "It is *often difficult*," &c., and "has *not unfrequently*," &c., or "*is frequently*," &c.

(*i*) Copl. Dict. tit. Cranium and Cretinism; see Mr. Erskines's speech in defence of Hadfield, Speeches, vol. v.

(*k*) Brown's Philosophy of the Human Mind; Locke's Essay; Reid on the intellectual Powers; 76; Hartley on Man; Cooper's Tracts, 273; El. Blum. 40 to 50, 53, 65, 541 to 550; 4 Good, 32 to 46; 3 Bost. 147 to 189; 3 Bell, 3 to 9; and numerous others.

(*l*) 4 Good, 42; 3 Bost. 164, &c.

(*m*) El. Blum. 65, 540 to 542; 3 Bell, 3; 4 Good, 32 to 47; Jackson, Prin. Med. 188.

(*n*) Coop. Dict. tit. Phrenitis.

(*o*) El. Blum. 66.

(*p*) El. Blum. 68, note P.; 3 Bost. 210 to 212; but see id. 213, where Dr. Bos-

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duly organized state, depends on *due exercise*, and the communications from or by the external senses; because, if born without them, man would be a mere automaton, devoid of intelligence;(q) and we venture to affirm that *a perfect brain is essential to a perfect mind*, though we are unable to say in what way this is so;(r) and that the brain, or rather its product, the intellect, is as capable of being enlarged and strengthened by its due mental exercise and education, as to become *even hereditarily* more perfect; and as the muscle of the body may by appropriate exercise become strengthened, or by inaction wasted, hence the high importance of *enlarged education* generally diffused.(s)

The *legal* view of the mind and intellectual faculties at different ages; and when a person is deemed to be of *sound mind*.

Having thus examined the physiological views of the mental faculties, we will now state the *legal* rules upon the subject; and here we shall find that the law has in general taken an accurate view of the progressive and ascending scale in the development of the mind, although all its regulations are not equally consistent. An infant under the age of *seven* is by law considered incapable of judging between good and evil, and, therefore, is wholly irresponsible for any crime; between the age of seven and fourteen the *presumption* of *incompetency* still continues; but it may be *rebutted*, and if it be expressly proved that the infant was *doli capax*, and could in fact discern between good and evil, then the rule is *malitia supplet ætatem*, and he may be convicted and executed for a capital crime, as arson or murder, though not *rape*.(t) After the age of *fourteen*, the infant, male or female, is in all respects presumed to know the difference between good and evil, and is, therefore, punishable for *crimes of commission*. After twelve in women, and fourteen in males, (the ages of puberty, and when sexual desires begin to influence,) each are legally competent, at least with the consent of parents, to contract marriage, and after the latter age a will of *personalty* will be valid, and contracts not under seal for *necessaries* will be binding; but until *twenty-one*, no deed can be executed, nor would a devise of freehold estate be valid, because until that age has been attained, the mental faculties are not supposed to have been sufficiently developed, or at least they are considered not to have been adequately *practised* and *experienced* to ensure just reasoning and judgment. When we refer to the fact that the brain is progressive in growth as well in size as in perfection until about the age of twenty-one, and when we remember that the mere exercise of the external senses for a short time will not suffice, and that to produce accuracy and perfection, all external objects must have been repeatedly and for a considerable time viewed with attention, to secure accurate mental perception, and afterwards associated, compared, reasoned upon and judged of, we shall find that the law, which must fix some precise periods, has upon the whole been very judiciously adapted to the progress of intellect; and though an exception is allowed at so early an age as fourteen in so important a contract as marriage, yet that has been permitted in respect of corporeal propensities, which it has been supposed it would be impracticable to counteract, but which is still wisely in a degree held in check by requiring the consent of parents. When the

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tock seems to deny that the bulk of an organ has any effect upon its perfection.

(q) 3 Bost. 129 to 130.

(r) 3 Bost. 213.

(s) Many circumstances concur in establishing this position. No doubt, that in general, the children of highly educated persons are more quickly susceptible of education than those of uneducated parents. It has been inferred that the present African is the only resemblance of man in his first creation, and has remained stationary from that time to the present, whilst the other species, especially Europeans and whites, are all from the same origin, having changed their character and improved both physically and intellectually by *civilization and education*, 3 Bost. 242, &c.

(t) 1 Hale, Pl. Cr. 25, 26; 1 Bla. Com. 464.

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age of twenty-one has been completed, and which is always at the first instant of the *day before the anniversary*,(*u*) the party is then in law *presumed* to be mentally competent to contract and perform every act, without the control or interference of any other person; and he who asserts the contrary, must prove the affirmative of his position by explicit evidence, and not by conjectural evidence;(*x*) and when all the mental faculties are in such a degree of perfection as to produce what is usually termed *common sense*, that is, as we have seen, adequate reasoning and judgment upon ordinary subjects like other rational men, then in legal consideration he is of *sound mind*.

Mental defects and *idiotcy, lunacy and insanity and weakness of mind*, and legal consequences. (*y*)

But when all, or at least some of the several mental faculties, which we have thus considered, are so materially *wanting* or *defective*, or so *perverted* as to occasion *erroneous* or *perverted* judgment upon all subjects or upon a particular *subject*, in so material a degree as to constitute what is termed mental *imbecility* or *delusion*, and render it at least uncertain whether the unhappy individual will evince *common sense;* then, according to the nature or degree of malady, he will in *medical* and *legal* consideration be either an *idiot*, a lunatic, or insane, or be of *unsound mind* or *memory*, and certain legal incapacity and responsibility will ensue.

Definition of *idiotcy* and *insanity*, and view of the *legal* incapacities and irresponsibilities of persons affected thereby.

The definition of *Idiotcy*, as differing from insanity, is *imbecility* or *sterility* of mind, whilst in insanity the mind is not imbecile or steril, but the understanding is *perverted*. Perhaps the most comprehensive definitions of insanity are threefold; as, *first*, a chronic disease manifested by deviations from the healthy and natural state of the mind; and such deviations consisting either in a morbid *perversion* of the feelings, affections, and habits; or, *secondly*, of disturbances of the intellectual faculties, under the influence of which the understanding becomes susceptible of hallucinations, or erroneous impressions of a particular kind; or, *thirdly*, a state of mental incoherence or constant hurry and confusion of thought.(*y*)

It has been considered that the true criterion or test of *insanity* (where there has not been any clearly demonstrated *frenzy* or *raving* madness) is the absence or the presence of what is termed *delusion;* and that whenever an individual once conceives something extravagant to exist, which has no existence, and when he is incapable of being *reasoned* out of that absurd conception, then he is to be considered as under a *delusion*, and either an idiot or insane.(*z*) Thus, if a parent should unjustly persist, without the least ground, in attributing to his daughter a continued course of vicious propensities and vices, and use her uniformly unkindly, there not being the slightest pretence or colour of reason for the supposition, a just inference of insanity or delusion is presented to the minds of a jury, because a supposition long entertained and persisted in after argument to the contrary, and against the natural affection of a parent, suggests that he must labour under some morbid mental delusion.(*a*)

The words "*unsound mind*," "*unsound memory*," and "*non sane memory*," were, in the older statutes, and in the ancient law books, in-

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(*u*) See the cases, Chitty's General Practice, vol. i. 776; and post, tit. *Ages*.

(*x*) *Groom* v. *Thomas*, 2 Hagg. Ecc. Rep. 434; *Dew* v. *Clark*, 3 Addams's Rep. 86.

(*y*) Besides the numerous and valuable medical treatises on these subjects in general, the students will find a very interesting modern view in Cyclop. Prac. Med. tit. *Insanity* and tit. *Sound* and Unsound Mind, by Dr. Pritchard.

(*y*) Cyclop. Prac. Med. tit. Insanity, by Dr. Pritchard; see definition of idiotcy, ante, 327, note (*s*.)

(*z*) See observations of Sir J. Nicholl, in *Dew* v. *Clark*, 3 Add. 90, 91; and Dr. Connolly's Inquiry into Insanity, 384.

(*a*) Id. ibid. and 180; and Hag. Rep. 27.

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discriminately used to signify not only lunacy, (which strictly means a madness with lucid or sane intervals,) but also any permanent *adventitious* or *acquired* insanity, as distinguished from *idiotcy*, which usually meant congenital incapacity.(*b*) The recent act, 11 Geo. 4, and 1 Wm. 4, c. 64 and 65, in the enacting clauses uses only the term *lunatic;* but then a subsequent clause declares that that term shall extend to any *idiot* or person of *unsound mind,* or *incapable of managing his affairs;* and the last term may be taken as synonymous to the preceding expression, or at least as a legislative exposition of the term unsound mind, or indeed as of still more extensive signification, namely, *any incapacity* that has, in the opinion of a jury, rendered the individual unfit to be intrusted with the possession or management of his property, and rendering it essential, in their opinion, that a commission of lunacy should be issued against him, so that some person should be appointed to take care of him and his property,(*c*) and this without actually finding that the party is an idiot, lunatic, or insane; so that in a legal view there are now four descriptions of mental incapacity; namely, first, *Idiotcy*, secondly, *Lunacy,* (where the individual is sometimes sane in *all* respects;) thirdly, *insanity*, which may be either general or partial, in the latter case termed monomania; and, fourthly, any such degree of imbecility as to *incapacitate a party to take care of his own property;* and in each of which cases the law interferes, at least, as regards civil cases. Indeed, even before the last act, Lord Eldon and Lord Redesdale, contrary, however, to Lord Hardwick, considered that such a weakness as to endanger the care of property satisfied even the then more strict definition of the term "*unsound* mind." But the express words in the last act, "*or any person incapable of managing his affairs,*" remove all doubt, and, at all events, *practically* afford to a jury the power of finding their verdict, so as to authorize a commission of lunacy, whenever they think that the party has evinced *such a degree of weakness of mind as to be incapable of managing his own affairs*, so that now a jury need not be perplexed with any medical technicality upon the precise nature or name of the mental infirmity, and a commission may now be obtained and supported, if a jury should think fit, against any person whose *mental* faculties are so enfeebled as to render him incompetent to act for himself, without any precise inquiry whether he was born an idiot, or afterwards became insane, or has been enfeebled by old age, or by intoxication, or other means, and the *substance* of the question, at least to a jury impannelled to inquire into the propriety of a commission of lunacy is, whether the party is capable of managing his own affairs?(*c*)

The four deviations of idiotcy, lunacy, insanity, and weakness of intellect.

In *criminal cases*, also, and as regards the protection from punishment for committed acts whilst in a state of mental derangement, the question is simple, and adapted to the comprehension of every juryman, namely, "*Whether at the time the act was committed, the prisoner was incapable of judging between right and wrong, and did not then know that the particular act was an offence against the law of God and nature?* The law presumes the competency, and therefore the question is always presented to a jury upon the negative, which must be established on the behalf of the prisoner; but this point will presently be more particularly considered.(*d*)

(*b*) *Lord Ely's case*, Ridg. P. C. 518; 3 Atk. 171; and see the older statutes, 39 and 40 Geo. 3, c. 94; 43 Geo. 3, c. 75; 6 Geo. 4, c. 74; 7 Geo. 4, c. 57, s. 73.

(*c*) *Carew* v. *Johnston*, 2 Sch. & Lef. 280; and *In re Earl Portsmouth*, 22 April, 1815.

(*c*) And see *Ridgway* v. *Darwin*, 8 Ves. 65; *Ex parte Cranmer*, 12 Ves. 447; 2 Mad. Ch. Pr. 731, 732; Lord Erskine's observations in *Ex parte Cranmer*, perhaps suggested the introduction of the latter words in 11 Geo. 4, and 1 Wm. 4, c. 64 and 65; and see *Sherwood* v. *Sanderson*, 19 Ves. 280; Coop. Ch. C. 108, S. C.

(*d*) Post.

Medical professors, who naturally have investigated every subject relative to the distressing defects in the human understanding more laboriously than lawyers or jurymen can do, have, with a laudable desire to discover the best remedies in all the variations of mental weakness or aberration, long subdivided and assigned particular appropriate names for every deviation from mental perfection, and have assigned the term *Idiotcy* to be properly congenital mental imbecility, or original sterility of mind; and *Insanity*, as a general term, applicable to all other cases, but subdivided as follows: namely, *Lunatic*, for one who has lucid intervals; *Maniac*, or phrensy, for one whose madness is of a more violent description, frequently dangerous; *Melancholic*, when the disease produces constant depression; *Monomania*, where there is delusion only on a *particular* subject; and *Demency*, where there there is by accident or rather adventitious circumstances or old age, as it were second idiotcy or fatuity, &c.;(*e*) and it will be proper to examine the import of each.

Who is an *idiot*, or what is idiotcy or fatuitas.(*f*)

Idiotcy, sometimes called Fatuitas, is usually a congenital disorder, consisting in a defect or *sterility* of the intellectual powers, not like lunacy or madness, which is a *perversion* of intellect; but it may be induced in after-life; and something allied to it frequently appears in extreme old age, or second childhood, when the vigour of the mind decreases, and all the rational powers are enfeebled, and even mania sometimes subsides into this hopeless state.(*g*) An *Idiot* is defined to be a person who has been defective in intellectual powers from the instant of his *birth*, or at least before his mind had received the impression of any idea;(*h*) he is a fool natural, who from his *nativity*, by a perpetual infirmity, must in time appear non compos mentis.(*i*) Therefore, where an inquest found a person "*an idiot*," and added, "not having lucid intervals for the space of eight years last past," although it was considered by Lord Nottingham that the finding was repugnant, yet it was decided good at law, on the ground that the very term *idiotcy* implied an infirmity *a nativitate*, and consequently the finding as to the eight years ought to be rejected as surplusage.(*k*) The grounds for inferring idiotcy assigned in the old books, if taken strictly as a rule instead of an instance, have been considered ludicrous, as "it is he who from his birth cannot count or number twenty pence, nor tell who was his mother, nor how old he is; but that if he have sufficient understanding to know and understand his letters, and to read by teaching or information of another man, then he is not an idiot;" but as observed by Lord Tenterden, the latter part of such definition is contrary to common sense, because as to repeating the letters of the alphabet, or reading what is set before him, a child of three years old may do that, and, therefore, the ability to perform such a task is no proof that a person is not an idiot;(*l*) but it has been justly observed that the slender abilities alluded to were not intended as a precise *legal definition*, but merely as some of many *instances* that might be put of great imbecility of mind, or of a degree of ability; and it is very clearly established that the question whether idiot or not, must be decided by a jury, after hearing all the evidence.(*m*)

Such definition, however, gave rise to an absurd notion, and, indeed,

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(*e*) And see other varieties, 4 Good, *per tot.*

(*f*) G. Smith, For. Med. 426 to 428, under title Fatuitas; and see medical view, 4 Good, 130; see also Ryan, Med. Jur. 279.

(*g*) G. Smith, For. Med. 426.

(*h*) Id. note (*a*.)

(*i*) Co. Lit. 246, 247 a; 4 Coke, 124; 3 Mod. 44; 1 Bla. C. 126, 302; 4 Bla. Com. 25.

(*k*) *Prodgers* v. *Frazier*, 3 Mod. 43; 1 Vern. 16.

(*l*) *Ball* v. *Mannin*, 1 Dow's Parl. Cases, New Series, 392; and 3 Bligh's Rep. N. S. 1 S. C. observing upon Fitzherbert's definition, Fitz. N. B. 583, 283; but see Lord Eldon's observation in *Sherwood* v. *Sanderson*, 19 Ves. 286, post, 352, 353, Evidence; and see *Lord Downegald's case*, Ves. scn. 407.

(*m*) Bac. Ab. tit. Idiots and Lunatics, A.

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legal rule, still standing uncontradicted in many of our law works, namely, that persons born deaf, dumb, and blind,(*n*) or even deaf and dumb, though seeing, must necessarily be idiots,(*o*) on the ground that as the external senses are the only inlets of knowledge, when such important inlets have been closed, all ideas and associations belonging to them must be wholly excluded from their minds, and therefore they must as of necessity be idiots.(*o*) But even in the older books, though this *presumption* of law was indulged with respect to a person born deaf and dumb, (and we have seen that a suspension of speech is usually an incident of congenital deafness,(*p*) yet it was admitted that if it were made expressly to appear by distinct evidence that the unfortunate individual had the use of understanding, (which many of that condition had discovered by signs to a very great extent,) then he might, on attaining twenty-one, claim possession and management of his real and personal estate;(*q*) and he might be tried for a criminal offence, and suffer judgment and execution, but that great caution should be used therein.(*r*) It has been ascertained by post mortem examination that when a person has been born deaf, dumb, and blind, there has not always, or even generally, been found any peculiar appearance in the brain, or that it has been in any respect defective, or unduly pressed by the bones of the cranium, and hence it may be inferred that the use of one or more of the external senses has been destroyed or suspended by some local defect not at all arising from or accompanying or connected with any defect in the mental faculty.

Locke's description of the term *Idiot* seems to be legally regarded (*s*) as the best. He observes that the defect in naturals (synonymous to idiots) seems to proceed from *want of quickness*, *activity*, and *motion*, in the intellectual faculties, whereby they are deprived of reason, whereas *madmen or lunatics* seem to suffer by the *other extreme;* for they do not appear to have lost the *faculty* of *reasoning*, but having *joined together some ideas very wrongly*, they mistake them for truth, and they err as men do that argue right from wrong principles; for by the violence of their *imaginations*, having taken their *fancies* for realities, they make right deductions from *them*.(*s*) In idiots the imbecility of mind is *original or connate*, and the mental powers must in general *continue infantine*, because the train has never developed itself. In such an individual the understanding makes little progress with years; yet even then, unless the imbecility be extreme, some improvement may take place, some progress in knowledge beyond mere infancy may be made by the help of *limited memory*, by *imagination* and by *habit*, and such an individual may acquire many ideas, may recollect facts, circumstances, and places, and hackneyed quotations from books, may conduct himself orderly and mannerly, make a few rational remarks on familiar and trite subjects, retain self-dominion, and perhaps spend his own little income in providing for his wants; and yet may be an idiot, or in other words labour under such an infirmity of mind as to render him very liable to fraud and imposition. The principal marks and features of imbecility are the same which belong to childhood, of course varying in degree in different individuals; frivolous pursuits, fondness for and stress upon trifles, inertness of mind, paucity of ideas, sometimes shyness, timidity, submission to control or acquiescence under influence. Perhaps the most striking distinction between *idiotcy* and *insanity* is that an idiot cannot *reason at*

(*n*) Co. Lit. 42 b; 287, 288, 301, ante.

(*o*) 1 Hale, P. C. 34; and 1 Russ. on Crimes, 7.

(*p*) Ante, 288, 289, 303.

(*q*) Ante, 303.

(*r*) 1 Hale, Pl. Cr. 34.

(*s*) Locke's Essay on Human Understanding, b. 2, c. 11, s. 12, 13; see also ante, 327, note (*s*,) and 345, note (*y*.)

all, or at least he does so in a much less degree than the generality of mankind; whilst on the other hand a lunatic or insane person reasons, and perhaps with great acuteness, though upon false and fancied hypotheses, at least as regards all subjects within the range of or affecting his malady. In all these cases the law will interfere by commission or otherwise to protect the individual and his property from the artifices of others. Perhaps the most illustrating recent cases of this nature respecting idiotcy and imbecility of mind, were those of *Ingram* v. *Wyatt*,(*t*) the Earl of Portsmouth(*u*) Bagster against Newton,(*x*) the latter two of which were cases of ill-judged marriage, afterwards set aside,) and the case of Mr. Davis.

We have seen, that, in general, the bones of the head of an idiot are particularly constructed, and much under the proper size, especially in circumference, and which, instead of being 22 inches horizontally, is, perhaps, not even sixteen inches, and the brain itself is too small, as much under three pounds in weight.(*y*) Idiots are, in general, inoffensive, but particularly as regards the female sex, sometimes there are dangerous exceptions.(*z*) In them is usually to be observed a vague, unsteady wandering or protuberant eye, seldom fixed upon or observant of any one object, a stupid expression of countenance, evincing no sign of intelligence, a gaping mouth, with a frequent unconcealed flow of saliva, a perpetual rolling and tossing of the head, no memory, no language, no reason, and speech sometimes imperfect. But all idiots are not of the same degree of intellectual deficiency; some possess a degree of memory, and evince a talent of imitation; will repeat passages from books, which they have been taught by ear; but they are incapable of comprehending what they repeat. However, by education and constantly frequenting good society, it has been observed that they will, either by imitation or otherwise, assume the appearance of an inquiring mind; but they will put numerous questions, usually unconnected with each other and leading to no useful result, in rapid succession, without scarcely listening for the reply or caring whether they attempt to understand it.

Dr. Male has observed that *idiotcy or fatuity is seldom curable*, except when it arises from debilitating causes; in which cases, he observes, that exercise, sea bathing, bark, change of air and nutritious aliment may be useful.(*z*) Its baneful consequences, however, may be much modified by care and attention, though unhappily as the idiot has never excited any lively interest in his favour, he is usually neglected and treated as a family blemish or disgrace.

The principal *legal* and *practical* distinction between idiots and lunatics or insane persons is, that in the case of idiotcy from nativity, it being presumed that as the mental faculties are actually wanting or defective, and not to be supplied, the idiotcy must continue, and therefore during the life of the individual, the king, by his prerogative, is the curator, and entitled to the rents and profits of the estate, without liability to account;(*a*) whereas in lunacy and insanity, the law always supposes the possibility of recovery, and therefore the king is accountable to him or his representative for the profits of his estate.(*a*) Another difference has been assigned, namely, that idiotcy may be tried by inspection, because it may be discerned; but not lunacy, without taking out a commission.(*b*)

(*t*) 1 Hagg. Ec. Rep. 401 to 404, where Sir John Nicholl describes the characteristics of an *idiot*.

(*u*) 3 Add. Rep. 63; and 1 Hagg. Ec. C. 369, as a case of *weakness*, not strictly idiotcy.

(*x*) *In re Bagster*, alias, *Newton* 16 June, 1832.

(*y*) Ante, 249.

(*z*) G. Smith, For. Med. 427; 1 Paris & Fonb. 311.

(*z*) Male's Med. Juris.

(*a*) Dyer, 25; Moore, 4; Bro. Idiot, F. N. B. 233; Bac. Ab. Idiots and Lunatics.

(*b*) Skinner, Rep. 5; but see *Ex parte Bampton*, Mosel, 78, as to superseding a

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Of *lunacy*, and who is strictly a lunatic.

The term *Lunatic* was adopted at the time when it was *erroneously* supposed that the moon influenced mental disorders, which it has been clearly established it does not.(*c*) In legal acceptation it imports any one who has for a time had understanding, but has by grief, disease or injury, afterwards lost the use of his reason;(*d*) and according to Lord Coke a lunatic at intervals has his understanding, *qui gaudet lucidis intervullis*, and therefore, as distinguishable from an idiot, is only called *non compos mentis* so long as he has not understanding.(*e*) Strictly, therefore, lunacy is only a *periodical madness*, though inaccurately also used to import any *permanent adventitious* insanity, as distinguished from idiotcy,(*f*) and in the modern statutes lunacy is used in such comprehensive sense.

Of *insanity;* of maniacs and mania or phrensy.

Sir John Nicholl has observed, that it may be difficult and perhaps dangerous to attempt to define what is the essence of *insanity;* but that *delusion* has been generally laid down as essential, that is, the fancying things to exist, which can have no existence, and which fancy no proof or reasoning will remove.(*g*) *Insanity* is *medically* distinguished and divided into several descriptions.(*h*) *Mania* is the first, and is where not only the mind is disordered, but the body is sometimes excited into dangerous violence towards third persons, frequently the dearest relations, without any cause. This description is also termed *phrensy*, and which Arbuthnot described as *Inflammation* of the brain, occasioning profuse hemorrhage from the nose, and requiring copious bleeding in the temporal arteries.(*h*)

Melancholy, the second in order, is usually a general derangement, but sometimes, it is said, is only partial, particular or limited.

Of *monomania* or partial insanity, or delusion, on only one subject. (*i*)

Monomania, (from the Greek μονος solus and μανια furor,) is insanity only upon a particular subject, and with a single delusion of the mind, or rather a delusion on a particular subject or isolated train of ideas, and which it has been supposed leaves *in all other respects* the intellectual powers *unaffected*, because persons thus afflicted often appear reasonable when conversing on subjects beyond the sphere of their delirium, until some circumstance suddenly rouses the diseased brain. These individuals are frequently passionate and dangerous, when the train of their particular delusion has been touched.(*k*) Some interesting instances of monomania were collected and illustrated by Lord Erskine in his speech on behalf of Hadfield, and which will hereafter be stated.(*l*) A recent decision, as regards responsibility for crimes committed by a person affected with this partial malady, has also taken place, and will be presently stated.(*m*) In a recent valuable work, there are assigned some strong

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commission of lunacy on examination by the chancellor.

(*c*) Hale, P. C. 31; 3 Atk. 174; Du Cange's Glossary, tit. Lunaticas, and Dr. Mead's Treatise.

(*d*) Co. Lit. 247 a; 4 Coke, 124 b; 4 Bla. Com. 25.

(*e*) Id. ibid.; 1 Bla. C. 304; see also definition of lunacy, *Wheeler* v. *Alderson*, 3 Hagg. Ec. Rep. 599.

(*f*) *Lord Ely's case*, 1 Ridg. Parl. Cases, 518; Atk. 171.

(*g*) *Wheeler* v. *Alderson*, 3 Hagg. Ecc. Rep. 598, 599; *Dew* v. *Clark*, 3 Addams, 90; as to *delirium*, see *Brogden* v. *Brown*, 2 Add. Ec. Rep. 441.

(*h*) See G. Smith, For. Med. 416 to 430; see Dr. Burrows on Insanity; Hill on Insanity; Dr. Cullen; Dr. Thompson; Haslam on Madness; Connolly on Insanity; 1 Ryan, Med. Jur. 279; and numerous others.

(*h*) Arbuthnot on Ailments; as to mania, see Cyclop. Prac. Med. tit. Insanity.

(*i*) See, in general, Cyclop. Prac. Med. tit. Insanity, and tit. Soundness of Mind. Jackson, Prin. Med. 237.

(*k*) Dr. Burrows on Insanity, 257; Fodere Traité du Delire, vol. i. 385; and see 1 Beck, Med. Jur. 341.

(*l*) Erskine's Speeches, vol. v. referring inter alia to *Greenwood's case*, 13 Ves. 89; 3 Bro. C. C. 444; 1 Addams, 283; *Dew* v. *Clark*, Haggard, Rep. 18; 1 Addams, 279; 2 Add. 102; 3 Add. 79, 94, 209; *Rex* v. *Offord*, 5 Car. & P. 168; post, 355, 356.

(*m*) *Rex* v. *Offord*, 5 Car. & P. 168;

grounds for requiring very great caution in allowing effect to *any* civil act done or criminal responcibility, to affect *any* criminal act committed by an individual affected with any such *partial* insanity, unless there be the clearest evidence that the mental malady had not some influence on the act.(*n*) CHAP. IX. SECT. V. OF THE MIND, &c.

Demency or dementia, or amentia.(*o*)

Demency, sometimes termed *Fatuity*, is a defect, *hebetude* or imbecility of the understanding, general or partial, but confined to *individual faculties* of the mind, particularly those concerned in *associating* and *comparing* ideas, whence proceeds great confusion and incapacity of *arranging* the thoughts. In this state the countenance and eye are dull and stupid, the gait feeble or lounging, and appetites depraved, with unconciousness of the calls of nature.(*o*)

All these variations in insanity, their causes, moral treatment and remedies, will be, more properly, fully considered in the next part. The distinction will be rarely of importance in a *legal* view, excepting as regards lucid intervals, cases of monomania, and, as may respect medical responsibility, erroneous treatment.

Causes of deviations from perfect intellect.

The causes of idiotcy or mental imperfection, with the physical and moral remedies and treatment, will be more properly considered in the next part of this volume. They are various, as will appear from the numerous works upon insanity.(*p*) In general they may be attributed either to the defective quantity of brain, or its diseased state, or to the undue pressure of the bones of the cranium, where the ossification has been irregular; but not unfrequently hypochondriasis and different species of mental aberration, are attributable to defects or misplacement in other parts of the body; and it has been well authenticated that a displacement of the transverse colon has not unfrequently led to insanity, especially that species which induces self destruction.(*q*) It has been acknowledged that notwithstanding the great ability evinced by medical authors, foreign and English, on the subject of idiotcy and insanity, still the knowledge of the subject as well as the authorities are very imperfect. The legal and medical student will do well to consult one of the most recent publications upon the subject by Dr. Pritchard, in the Cyclopædia of Practical Medicine,(*r*) from which it seems that the continental physiologists acknowledge that there appears to be a very prevalent description of insanity, in which it is supposed that the *intellectual faculties* continue perfect, and even struggle against and endeavour to counteract the effects of the disorder; but there exists what is termed *a moral insanity* or madness, consisting in a *morbid perversion* of the *natural feelings*, affections, inclinations, temper, habits and moral disposition, without any recognised *lesion* of the intellect or knowing or reasoning faculties, and particularly without any *maniacal* hallucination: such are cases of violent desires in parents to destroy their own offspring, or to commit theft, without the least occasion; or to destroy property, without any discovered motive of revenge, &c.(*s*) In England, especially of late, many instances of this kind have occurred; but no attempt to introduce any distinction between this and other descriptions of insanity, either medically or legally, has, it is believed, as yet been made; and unless a jury should be satisfied

Medico Chirurg. Rev. vol. i. 246, 269; Dr. Burrows on Insanity, 484, 485.

(*n*) See Cyclop. Prac. Med. tit. Soundness and Unsoundness of Mind.

(*o*) As to these and Dementia, see Cyclop. Prac. Med. tit. Insanity; and as to Senile Dementia, Amer. Cyclop. Prac. Med. tit. Ages.

(*p*) And see 4 Good, 47 to 138.

(*q*) 4 Good, 55 to 57, and authorities there referred to.

(*r*) Cyclop. Prac. Med. tit. Insanity, and tit. Soundness and Unsoundness of Mind.

(*s*) Cyclop. Prac. Med. tit. Insanity.

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that the *mental faculties* have been *perverted*, or, at least, the faculty of reasoning and judgment, it is believed the party subject to such a *moral* insanity, as it is termed, would not be protected from criminal punishment.

The *civil* or *legal* consequences of being an idiot, lunatic, or of unsound mind.

The *civil* consequences of idiotcy, and of the other mental defects of a specific nature, are principally that the law protects the unhappy individual whilst in that state from the frauds and artifices of others, and therefore considers him incompetent *to marry*,(*t*) or to affect his property, excepting in payment *for necessaries*, or performance of contracts made without fraud.(*u*) An idiot is always incompetent to *marry* or to *alienate* property, or to make a *will* even of personal property, still less of realty; and an insane person labours under the same disabilities, excepting in the case of lunacy and during a lucid interval;(*x*) and even in case of continuing *monomania*, that is, partial insanity or delusion upon a particular point,) it seems that a contract or a will, connected with and having in view the *subject of the delusion*, *will be void*, although, in all other respects, the testator appear to have perfect possession of his faculties.(*y*) But a testamentary paper cannot be set aside on the ground of monomania, unless there be the *most decided evidence that at the time of the factum* or signing of the paper, the belief in the testator's mind, not only amounted *to insane delusion*, but also *was connected with*, and, probably occasioned by, the continuing delusion.(*x*) But, if there were actual ground for suspicion of an injury, though in fact not well founded and disbelieved by others, the misapprehension of the facts will not be considered mental delusion, and a will made by the party affected by such suspicion may be valid.(*y*)

Contracts for necessaries, or even for a carriage, made by a lunatic, or perhaps an idiot, and perfected by delivery, will be binding on him, and enforced by action, unless in cases where his imbecility has been fraudulently taken advantage of;(*z*) and, it is scarcely necessary to observe, that a marriage, other contract, or will, executed during a clearly established lucid interval, and without fraud, would be binding.(*a*) And as

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(*t*) *Turner* v. *Mayer*, 1 Hagg. Con. R. 414; *Browning* v. *Renne*, 2 Phil. 69; *Inre Portsmouth*, 3 Addams, 63; 2 Hagg. Con. R. 423; 1 Hagg, Ecc. R. 355; *Bagster* v. *Newton*.

(*u*) Incompetent to alienate by deed, *Mannin* v. *Ball*, 1 Smith & Beatty, 183; *Ball* v. *Mannin;* 1 Dow. P. C. N. Series, 383; 3 Bligh, N. S. 1; and 1 Smith & Beatty, 454.

(*x*) The wills of lands are by 34 and 35 Hen. 3, c. 14, declared void as to *idiots*, *lunatics*, persons of unsound mind; per Sir J. Nicholl, 2 Hagg, Ecc. Rep. 122; but if made during a lucid interval, it will be valid, 9 Ves. 610. As to what evidence is necessary to prove a lucid interval, see *Wheeler* v. *Alderson*, 3 Hagg. Ecc. Rep. 599.

(*y*) *Greenwood's case*, 13 Ves. jun. 89; 3 Bro. C. C. 444; *Dew* v. *Clark*, 1 Add. 274; 3 Add. 79, 209; *Heath* v. *Watts*, Prerog. 1798; Deleg. 1800. In Mr. Erskine's speech for Mr. Hadfield, vol. v. 12, 13, 17, he appears to have supposed that the rule in civil cases went further, and even invalidated the will, though the object of bequest or devise was in *no way connected* with the influence of the insanity, and that such rule of law proceeded from the extreme difficulty of tracing with precision the secret motions of a mind deprived by disease of its soundness and strength in any material respect. But the reported decisions do not appear to go to that extent. In Cyclop. Prac. Med. tit. Soundness and Unsoundness of Mind, 45 to 48, there will be found some observations which tend to fortify Lord Erskine's supposition that the will of a person afflicted with monomania ought to be considered void, unless it be clearly shown *affirmatively* that no part of the written will could have by any probability have been affected by the mental disorder.

(*x*) Id. ibid.; *sed quære*, 348, (*n.*)

(*y*) *Fullock* v. *Allison*, 3 Hagg. Ecc. R. 527, 547.

(*z*) *Bagster* v. *Earl Portsmouth*, 5 Bar. & Cress. 172; 7 Dowl. & Ry. 618; *Brown* v. *Joddrell*, 3 Car. & P. 30; 1 Mood. & M. 105, 106.

(*a*) 9 Ves. 610; *Turner* v. *Mayers*, 1 Hagg. Cons. R. 414; *Browning* v. *Reeve*, 2 Phil. 69; but see as to marriage, id.;

regards any doubt, whether a commission of lunacy ought, or not to be issued, the question merely is whether the party is in such a state of mental imbecility as to be incompetent to manage his own affairs.(*b*)

Weakness of intellect.

With respect to mere imbecility, or *weakness* of understanding, not amounting to idiotcy nor insanity, *at law* the party will be bound by his contract, and his marriage and will would be valid, unless misrepresentation or other fraud has been practised to obtain it; but, in the latter case, the transaction will be void at law as well as in equity, and in the ecclesiastical courts;(*c*) and courts of equity will frequently relieve against *catching bargains*,(*d*) or improvident contracts made by very weak persons, although the opposite party used no misrepresentation or fraud in fact. So, though in general, as figuratively expressed, the courts cannot measure the size of people's understandings or capacities, and, therefore, will not, in general, relieve merely because a person was of weak intellect,(*e*) and there is no such thing as an *equitable incapacity*, where there is a *legal capacity*;(*f*) yet it will be observed, that the 11 Geo. 4, and 1 Wm. 4, c. 60, has, to remove doubts upon the jurisdiction, introduced a power to issue a commission of lunacy in all cases where an individual is *incapable of managing his affairs*, although he be neither an idiot nor a lunatic, nor of unsound mind, in the strict sense of those terms.(*g*)

The malicious untrue written assertion, that the king or any person is afflicted with insanity, is considered a criminal and indictable act, since it imputes to the party a malady generally inducing mankind to shun his society,(*g*) though as no one is of perfectly sound mind but the Deity, it is not libellous merely to say that a man is not of *sound mind*.(*h*) If a person be imprisoned without cause or legal warrant, upon supposition of insanity, he may in point of law, sustain an action, although there might be reasonable ground for suspecting insanity, if it did not in fact exist.(*i*)

Irresponsibility for *crimes* committed by persons in a state of insanity.

With respect to *crimes*, the statute 39 and 40 Geo. 3, c. 35, and subsequent acts enact, that when upon the trial of a person charged with treason, murder or felony, it shall be given in evidence that the prisoner was *insane at the time of the commission of the offence*, and such person shall be acquitted, the jury shall be required to find specially *whether such person was insane at the time of the commission of such offence*, and to declare

and statutes 15 Geo. 2, c. 30; 51 Geo. 3, c. 57; 1 Hagg. Cons. R. 417.

(*b*) Ante, 345, 346; *Sherwood* v. *Sanderson*, 19 Ves. 280; Coop. Ch. Ca. 108, S. C.

(*c*) *Portsmouth* v. *Portsmouth*, 1 Hagg. Ecc. R. 360, where the marriage was set aside in respect of fraudulent contrivance, although the husband was not strictly an idiot.

(*d*) See 13 Ves. & B. 117; Vin. Ab. tit. Catching Bargains; Chitty, Eq. Dig. tit. Agreement. Equity may relieve against a catching bargain, but not a court of law, at least, *directly*, id.; see singular case, 2 Lord Raymond, 1164; 1 Lev. 111; but sometimes a jury, unless the damages be stipulated, will give only nominal damages, 1 Lev. 111.

(*e*) See cases collected, 2 Chit. Gen. Prac. 826, 827, 838.

(*f*) *Osmond* v. *Fitzroy*, 3 P. Wms. 128; *Willis* v. *Jernegan*, 2 Atk. 251.

(*g*) And see ante, 345, 346. It will be perceived from the older reports that the courts used rather to laugh at a person who was circumvented than afford him relief, or punish the party guilty of the fraud; but a more moral and honourable principle has been introduced in modern legislation, by punishing those who take advantage of the *weakness* of others, *per* Lord Kenyon, in *Rex* v. *Young*, 3 Term Rep. 98, 106.

(*g*) *Rex* v. *Harvey*, 2 Bar. & Cres. 257; 3 Dow. & Ry. 464, S. C.

(*h*) Per Lord Ellenborough, on the trial of Mr. Perry, of the Morning Chronicle, for a libel, in ascribing mental imbecility to the late King George the Third. Dr. Haslam, in his evidence in *Bagster* v. *Newton*, and Dr. Uwins on a subsequent trial, swore that no man is of perfectly sound mind, and, indeed, that all mankind are, more or less, insane.

(*i*) *Anderson* v. *Burrowes*, 4 Car. & P. 210, 214; see other cases, 402.

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whether such person was acquitted by them on account of *such insanity*, and if they should so find, then the prisoner is to be kept in strict custody until his majesty's pleasure be known. In practice, to prevent the jury being embarrassed by any technicalities respecting the import of this term *insane*, the substantial question presented to the jury in this and all cases, whether of alleged idiotcy, lunacy or insanity, either in general or monomania, that is, delusion confined to a particular subject, is, "*Whether, at the time the alleged criminal act was committed, the prisoner was incapable of judging between right and wrong, and did not then know he was committing an offence against the law of God and of Nature?*"(k) If he were so capable, then, although the mental delusion might be connected with the crime, and stimulated him to commit a murder in revenge for the imaginary injury, yet if he knew he had no right so to revenge himself, he will be criminally responsible.(l)

As to *suicides*.

We have already alluded to the strict law, that a person of competent *sound mind*, at the time of committing *suicide*, is deemed a felon, and forfeits his goods to the crown, although formerly it was supposed that the very act of self-destruction was evidence of existing madness;(m) and even the unsuccessful attempt to commit the act is an indictable misdemeanor;(n) nor however unaccountable the act may be, is it to be thence inferred that he was insane,(o) though it is laid down that *very slight evidence* of derangement at the time will warrant a jury in finding that fact;(p) and juries, commiserating the probable antecedent mental sufferings of the unhappy individual, are, perhaps, too prone to find a felo-de-se insane, in order to save his property for his relatives, even at the risk of thereby probably fixing a stigma of a family predisposition to insanity. Another motive for inclining to such a verdict formerly was that a felo-de-se was not allowed Christian burial,(p) but was interred in a four-road way, with a stake passed through the body, and without any funeral ceremony: but that relict of barbarism was repealed by 4 Geo. 4, c. 52. Perhaps, if juries were more frequently to find verdicts subjecting parties to forfeitures and some ignominy, in cases where there is no pretence for suspecting insanity, the apprehension of such a result might tend to prevent the frequency of such acts.

The *evidence* to establish idiotcy or lunacy, &c.

With regard to the *proof of evidence* of insanity, as the imputation is contrary to the natural presumption of adequate intellect, the defect should be established by direct and positive evidence, and not by mere probable or conjectural proof.(q) And in practice, proof of delusion and acts of madness is required, and not general evidence that the party is insane;(r) and, therefore, although we have seen that most able physio-

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(k) *Rex* v. *Offord*, 5 Car. & P. 168; *Bellingham's case*, Collison on Lunacy, Addenda, 630; *Lord Ferrer's case*, Howell's State Trials, vol. xix. 947, 948; *Hadfield's case*, id. 27; Erskine's Speeches, vol. v; *Martin's case*, Annual Reg. vol. lxxi. 301; and see separate Report published by Baldwin and Craddock, A. D. 1829; and see observations in *Dew* v. *Clark*, 3 Add. 93; Hagg. 13.

(l) *Rex* v. *Offord*, 5 Car. & P. 168.

(m) Comb. 2, 3; 4 Bla. Com. 189; 3 Mod. Rep. 100; Bac. Ab. Idiot, E.

(n) 1 Dow, Parl. Cas. 148, 187; Comb. 2, 3; Hawk, P. C. c. 27, s. 3.

(o) 1 East, P. C. 389; Coll. on Lunacy, 491; but see Shelford on Lunacy, 58, who contends that the very act of self-destruction should be considered as affording evidence of co-existing insanity. And see some valuable observations on this subject to the same effect, Cyclop. Prac. Med. tit. Soundness and Unsoundness of Mind, 53, 54; and Erskine's Speeches, vol. v. 11; citing Lord Hale, P. C.

(p) Id. ibid.; 1 Dow's Parl. Ca. 148; but see id. 187; and *Burrows*, v. *Burrows*, 1 Hagg. Ecc. C. 109.

(p) See *Kemp* v. *Wickes*, 3 Phil. Ec. Cas. 272, 273.

(q) Ante, 345, note (x;) *White* v. *Wilson*, 13 Ves. 88; Co. Lit. 246 b, note 1; 1 Hale, P. C. 33; 1 Dow. Parl. Ca. 177.

(r) 2 Atk. 340, *Wheeler* v. *Alderson*, 3 Hagg. Ecc. Rep. 598, 599.

logists have contended that phrenology and physiognomy ought to have weight, yet they are not allowed in evidence;(*s*) and although it seems to be admitted that insanity may unhappily be hereditary, and the opinion that it is so is allowed to be a decided objection to matrimony, at least during the ages of procreation, yet it is an established rule of law that proof that other members of the same family have decidedly been insane is not admissible either in civil or criminal cases.(*t*)

As regards the proof of *individual* idiotcy or insanity, when the manifestations are not *very strong*, the greatest difficulty frequently arises, not only on account of the varying degrees between mere weakness or imbecility of mind (perhaps greatly mitigated, regulated, tutored or concealed by education or habit, or temporary advice,) and the most outrageous phrensy intermixed very frequently with strong powers of reasoning; and on account of the conflicting interests of witnesses, some anxious to sustain the affirmative, and others the negative, and some of whom may speak of acts and circumstances occurring at different times, and under different circumstances.(*u*) The circumstance of a person evincing the most harsh conduct, sudden bursts of passion, or of display of unkind or unnatural feeling toward a child, without any cause, will not of themselves establish insanity;(*x*) so the proof that a person had given way to the supposition that he had actually seen an apparition, we have seen is not legal evidence of insanity, but only of weakness or imbecility, perhaps, attributable to temporary weakness or ill health.(*y*) Nor will proof of great eccentricity establish insanity.(*z*)

The proofs of *idiotcy* and of *insanity* must necessarily differ from each other; and as regards evidence of insanity, it must vary in each case, as the manifestations of deviations from sound intellect are scarcely ever similar.

As to *idiotcy* or *congenital* want of intellect, the defect must in general prevent the idiot from ever *acquiring* sufficient knowlege to enable him in *all* the relations of life to judge correctly, although he may by habit or accident be accurate on *some* occasions. And, therefore, the ancient law books laid it down as a rule, that if it were proved that an individual, having lived in society and been offered moderate education, and having attained an age of fourteen, when persons of ordinary understanding usually develop some intelligence upon common subjects, yet cannot number twenty, nor tell the days of the week, nor know his father or mother, nor his own name, he is to be considered an idiot and incapable of taking care of himself or his affairs.(*z*) But those cases of gross ignorance were put only *as instances*, and not as a positive rule, for idiot or not is a question of fact to be tried by a jury, upon full proof of the whole scope of his intelligence, or by inspection or interrogation.(*a*) Undoubtedly the mere proof that a person cannot count numbers, does not demonstrate *sterility* of mind, unless it be also proved that every due attempt has been made in vain to instruct him in arithmetic, &c. But if such evidence be established, then a fair inference of idiotcy is afforded; for though Lord Tenterden objected to the rule as laid down in Fitzherbert,(*b*) Lord Chancellor

(*s*) Ante, 257; and see Lord Erskine's speech in defence of Hadfield, vol. v. 27.

(*t*) *M'Adam* v. *Walker*, 1 Dow, P. C. 148, 174.

(*u*) 5 Dow, Parl. Ca. 242; *Lowe* v. *Jolliffe*, 1 Bla. Rep. 365; *Wright* v. *Tatham*, 16 June, A. D. 1831.

(*x*) *Per* Sir John Nicholl, in *Dew* v. *Clark*, 1 Add. Rep. 284, where he also stated the necessity for having the *whole history* of the supposed insane before the court.

(*y*) Ante, 331, 332.

(*z*) *Dew* v. *Clark*, 3 Addams, 87, 182; Dr. Gooch's Account of Diseases peculiar to Women.

(*z*) Dyer, 25; Moore, 4; Bro. Ab. Idiot, 1; Fitzg. N. B. 233, 583.

(*a*) Bac. Ab. tit. Idiot.

(*b*) In *Ball* v. *Mannin*, 1 Dow, Parl. C.

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Eldon said, "The want of power to comprehend the most simple proposition of figures, or that two and two make four, may be more or less evidence of unsoundness of mind; though its weight and character are to be estimated with reference to *age, situation and all the other circumstances* by which it may be affected, and that he did not find it easy to comprehend what some of his predecessors intended, when they intimated that the *incapacity* proved by the want of power to comprehend the most simple proposition of figures, is not evidence of an unsound mind.(*c*) It will, however, be observed, that Lord Tenterden's observations went rather to establish that proof of the *converse*, namely, that a person decently educated *could count* twenty, and knew his father and mother and his own age, and even more by the help of forced education, was by no means conclusive evidence that the individual was of sound mind.(*d*) Perhaps, the most illustrating modern case upon this subject is that of *Bagster* v. *Newton*, in which upon a commission of lunacy a jury of twenty jurors out of twenty-two, on the 14th July, 1832, found Miss Bagster of "unsound mind, so that she was not sufficient for the government of her freehold or personal property on 1st November, 1830," although she had by means of some, although a defective education, attained considerable knowledge and some accomplishments; and the result of that case establishes that in all questions of the nature, *all the circumstances of age, society, education and conduct* of the individual are to be proved and taken into consideration by the jury, and who, if they think the party incompetent to manage his or her own affairs, will, as in that case, in general find the party to have been of *unsound mind*.

The opinion of medical witnesses, who have seen the alleged lunatic, is unquestionably admissible, (*e*) and moreover, although they have not seen the lunatic, yet their opinion, after hearing all the evidence whether or not a person having so acted and evinced such delusion, ought to be deemed a lunatic, it seems, is admissible; although, in the most recent case upon the point, Mr. Justice Park doubted the admissibility, and allowed the evidence principally on the authority of a prior Nisi Prius decision.(*f*)

Where a commission of lunacy has once been found against a person, then the legal inference will be, that he continues incompetent, and the *onus* of proving a lucid interval is upon the party who would establish the validity of a particular contract, will, &c.(*g*) It will not, however, be necessary to prove that the person has become of *as* sound intellect as he was before the original lunacy; but it suffices to show that he had recovered such a degree of strength of disposing mind, at the time of performing the act, as ought to give it effect. (*h*)

Lord Hale, speaking of *criminal* responsibility for actions *prima facie* criminal, observed, that though it be difficult to define the invisible line that divides perfect and partial insanity, yet it *must rest upon circumstances duly to be weighed and considered both by the judge and jury, lest*, on the

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N. S. 392; and 3 Bligh's R. N. S. 1, S. C; and *Lord Donegall's case*, 2 Ves. sen. 407.

(*c*) Per Lord Eldon, in *Sherwood* v. *Sanderson*, 19 Ves. 286.

(*d*) *Ball* v. *Mannin*, 1 Dow, Parl. Ca. N. S. 392; 3 Bligh's R. N. S. 1, S. C.

(*e*) See reasons, Haslam's Med. Jur. 290, &c. (Cooper's Tracts;) G. Smith's For. Med. 428, 2d ed.; and Dr. Latham's opinion, Minutes of Evidence before Committee of House of Lords, A. D. 1828, p. 97; Smith's An. Med. Ev. 197.

(*f*) *Rex* v. *Wright*, 1 Russ. & R. Cr. C. 456; *Rex* v. *Searle*, 2 Mood. & M. 75; and see the duties of medical men as to evidence in such cases, in Dr. Connolly's Inquiry concerning the Indications of Insanity.

(*g*) *White* v. *Wilson*, 13 Ves. 88, Butl. Co. Lit. 246 b; 1 Dow, P. C. 177; *The Attorney-General* v. *Parnther*, 3 Bro. C. C. 443. What is evidence of a lucid interval or restoration of sanity, *Hoby* v. *Hoby*, 1 Hagg. R. 146, 153.

(*h*) *Ex parte Holyland*, 11 Ves. 11; 5 Dow. P. C. 236; and see *Lopdall* v. *Creagh*, 1 Bligh's R. N. S. 266.

one side there be a kind of inhumanity towards the defect of human nature, and on the other too great an indulgence given to great crimes; and that the best measure he could think of was this:—such a person as labouring under melancholy distempers, hath yet usually as great understanding as ordinarily a child of fourteen years hath,(*i*) in such a person as may be guilty of treason or felony.(*k*) We have, however, seen that now the question is still more general, and is relative, namely, whether the person had, at the time of the offence, the exercise of such a degree of intellect as to instruct him to know that he was doing an act that he ought not to perform.(*l*)

Illustrations relative to insanity.

Perhaps as illustrative of the powers of *reasoning* and degrees of intellect frequently evinced by insane persons, and of the principles of the law relating to their incapacities in *civil* cases, and their protection from punishment in criminal cases, we may now be allowed to refer to some arguments and authorities not strictly legal, but still of great weight.

Lord Erskine's illustrations.

The late Lord Erskine, in his speech in defence of Hadfield, for treason in shooting at the king at Drury Lane Theatre, thus argued:(*m*)—"The law as it regards this most unfortunate infirmity of the human mind, like the law in all its branches, aims at the utmost degree of precision; but there are some subjects, and the present is one, upon which it is extremely difficult to be precise. The *general principle* is clear, but the *application* is most difficult. It is argued by all jurists, and is established by the law of this and every other country, that it is the *reason of man* which makes him accountable for his actions, and that the deprivation of reason acquits him of crime. This principle is indisputable; yet so fearfully and wonderfully are we made, so infinitely subtle is the spiritual part of our being, so difficult is it to trace, with accuracy, the effect of the diseased intellect upon human action, that I may appeal to all who hear me, whether there are any causes more difficult, or which indeed so often confound the learning of the judges themselves, as when insanity, or the effects and consequences of insanity, become the subjects of legal consideration and judgment. I shall consider insanity, *first*, as it annuls a man's *dominion over property; secondly*, as it *dissolves his contracts* and other acts which otherwise would be binding; and *thirdly, as it takes away his responsibility for crimes*. If I could draw the line in a moment between these several views of the subject, I am sure the judges will do me the justice to believe that I would fairly and candidly do so; but great difficulties press upon my mind, which oblige me to take a different course. I agree that the law, in neither civil nor criminal cases, will measure the degrees of men's understandings, and that a *weak* man, however much below the ordinary standard of human intellect, is not only responsible for crimes, but is bound by his contracts, and may exercise dominion over his property.(*n*) Sir Joseph Jekyll, in the *Duchess of Cleveland's case*, took the clear legal distinction, when he said, '*The law will not measure the sizes of men's capacities, so as they be compos mentis*.' And Lord Coke, in speaking of the expression *non compos mentis*, says, 'Many times, as here, the Latin word expresses the true sense, and calleth him not *amens, demens, furiosus, lunaticus, fatuus, stultus*, or the like; for *non compos mentis* is the most sure and legal.' He then says, '*Non compos mentis* is of four sorts, *first*, *idiota*, he who from his *nativity*, by a *perpetual* infirmity, is

(*i*) Note, *fourteen* was mentioned as the age when the law infers perfect competence to judge between right and wrong.

(*k*) Hale, P. C. 30.

(*l*) See the question now presented to a jury in a criminal case, ante.

(*m*) See Erskine's Speeches, vol. v. p. 8, &c.; and Howell's State Tr. vol. xxvii. 1307.

(*n*) Ante, 353.

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non compos mentis; secondly, he that by sickness, grief, or other accident, *wholly* loses his memory and understanding; *thirdly,* a *lunatic* that hath *sometimes* his understanding, and sometimes not, *aliquando gaudet lucidis intervallis,* and, therefore, he is called *non compos mentis,* so long as he hath not understanding.' But notwithstanding the precision with which this great author points out the different kinds of this unhappy malady, the nature of his work, in this part of it, did not open to any illustration which it can now be useful to consider. In his Fourth Institute he is more particular. But the admirable work of Lord Chief Justice Hale, in which he refers to Lord Coke's Pleas of the Crown, renders all other authorities unnecessary.

"Lord Hale says, 'There is a *partial* insanity of mind, and a *total* insanity. The former is either in respect to things *quoad hoc vel illud insanire.* Some persons that have a competent use of reason in respect of some subjects, are yet under a *particular dementia* in respect of some *particular* discourses, subjects, or applications, or else it is partial in respect of *degrees;* and this is the condition of very many, especially melancholy persons, who for the most part discover their defect in excessive fears and griefs, and yet are not wholly destitute of the use of reason; and this partial insanity seems not to excuse them in the committing of any *offence* for its matter capital; for doubtless most persons that are felons of themselves, and others, are under a degree of partial insanity when they commit these offences. It is very difficult to define the invisible line that divides perfect and partial insanity, but it must rest upon *circumstances* duly to be weighed and considered both by judge and jury, lest on the one side there be a kind of inhumanity towards the defects of human nature, or, on the other side, too great an indulgence given to crimes.' Nothing can be more accurately nor more humanely expressed, but the *application* of the rule is often most difficult. I am bound, besides, to admit, that, *there is a wide distinction between civil and criminal cases.* If, in the former, a man appears, upon the evidence, to be *non compos mentis,* the law avoids his act, *though it cannot be traced or connected with the morbid imagination which constitutes his disease, and which may be extremely partial in its influence upon conduct;*(*o*) but, to deliver a man from responsibility for crimes, above all for crimes of great atrocity and wickedness, I am by no means prepared to apply this rule, however well established, when property only is concerned. In the very recent instance of Mr. Greenwood,(*p*) the rule in civil cases was considered to be settled: that gentleman, whilst insane, took up an idea that a most affectionate brother had administered poison to him. Indeed it was the prominent feature of his insanity. In a few months, he recovered his senses. He returned to his profession as an advocate, was sound and eminent in his practice, and in all respects a most intelligent and useful member of society; but he could never dislodge from his mind the morbid delusion which disturbed it, and, under the pressure, no doubt, of that diseased prepossession, he disinherited his brother, The cause to avoid this will was tried here. We are not now upon the evidence but upon the principle adopted as the law. The noble and learned judge who presides upon this trial, and who presided upon that, told the jury that if they believed Mr. Greenwood, when he made the will, to have been insane, the will could not be supported, *whether it had disinherited his brother or not;*(*q*) that the act, no doubt, strongly confirmed the existence of the false idea, which, if believed by the jury to amount

(*o*) *Sed quære* this position; see ante.

(*p*) Ante, 350; *Greenwood's case,* 13 Ves. 89; 3 Bro. C. C. 444; 3 Add. 93; Shelford, 6, 43, 296; *Dew* v. *Clarke,* 1 Add, 274; 3 Add. 79.

(*q*) *Sed quære,* ante, 352, note(*y.*)

to *madness*, would equally have affected his testament, if the brother, instead of being disinherited, had been in his grave; and that, on the other hand, if the unfounded notion did not amount to madness, its influence could not vacate the devise.(*r*) This principle of law appears to be sound and reasonable, as it applies to *civil* cases, from the extreme difficulty of tracing with precision the secret motions of mind deprived by disease of its soundness and strength.(*s*) Whenever, therefore, a person may be considered *non compos mentis*, all his civil acts are void, whether they can be referred or not to the morbid impulse of his malady, or even though to all visible appearances totally separated from it;(*t*) but I agree with Mr. Justice Tracy, that it is not every man of an idle frantic appearance and behaviour who is to be considered as a lunatic, either as it regards obligations or crimes, but that he must appear to the jury to be *non compos mentis*, in the legal acceptation of the term, and that not at any anterior period, which can have no bearing upon any case whatsoever, but at the moment when the contract was entered into or the crime committed. The attorney-general, standing, undoubtedly, upon the most revered authorities of the law, has laid it down, that, to protect a man from criminal responsibility, there must be a *total* deprivation of memory and understanding. I admit that this is the very expression used both by Lord Coke and by Lord Hale; but the true interpretation of it deserves the utmost attention and consideration of the court. If a *total* deprivation of memory was intended by these great lawyers to be taken in the literal sense of the words, if it was meant that to protect a man from punishment he must be in such a state of prostrated intellect as not to know his name nor his condition, nor his relation towards others; that, if a husband, he should not know he was married; or, if a father, could not remember that he had children; nor know the road to his house, nor his property in it; then no such madness ever existed in the world. It is idiotcy alone which places a man in *that* helpless condition, where, from an original malorganization, there is the human *frame* alone without the human *capacity*, and which indeed meets the very definition of Lord Hale himself, when referring to Fitzherbert; he says, 'Ideocy or fatuity, *a nativitate vel dementia naturalis*, is such a one as described by Fitzherbert, who knows not to tell twenty shillings, nor knows his own age, or who was his father.' But, in all the cases which have filled Westminster Hall with the most complicated considerations, the lunatics and other insane persons who have been the subjects of them, have not only had memory *in my sense of the expression*, they have not only had the most perfect knowledge and recollection of all the relations they stood in towards others, and of the acts and circumstances of their lives, but have in general been remarkable for subtlety and acuteness. *Defects in their reasonings have seldom been traceable*, the disease consisting in the *delusive sources of thought;* all their deductions within the scope of the malady being founded upon the *immoveable* assumption of matters as *realities*, either without any foundation whatsoever, or so distorted and disfigured by fancy, as to be almost nearly the same thing as their creation. It is true, indeed, that in some, perhaps in many, cases, the human mind is stormed in its citadal, and laid prostrate under the stroke of frenzy: these unhappy sufferers, however, are not so much considered by physicians as *maniacs*, but to be in a state of delirium, as from *fever*. There, indeed, all the ideas are overwhelmed, for reason is not merely disturbed, *but driven wholly from her seat*. Such

(*r*) N. B. The jury found for the will, but after a contrary verdict in the Common Pleas, a compromise took place. Erskine's Speeches, vol. v. p. 13.

(*s*) And see ante, 351, note (*n*.)

(*t*) *Sed vide* ante, 351, note (*n*,) 352, note (*y*.)

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unhappy patients are unconscious therefore except at short intervals even of *external objects*, or at least are wholly incapable of considering their relations. Such persons, *and such persons alone*, (except idiots,) are *wholly* deprived of their understandings, in the attorney-general's seeming sense of that expression. But these cases are not only extremely rare, but never can become the subjects of judicial difficulty. There can be but one judgment concerning them. In other cases, reason is not driven from her seat, but distraction sits down upon it along with her, holds her trembling upon it, and frightens her from her propriety. Such patients are victims to *delusion* of the most alarming description, which so overpowers the faculties, and usurps so firmly the place of realities, as not to be dislodged and shaken by the organs of perception and sense; in such cases the images frequently vary, but in the same subject are generally of the same terrific character. Here, too, no judicial difficulties can present themselves, for who could balance upon the judgment to be pronounced in cases of such extreme disease? Another class branching out into almost infinite subdivisions, under which, indeed, the former and every case of insanity may be classed, is where the *delusions* are not of that frightful character, but infinitely various, and often extremely circumscribed, yet where imagination (within the bounds of the malady) still holds the most uncontrollable dominion over reality and fact; and *these are the cases which frequently mock the wisdom of the wisest in judicial trials*, because such persons often reason with a subtlety which puts in the shade the ordinary conceptions of mankind; their conclusions are just, and frequently profound; but the premises from which they reason within the range of the malady, are uniformly false; not false from any defect of knowledge or judgment, but because a *delusive image*, the inseparable companion of real insanity, is thrust upon the subjugated understanding, incapable of resistance, because unconscious of attack.

"*Delusion*, therefore, where there is no frenzy or raving madness, is the true character of insanity; and where it cannot be predicted of a man standing for life or death for a crime, he ought not, in my opinion, to be acquitted; and if courts of law were to be governed by any other principle, every departure from sober rational conduct would be an emancipation from criminal justice. I shall place my claim to your verdict upon no such dangerous foundation. I must convince you not only that the unhappy prisoner was a lunatic within my own definition of lunacy, but that *the act in question was the immediate unqualified offspring of the disease.* In civil cases, as I have already said, the law avoids every act of the lunatic during the period of the lunacy, although the delusion may be extremely circumscribed, although the mind may be quite sound in all that is not within the shades of the very partial eclipse, and although the act to be avoided can in no way be connected with the influence of the insanity;(*u*) but to deliver a lunatic from responsibility to criminal justice, above all in a case of such atrocity as the present, the relation between the disease and the act should be apparent. Where the connexion is doubtful, the judgment should certainly be most indulgent, from the great difficulty of diving into the secret sources of a disordered mind; but still I think that as a doctrine of law, *the delusion and the act should be connected.*

"You perceive, therefore, gentlemen, that the prisoner, in naming me for his counsel, has not obtained the assistance of a person who is disposed to carry the doctrine of insanity in his defence, so far as even the books would warrant me in carrying it. Some of the cases, that of Lord Ferrers, for instance, which I shall consider hereafter, distinguished from the present, would not in my mind bear the shadow of an argument as a

(*u*) *Sed quære, vide* ante, 351, n. (*n.*)

defence against an indictment for murder. I cannot allow the protection of insanity to a man who only exhibits *violent passions and malignant resentments*, acting upon *real* circumstances, who is impelled to evil from no morbid delusions, but who proceeds upon the *ordinary perceptions of the mind*. I cannot consider such a man as falling within the protection which the law gives, and is bound to give, to those whom it has pleased God, for mysterious causes, to visit with this most afflicting calamity. He alone can be so emancipated whose disease (call it what you will) consists not merely in seeing with a *prejudiced eye*, or with *odd and absurd* particularities, differing in many respects from the contemplations of sober sense upon the *actual existence* of things; but he only whose whole reasoning and corresponding conduct, though governed by the ordinary dictates of reason, proceed upon something which has *no foundation or existence*."

It has been justly observed, that the principles of law advanced by Mr. Erskine, subject to the doubts suggested in the notes, on a solemn trial at bar, and acted upon by the whole Court, who directed the acquittal of the prisoner, may be considered as the most correct elucidation of this interesting branch of jurisprudence.

Mr. Erskine, in the same speech, in order to demonstrate how cunning and acute in reasoning insane persons frequently are, and consequently how difficult it is sometimes to discover any symptom of delusion, referred to a case where an unfortunate gentleman had indicted his brother and the keeper of a mad-house at Hoxton for having imprisoned him as a lunatic whilst, according to his evidence, he was in his right senses, and where Mr. Erskine, in defence of the prosecution, was only instructed generally that he was still insane, but not having the clew, the prosecutor, notwithstanding a long and acute cross-examination, completely foiled Mr. Erskine in every attempt to expose his infirmity, and after a very long trial the judge and jury considered the prosecutor the victim of a most wanton and barbarous oppression; but fortunately, almost at the instant before a verdict against the defendants, Dr. Sims, who knew the subject of delusion, came into Court, and communicated to Mr. Erskine that the prosecutor believed himself to be the Lord and Saviour of mankind, at the very time he had been triumphing over any attempt to surprise him on the concealment of his disease; upon which Mr. Erskine, affecting to lament the indecency of his examination, begged that the prosecutor's *Christian* feelings would induce forgiveness, whereupon the prosecutor, with the utmost gravity and emphasis, in the face of the whole Court, ejaculated "*I am the Christ!*" and so the cause ended. Another instance was stated by Lord Mansfield, of a Mr. Wood having instituted a similar prosecution, in Middlesex, against Dr. Monro, and whose infirmity could not be exposed by the defendant's counsel by the most severe examination, but Dr. Battye having suggested the question, what was become of the princess whom he had corresponded with in cherry juice from a high tower? the prosecutor exposed his malady by narrating how he carried on such ideal correspondence, upon which Lord Mansfield immediately directed an acquittal. But the prosecutor again indicted Dr. Monro for the imprisonment in London, and being cunning enough to recollect that he failed on the prior occasion by his having narrated his correspondence with the princess, he, on the second trial, absolutely refused any communication on that subject, upon which his evidence at Westminster was proved against him by the short-hand writer, and there was of course a second acquittal.(*v*)

(*v*) A barrister was suddenly, without instructions upon any particular point of mental delusion, retained as counsel to examine a lady alleged to be lunatic, and who for two hours answered every question with the appearance of excellent

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In illustration of Mr. Erskine's admission, that if malicious mischief or revenge, and not insanity, impel a man to do an act, then he ought to be, and is, in law, *criminally responsible*, because, in such a case, the act might be justly ascribed to malignant motives, *and not to the dominion of disease;* he referred to Lord Ferrers' case, who was prosecuted for the murder of his steward, Johnson, whose conduct in the management of his property and controlling his lordship, under the direction of certain trustees, he resented *on actual grounds*, and not under any illusion, and who was instigated to the crime by the indulgence of such revenge, founded on actual facts, and not on any illusion. Mr. Erskine demonstrated, that if Lord Ferrers had committed the murder in consequence of a complete illusion, he ought to have been acquitted; but that as it merely appeared he was a man of turbulent passion, and not disturbed by any *fallacious* images of things without existence, but actuated by resentment, founded on real facts, he was properly condemned. On the same distinction also he admitted that two persons, of the name of Arnold and Oliver, had respectively been with propriety convicted of murder; and that the unfortunate woman who had been seduced and deserted by Mr. Errington, whom she had murdered, might, in point of law have been correctly convicted, though happily she was acquitted by a humane jury, who erroneously pronounced her insanity to have been predominant over resentment.

Dr. Johnson's illustration.

That great master of the human mind, Dr. Johnson, in his Rasselas, Prince of Abyssinia, in his description of the Philosoper and *Astronomer*, has further illustrated the capacities of many insane persons to reason and judge well upon all subjects excepting that of their delusion. He describes the unhappy individual as of the greatest mental attainments, and a profound philosopher, but who demonstrated his malady by imparting to *Imlac* what he considered a most momentous secret, "Hear, Imlac! what thou wilt not without difficulty credit. I have possessed for five years the regulation of weather and the distribution of the seasons; the sun has listened to my dictates, and passed from tropic to tropic by my direction; the clouds, at my call, have poured their waters, and the Nile has overflowed at my command; I have restrained the rage of the dog-star, and mitigated the fevers of the crab. The winds alone, of all the elemental powers, have hitherto refused my authority, and multitudes have perished by equinoctial tempests, which I have found myself unable to prohibit or restrain. I have administered this great office with exact justice, and made to the different nations of the earth an important dividend of rain and sunshine. What must have been the misery of half the globe if I had limited the clouds to particular regions, or confined the sun to either side of the equator."(x)

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sense, high attainments and accomplishments, and, in a manner, which denoted her to be perfectly competent to take the best care of her property and herself; but it being suggested, on a slip of paper, that ever since the lady had passed a house, upwards of nine years before, she constantly insisted that a piece of wood was burning in her throat, and had consulted numerous medical gentlemen how to effect a cure, the author interrogated her whether she still experienced that sensation? Upon which she became violently indignant, and appealed to the commissioners for protection, who advised her to answer; and on being assured that the author intended no offence, she fully described the supposed fire to be still burning, and stated, that if she put her finger towards the root of her tongue she felt that it was scorched. Upon which the jury instantly found her insane.

(x) Dr. Johnson obviously drew this melancholy picture to demonstrate how vain are all human calculations upon happiness, and the necessity for contentment of mind and submission to the will of Providence. In *Dew* v. *Clark*, 3 Addams' R. 200, the testator, who was a surgeon, was insane in insisting that he could deliver

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Importance of extended education, as it actually enlarges and improves the structure of the brain and the intellectual faculties.

A highly interesting fact has been established, viz. that the judicious exercise and cultivation of the mental faculties during youth, or at least of such as are most obviously developed, will actually gradually increase the dimensions and improve the qualities, strength, and powers of the *brain;* and generally all the organs of intellect, in like manner as the muscular powers are, by their due exercise, strengthened and improved; and hence it has been perhaps justly insisted that, independently of the effect of early imitation by infants, the children of highly educated people are quicker in their *natural* capacity to learn than the children of the uncultivated clown, and that hence mental capacity may become in a degree hereditary. And this conclusion seems natural, for we know that in one of the senses, that of *sight*, the focus and power of the eye will become altered by habit, and short-sightedness thus produced also may become hereditary.(*y*) And some descriptions of insanity are certainly hereditary, and why not the converse? for if the bodily strength and powers are increased by exercise, why should not the brain, the admitted organ of the mental faculties, also be strengthened by its appropriate exercise? It is therefore contended, that by extending education, not only the knowledge of the instructed individuals may be extended, but even the *natural* capacity of *succeeding generations.* But, on the other hand, and especially as to the *degree* or extent of mental exercise, there is another established fact, viz. that whenever there is a known *hereditary* disposition towards insanity, the children of such parents should be educated accordingly, and at all events with such adequate proportions of *bodily exercise* as will tend to render the habit of *body robust*, and harden the frame against the ordinary physical causes of madness, and particularly to place such children under *different circumstances* from those with which their parents were environed; in short, it has been recommended to put in practice the aphorism of Hippocrates, who advised to *alter the constitution* of individuals, in order to prevent the diseases with which they are threatened by the hereditary predisposition of their family,(*z*) and even the *precise education* has been described in preference to a too mentally laborious system by which, especially with the fair sex, it lamentably happens that the physical and moral powers are in general sacrificed to mere acquisition of knowledge, much of which is ill-chosen and comparatively valueless, incumbering the frame with too much mental exertion, or a crowd of ornamental accomplishments, too much for the constitutional strength of the body or mind to bear.(*a*) As regards the fair sex in particular, it will be found of the greatest practical importance that the education should comparatively be *more rational* than *ornamental.*(*b*)

The result, that due education should be legally enforced.

From these premises it results, that as happiness is increased in proportion to the extent of knowledge, and as the intellectual faculties may be strengthened and extended by *due* mental exercise and attainments, not only in the individual, but even hereditarily, therefore enlarged education should be encouraged, if not *enforced*, by legislative enactments; and though the natural affection of parents towards their children ought and might *in general* induce them to afford adequate instruction, yet, as there are lamentable instances to the contrary, the *law* ought to enforce the moral obligation. The Court of Chancery interferes only when an infant has *property*,(*c*) in which case a child may be taken from the cus-

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pregnant women by *electricity*, and was endowed by a supernatural power.

(*y*) 3 Bost. 87.

(*z*) See the interesting article, title Insanity, by Dr. Pritchard, Cyclop. Prac. Med.

(*a*) See Dr. Pritchard, Cyclop. Prac. Med. tit. Insanity.

(*b*) Fletcher's Work, 368, 369.

(*c*) 10 Ves. 57, 58, 61.

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tody even of his father, if he should be giving him an immoral or improper education, and out of the fund in court proper education will be enforced.(*d*) But in the present state of our law, unless the infant be a ward of that court, there can be no interference with the parent's authority, and neither the common nor the statute law enforces more than food and maintenance, and it does not interfere with mental improvement.(*e*) Sir William Blackstone observed, that the municipal laws of most countries seem to be *defective in this point, by not constraining* the parent to bestow a proper education upon his children, perhaps considering that the almost necessary consequence of defects in his child would be so powerful a punishment upon the parent as of itself to deter him from the moral delinquency of omitting proper education.(*f*) The Lord Chancellor Brougham in an able speech in the House of Lords, condemned in strong and decided language all *general* plans of *public* education which would render it *compulsory* on parents to resort to it on behalf of their children, and asserted his belief that such a principle would be odious to the poor, and indispose the rich to the continuance of their voluntary contributions, by which so large and increasing a number of schools are maintained throughout the realm; and the difference in religious tenets and prejudices constitutes another difficulty in framing any imperative general rules for enforcing education, at least upon the most important subjects connected with religion, which ought to form so considerable a part in all systems of education.(*g*) But, at least, the law ought, as it does in France, to interfere and punish parents and others when absolutely guilty of inculcating demoralizing or atheistical education and principles in their children.(*h*)

In any interference, however, with education, it must be kept in view that excessive mental exercise may become most banefully prejudicial, and either occasion a thickening of the bones of the skull, and injurious pressure on the brain itself, and insanity or other mental malady,(*i*) or such excessive mental application without a due admixture of healthy exercise, especially if accompanied with free living, will render the brain incapable of bearing that stimulus which otherwise might have been sustained with impunity.(*k*) This established truth, in its application to children and youth and their education, should be anxiously attended to, lest in attempting to increase the mental attainments the bodily structure should become enfeebled; and, unquestionably, the

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(*d*) Id.; and per Lord Chancellor, in *Wellesley* v. *Duke of Beaufort*, 2 Russ. Rep. 21; 1 Dow's Rep. N. S. 154; 2 Bligh's Rep. N. S. 124, where see the extraordinary demoralizing letters written by the father to his son; and see *Lyons* v. *Blenkin*, 1 Jacob's Rep. 245, 254, 264, n. (*b*;) and other cases, 1 Chitty's Gen. Prac. 64, 65.

(*e*) 1 Bla. Com. 450, 451.

(*f*) 1 Bla. Com. 450. Upon this interesting subject, see Mrs. Austin's translation of M. Victor Cousins' Report on State of Public Instruction in Prussia, and which is entitled to general and serious consideration with regard to education in our own country.

(*g*) See Lord Brougham's Speech on Progress of Education, in House of Lords, Wednesday, April 16, 1834.

(*h*) See Code Penal, Pailliet Manuel de Droit Français, 1120. "Quiconque aura attenté aux mœurs en excitant, favorisant ou facilitant habituellement la débauche ou la corruption de la jeunesse de l'un ou de l'autre sexe au-dessous de l'âge de vingt-un ans, sera puni d'un emprisonnement de six mois à deux ans et d'une amende de cinquante francs à cinq cents francs.

"Si la prostitution ou la corruption a été excitée, favorisée ou facilitée par leurs pères, mères, tuteurs ou autres personnes chargées de leur surveillance, la peine sera de deux ans à cinq ans d'emprisonnement et de trois cents francs à mille francs d'amende. Les sept Codes Français, ed. 1834, par Rondonneau—Code Penal, Liv. III. s. 334.

(*i*) Copl. Dict. tit. Cranium; Park's Inquiry, tit. Attention.

(*k*) Cyclop. Prac. Med. tit. Diseases of Artist and Literary Men, where instances are stated; Madden, Infirmities of Genius.

hours of exercise and recreation usually allowed at schools, are inadequate to healthy growth of body and mind.

Postponement of a trial, and education of a witness in mean time, to render him competent to give evidence.

There is one instance in which the law will directly interfere as regards the improvement of the mental faculties, and recognises a certain principle, namely, that although the mind of a witness may be so imperfect at the time a crime has been committed, and the infant witnessing it was so young or uncultivated, and unimpressed with a sense of moral and religious duties, as for a time to be incompetent to prove the offence, yet the trial of the culprit may be postponed until adequate instruction has been given; after which it is supposed that his natural memory will enable the infant, who has at length become instructed in the moral and religious obligation, to state the truth retrospectively, and with propriety to swear to the offence.(*l*)

The utility of parental and medical care of persons of weak or impaired mental faculties.

The parental and medical care of persons having the least tendency to *weakness* or aberration of mind is, perhaps, the most interesting and important. Many are the instances where error or harshness in treatment has prevented adequate development of mental faculties, attainments in *some* departments of science, or the recovery from a degree of insanity.(*m*) So, indiscreet and misapplied study of religion has increased depressing passions, and occasioned melancholy madness.(*n*) On the other hand, the undue encouragement of early precocity of talent, by absurdly causing children to endure too much study and confinement, when the growing body should acquire strength by due recreation and exercise, is banefully influential.(*o*)

The remedies for diseases or disturbances of the mind or intellectual faculties.

The *defects* and *diseases* of idiotcy and insanity, and all their variations, will be more properly considered in subsequent pages, and it must suffice here to observe, that as *aliment* nourishes the *body*, and medicine is the remedy for its ailments, so literature is the food of the *mind*, that may be taken in excess and requires moderation, and there are appropriate remedies for mental disorders, whether arising from the passions or from diseased brain, or pressure of the cranium, or from excessive mental labour.(*p*) It would be beyond our limits to attempt in this place to detail all those remedies, but I must refer to one powerful instance of a comparatively idle man, after severe affliction, having been saved from a mad-house and restored to happiness by the recommendation of practising composition;(*q*) and in a recent case, a gentleman, who in the middle part of his life had become a hypochondriac, declared at the age of seventy that he had enjoyed the last twenty years of his life more than all the prior, by regularly revising and enlarging upon his classical attainments which he had acquired between the age of fifteen and twenty-eight.

The moral treatment of such idiots or insane persons.

The *moral* treatment of all persons afflicted with mental weakness or aberration will be more properly considered in the next part, but as we are here taking a general view of the subject, we may advert to the melancholy absence of due feeling, affection, and attention on the part of friends, and still more of relatives, in very many of these numerous cases, where (in lieu of a cure that might by their *personal* presence, kindness, and society, be frequently effected,) either an *increase* of the disease, or,

(*l*) 1 Leach, Cr. Cas. 430, n.; 2 Bac. Ab. 577; 1 Stark. Evid. 93, 94.

(*m*) See Cyclop. Prac. Med. tit. Insanity.

(*n*) Id. 850; 1 Par. & Fonb. 314, n. (*a*,) 363.

(*o*) 1 Par. & Fonb. 184.

(*p*) Cyclop. Prac. Med. tit. Antiphlogistic Regimen, and tit. Insanity and Soundness of Mind. In lunacy or insanity *medicine* is found to have but feeble effect, 3 Greg. Econ. Nat. 441.

(*q*) Fletcher on the Influence of the Troubled Mind on Health, 150 to 162.

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at least, its *continuance* is occasioned by their cruel neglect and apathy.(r) The husband, the wife, the parent, the child, the friend, who were proud of the society of the man of talent, whilst sane, because it flattered their selfish vanity to be in association with such a man, the instant he becomes deranged speak of and act towards him as if he would contaminate or tarnish their own character; and instead of softening his affliction, first desert and then neglect, and at most hand their relative over to the mercenary care of others, who can never be influenced in their attentions by the endearing solicitude which should be evinced by the relative or friend. Nay, even too frequently, they think the least purchasable comfort a wasteful expenditure, and seek, by the most parsimonious bargain, to accumulate savings for the advantage of those who never felt for, and, consequently, never deserved the property of, their distressed relative. This is a melancholy and degrading, but correct view of the selfishness of human nature, even amongst the most cultivated classes of society. If the unhappy individual had always been an *idiot*, or a raving maniac, then, as no friendship might ever have been excited for the former, and personal danger might attend the constant society of the latter, or the excitement might increase the disorder, then, perhaps, absence, when recommended medically as essential, might be excused; but those instances are comparatively few, and, therefore, the moral delinquency of too many members of society is lamentably apparent. An instance was established by a witness of undoubted veracity before a committee of the House of Commons, in 1815, of a lady who became insane soon after giving birth to a son, and who might very soon have been recovered, but she was confined by her husband in a back garret, and there coarsely fed and barely clothed, while her husband enjoyed every luxury, till the melancholy lapse of twenty-one years, when the same son came of age, and had her released. And in another case, a brother kept his own brother confined for seven years, without adopting any means of recovery, and for the sake of his property, though they were all in opulent circumstances; and the same witness stated another instance, of a son very evidently taking measures to prevent the recovery of his own father; and several instances of people of opulence taking measures to prevent the recovery of their own brothers. He had seen evident proofs of vexation and disappointment in a wife on the unexpected recovery of her husband; the same in a husband on the recovery of his wife, and in a mother on the unexpected recovery of her own son.(s) Some instances have also occurred in my own experience of inferior medical practitioners combining with the relatives of a person for the very purpose of certifying, so as to confine their relatives without any probable cause; and a recent instance occurred of a careless and false certificate occasioning confinement even by a medical practitioner in other respects of unimpeachable character.(t) But these are crimes and offences punishable by law; and we would animadvert more particularly upon those violations of moral duties which are not punishable by law, and consist merely of neglect and apathy, and of which we fear too many members of society are unquestionably guilty, and whom it would be well publicly to degrade, as by the Roman law.

Punishments for

As regards the administration of justice, all subjects connected with the mind are most interesting, and if they had been duly considered by

(r) Dr. Latham's First Report on Mad-houses, 25th May, 1815, p. 124, 128, 129; Dr. Haslam on Moral Management of Insane Persons, A. D. 1817, p. 11, 15, 16; Dr. Burrows' Commentaries on Insanity, 507; Dr. Battie on Madness, 93, 94; Dr. Reid on Hypochondriasis, 303, 305; Male's For. Med. (Cooper's Tracts,) 261, 262.

(s) First Report on State of Mad-houses, House of Commons, 25th May, 1815, p. 124.

(t) *Rex* v. *Jones*, 2 B. & Adol. 611.

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Injuries to the intellectual faculties.(*u*)

our legislators and lawyers, we should not, perhaps, have had it laid down by high legal authorities that the deliberately and maliciously acting upon the *mind*, by occasioning terror, continual griefs, or vexations, with intent to kill, and thereby succeeding in occasioning death, is not *murder*, unless there be some *personal violence or bodily poison;*(*x*) nor should we in still more modern times have had it decided that the terrifying a person to death, by assuming the semblance of a ghost, is merely a misdemeanor.(*y*) If legislators had sufficiently considered the connexion of the mind with external objects, and that *the miseries and sufferings of the mind may be infinitely greater than those of the body*, adequate punishments would have been provided for many mental injuries which at present can only be visited by the censure of mankind, or at most by inadequate discretionary punishment, limited to fine and imprisonment:(*z*) but when considering the passions and emotions, we have already shown the defects of the law in this respect.(*a*) In one class of cases, however, those of malicious injuries and criminal conversation, and debauching a daughter or servant, the law thus far punishes the offender, that if he be in execution upon a judgment in a civil action for either of those injuries, he is not absolutely entitled to his discharge under the insolvent act until he has suffered imprisonment for two years.(*b*)

Sect. VI.—Of Conscience and the Soul, Morality and Religion.

Sect VI. Of Conscience and the Soul.

It has been well observed, that the physician who has not studied the influence of conscience and religion upon the human frame, with the appropriate remedies, physical and moral, for any injurious result, is not master of his profession, and that legislators and lawyers who do not understand their influence, must also continue inefficient in their respective departments. Some have objected, that the examination of these subjects is objectionable, as an improper inquiry into the works of the Almighty, intended to be withheld from our knowledge; but the wisest and best divines and philosophers consider that the inquiry into the attributes and immortality of the soul are not only not prohibited by the Almighty, but even that it may be acceptable to him to exercise to the utmost the mental faculties with which he has endowed us in search and explanation of *all* his works.(*c*)

Conscience, as distinguished from *religion* and its precepts, is that innate mental sensation which powerfully affects the mind, and through its influence, the body, in a degree, in all persons, whether uneducated, well-educated, ill-educated, or profligately educated, so that even the savage, who never heard of God, and worships the sun only because his few limited perceptions inform him that that orb is the probable cause of most of his enjoyments, feels its influence. It is that monitor inseparable from our natures, with which the Almighty has endowed us, informing the cultivated as well as the ignorant mind, the difference between natu-

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(*u*) As to injuries to the passions and emotions, ante, 311 to 323; and see several instances in Park's Inquiry, 216 to 255.

(*x*) 1 East's P. C. 225; 4 Bla. Com. 197, n. 17; 201, n. 25; 1 Hale's P. C. 429. 2 Par. & Fonb. 110; ante, 321.

(*y*) *Rex* v. *Smith*, 4 Bla. Com. 201, note 25; and 321.

(*z*) 3 Inst. 48; Fost. 48; 4 Bla. Com. 196, 197.

(*a*) Ante, 311 to 323. Many of the provisions in the French Code in this respect might with great advantage to society be introduced into ours. See regulations, Pailliet Manuel de Droit Français, ed. A.D. 1818, p. 1115 to 1149; ante, 364, n. (*h*.)

(*b*) 7 Geo. 4, c. 57, s. 49.

(*c*) Ante, 18; El. Blum. 40 to 50, 66, 74 to 81, 561; Descartes' Dissertations, Moral and Critical, 4to. p. 242; and Sir C. Bell's Essays on Anatomy and Philosophy of Expressions, Preface, 2d ed. xii.

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ral good and evil, and to avoid the latter from the dread of some perhaps unknown consequence, and sometimes to arrest, and even paralyze any sinful attempt, even at the instant before completion. It is that sensation so incident to our natures, that man cannot err without a sense of shame and consciousness of guilt, and which of itself, even without the aid of education or religion, tends to diminish the propensity to crime, unless perhaps in one singular exception, *i. e.* where it is counteracted by a propensity to *religious persecution*, which sometimes so blinds the mind as to induce the supposition that even criminal persecution of an individual of another faith or sect will actually be acceptable to God. It is that sensation which, in the language of the law teaches all men what are *mala in se*, as contrary to what are merely declared by human law, and termed *mala prohibita*. It has been defined to be that knowledge which a man hath of his own thoughts and actions. It is that innate feeling which has been seen to stop the purpose of an enraged savage in the act of hurling an infant from a precipice, and caused the tears of admonished nature instantly to flow. We learn that when Paul reasoned before Felix of righteousness, temperance, and judgment to come, conscience caused *Felix to tremble*.(*d*) It is the certain knowledge of the adequacy of this monitor to deter all persons of sound mind, and under ordinary circumstances, from the commission of murder and other crimes against the order of nature, that has induced all civilized states, without exception, to concur in not admitting the most positive proof of the defect, or even total absence of education, either moral, religious, or intellectual, as any defence or excuse for the commission of *such crimes*, although juries may commiserate and judges incline to mitigate the punishment, on account of the baneful influence of early associations and example. It will be remembered, that in favour of learning, very singularly by our ancient law, during a part of our history, all persons who could *read*, were entitled to a degree of exemption from or mitigation of punishment, called *benefit of clergy*, the same as had originally been allowed only to actual clergymen; although it would seem, on principle, that the better informed an individual who has committed a crime then was, the greater ought to be the punishment, since he had not the excuse of ignorance between right and wrong.(*e*)

Benefit of clergy.

In a *medical* view, not only an innumerable train of corporeal maladies are the consequences of a troubled conscience, (*f*) but the most melancholy descriptions of insanity are not unfrequently the direct result.(*g*)

The remedies or alleviations of the dreadful consequence of a mind affected with a troubled conscience, are principally the mild, consoling, and cheering influence of *true religion;* but even this blessed resource

(*d*) The Acts, chap. xxv.

(*e*) 4 Bla. Con. 366, 367.

(*f*) See Fletcher on Influence of the troubled Mind on Health, 232, &c.

(*g*) See numerous instances, Cyclop. Prac. Med. tit. Insanity. An awful instance of the effect of conscience occurred in a recent case of Alexander, a printer of Hebrew, against one of the insurance companies for an alleged damage by fire to a literary work, under very suspicious circumstances, tried at Guildhall, London, before Lord Tenterden (being a third action for similar pretended loss,) a young woman, apparently respectable, well-educated, and sensible, swore to the circumstances of the alleged loss, in a very positive and distinct manner, in favour of the plaintiff's claim. The counsel for the defendant cross-examined her in a solemn and impressive manner, and implored her, by her hopes of future happiness, to atone for her previous mis-statement by an admission of its falsehood, before she sealed her fate by wilfully persisting, and closed his question by invoking her to declare its falsehood. The witness, conscience stricken, exclaimed—"By heavens, it is false!" and immediately sunk as if stricken to the ground by lightning, and she became and continued insane for several months, and until by proper moral and religious persuasion that her sin might be forgiven, she recovered.

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requires very careful and judicious application, for otherwise the worst description of melancholic insanity may ensue.(*h*) It has been observed, that medicinal remedies have but little efficacy when the body has become disordered through mental suffering.(*i*) It may, however, be useful, by allaying irritation, or supporting an enfeebled frame. Judicious moral treatment, however, will exercise the more powerful influence. The benevolent Dr. Letsom, and many others, have established that if a guilty individual can be persuaded that he has gained the confidence or favourable opinion, or even *friendly feeling*, of one worthy member of society, he may be really restored to his own moral rectitude, and to mental happiness; a truth obviously to be kept in view, in medical jurisprudence, and all regulations respecting it.

Many well authenticated instances are on medical record of the beneficial effects of judicious regimen, physical as well as mental, having been so efficacious as to prevent complete insanity and suicide, which would otherwise have resulted from the perturbations of conscience. The prescription in one case was simple diet, a very vigorous unremitting employment of the mind, so as to suspend the operation of memory or imagination; accompanied with the daily consolation of milder religious views, infused by a judicious friend, and which removed all the symptoms of approaching insanity in about three years; and where the subject can be persuaded to attempt any literary composition, that mode of mental employment has been found the best;(*k*) perhaps might be added the encouragement of every attempt to acquire a knowledge of some of the lighter accomplishments and the fine arts, which, in their earliest stages of study, under a judicious instructer, very soon afford a degree of mental enjoyment; several instances have occurred, even late in life, of most beneficial results from a quick succession of instructions in sketching portraits and landscapes.

How far our law punishes violations of conscience and morality, but is defective.

The English law relative to conscience and morals is very imperfect, indeed more so than in France and other European states. Its defects have been alluded to by Sir William Blackstone, although he in general advocates the comparative perfection of our municipal laws.(*l*) It seems to have been a general principle, that it is better to leave morality and conscience to its own force, and not to legislate or compel what it was hoped would spontaneously be performed, lest the performance should lose its virtue and higher influence, by the very circumstance of its being legally compulsive. Hence so many moral duties remain, as it is termed, of *imperfect* obligation, and many violations of manifest duties are not punishable. However, to a limited extent, the law does interfere.

The *law* applicable to this branch of injury may be considered, *first*, as regards a party committing an act which he is supposed to have known was immoral; and *secondly*, as regards a person attempting to persuade another to commit such an act. As regards the former, all persons above the age of fourteen are supposed, whether educated or not, to have been sufficiently informed by *conscience* that they ought not to have committed an *immoral* act; and this presumption is so violent, that the law will not in general admit of express proof to the contrary, as constituting any defence or excuse. Indeed, the maxim *Ignorantia juris quodquisque te-*

(*h*) See Illustration, Cyclop. Prac. Med. tit. Insanity.

(*i*) 3 Greg. Econ. Nat. 441; great difficulties arise in the medical treatment of this description of insanity; sometimes erroneously, to prevent suicide, the palliatives have been purgatives when they should have been applications near the brain. See Fletcher, Influence of troubled Mind.

(*k*) Fletcher, on Influence of Mind on the Body, &c. 234, 235, 302, 311, 319 to 221.

(*l*) 1 Bla. Com. 450.

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netur scire neminem excusat, at least as regards acts and omissions *mala in se*, is as well the maxim of our law as it was of the Roman;(*m*) and this rule is in general strictly observed in all cases where the act done is *malem in se*, and therefore contrary to conscience; the only modern exception was in a case where a prisoner was indicted for maliciously shooting at a person within a few weeks after the passing of the 39 Geo. 3, c. 37, (which for the first time made that offence a capital felony,) and before he could have had notice of the enactment; and the judges thought that as the prisoner could not have known of that act, he ought to be pardoned; but then it will be observed, that as the act of firing at the party was in itself immoral and contrary to conscience, the *conviction* was sustainable in point of law, although the prisoner was not executed.(*n*)

With respect to *third persons* encouraging or attempting to persuade another to commit an illegal act, our law is limited, and in some respects defective. The principle of our law against *conspiracies*, where all the parties concerned are considered to encourage each other to commit an illegal act, mainly proceeds on that ground; for it frequently occurs that either of the conspirators might with impunity himself *separately* have committed the act; but the concurrence of *several* in any immoral act, calculated to injure another person, is more likely to effect the object, and more dangerous to the well-being of society, and therefore is indictable, as in the instance of the conviction of several persons for conspiring to go to the theatre and hiss a particular actor, though it was held that if each had gone to the theatre with the same purpose, but without conspiring, neither could have been punished for so malignantly acting towards the performer.(*o*) So our law punishes subornation of perjury, provided the false oath be afterwards taken in consequence of such solicitation, but not otherwise.(*p*) However, any other criminal solicitation to commit an indictable offence, although the offence be not committed, is itself indictable as a misdemeanor at common law.(*q*)

But as regards solicitations or encouragement of immorality and vice in general, our law is singularly silent and defective, whilst the French code is replete with wholesome regulations of a comprehensive nature, particularly well adapted to prevent the encouragement of juvenile offenders, and numerous immoralities, which, in England, are not punished. Thus any person, who favours or facilitates habitual debauch, or any corruption of the morals of a person of either sex, under the age of twenty-one, is subjected to not less than six months, nor more than two years' imprisonment;(*r*) and if a parent, or other person having the care of an infant, be guilty of any such misconduct, he may be imprisoned even for five years, and fined even a thousand francs; and a wife, guilty of adultery, may be imprisoned for two years, unless the husband consent to take her back;(*s*) and even the dishonourable disclosure of confidential communication,(*t*) and all slanders unless in the course of judicial inquiry, or after its truth has been previously judicially established, are treated as crimes against public justice,(*u*) and punished accordingly, and thus upon sound principles of judicial police the municipal law co-operates with the law of conscience to repress violations.

Of the soul and its im-

With respect to the *Soul and its immortality*, it is a subject which some have considered beyond the scope of physiological inquiry, as in-

(*m*) Plowd. 343; 4 Bla. Com. 27.
(*n*) *Rex* v. ———, Russ. and Ry. C. C.
(*o*) 2 Campb. 358; and see 1 Lev. 62; 1 Vent. 304.
(*p*) 3 Mod. 122; 1 Leach, 455, in notes.
(*q*) 2 East, 17; 6 East, 464; 1 Hawk. c. 19, s. 10.
(*r*) Code Penal, livre iii. titre ii. s. iv. pl. 334; ante, 364, n. (*h*.)
(*s*) Id. pl. 337.
(*t*) Code Penal, livre iii. titre ii. s. ii. pl. 378.
(*u*) Id. pl. 367 to 377.

deed it is in a great measure beyond all human research. We are, however, in addition to that *faith in Revelation*, which we ought all to have imbibed from the earliest development of our intellectual faculties, taught by the ablest divines and philosophers, that the promises of the New Testament are the proper, if not the only known foundation of our hopes of *immortality*, and that while those are wrong who think there can be any thing like an argument against a future life in another order of things, as declared by Revelation, it is strange that others should think it necessary to attempt rendering the pronunciation of Scripture as it were more probable, and that by an hypothesis, which is at best but the remains of unenlightened times, and should require any assurance besides that of the gospel itself, which they read "has brought life and immortality to light." They should reflect that the belief of an *immaterial* substance removes no imagined difficulty, as it is the peculiar doctrine of *Scripture*, in distinction to that of all the heathen supposed philosophers, that the resurrection shall be positively of *body;* that in our *flesh* we shall see God, and that therefore our minds must appear as much a property of body hereafter as at present. This, the true *Christian* doctrine of a future state, is reasonable. The heathen doctrine was grounded on the supposed inherent immortality of a supposed substance, distinct from the body. The *Christian* doctrine teaches the resurrection of what we obviously are, *bodies*, and that through a *miracle of the Almighty;*(*x*) and as Paley has observed, whether the bodies with which we shall arise be *new* bodies, or the *same* bodies under a new form, is a question by which we are not to be at all disturbed; for no alteration will hinder us from remaining the same, provided we are sensible and conscious that we are so, any more than the changes which our visible person undergoes even in this life, and which from infancy to manhood are undoubtedly great, hinder us from being the same to ourselves and in ourselves, and to all intents and purposes.(*y*)

Mortality, and effects of religion, and consequence of its absence.

There can be no *moral* inducement to virtue equal in effect to the *religious* assurance and belief that the *soul is immortal*, and to be rewarded or punished *hereafter* according to good and evil actions in this life; and Revelation abundantly establishes that truth; and none but the eternal enemy of mankind or his disciples would, under pretence of false philosophy, and cunningly engaging individuals in conceited speculation, subversive of their happiness, attempt to take from man this strong excitement towards good and avoidance of evil, or the powerful consolation and support in every trial of adversity or temptation of fortune. Every good man, to be happy, should be able to apply to himself the observation of the late Bishop of Landaff: "As a *Deist*, I should have little expectation, but as a *Christian*, I have no doubt of a future state;" or Locke's observation, that "All the great ends of religion and morality are secured by the immortality of the soul, without regard to any question, whether it is material or immaterial;" and he should conclude with that philosopher and the Bishop of Landaff—"Believing, as I do, in the truth of the Christian religion, which teaches that men are accountable for their actions, I trouble not myself with dark disquisitions concerning necessity and liberty, matter and spirit; hoping, as I do, for eternal life through Jesus Christ, I am not disturbed at my inability *clearly to convince myself* that the soul is or is not a substance distinct from the body."

The practical effects of the presence or *absence* of true religion as diminishing or increasing insanity have been well established and illustrated by M. Esquirol, who has shown that in consequence of the decay in the influence of religion in France, the number of instances of insa-

(*x*) El. Blum. 77 to 80, and authorities there quoted.

(*y*) W. Paley's D. D. Sermons, vol. iii. 26; El. Blum. 4th ed. 80, note (*q*.)

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nity had greatly increased. He thus observes—"The changes which have taken place during the last thirty years in our moral sentiments and habits have produced more instances of madness in France than all our political calamities. We have exchanged our ancient customs and fixed habits, our old and established sentiments and opinions, for speculative theories and dangerous innovations. Religion now only comes forward as a formal usage in the solemn transactions of life: it no longer affords its consolations to the afflicted, or hope to the desponding. *Morality, founded on religion,* is no longer the guide of reason in the narrow and difficult path of life. A cold egotism has dried up all the sources of sentiment; there no longer exist domestic affections, respect, attachment, authority, or reciprocal dependencies; every one lives for himself; none are anxious to form those wise and salutary provisions, which ought to connect the present age with those which are destined to follow it."(*z*)

With respect to the *physical* and *moral* treatment of the numerous corporeal maladies attributable to the misapplication of *true religion*, and the dreadful apprehension that the soul is in danger of punishment in a future state, there can be no doubt that judicious treatment may be as influential as where there has been a *troubled conscience* from mere *moral* considerations. *True* religion is designed not only to *console* but to *support* and even *cheer* the mind, and to occasion joyful not morbid feelings; but if misunderstood or injudiciously applied, or perverted by a depressed or lowly mind, it has led to the most melancholy descriptions of insanity, or has occasioned even the most perverted notions of serving God by vindictive and cruel persecutions of others of different religious tenets, and this although they vary only in a very small degree from that of the persecutors.

As regards religion, our law has ever been vigilant to protect its true interests, indeed much more so than mere morality. In more modern times legislators have evinced better knowledge of the just principles of religion, and a happier disposition is gradually prevailing for introducing more liberal regulations, calculated to *tolerate* every description of sincere religious faith, however much it may deviate from what is termed the *National Religion.* And a person may even be allowed to give evidence which he considers obligatory on his conscience, although he do not believe in a future state.(*a*)

(*z*) See quotation from the able article on insanity by Dr. Pritchard, Cyclop. Prac. Med. This admission by a Frenchman of the decay of religion and morality in *France*, and of its tendency to insanity on account of the absence of the influence of morality and religion on the reasoning faculty, may unquestionably be taken as true. But let us not too hastily exult in the supposition that England is free from the same imputation.

(*a*) 1 Stark. Evid. 93. See *Omichund* v. *Barker*, Willes' R. 550; *The Queen's case*, 2 Brod. & Bing. 284; *Edmonds* v. *Rouse*, 1 Ry. & M. 77.

CHAPTER X.

OF THE FUNCTION OF GENERATION, AND ORGANS.

First, Necessity for consideration of Subject.
Secondly, Doubts as regards the propriety of the *Law* respecting it.
Thirdly, Doubts upon sufficiency of *Education* respecting it.
Fourthly, Knowledge of Subject, why essential to Heads of Establishments, Husbands, and Parents.
Fifthly, Several distinguishing peculiarities between the Sexes in general.
Sixthly, Monsters, and non-existence of Hermaphrodites.
Seventhly, Of Impotency and Sterility, when grounds of Divorce, &c.
Eighthly, Peculiarities of Male, and his Organs of Generation.
- 1. External Organs.
- 2. Fluids, &c.
- 3. Law of Rape and other sexual Crimes, considered.
- 4. Age of Puberty, and Males' capacity to commit sexual Crimes.
- 5. Male capacity to procreate, and Law.

Ninthly, Peculiarities of Female, and of her Organs of Generation.
- 1. Differences between the Sexes.
- 2. Female Organs of Generation in general.
  - 1. Pelvis.
  - 2. *External* parts of Generation.
    - 1. Pudendum and Mons Veneris.
    - 2. Clitoris.
    - 3. Nymphæ.
    - 4. Labia.
    - 5. Perinæum.
  - 3. *Internal* parts.
    - 1. Hymen.
    - 2. Vagina.
    - 3. Carunculæ myrtiformes.
    - 4. Uterus.
    - 5. Fallopian Tubes.
    - 6. The Ovaria and Ova and Corpus Luteum.
  - 4. Of Catamenia.
  - 5. Female Puberty, or Ages when Female power of Conception commences and ceases.
  - 6. Signs of Virginity.
  - 7. Of Impregnation, and progress of Ovum, Fœtus and Child in Utero.
    - 1. Umbilical Cord.
    - 2. Placenta.
    - 3. Temporary Membranes.
      - 1. Tunica Decidua.
      - 2. Chorion.
      - 3. Amnion.
    - 4. Liquor Amnii.
    - 5. Progress of Fœtus in Utero.
  - 8. Time of Gestation.
    - 1. Ordinary Time.
    - 2. Extreme Extension of Time.
    - 3. How early a Child may be delivered to attain maturity.
  - 9. Regimen and Exercise during Pregnancy.
  - 10. Preparation for Parturition, how far material in judicial inquiry.
  - 11. The natural Labour, Delivery, and accompanying and subsequent Treatment.
    - 1. The Labour itself.
    - 2. The Birth, and Medical and legal Evidence of of the Child having been born alive.
    - 3. Care of the Mother.
    - 4. Care of the Child.
    - 5. Proper Size and Weight of Child.
    - 6. How to ascertain Age of Fœtus by Examination of the Bones.
    - 7. Of the Sex, Likeness, &c. to what attributable.
    - 8. Delivery of a Child during a Voyage.
  - 12. The Medical and Legal duties of the Accoucheur.
    - 1. In ordinary Labours.
    - 2. In unnatural Labours.
  - 13. Of the Breasts (Mammæ) and Milk (or Lactation,) and expediency of Mothers themselves suckling their own Children.

Tenthly, Of moral and legal Impropriety of Marriage in certain Cases connected with this Subject.

So much of happiness or misery depend on the due regulation of this function, that however delicate the subject, it demands a degree of in- 1st, Necessity for

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consideration of this subject in the present work, and doubts respecting the propriety of our laws and education connected with the subject.

vestigation in any work upon medical jurisprudence, especially as perhaps the present system of *education*, and our *laws* connected with the subject, require considerable alteration. All physiologists agree, that, although this function in general *begins* to be developed about the age of *puberty*, that is, in fact, in this country, between thirteen and fourteen, or even afterwards, in *females*, and *after* fourteen in males; yet that the function is not *completely established* or matured for about six or seven years afterwards; and they all agree that excessive indulgence until after the latter period, is injurious to the constitution, occasioning premature old age, and imbittering the latter days of life; and yet our law has so far fixed the ages of puberty at even earlier periods, that it allows *females* to marry at any time after attaining the age of *twelve*, and *males* immediately upon having attained fourteen (subject only to the imperfect and *easily evaded* check of requiring the parents' consent,) and this even in a country where excess of population is admitted to be an evil, and although the ablest physiologists consider that early marriage and conception, even after puberty, is injurious to the individuals, and calculated to cause degeneracy in the race;(*a*) so that very absurdly and inconsistently the law allows and openly sanctions a contract of marriage at these very early periods, although it is an engagement of so important, continuing, and permanent a nature, as to require not only *mentally* a matured experience and sound judgment in the choice of the companion for life, but for the continuance of health, as well in the female as the male, a more matured constitutional vigour; and this although confessedly the union may be as injurious to the health and constitution as to the happiness of one or both of the parties; and although the law considers an infant under the age of twenty-one, in other respects incompetent to make any other contract, excepting for bare necessaries.

The *Ecclesiastical Courts* punish all solicitations to violate chastity at any age; and at *common law*, indecent exposure to an infant with that object,(*b*) or indeed any indecent exposure or publication,(*c*) is indictable; and if a master or medical attendant take indecent liberties with his scholar or patient, he may be convicted at least of an assault; and where a medical attendant, with an illicit intent, persuaded a female to strip, under pretence that an examination was essential to enable him to prescribe, he was convicted upon an indictment charging such special assault.(*b*) But still our law is defective in the want of an adequate *general regulation* to prevent the seduction of infants, and the injurious consequences, especially of *early* debauch;(*d*) though we have seen that by the French code such offences have judiciously, by a very comprehensive regulation, been repressed, by punishing every one who *excites*, *favours*, or *facilitates* habitual *debauch*, or *any corruption* of either sex under the age of twenty-one, to imprisonment from six months to two years, and a fine of 500 francs; and if a parent or tutor, or other person having the care of the infant, be the delinquent, the imprisonment may be for five years, with a fine of 1000 francs;(*d*) and hence it will be observed,

(*a*) G. Smith, 496, in note; 1 Par. & Fonb. 172, note (*c*,) where it appears that the Romans and Athenians prohibited early marriages, in order to ensure that perfect maturity and complete sexual vigour, then considered eminently essential for the propagation of the human species. See also Dewees, Children, 9 to 12.

(*b*) *Rex* v. *Nicholl*, Russ. & Ry. C. C. 130; *Rex* v. *Rozinski*, Russ. & Mood. C. C. 19.

(*c*) 2 Campb. 89; 1 Sid. 168; 1 Keb. 620; 1 Sess. Ca. 231; 2 Stra. 790.

(*d*) See Lewis's Essay upon the Tabes Dorsalis, 3 Good, 166 to 169; where a fearful picture is given of the baneful consequences, and which cannot be too frequently presented to the attention of youths, especially in this licentious metropolis, in order to deter them from plunging into evils to which they are so often exposed; see also death from, 3 Par. & Fonb. 44; danger in old age, Cyclop. Prac. Med.

(*d*) Code Penal, livre iii. titre ii. sect.

that, compared with the extent of population, the instances of *early* depravity are not so numerous in France as in England, where the present precocity in vice is lamentably conspicuous and extensive.

Education.

As regards *education*, at least in large and public schools, information and moral and religious advice respecting this function, are usually withheld by those who are most competent to influence and regulate youth, or at least there is no adequate regimen to prevent vices connected with the organs of generation, too prevalent at very early ages; and youth are allowed, and with another laudable object encouraged to read, hear, and study the Scriptures, but many parts of which contain passages exciting their curiosity, and who, whilst unable to obtain information from those who would accompany it with sound moral advice, seek for and obtain it from older and perhaps vicious companions, whose luxuriant and unqualified descriptions and communications too frequently excite the youthful passions to premature, irregular, and baneful indulgencies, equally ruinous to the mind as the body; and hence those numerous early emaciated frames, either wholly incapable of attaining maturity, or terminating in painful premature old age. If, on the contrary, parents and preceptors, instead of *solely crowding accomplishments*, were gradually, at the age when sexual desires begin to be developed, privately and individually to dispel all mystery, and describe nature as it is, and faithfully demonstrate how baneful, as well mentally as corporeally, are sexual and irregular indulgencies before the proper age, for the former and other prudential circumstances have combined in justifying marriage, good moral conduct, good vigorous manhood would be established on *principle*, and not left, as too generally the case, to mere accident. Dr. Copland, in his valuable work,(*e*) makes the following strong remarks upon this subject: "The practices which both sexes are liable to acquire at this period of life, and to which they are commonly addicted when they associate in numbers at seminaries and academies, demand the strictest supervision. They have been, too generally, overlooked, both morally and medically, from the circumstance of their consequences having been imperfectly appreciated. There is no practitioner of observation and experience, certainly none of even limited knowledge, who has travelled into foreign countries, and is yet unacquainted with the physical exhaustion, the mental torpor, and all but annihilation of existence, which is the ultimate result of indulging them. From this source often spring impotency hereafter, the extinction of families, and hereditary honours—honours which such persons are incapable of achieving; the infliction, during after life, of many of the diseases which proceed from debility, and the exhaustion of the nourishment and vital energy of the various structures and organs; of numerous nervous and convulsive maladies, as hysteria, epilepsy, neuralgia, chorea, melancholia, mania, idiotcy, &c. the dangerous or fatal visitation of fevers, diseases of the heart, disorders of the digestive organs, premature baldness, and old age, the formation of tubercles, and the production of pulmonary consumption; and lastly, the transmission of weak and decrepit bodies and minds to their offspring, of scrofula, rickets, verminous complaints, marasmus, hydrocephalus, convulsions, tubercles, chorea, &c.; the curse is visited on the children to the third and fourth generation, until the perpetual punishment extinguishes the very name of the aggressor."(*f*)

To these considerations may be added the imperative necessity for all heads of establishments, public and private, all husbands and parents,

iv.; Pailliet Manuel de Droit Français, edit. A. D. 1818; ante, 361, n.(*h*.)

(*e*) Copl. Dict. Prac. Med. tit. Age, 43.
(*f*) Id.; and see 3 Good, 168.

to secure some knowledge of the subjects, on the ground that they are morally responsible for many of the miseries experienced, especially by females as well in child-bearing as in the later part of life, in consequence of their not having, when young, been allowed, nay even compelled, daily to take adequate walking and other exercise, and being suffered to indulge in too sedentary habits, occasioning deformity or weakness in the pelvis and abdominal muscles, and parts especially connected with generation; or on the other hand being allowed, during certain monthly periods, for the sake of temporary pleasure, to indulge in too active amusements, materially injurious to health. We will, therefore, anticipate that no objection will seriously be entertained to the statement of the best received opinions on points of practical importance connected with this subject, and so essential to be understood by all heads of families. It also appears, from a work of the highest authority, that it may become of the greatest importance that females, when affected by local pains about the pelvis, should, after they have examined a skeleton or plate delineating the parts, be enabled to describe to their medical attendant the seat of their pain or peculiar sensation.(*f*)

The general distinguishing peculiarities between males and females; and of monsters and supposed hermaphrodites.

We have seen that as regards the bones of the skeleton, especially those of the pelvis, which surround, protect, or support the organs of generation, there are a few leading distinctions between the sexes, which, after complete decomposition of every other part, have assisted in legal investigation and detection of crime.(*g*) The blood of females usually contains more water and fewer red globules than that of men, and whilst its odour is stronger in males than females;(*h*) in numerous other respects also it will be found, that before decomposition, any *considerable* difficulty in deciding upon the sex of a particular individual, cannot well attend the investigation, as the notion that there can exist an *hermaphrodite*, or such a union or confusion of the genital parts of both sexes in one individual, as to render it questionable which of the sexes is predominant, is now generally denied by the best authorities, although certainly formerly credited.(*i*) There are, however, no doubt, many instances of *monsters* so partaking of the appearance of the *brute* creation, that according to our ancient law they could not inherit,(*k*) but from which authorities it further appears, that any production of lawful marriage, having the *human shape*, may inherit and enjoy real estates for its life, without regard to any question whether such production could itself procreate or continue the inheritance.(*k*) A perfect knowledge of all the parts of the organs of generation is most essential to surgeons, for when the sex is doubtful, or the organs are not in perfect operation, a surgical operation may remove the imperfection, and occasion procreation and child-bearing, when it has merely been impeded; and in many cases of supposed impotence, adequate powers may be established by regular surgical assistance;(*l*) and the ascertaining the sex of a child which has died shortly after birth, may be most important, not only as regards the right of a father to hold real property as tenant by the cour-

(*f*) Denman's Pr. Mid. 10; Dewees, Children, 16; see plate, post, 387.

(*g*) Ante, 56, 57.

(*h*) Dr. Turner's Elements of Chemistry, 552.

(*i*) G. Smith's For. Med. 498; 3 Bost. 19, 20; id. note; 1 Par. & Fonb. 227; where the doubts of several learned authors are stated whether there is any case of real mixture or participation of the organs of both sexes; and see 3 Bost. 20, note; post; and 2 Bla. Com. 207, 227, 246, 283, 288. See Milton's Paradise Lost, book iv. p. 297; El. Blum. 557; 2 Dungl. Phy. 276.

(*k*) 2 Bla. Com. 246, 247, citing Bract. book i. c. 6, and l. 5, c. 30; Co. Lit. 29.

(*l*) Farr's Med. Jur. 11; (Cooper's Tracts,) in notes; as to removal of impediments in *males*, Cyclop. Prac. Med. tit. Impotence; and in *females*, id.

tesy, but also as respects the law of descent; for if a woman be tenant in tail male, and have only a daughter born alive, the husband is not thereby entitled to be tenant by the courtesy, because such issue female could never inherit the estate thus limited in tail male:(*l*) and it is, therefore, the professional duty of every accoucheur or medical attendant, at the time of a birth, very carefully to observe and note in a general book the sex of every child delivered in his presence, as the same, especially if it admit the receipt of his professional remuneration, may even after his death be received as evidence of the fact.(*m*) We shall here confine our observations to those parts of the subject which are absolutely essential to be known in ordinary practice, and a knowledge of which will be found indispensable as well regarding suits for divorce, *propter impotentiam*, and questions of legitimacy, as relative to a very extensive class of crimes and offences, unhappily daily subjects of prosecution, namely, rapes and other illegal sexual intercourse, attempts to cause abortion, infanticide, and all infamous crimes, and all prosecutions and actions for *mala praxis*. Medical students and barristers may extend their knowledge upon these subjects by examining the references; we shall here content ourselves with stating the present doctrines and opinions upon the subject, generally acknowledged to be correct.

The non-existence of an hermaphrodite.

We have adverted shortly to the possibility of the actual existence of any being resembling the human frame, actually combining and possessing the generative organs as well of male as female in the same individual, termed Hermaphrodites (from ἑρμης and αφροδιτη.) (*n*) Such a possibility, in the *strict* sense of that word, has been denied by the most eminent modern physiologists,(*o*) though it is admitted that the malformation or imperfection of a part may be so considerable as to render it difficult, at least in the infant state, to determine which sex predominates.(*o*) But even in such cases a surgical operation might be performed, restoring the original imperfectly developed part to at least an approximation to perfection.(*p*) Consequently, as well on physical as legal grounds, a charge or assertion that a party is an hermaphrodite is not actionable unless attended with actual damage; and where a dancing master proceeded in an action for slander in calling him an hermaphrodite, it was decided that such action was not sustainable, first, because such union of the sexes cannot exist *in fact*, and every one must be supposed to know it, and consequently the assertion could not be supposed to prejudice; and secondly, because admitting the possibility of such double function, the party would be just as good, and, perhaps, a safer dancing master, as if only one perfect sex had been discoverable, and consequently the words would not, in legal presumption, injure him in his profession or occupation.(*q*) It should seem that if the birth be monstrous, and the production be obtained from the parents for the purpose of exhibition, the Chancellor will decree the profits to be paid to the parents; and if the production be dead, that it shall be buried in a week.(*r*)

Defects and impotency, and

Questions relative to *impotency* or *sterility* in either sex, will be more properly considered in the following part. It may here suffice to observe, that imperfections constituting impotency rarely occur, and that many

(*l*) Co. Lit. 29; 2 Bla. Com. 128.

(*m*) *Higham* v. *Ridgway*, 10 East, 109.

(*n*) See the singular supposed fabulous origin of this term in Ovid's Met. 4, v. 288, 347; and Lempr. Class. Dict. tit. Hermaphroditus.

(*o*) See, in general, G. Smith's For. Med. 498; 1 Par. & Fonb. 383, &c.; 3 Bost. 20; id. note; 1 Beck's Med. Juris. 60 to 72; but see Farr's Med. Juris. 24, 25.

(*p*) Farr's Med. Juris. 13, 14; (Cooper's Tracts.)

(*q*) 3 Salk. 397; Starkie on Slander, 143; the legal ground was, however, there the only reported point in discussion.

(*r*) *Herring* v. *Wallround*, Select Ca. Ch. part ii. 110.

CHAP. X. OF GENERATION, AND ORGANS.

sterility, when grounds of divorce.

supposed defects may be removed by surgical operation.(*s*) *Impotency* may exist on the part of the man or of the woman, though in the great majority of instances on record, it has been alleged against the former; and though not a very frequent event in either sex, is comparatively more rare in the female.(*t*) In the male it denotes an incapacity *erectio ac intromissio penis cum emissione seminis*. In the female, impotence is limited to an impervious vagina. *Sterility* imports, that notwithstanding the existence of an aptitude for the act of intercourse, there is no power of procreation, and the defect is confined to females; for where no charge of impotence can be established against a man, neither physiologically nor in law can sterility be imputed to him,(*u*) though probably want of perfection in the seminal fluid may occasion his sterility. As far as regards the *law* on the subject, it is an implied part of the contract of marriage, that both the parties shall be, at the time of the celebration of the ceremony, *habiles ad matrimonium*, and therefore if it should afterwards, even after the lapse of eight years, appear that at the time of *the marriage* either party was *impotent*, that is, unable to consummate, and such inability should continue, it will be a ground for annulling the marriage in the Ecclesiastical Court, although the party were ignorant of the constitutional defect,(*x*) unless the defect were before the marriage fully made known to the other party, who in that case could not afterwards object, or the parties, when marrying, were at advanced ages; nor can a man avoid a marriage by setting up his own incompetence or frigidity.(*y*) But consummation of a marriage is not essential to be alleged or proved in a suit for a divorce on account of the adultery of the wife.(*z*) In a suit in respect of impotency, the party complaining must establish that the incapacity existed at the time of the marriage, and continues to be of a nature incurable; and if the impediment was not natural but supervened after the marriage, it will constitute no ground of divorce.(*a*) In a suit of nullity by reason of the alleged impotency of the husband, a *certificate*, twelve years after the marriage, that the wife still was *virgo intacta*, although *apta viro*, coupled with two several confessions of the husband of his incapacity, and with proof that the woman's health had suffered, though the husband had not given in his answers, and that he had removed into France, and had refused to undergo surgical examination, was holden sufficient in the Ecclesiastical Court.(*b*) On the continent, suits for a divorce on this ground are frequent; but for the honour of English ladies, their delicacy in general deters them from thus publicly complaining, and such suits are comparatively rare, unless there be other strong ground for seeking a dissolution of the contract, as intolerable ill-temper, which, although not of itself a sufficient ground for a divorce,(*c*) may yet constitute an inducement to make the disagreeable disclosure, and proceed for a divorce on the legal ground of the incapacity of the husband.

(*s*) See cases Cyclop. Prac. Med. tit. Impotency; and G. Smith's For. Med. 446 to 466; 1 Par. & Fonb. 197 to 229; and per Sir W. Scott, in *Briggs* v. *Morgan*, 3 Phil. Ec. Ca. 327.

(*t*) Authorities cited in *Norton* v. *Norton*, 3 Phil. Ec. Ca. 148, 149; *Briggs* v. *Morgan*, id. 325.

(*u*) G. Smith, 447 to 466; 1 Par. & Fonb. 197.

(*x*) *Greenstreet* v. *Cumyns*, 2 Phil. Ec. Ca. 10; 3 Phil. Ec. Ca. 156; 1 Bla. Com. 440.

(*y*) 1 Par. & Fonb. 172, 173, note (*d*;) *Norton* v. *Seton*, 3 Phil. Ec. Ca. 147; and per Sir W. Scott, in *Briggs* v. *Morgan*, 3 Phil. Ec. Ca. 329.

(*z*) *Patrick* v. *Patrick*, 3 Phil. Ec. Ca. 596.

(*a*) 1 Par. & Fonb. 172, 173, note (*d*;) *Brown* v. *Brown*, 1 Hagg. R. 523; *Greenstreet* v. *Cumyns*, 2 Phil. Ec. Ca. 10; 1 Bla. Com. 440; see also Ryan, Med. Jur. 95 to 111.

(*b*) *Pollard* v. *Wybourn*, 1 Hagg. R. 725; the evidence to be adduced in support of a suit for a divorce on this ground, will be considered in the next part. The court always requires a certificate of medical persons, as to the state and condition of the woman, id. 727.

(*c*) *Evans* v. *Evans*, 1 Hagg. R. 36.

CHAP. X. Of the Male Organs of Generation, &c.

The peculiarities distinguishing men from women, as regards the *pelvis*, have been adverted to, and will be further noticed when we examine the female pelvis. The male organs of generation consist of, 1st, the *urethra*, before described(*b*) (usually as regards this branch of inquiry known by another name,) and every part of which has particular names, namely, amongst others the *corpora cavernosa*, the *corpus spongiosum*, its glands, the *urethra* itself, or central canal, with the arteries and veins, and invested with integuments, the principal of which are the prepuce and the *frænum preputii*, and a particular knowledge of each of which may become essential in legal investigation, though not very frequently so, especially since the recent alteration in the criminal law;(*c*) 2dly, the *scrotum*, suspended under such parts; 3dly, the *testes* or *testicles* contained therein;(*d*) 4thly, the *vasa deferentia* and *vesiculæ seminales*, which are situated within the pelvis, between the under and lateral parts of the bladder and the rectum;(*e*) and to which is added, 5thly, the *prostate gland*.

But the principal, if not the only cause of procreation, is the *male semen*,(*f*) for it has been established by experiment, that if that fluid be separately injected by a syringe into the uterus, there may be conception.(*g*) For the purpose of secreting this fluid, the testes are placed in the scrotum, and each of which testes are composed of exceedingly minute tubes, so that the vessels of even one of them are capable of being drawn out to the immense extent of even 500 feet;(*h*) and these minute vessels elaborate the semen in the testes. The vasa deferentia convey the seminal fluid from the testicles into the abdomen, and round the bladder, where they join the vesiculæ seminales. These *vesiculæ seminales* are also supposed to *assist* in the secretion, though that point has been disputed.(*i*) Dr. Paris observes, that the experiments and observations of our most accurate physiologists, establish that the fluid expelled in copulation is furnished only in a small proportion by the testes, and that to this a peculiar secretion of the vesiculæ seminales is added; and that the chief bulk is made up of the prostatic fluid or secretion from the prostate gland, so that the fact of emission in eunuchs is not extraordinary, although the discharged fluid cannot be properly said to be seminal or procreative.(*k*) It has been supposed that monorchides, or persons with but one testicle, are not deprived of the power of procreation; and although in A. D. 1665, the parliament of Paris decided that such an imperfection rendered a matrimonial contract void; since that

(*b*) See fully ante, 239, 240; and see authorities in Cyclop. Prac. Med. tit. Impotence; 2 Horn. Anat. 77; 3 Bost. 4 to 6; Coop. Surg. Dict. tit. Penis; 2 Dungl. Phy. 258, 259; Brous. Phy. 519 to 521; 3 Par. & Fonb. 178, Index, tit. Penis; G. Smith, Index, tit. Penis, and 447 to 459.

(*c*) And, therefore, for obvious reasons, we shall here forbear to give a more particular description. As regards malformation or disease of urethra, &c. occasioning impotence, and the remedies, see Cyclop. Prac. Med. tit. Impotence.

(*d*) 2 Horn. Anat. 85; as to inflammation of testicles, see 2 Good, 376; as to the testes, see 1 Par. & Fonb. 192, 197, 201, 202.

(*e*) 3 Bost. 6, 7, note. The presence of seminal secretion in the vesiculæ seminalis, or some of the contiguous parts, is supposed to excite sexual desire; 3 Bost. 141; but it is admitted that the process of generation is still in a degree, a mystery; Cyclop. Prac. Med. tit. Impotence; 2 Dungl. Phy. 315.

(*f*) 3 Bost. 28, note; but see 5 Good, 10, &c. It is a disputed point whether there is any *female* semen, which some have supposed intermixes with the male semen, and thus creates the fœtus; id. ibid.

(*g*) Cyclop. Prac. Med. tit. Impotence; and see Richerand, Physiology.

(*h*) Haller's El. Ph. xxvii. 1, 16; 3 Bost. 6; 2 Horner, Anat. 89.

(*i*) 3 Bost. 7, 8, note 6; id. 178. In Cyclop. Prac. Med. tit. Impotence, 595, the testicle is treated as the *only* essential organ concerned in the secretion of semen.

(*k*) 1 Par. & Fonb. 434, note (*a*.)

CHAP. X. The Male Organs, &c.

decision, numerous instances have completely disproved that opinion.(*l*) And although the extirpation of *both* the testicles will decidedly deprive the individual of the power of procreation, yet it will not totally extinguish venereal desire, and eunuchs retain the power of penetration and copulation, though in an imperfect degree, and which is so well known in the east, that the eunuchs there who have the care of seraglios are deprived of the external organ as well as the testicles, or at least of the former.(*m*)

The seminal fluid is a mucous secretion, possessing properties of a specific and peculiar nature and odour.(*n*) In man, and various other species of male animals, it is now ascertained beyond doubt to contain, when in a perfect state, innumerable *living spermatic animalcules*, so small that the calculations upon their dimensions almost excite the suggestion of invention, for it is said that even 10,000 may exist in a space that would be occupied by a single grain of sand.(*o*) These, it is said, are not derived from any extraneous source, but from one of the indispensable components of perfect semen, and they do not exist where there is sterility or inefficacy in the power of procreation, whether attributable to disease or age.(*p*) A very small portion of this essential fluid will perfect impregnation; and it is said that even where it had been so diluted in water, that the mixture contained not much more than $\frac{1}{3000}$ part of the secretion, a single drop of such diluted fluid is capable of producing impregnation.(*q*)

By the excitement of the sexual passion, which also influences the muscle termed the erector, the male organ becomes in general capable of penetrating the vagina, or at least sufficiently so as to propel an adequate quantity of the essential fluid into the cavity of the uterus, or possibly into the Fallopian tubes, presently described, and thus completing the sexual congress.(*r*) But in general this fluid is carried no further than the uterus, where it is supposed to act upon the ovaria by sympathy or absorption;(*s*) and even a much less efficient penetration may occasion procreation, as if even the entrance, or rather mere approach, accompanied *with any contact*, be no further than the *Labia*, and a portion of the essential fluid be there deposited, even outside the hymen and vagina, although the hymen be *unbroken*, procreation may take place by absorption, so that the circumstance of the hymen being unbroken, is by no means conclusive evidence of virginity, nor does it exclude the possibility of conception;(*t*) and in this respect it will be found that our criminal law adopts the views of physiologists.

Some authors have observed, that in males the sexual passion or desire is not, strictly speaking, *instinctive*,(*u*) but that it is connected with a specific and very powerful nervous sensation,(*x*) and that the seat of desire is in the cerebellum of the brain, which has been called the sexual sensorium, and that hence is the occurrence, in some cases, of apoplexy taking place, pending the indulgence of the passion, an incident by no means of rare occurrence.(*y*) But the latter notion has been recently

(*l*) Cyclop. Prac. Med. tit. Impotence.

(*m*) Cyclop. Prac. Med. tit. Impotence, citing also Juvenal, 6th Satire; and see 1 Par. & Fonb. 197, 198; Ryan, Med. Jur. 98.

(*n*) 3 Bost. 8; 2 Dungl. Phy. 267.

(*o*) Id. 8 to 12; and Leeuwenhoek, Opera; vol. i. 24, 25; 2 Dungl. Phy. 312 to 315.

(*p*) 3 Bost. 23, 24.

(*q*) Id. 51; 2 Dungl. Phy. 288.

(*r*) Id. 27.

(*s*) Id. 28, note; Dewees, Midwif. 68 to 70.

(*t*) 1 Par. & Fonb. 203, 432, 436; and see Cyclop. Prac. Med. tit. Impotence, an instance where conception was occasioned without perforation.

(*u*) Edinb. Trans. vol. vii. 67; 3 Bost. 13, note.

(*x*) 3 Bost. 13; ante, 271.

(*y*) See fully, El. Blum. 532, 533; G. Smith, 467; 3 Par. & Fonb. 44; but see denied by Desmoulins, in his observations on the nervous system;(*z*) hence also the melancholy consequences of excessive or irregular indulgences;(*a*) circumstances which ought not only to influence every individual against any intemperance as regards these organs, but will also account for certain sudden deaths under otherwise suspicious or unaccountable circumstances.(*b*) It is supposed that sexual desire is greater in men than women, and this on account of the cerebellum being larger in man than in woman.(*c*)

The law of rape, &c. and the principle on which it proceeds, and doubts as to its expediency.

As one of the objects of this work is to examine the *principles* of the existing law relative to injuries to the person, and its improvement, a few words on the subject of *rape* and other crimes connected with the sexual organs may here be admitted. The ecclesiastical law, the common law, and the statute law of England, have uniformly prohibited all sexual intercourse excepting after certain ages, and then only between persons legally married; and they subject unmarried women to censure and punishment; and universally, in England, an unmarried woman, who has had sexual intercourse, *even by such violence* that she was unable to *resist* with effect, is, in a degree disgraced, or rather no longer retains her virgin purity in the estimation of society, and there is a natural, delicate, though perhaps indescribable feeling that deters most men who know that a female has been completely violated, though manifestly after every effort of resistance, from taking her in marriage, but which does not exist, at least in so powerful a degree, if he be certain that the sexual intercourse was *incomplete*, according to the ancient law of rape, which, intending to distinguish between the degrees in the enormity of offences of this description, made a marked distinction between *ineffectual attempts* completely to violate, and cases where the violation was so complete that the female could no longer be considered in fact a virgin, and therefore required the most explicit evidence of such a *completion* of the offence, that might, under ordinary circumstances, occasion conception; and consequently not only the actual introduction of the male organ, but also of the essential fluid was formerly required to complete the crime of rape, and without which proof it was supposed that no man could object to the female as actually contaminated or affected in her virgin purity.

In that state of the law, and when such completion of the operation was essential to complete the offence of rape and other crimes connected with the organs of generation, if the prosecutrix failed in proving either the introduction of the male organ or of the fluid, or if it appeared that the prisoner was a eunuch, and that consequently the fluid was deficient in perfect seminal qualities, acquittals frequently took place, and other indelicate and difficult questions and discussions arose, and on

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3 Bost. 141, where sexual desire is attributed more directly to the presence and accumulation of the seminal secretion in the vesiculæ seminales, or some of the contiguous parts; and in 3 Bost. 142, it is doubted whether there is any other specific agent; but the former supposition of the nerves and of the cerebellum, and even sensorium, in general, having the principal influence; seems to be well founded; for, however superabundant may be the accumulation of the secretion, yet unless *the mind* concurs, no sexual intercourse may be accomplished, as established by the instance of the Earl of Essex; see Montaigne's Essays on Impotence, chap. xx; Baumer's Medicini For. 135; G. Smith's For. Med. 457, 458; and 1 Par. & Fonb. 210, 211; and see Cyclop. Prac. Med. tit. Impotence, moral cause of, Ryan, Med. Jur. 107, 108.

(*z*) 3 Bost. 308; ante, 271.

(*a*) Cyclop. Prac. Med. tit. Impotence; and see 3 Good, 166 to 169; as to tabes dorsalis and night pollution, 4 Good, 126; danger of climacteric disease by marriage at an advanced age, Cyclop. Prac. Med. tit. Age.

(*b*) 3 Paris & Fonb. 44.

(*c*) El. Blum. 533; ante, 271.

CHAP. X. The Male Organs, &c.

that account the statute 9 Geo. 4, c. 31, thus enacted: "And whereas, upon trials for the crimes of buggery and rape, and of carnally abusing girls under the respective ages therein before mentioned, offenders frequently escape by reason of *the difficulty of the proof* which has been required of the completion of those several crimes; for remedy thereof be it enacted, that it shall not be necessary in any of those cases to prove the actual emission of seed in order to constitute a carnal knowledge, but that the carnal knowledge shall be deemed complete upon proof of penetration only." At first this enactment was, as might be supposed from its terms, construed by a very learned judge merely to relieve a prosecutrix from the necessity of her proving the completion of the offence according to the old law; and he considered that if the essential fact of emission were explicitly negatived in evidence, then the prisoner must be acquitted of the capital charge;(*d*) but in subsequent cases the judges decided that this statute not merely affected the evidence but altered the character of the offence; and that therefore as well in prosecutions for rape as for carnal knowledge of infants, and unnatural crimes, the capital offence is complete if perforation be proved, although emission be negatived,(*e*) and this although the hymen be unbroken, and the vagina continue so small that even a finger could not be introduced;(*f*) and perhaps as a eunuch and an infant under the age of fourteen may be capable of penetration, though not of perfect emission, he might, since the last enactment, be convicted of a rape or unnatural offence.(*g*)

This act has certainly been convenient in practice, by putting an end to all difficulties of that nice and delicate nature as regards the enumerated *criminal prosecutions*.(*h*) But as respects questions of *impotency* in suits for divorce, and as regards *legitimacy*, it may still be essential in medical as well as judicial inquiries to ascertain the precise components of the secretion.

Doubts whether the alteration in the law of rape is expedient.

Perhaps the want of distinction between the actual and perfect *completion* of the offence and cases where the attempt has been defeated, may unfortunately have had the effect of inducing some offenders *to complete the outrage* in cases where, under the old law, the fear of the higher punishment might, especially if opposed with sturdy resistance, have been prevented. Under the existing law capital punishment is the result, although there have been an incomplete assault and the slightest introduction of the male organ infra labia, without further perforation or the slightest laceration or actual injury to the vagina, and although seminal discharge be clearly negatived. An offender under such circumstances, knowing that he may be equally punished whether he complete his purpose or not, naturally resolves to complete the really greater offence; and thus cases may have occurred where, contrary to the sound policy of legislators in framing an ascending scale of punishment in proportion to the injury or evil to be repressed, the offender is not induced to exercise any locus penitentiæ, but completes what is confessedly a *greater* injury. Many experienced individuals have, therefore, more than doubted whether some modification of this modern law is not called for.(*i*)

(*d*) Per Taunton, J. in *Rex* v. *Russell*, 2 Mood. & M. C. N. P. 122.

(*e*) *Cox's case*, 1 Mood. Crim. Ca. 337; *Rex* v. *Reekspear*, id. 142.

(*f*) 4 Car. & P. 249; *Cox's case*, 1 Mood. Crim. Ca. 337.

(*g*) *Semble*, 1 Par. & Fonb. 433, 434; and post, 383, note (*o*.)

(*h*) 9 Geo. 4, c. 31, s. 13 to 19. Quære, could a eunuch now be convicted of a rape? According to the Romans, it was supposed that he might, in fact, deflower, though not impregnate, 1 Par. & F. 433, 434, in notes.

(*i*) It is not here intended to urge that every brutal attack upon a female does not deserve very severe punishment; but no one who justly estimates the natural

The age of puberty, and capacity to commit crimes in males.

In legal consideration, *males under the age of fourteen* are incapable of committing the crime of *rape*, or indeed any other sexual crime,(*k*) nor before that age can they marry,(*l*) it being supposed that until that age had been attained that the two capacities, which according to the ancient law must have combined, could not exist; and it being expedient for legal purposes to fix some precise age, so as to avoid difficulty in evidence and uncertainty in legal investigation.(*m*) And although that doctrine originated at a time when the concluding part of the proceeding was essential, as affording the most decisive evidence of the characteristic of manhood, and to the completion of the offence,(*n*) and although now that part of the process is no longer essential, perhaps a different rule might without impropriety be adopted, so as to include offenders of an earlier age than fourteen, (who are between that age and seven, legally, capable of committing *other* crimes,) yet as the law has once fixed that age as the earliest time when the ability to commit a sexual crime is to be considered as established, it is most probable that the rule would be still adhered to, although one of the reasons for its adoption has ceased.(*o*)

It will be observed that our law merely protects *infant females* from too early sexual intercourse, and under the age of ten and twelve supposes her incapacity to consent;(*p*) whilst improvidentially it permits, or rather does not punish, females, especially elders, who not unfrequently too early excite the indulgence of imperfect desires of *male* infants, so ruinous to their ultimate powers and health. Nor is there in this country any punishment against males under fourteen who excite in others or themselves indulgence in prejudicial propensities, though the law of

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feelings of man, and his repugnance to form a matrimonial connexion with a female who has been *completely* violated, according to the requisites of the ancient law, will hesitate in admitting that an *incomplete attempt* is not so great an injury as that, which, according to the ancient law, must have been completed; and in legislating, it is submitted that some distinction in punishment should if possible be introduced.

(*k*) If an unnatural offence be committed on a boy under the age of fourteen, it is felony only on the part of the individual above that age, 1 Hale, P. C. 670; 3 Inst. 39; note (*n*.)

(*l*) 1 Bla. 436; G. Smith's For. Med. 107; 1 Russ. & R. Cr. C. 48.

(*m*) 1 Hale, P. C. 631; 4 Bla. Com. 212; and see 1 Par. & Fonb. 191. There are, however, many instances of much earlier development of sexual powers, see id. and Cyclop. Prac. Med. tit. Impotence.

(*n*) 12 Coke's Rep. 37; Hawk, B. 1, c. 41, s. 3; *Hill's case*, 1 East, P. C. 437, 438; by a large majority of the judges, dissentient Buller, Loughborough, and Heath, C. J. It was on account of the supposed mental as well as bodily imbecility of a boy under fourteen, to have perfect knowledge of the immorality of the act, that it was decided, that if an unnatural offence be committed on a boy under fourteen it is felony in the adult party only, 1 Hale, P. C. 470; 3 Coke's Inst. 50; and see G. Smith's For. Med. 407. The legal consequences of the alteration of the law by 9 Geo. 4, c. 31, may, perhaps, be more extensive than has been supposed.

(*o*) See also 1 Par. & Fonb. 191.

(*p*) By 9 Geo. 4, c. 31, s. 17, it is enacted, that if any person shall unlawfully and carnally know and abuse any girl under the age of ten years, every such offender shall be guilty of felony, and being convicted thereof, shall suffer death as a felon; and if any person shall unlawfully and carnally know and abuse any girl, being above the age of ten years and under the age of twelve years, every such offender shall be guilty of a misdemeanor, and being convicted thereof, shall be liable to be imprisoned, with or without hard labour, in the common jail or house of correction, for such time as the court shall award.

Sect. 18. And whereas upon trials for the crimes of buggery and of rape, and of carnally abusing girls under the respective ages hereinbefore mentioned, offenders frequently escape by reason of the difficulty of the proof which has been required of the completion of those several crimes; for remedy thereof, be it enacted, that it shall not be necessary, in any of those cases, to prove the actual emission of seed in order to constitute a carnal knowledge, but that the carnal knowledge shall be deemed complete upon proof of penetration only.

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France extends to all acts of this nature. It has been suggested that when this has been occasioned, as not unfrequently, by the profligate seduction of elder matrons, it would be well if the legislature subjected them to punishment. The French code certainly subjects all such seducers to imprisonment for two years, and if she be a parent, tutor, or governess, to even five years' imprisonment.

Of the physiological and legal view of puberty, and the male and female capability to procreate in general.

The period when the ability to procreate commences in both sexes is technically called *puberty*, and which, in fact, is not in general apparent in females or males till the age of fourteen and upwards, though the *law* fixes the age of twelve in females, and fourteen in males. In males, at that age the beard gradually appears; the voice is changed and vulgarly said to break, though in reality merely becomes fuller, deeper, and more sonorous;(*q*) the secretion of semen commences, and hereditary diseases and predispositions become more identified, and the mental faculties manifestly become more rapidly developed;(*r*) and whilst, it has been supposed, before that period memory has been superior, and, consequently, antecedently was the time to pour in and impress *new* ideas upon every subject of mental attainment, yet at fourteen has arrived the time when *imagination*, and the still more important faculties of *reasoning* and *judgment*, become predominant, and consequently comparison of previous attainments and mental taste are to be more particularly cultivated.(*s*) At this tumultuous period parents and preceptors are more attentively to inculcate moral and religious principles, so as to counteract the increasing corporeal powers and the passions, and more deeply impress the value of discretion and virtue.

At this time the *law*, assuming to adapt itself to the physiological view of the subject, (though, as we submit, erroneously,) treats the female and the male to be capable of procreating, and though it forbids sexual intercourse with a female, even with consent, before she has attained the age of twelve,(*t*) yet permits a perfect and complete marriage of a male who has attained fourteen, and a female twelve.(*u*) By the ancient ecclesiastical law, (no longer in force,) (*x*) a male under fourteen, or a female under twelve, and above seven, might marry, although such marriage was only inchoate and imperfect, and either of them might on attaining their age of puberty disagree and declare the marriage to be void, without any divorce or sentence in the spiritual court, unless they had previously perfected the requisite sexual congress, and shown themselves *habiles ad matrimonium;*(*y*) and our common law so far concurred, that if at the age of consent the parties agreed to continue together, they need not be married again.(*z*) But a marriage under the age of seven, except in the case of marriage of princes made by the state, was absolutely void.(*a*) In a medical as well as judicial view, therefore, it may still become a question whether the male or female were or are, in fact, *habiles ad matrimonium*.(*b*)

The capacity of a male to procreate may be readily supposed to *continue* whilst the two principal faculties continue in an adequate degree,

(*q*) Ante, 97.

(*r*) 5 Good, 2; 2 Dungl. Phy. 397; G. Smith, 407, 496; 1 Par. & Fonb. 187; and as regards the voice at this time, the larynx and glottis are rapidly enlarged; 5 Good, 8; 1 Par. & Fonb. 185; and see Johnson's Dict. tit. Puberty, as to the cause of change of voice at that age; Brous. Phy. 553.

(*s*) El. Blum. ss. 653, 654, p. 524; 1 Par. & Fonb. 185.

(*t*) 9 Geo. 4, c. 31, s. 17, ante, 383.

(*u*) 1 Jac. 1, c. 11, s. 3; Russ. & Ry. Cr. C. 48; 1 Bla. C. 436, n. 12.

(*x*) Bills or suits to compel performances of a contract to marry cannot now in any case be sustained, 4 Geo. 4, c. 76.

(*y*) 1 Par. & Fonb. 170; 1 Hale, P.C. 17; G. Smith, 407, 496, in notes; 1 Bla. Com. 436.

(*z*) Co. Lit. 79.

(*a*) Swin. Mat. Contr.; and see Ward. L. Nat.

(*b*) 1 Bla. Com. 436.

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but the period of cessation is not so marked as we shall perceive it is in women by the cessation of catamenia. The ages from sixty-five to seventy have been supposed the general limit.(*c*) But by too early, or excessive, or irregular indulgence, or by illness, and consequent debility, the age of cessation may be greatly anticipated. Whilst, on the other hand, a few extraordinary instances have appeared of protracted powers, as that of old Parr, who married at the age of 122, and lived till he was 152, and did penance for an illicit amour, at the age of 102. But these are singular exceptions, and in general the rule, as observed by M. Virey, is, that sexual ability exists only between the ages of fourteen and sixty-five.

Ninthly, Of the peculiarities in females, and especially in their organs of generation.

We are now to examine those circumstances which distinguish females from males, or, rather, those which are peculiarly important in procreation, and this is marked very early, even at the instant of birth; for even at *birth* the average weight of a male child is said to be 7lb. 5oz. 7drms. whilst that of a female is only 6lb. 11oz. 6drms.(*d*) Male skeletons also differ from the female, not only in the whole combination, but also in the form and properties of certain individual parts. The bones of the female are smaller and more delicate, and the *muscular impressions* and asperities are less distinctly marked. The articulations or joints are smaller, and in other enumerated particulars they materially differ.(*e*) But as men themselves differ so much in their relative proportions, any differences might be attributed to a diminutive size, and it seems that the only, or at least the most *decisive* mark by which a female skeleton can be at once distinguished is to be found in the structure of the *pelvis*, and arises from the obvious design of nature to frame the female in that part more capaciously to fit her to become a mother. The capacity of the pelvis of a female, at the level of the *linea innominata*, or, rather, *linea ilio pectinea*, formed by the lower part of the inside of the ileum and ridge of the pubis, is much more capacious from side to side than in the male, (in an average, with reference to the height of the individual, of about one inch wider than in the male pelvis. The entrance or brim of the cavity is also more oval, the greatest diameter being from side to side, whilst in the male it is more triangular, and in males the greatest diameter is from the fore to the back part.(*f*) In other words, the arch of the pubis, or front border of the inferior aperture, is much larger in women than in men, which circumstance is favourable to the passage of the head of the child at the time of birth, and constitutes the most distinguishing mark between the male and female pelvis.(*g*) Several other differences are also observable in this part of the human skeleton. The inferior transverse diameter of the pelvis should, it is said, be about four inches or more, and if it be much less there is hazard in labour, and especially if there be only an inch and a half from the pubis to the sacrum;(*h*) but these, together with the dimensions of the head of the child, will be presently more particularly examined.(*i*)

The *lungs* of the female are usually less than those in the male;(*k*)

(*c*) Amer. Cyclop. Prac. Med. tit. Ages; G. Smith, 496; 1 Par. & Fonb. 170, 172 b, 185; Cyclop. Prac. Med. tit. Impotence. In France, a *male* before *eighteen*, and a *woman* before *fifteen*, cannot marry without dispensation from the king, Code Civil, livre i. titre v. pl. 144, 145.

(*d*) Dr. Clark, in 2 Phil. Trans. vol. lxxiv.; 5 Good, 103; 1 Beck, Med. Jur. 167.

(*e*) 5 Par. & Fonb. 77.

(*f*) Id. 77 to 79; Pelvis, Symphysis Pubis; 5 Good, 140; Cæsarian operation, 5 Good, 141; 1 Horner, Anat. 106, 107.

(*g*) Dewees, Midwif. 17 to 40; James' Burns, 1 to 24.

(*h*) 5 Good, 140, 141; 3 Par. & Fonb. 77 to 79; Pelvis, Symphysis, Pubis, 5 Good, 141; Cæsarian operation, 5 Good, 141.

(*i*) Post, 386; and see Dewees, Midwif. 41 to 44; James' Burns, 24 to 27.

(*k*) Meckel's Anat. by Jourdan and

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and the *pulse* is cæteris paribus more frequent in women than in men,(*l*) and we have noticed some other differences.(*m*)

OF THE FEMALE ORGANS OF GENERATION.(*n*)

The female organs of generation, with their collateral parts, are much more numerous, complicated, and elaborate than in the male. The part which the male bears in congress is quickly accomplished, and is confined to the mere act of penetration and impregnation, and there terminates; whilst the female, although when sensible of the proceeding (which is by no means universal) is simultaneous in the congress, yet in the completion of her part she has to undergo a series of operations and changes which occupy a great length of time, and comprehend conception, gestation, parturition, and afterwards lactation.(*o*)

The female pelvis.(*t*)

With respect to her *organs of generation*, they are surrounded and protected by the pelvis, of which a general description has already been given,(*p*) and the bones of which in front (or rather, the membranes between them, for the bones themselves are never actually joined, according to the opinion of many) have providentially a *capacity* to open or relax in their membranous connexion to a small extent, (perhaps, as some contend, two or three inches in width, in parturition,) and ordinarily the head and parts of the child are adapted to the dimensions and such capacity.(*q*) Thus, the long measure of the child's head is, from the vertex, or crown, to the chin, $5\frac{1}{4}$ inches; the short measure, from the protuberance of one parietal bone to the other, is $3\frac{1}{4}$ inches; whilst from the lower part of the occiput to the lower part of the os frontis, directly across, it is $4\frac{1}{4}$ or $4\frac{1}{2}$ inches; so that, with reference to the before-mentioned size of the pelvis, and the capacity of the sutures to overlap each other and compress, there is not usually any serious difficulty in the passage of the fœtus.(*r*) The female organs of generation themselves may be treated as principally of five orders; *first*, the bony pelvis; *secondly*, the external fleshy parts bounded by the hymen; *thirdly*, the hymen, vagina, and other parts, which receive the male organ and semen, and convey the latter towards its destination; *fourthly*, the organ upon which the male semen is considered principally to act so as to perfect the inception of a fœtus, and called the *ovarium;* and, *fifthly*, the organ which is destined for the reception and nutrition of such fœtus after it has been so perfectly originated, and which is called the *uterus*, or womb.(*s*) As an adequate knowledge of the correct anatomical and physiological view of all the parts of these organs is frequently of the utmost importance in judicial inquiry, we must here consider them in natural order.

Breschet, vol. iii. 521; and see Denman's Prac. Mid. 7th edit. 20; and post.

(*l*) El. Blum. 4th ed. 89.

(*m*) Ante, 376.

(*n*) See Anatomical description, 2 Horner, Anat. 100 to 120; 2 Dungl. Phy. 268 to 275.

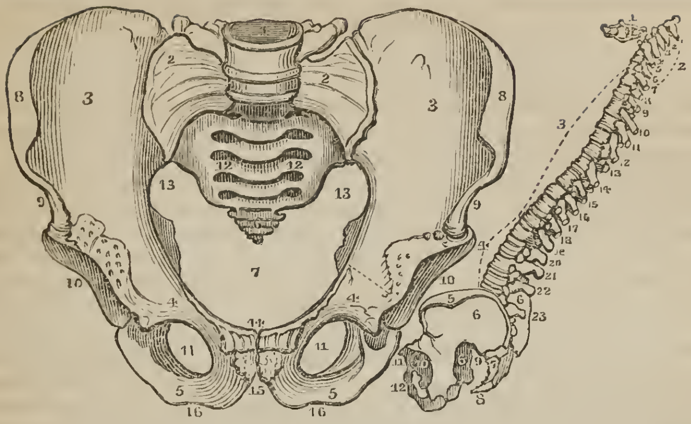
(*o*) 3 Bost. 14.

(*p*) Ante, 74.

(*q*) Dr. Denman's Prac. Mid. 7th ed. Blun. Lect. Mid. 18; 5 Good, 214. But it seems that an actual separation does not *universally* take place at the time of delivery; see Dr. Denman's Prac. Mid. 7th ed. 8. Though most who have borne many children declare they have uniformly experienced such separation. See *contra*, Dewees, Midwif. 21 to 28.

(*r*) James' Burns, 26; ante, 385.

(*s*) 3 Bost. 14.



Explanation of Pelvis.

1. Last lumbar vertebra.
2. Sacrum.
3. Ilium.
4. Pubis.
5. Ischium.
6. Coccyx.
7. Cavity of pelvis.
8. Crest of ilium.
9. Anterior inferior spine of ilium.
10. Acetabulum or socket for the head of the thigh bone.
11. Thyroid foramen, or foramen ovale.
12. Holes for sacral nerves.
13. Sacro ischiatic notch.
14. Symphysis pubis.
15. Arch of pubis.
16. Tuberosity of Ischium.

Explanation of Spinal column and Pelvis.

1. Atlas.
2. Sixth cervical vertebræ.
3. Twelve dorsal vertebræ.
4. Fifth lumbar vertebræ.
5. Crest of ilium.
6. Ilium.
7. Sacrum.
8. Coccyx.
9. Sacro ischiatic notch.
10. Acetabulum.
11. Os pubis.
12. Ischium.

Plate of the pelvis.

The above plate first describes a *lateral* view of all the vertebræ cervical, dorsal, and lumbar, and of the sacrum, os coccygis, and lateral bones of the pelvis; and, secondly, is prefixed a front view of the pelvis, with all its component bones and parts, and their names, and the knowledge of which is indispensable, not only to those who immediately practise midwifery and surgery, but, in some cases, to lawyers.(*t*)

The female pelvis.

The spinal column, with the pelvis at the base, in its perfect natural state, is bent as appears in the above plate.(*u*) The *pelvis* itself may be considered, first with reference to its bones, and, secondly, its central cavity. The principal of these, with their names, are shown in the above plate of the pelvis. In the adult state it is composed of *four* bones, namely, the *sacrum*, the *os coccygis* below it, and the two *ossa innominata*, one on each side, and which together form (as may be collected from the name pelvis) the appearance of a *basin* with the centre or bottom removed, and through which lower aperture the child escapes; but these four in infancy are composed of several more bones, which gradually become so united as scarcely to be distinguishable; but still the different parts retain several more names than those of the four principal enumerated bones.(*x*) The

The bones of the pelvis.

(*t*) See Dr. Wm. Hunter's Medical Observations and Inquiries relative to the Bones of the Pelvis; Dr. Denman's Prac. Mid. 1 to 27; 2 Horn. Anat. 104 to 106; Dewees, Midwif. 17 to 21; Dr. Ryan's Works, &c.

(*u*) See ante, 70, 71.

(*x*) 1 Horner, Anat. 99 to 104.

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sacrum is a distinct bone, though in continuation of the lumbar vertebræ, and usually contains six bones, called *false vertebræ* and in the inner surface of which there are five pairs of, or ten, holes, (or sometimes only four pairs, with eight holes,) through which nerves pass for the supply of the contents of the pelvis, and a continuation of the spine (which latter is termed the *cauda equina*) passes down the upper four of these false vertebræ, and sometimes, in the latter stage of gestation and during labour, the pressure of the child upon these nerves occasions cramps, not unfrequently complained of in that stage. The sacrum externally and posteriorly is rough, with numerous elevations and depressions for the insertion of muscles. The *os coccygis* is that bone which in the plate appears at the bottom of the os sacrum, and is usually composed of four bones, gradually diminishing nearly to a point, and the last of which is sometimes called the *little angle* of the sacrum; but the os coccygis, in its proper state, is composed of *four* distinct bones, not united to the sacrum, though articulated by intermediate cartilages, but which, in their proper state, are in a degree pliant, so as to be bent or forced by the pressure of the child, or artificial means, at least an inch backwards, and thereby to that extent enlarging the passage from front to back (usually from *four* inches to *five* inches.) Where there has been a complete anchylosis, or ossified junction, between the sacrum and the os coccygis, destroying the due pliancy of the latter, and diminishing the power of enlarging the dimensions of the passage of the child during parturition, then the use of the forceps may be required, especially when women begin to breed late in life, and other remedies may become advisable for the purpose of enlarging the cavity of the passage. There are *two ossa innominata*, namely, one on each side, and the description of one will suffice for both. This is a broad large bone, composed originally of three bones, and forms the fore part and one side of the pelvis. The three bones which are so united at maturity that no division is perceptible, still retain their original names, namely, the os ilium, os ischium, and os pubis. The *ilium* is the uppermost, and forms the principal part of the basin-like appearance of the pelvis, and has its various named parts, as, at the top, the *crista*, vulgarly called the hip; the *linea ilio pectinea*, extending round towards the sacrum. The *ischium* forms the lowest external part of the os innominatum; its parts are usually described under the name of body, tuberosity, or obtuse process and ramus; in its body, and nearly in the centre and strongest part of the entire os innominatum, and so placed as best to bear the weight of the superstructure and facilitate the motion of the thigh, is the *acetabulum*, being the socket of the thigh bone. The *os pubis* forms the *lowest* and *inner* part of the os innominatum, and is usually considered in three parts, namely, its body, its spine, and the *ramus;* the body extends from the central division towards, and contributes in the formation of the acetabulum; the anterior part of the *os pubis* is called *the angle*, or spine, and constitutes that surface which, being joined (or rather connected by membranes) to the *opposite* os pubis, forms the *symphysis* of the ossa pubis,(*y*) and is vulgarly called the share-bone, and will be presently noticed as regards parturition. The two ossa pubis connected together form on the external or inferior side an unequal concavity; but on the internal or superior surface they are pretty equally convex, and both the edges have a small degree of flexure outwards. The *arch of the pubis* is formed by its two descending processes, or rami, which diverge and meet the corresponding processes of the two ischia, which ascend to join them. Thus, the inferior aperture of the pelvis is formed

(*y*) *Symphysis*, from συν and φυω, *adhæresco*, and the term in its original signification denoted a cohesion or growing together, and in one sense means a growing together in adults of bones which in infancy were distinct.

by the diverging rami of the pubis and ischia, the tuberosity of each ischium, the point of the os coccygis, and two oblique ligaments, extending forwards from the os coccygis to each tuber ischii.

Ligaments between, constituting the symphysis of the ossa pubis.

These bones are respectively linked or connected by intervening cartilages, and the two ossa innominata are joined together in the front wherever they meet by a cartilage, which covers the scabrous end of each bone, and the space between them (usually about four lines, or the third of an inch,) is filled with a ligamentous substance, and which connexion is called the *symphysis of the ossa pubis.*

It has long been the subject of *controversy* whether in pregnancy or at the time of labour there is *uniformly* a considerable temporary separation between these ossa pubis, and to what extent. The best authorities consider it unquestionable that such expansion sometimes, if not generally, takes place when requisite, but that it is not universally so.(*z*) Even in man a separation has occurred to the extent of some inches, occasioned by a sudden blow.(*z*)

Dimensions of cavity of pelvis.

With respect to the general form and capacity of the upper and lower parts of the pelvis, which vary considerably in every individual, some authorities state that the *superior* aperture, which lies horizontally rather below the lowest lumbar vertebræ, is triangular, whilst others state it to be oval, with the widest part from one side to the other. But that the *inferior* aperture, independently of the ligaments and soft parts, cannot be said to resemble any known or general form, on account of its irregularity, though the widest part is, from the inferior edge of the symphysis in front to the point of the os coccygis behind, allowing for the progressive motion of that bone, about five inches.(*a*)

With respect to the general dimensions of the upper and lower apertures and cavity, providentially it will be found that in general nature has proportioned the parts to the size of the child to be born,(*b*) so that in ordinary circumstances the delivery is an operation of nature, and on that account females in this and every country (in France termed *Sages femmes*) have been allowed, as it has been termed to "*assist nature,*" although wholly unscientific;(*c*) but modern refinements, not allowing adequate healthy exercise during the progress of growth, and still worse, compressing dresses and bad habits, have occasioned such numerous deformities and deviations, especially in the higher classes, that no branch of medical science is now of more practical importance than the obstetric art.(*d*)

In a healthy, well exercised, and consequently in general well-grown woman, subject to very few deviations, the dimensions and the capacity of the bone of the female pelvis is upon the average at the *upper* aperture, *i. e.* from the *upper* part of the sacrum to the upper edge of the symphysis, about *four inches*, and between the two sides, it is about *five* inches and five inches and a quarter; at the *inferior* aperture the dimensions are in a degree reversed, the narrowest part being between the sides. The perpendicular *depth* of the pelvis, from the upper part of the sacrum to the point of the os coccygis, is about five inches; but this will be increased, when the latter bone is pressed backwards. From the margin of the pelvis to the inferior part of the obtuse processes of the ischia, the *depth* is about three inches, and at the symphysis about one inch and a half. Moreover, the depth of the pelvis at the posterior part is rather more than three times the depth at the anterior; and there is a gradual

(*z*) Denman's Prac. Mid. 7th ed. 8 to 13; ante, 383; see Dewees, Midwif. 21 to 28.

(*a*) Id. 19; Dewees, Midwif. 28, 29.

(*b*) Id. 21; 1 James' Burns, 20, 21.

(*c*) Denman's Pr. Mid. 244, 245, Ryan, Med. Jur. 89.

(*d*) As to the parts distorted and degree of defect, and the proper proceedings, see Denman's Pr. Mid. 245, 246; and post, 2d part; also Dewees, Midwif. 28 to 30; 1 James' Burns, 29 to 35.

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change between the two extremes, when the ligaments are considered as parts of the outline of the inferior aperture.(*e*) The knowledge of these capacities assists the medical practitioner in judging how far the head of the child has proceeded through the pelvis, and prevents any error that might proceed from the feel of the head at the anterior part.(*e*) It, however, has been cautiously observed, that no surgeon should proceed alone upon mechanical principles in assisting birth.(*f*)

The *external* female parts of generation.

We have secondly to consider what are termed the *external* parts of generation, and which are, the *mons veneris*, with the anciently termed tressoria or hair thereon, the *labia pudendi*, the *perinæum*, (extending from the uppermost part of and between the labia and the anus,) and the anterior part of which *perinæum* is called the *commissure*. On separating the *labia pudendi*, the more internal parts are brought into view, consisting of the *clitoris*, (in ancient law termed *superlabia*,) the *nymphæ*, triangular space between the nymphæ, the *meatus urinarius*, the orifice of the *vagina*, the hymen lying in the vaginal orifice, and the *curunculæ myrtiformes*, which may co-exist with the hymen,(*g*) which might conclude the enumeration of these *external* parts, as being the barrier between the external and internal parts; but as the principal parts of the hymen are connected with the internal parts, it will be more properly examined with them.

The pudendum or pubes, or mons veneris and tressoria.(*h*)

The *Pudendum* (including the *Mons Veneris* and the *Tressoria*) is placed above the upper part of the great orifice called the *Fossa Magna*, and this is usually in adult women covered with hair, called in ancient law proceedings *tressoria*,(*h*) and which extends towards the edge of the labia pudendi on each side, and extends perpendicularly from the mons veneris towards the lower part of the aperture, and within about an inch of the anus, and which intervening part is called the anterior perinæum. The absence of this tressoria has amongst the vulgar been considered matter of reproach; and we have on record, evidence of the barbarous state of the law, that when a female had been detected a third time in incontinent practices in the vicinity of the superior courts at Westminster, this tressoria was in punishment of the offence cut off in open court.(*i*) Some-

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(*e*) Denman's Pr. Midwifery, 7th ed. 20, Dewces, Midwif. 28 to 38; and as to the usual and appropriate size of the child's head, Dewees, Midwif. 41 to 44. The pelvis may be divided into two parts, the true and the false, by the linea ilio pectinea; the upper or false requires little attention from the *accoucheur*. The true or lower part may be divided into three portions, the brim, the cavity, and the outlet. The shape of the pelvis is *oval*, its long measure from side to side, its short measure from before to behind; it is five or five and one quarter inches from side to side, four inches from behind to before, and five and one-eighth inches obliquely; but the regularity of the oval is broken in upon by the promontory of the sacrum.

(*f*) Denman's Pr. Mid. 22, 23; Dewees, Midwif. Introd. xiii.

(*g*) 2 Horner, Anat. 100 to 104; 2 Dungl. Phy. 268 to 370.

(*h*) Perhaps the following description may be preferable. The term *pudendum* is applied to the external parts of the female, consisting of two elliptical folds, called the external labia, and the nymphæ or internal labia. They are surmounted by a slight prominence of fat placed on the ossa pubis, and covered with hair, called the tressoria. Within the labia externa, at the upper part, is the superlabia or clitoris, corresponding in structure and appearance to the male member (or penis.)

(*i*) *The Marshalsea case*, 10 Coke's Rep. 77. In this case the counsel in the course of argument thus observed: "And as to the said case of 7 Edw. 3, c. 23, b. 24 a, by the common law it belongs to the office of the marshal to protect the court from whores, as appears in Fleta, lib. 2. c. 5, (3 Inst. 205.) Mareschalli interest virgatam a meretricibus omnibus protegere et deliberare et habet Mareschal' ex consuetidine pro qualibet meretrice communi infra metas hospitii inventa 4d primo die; quæ si iterum in ballivâ suâ inveniat', capiatur et cor' seneschal' inhibeant' ei hospitia legis reg', et liberor' suor', ne îterum ingrediatur et nomina ear'im brevient'; quæ si iterum inventæ fuerunt hospit' secutrices, tunc aut remaneant in prisonâ in vinculis, aut sponte præd' hospit' abjurent, quæ si autem *tertio* times the ossa pubis have been divided, not indeed by separating the bony part, but merely the intervening ligaments or membrane, or the Cæsarian operation has been resorted to in order to secure the child, though usually fatal to the mother.(*k*) CHAP. X. The Female Organs, &c.

The *Clitoris*, sometimes called *Superlabia*, (because it is placed *above* the labia on each side of the aperture,) is situate just below the pubes, or mons veneris, and extends about half an inch in length, and about the third of an inch in thickness. It has been considered by some as the seat, or at least manifestation of desire; and, anciently, if an incontinent woman was detected a fourth time in the vicinity of the superior courts, this superlabia was amputated in open court.(*m*) But whatever additional influence this part may have, it is now supposed that female sexual desire is principally a nervous function, originating in the cerebellum of the brain,(*n*) though that supposition we have seen has also been denied.(*o*) Clitoris or superlabia.(*l*)

Below the *Clitoris* are two bodies called *nymphæ*, which run obliquely downwards and outwards along the inside of the labia. These assist in directing the course of the urine from the *urethra*. The nymphæ and labia.(*p*)

The *internal* parts are the *Hymen*, the *Vagina*, *Uterus*, *Fallopian Tubes*, *Ovaria*, &c. The orifice of the vagina is placed immediately under that of the urethra, which conveys the urine from the bladder, and the upper part horizontally in the fleshy part over the bone described in the antecedent plate. In the virgin state the orifice of the vagina is more contracted by the substance called the *Hymen*, (so called from the Greek word υμην, pellicula, a thin skin or membrane,(*q*) which partly surrounds it; but its circle is incomplete at the upper part of the vagina, next the orifice of the urethra, the broad part being turned downwards. The internal organs.

The *Hymen* is a thin tense membrane, usually situate at the entrance into the vagina, of an oval figure, sometimes circular and sometimes semilunar, and shutting up the greatest part of the passage.(*s*) But sometimes it has been found an inch and a half within the vagina.(*t*) When this hymen has been *ruptured*, it degenerates, according to the opinions of some authors, into small *conical papillæ*, termed *carunculæ myrtiformes*, from their supposed resemblance to myrtle berries, and the appearance of which, instead of the hymen, is one of the signs of the loss of virginity.(*u*) At the upper part there is a *semilunar* vacancy, in- The hymen. (*r*) Carunculæ myrtiformes.

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inventæ fuerint, considerabitur quod amputeter *eis tressoria et tondeantur;* quæ quidem *si quarto* invenient,' tunc amputeter eis *superlabia, ne de cætero concupiscant* ad libidinem." Modern anatomists and physiologists deny such supposed consequence of the latter barbarous amputation.

(*k*) 5 Good, 141; G. Smith, 329; Coop. Surg. Dict. tit. Cæsar. operation; 1 Paris & Fonb. 226, 274, and post..

(*l*) As to the clitoris in general, see 2 Horner, Anat. 101, 102; Dewees, Midwif. 45, 46; 1 Paris & Fonb. 207, 286, 288, 307; as to cutting it off, see 5 Good, 79, 80; 3 Good, 239; El. Blum. 530; *The Marshalsea case*, 10 Coke, Rep. 77, ante, 390, note (*i*;) as to the enlargement of the clitoris, see 1 Paris & Fonb. 286, 288; 1 James' Burns, 55.

(*m*) Id. ibid.; ante 390, note (*i*.)

(*n*) Ante, 381; El. Blum. 532, 533.

(*o*) Ante, 271, 380, 381.

(*p*) See also post, 398, 399, in description of signs of virginity, and as to defects in vagina or hymen, and remedies, &c., 1 Par. & Fonb. 207, 208, 431; 1 James' Burns, 54; Dewees, Dis. Fem. 27 to 30.

(*q*) 1 Paris & Fonb. 129, note (*a*,) where this membrane is fully described; Dewees, Midwif. 47.

(*r*) See post, 398, 399, as to signs of virginity. If the hymen be without any aperture whatever, an operation may become essential at puberty; G. Smith, 410; 1 Par. & Fonb. 207; 1 James' Burns, 56; Dewees, Dis. Fem. 43.

(*s*) 2 Dungl. Phy. 271; 2 Hor. Anat. 106.

(*t*) 1 Paris & Fonb. 429, 430.

(*u*) But sometimes they co-exist with the hymen, ante, 382, n. (*g*;) Dewees, Midwif. 48.

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tended for the transmission of the menstrual fluid, so that it assumes the form of a *crescent,* a circumstance which affords the true explanation of the origin and meaning of the symbol so characteristically assigned to Diana, the goddess of Chastity.(*u*)

The vagina.

The *vagina* itself is a membranous canal, which extends from the hymen to the cervix, or neck or orifice of the uterus. It is situated between the bladder and the rectum, and extends a little beyond the orifice of the uterus. The dimensions of the vagina vary according to the temperament of the body, and become larger in women who have borne children. The canal of the vagina is composed of dense cellular membrane, and some circular muscular fibres, lined with mucous membrane, and furnished internally with numerous rugæ, or wrinkles and nervous papillæ, which add to the sensibility of the canal. These are deepest, largest and most crowded towards the anterior part of the vagina, and are more conspicuous in virgins, less so in married women, and become more and more effaced in those who have frequently borne children. The vagina, or canalis uteri, is destined to receive the male organ, and in it the semen is deposited, whilst on the other hand the menstrual discharge is poured out from the inner surface of the uterus, and is passed off through the vagina, and through which also the fœtus, its membranes, and the subsequent discharge are successively expelled.(*x*)

The uterus.

The *Uterus,* commonly called the womb, in its unimpregnated state, is a compact, dense, solid body, of a triangular form; in an adult woman is in length about two and a half inches, in thickness one inch, in breadth at the fundus something less than its length, and at the cervix or neck about half or three quarters of an inch, and has been described as resembling a compressed pear.(*y*) It is possessed of great muscular power of contraction, though some physiologists deny the existence of muscular fibres.(*z*) The internal cavity of the uterus, like its *external* part, is of a triangular form, but is small in proportion to the external size of the organ, such cavity being so small, previous to impregnation, as to be scarcely capable of containing the kernel of an almond, and has in its unimpregnated state its opposite surfaces closely applied to each other.(*a*) A more particular description will be given when examining its progress during the period of gestation.(*b*) The uterus is that cavity into which the male semen is usually supposed to be thrown or absorbed, and in which the supposed ovum is deposited from one of the ovaria or ovaries, which are two in number, and are placed externally to the cavity of the uterus, between two layers of the peritoneum; and then becomes a fœtus, connected by the membranes of the womb to its inner surface, there to be nourished and increased.(*c*) The under part of the cervix of the uterus projects into the vagina, and is perforated by a transverse slit, termed *os tincæ*, or *os uteri*, from its supposed resemblance to the mouth of a tench. This in a virgin uterus is about the size of the opening of the male urethra, or about the size of an ordinary goose quill, or the sixth part of an

(*u*) 1 Paris & Fonb. 429, note (*a*,) cites Tolberg de Varietate hymenum, Hal. ed. A. D. 1791. This has no connexion, however, with Hymen, the heathen god, who it was supposed always presided over nuptials, otherwise they were unhappy.

(*x*) 2 Horner, Anat. 104, 105.

(*y*) See fully as to size, situation, &c. 2 Horner, Anat. 107 to 112; 3 Paris & Fonb. 67; 3 Bost. 16, 17, and notes; and 2 Dungl. Phy. 271 to 274.

(*z*) 3 Bost. 17; Dewees, Midwif. 50.

(*a*) 2 Dungl. Phy. 272.

(*b*) But see Dewees, Midwif. 50 to 56.

(*c*) As to the description of the uterine organs, &c. G. Smith, Med. Jur. 481; 2 Dungl. Phy. 274, 275; 3 Paris & Fonb. 67, 68; 3 Bost. 14 to 16; as to Prolapsus Uteri, Dewees, Dis. Fem. 193 to 205; inflammation of womb, Dewees, Dis. Fem. 325 to 343; extirpation of a scirrhus or ulcerated uterus, El. Blum. 582; see also Dewees, 245 to 292.

inch, but is nearly twice as large in the uterus of a woman who has borne children.(*d*) The cervix of the uterus closes and becomes impervious after it has been impregnated, and afterwards no fresh semen is admitted.(*e*) The uterus, in the state of pregnancy, is technically termed *gravidus uterus*, and will be presently separately considered.

The Fallopian tubes.

The *Fallopian Tubes or Ducts*, so termed from their being first discovered, or perhaps rather *described*, by Fallopius, were compared by him in shape to that of a trumpet; they are two conical and vermiform canals attached to the angles of the uterus, and terminating in each by a very small opening, which scarcely admits the entrance of a bristle, though at the other end it is more open, like a diminutive trumpet. The trumpet-like extremities, which are fringed, lie near the ovaria. The structure of the tubes is nearly the same with that of the uterus. They are supposed to convey, principally by absorption, the prolific or procreatic part of the male semen from the uterus to the ovaria, in order to fecundate the ova; and by grasping that part of the ovarium, where the ripest ovum is situated, and to which it has been attracted to carry the ovum, according to some authors, or, according to others, its contents only, to be mixed with the male semen, and to be lodged and matured in the cavity of the uterus.(*f*) It seems clearly established that these tubes are essential to procreation; for if by accident or design they be divided, procreation ceases.(*g*)

The ovaria and ova.

The *Ovaria and Ova.*—The name *ovarium* was first applied to this organ from its analogy to the like organ of oviparous animals, and especially in the ordinary hen and her eggs, upon which experiments have principally been made.(*h*) The ovarium in woman is composed of a particular kind of cellular substance, in which are contained a number of vesicles called ova, filled with an albuminous fluid, and each of which it is supposed is capable of producing a fœtus, by the application of the male secretion.(*i*) The two *ovaria* are situate at the sides of the fundus uteri, about an inch distant from it, and are contained in the posterior margin of the ligamenta lata, which form a coat to them. They are plain above, and prominent and semi-oval below, flattened at their anterior and posterior surfaces, and the size of each, when in a state of the greatest maturity, is nearly equal to half of the male testicle, but become small, unequal and shrivelled in old women. They are composed internally of a loose, whitish, cellular substance, intermixed with vessels and nerves, and contain a number of small vesicles, called *ova*, filled with a limpid fluid, which partakes of the qualities of the white of an egg. These vesicles are seldom equal to the size of a small garden pea. The number of ova is differently estimated, from ten to twenty and upwards having been found in one ovarium.(*k*) The ripest ovum is supposed to be embraced by the fimbriæ of the Fallopian tube, and then the same, or according to some, only its contents in the shape of one drop of albuminous fluid, is forced or attracted from its former position in the ovarium, along the Fallopian tube, into the uterus, where it ultimately constitutes the embryo fœtus.(*l*)

The ova.

It has we have seen been a disputed point, whether there is any female seminal secretion resembling that of males, or whether there is only a previous germ called the ovum, simply acted upon by male semen; and

(*d*) 2 Horner, Anat. 108.
(*e*) 1 James' Burns, 145.
(*f*) Dewees, Midwif. 53, 54; 3 Bost. 16; 2 Dungl. Phy. 274; 2 Horn. Anat. 112.
(*g*) 3 Bost. 19, note 1; 1 Paris & Fonb. 191, 192.
(*h*) Steno, Myolog. Spec. 145; 3 Bost. 15.
(*i*) 2 Horner, Anat. 113, 114; 2 Dungl. Phy. 275.
(*k*) Ibid.
(*l*) Ibid.; 3 Bost. 21; Dewees, Mid. 72.

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the latter seems to be now the better opinion;(*m*) and from Dr. Blundell's experiments it is considered to be established, that although the female genital organs may be excited, yet that the formation of a fœtus or an animal cannot be effected, unless the male semen and the female rudiments, as they are termed, be brought into actual contact.(*n*)

Of catamenia, menstruation or the menses.

There is a peculiar secretion from the mucous membrane of the uterus, or secreted by the small arteries in its internal surface, called *Catamenia*, (from the Greek κατα μην,) but more commonly *menstruation* or *menses*, from its *generally* occurring once every lunar month of twenty-eight days (though in some women it seems every third week, in others every calendar month, and in others, though very rarely so, every five weeks.) In some women this returns precisely at the usual time, to a day, or even hour, whilst in others there may be occasional variation even of several days, without inconvenience.(*o*) This course of nature, subject to such occasional variations, is so established and certain that its observance has sometimes had decisive effect in legal investigation.(*p*) This production is peculiar to women, at least in appearance, and unknown in other female animals; although at the season, when animals usually copulate, there is a mucous discharge in the female, supposed to perform a similar office.(*q*)

At whatever period of life this secretion first appears, in *medical* consideration, the female has attained puberty, though of this it is a consequence and not the cause.(*q*) The *law* in this country has fixed the age of *twelve*, and therefore permits marriage of a female after she has attained that age, although it usually in fact does not commence until between the age of thirteen and fourteen, or afterwards, varying considerably in different women. It *continues* as long as the power of bearing children remains, which is usually the age of forty-five, or sometimes even fifty, after which time women rarely bear children;(*r*) and when the female is in health this secretion then ceases. It is, however, usually *suspended* during pregnancy,(*s*) and also during lactation,(*s*) or at least

(*m*) 5 Good, 16, 17; 3 Bost. 27, note 43; 2 Dungl. Phy. 302 to 315; Dewees, Midwif. 68.

(*n*) Denman's Prac. Mid. 7th ed. *per* Dr. Waller, 121, 122; Brous. Phy. 530. The place or vesicle, from which such ovum has been forced, experiences a peculiar change in its texture and appearance, and constitutes what is called the *corpus luteum*, 3 Bost. 29: see also description, 2 Dungl. Phy. 295; and the discovery of which may, it has been supposed, be one mode of deciding whether impregnation has ever taken place in a deceased female, 3 Bost. 30, note 7; but this is considered a very questionable point of evidence, id. 31, and note.

(*o*) Denman, Pr. Mid. 101; and Dewees, Dis. Fem. 58.

(*p*) It was by the discrepancy in the story of the impostress, Elizabeth Canning, upon this occasion, that its falsehood was detected, contradicting her pretence that she had been imprisoned in a loft by the party prosecuted, from Tuesday, the 2d January, at 4 o'clock, A. M. until Monday, the 29th January, at 4 P. M. In the course of her evidence, she, in order to account for there being no particular appearance in the loft that might have been expected during her long confinement there, she ventured to swear to the extraordinary phenomena, that during all that time she had no evacuation, except urine; whereupon a midwife suggested that she must, during that time, have menstruated, and if so imprisoned, there would have been some vestige of such discharge; and which suggestion, unexplained by the prosecutrix, immediately satisfied the jury that the charge had been entirely fabricated; see the Trial, 10 Harg. State Trials, 205; and 19 Howel's St. Trials, 262; and Med. and Phys. Journal, vol. xx. 402, 527; vol. xxi. 60; vol. xxiv. 309; vol. xxix. 109, 409, 469; vol. xxx. 21, 103, 187; 1 Paris & Fonb. 369.

(*q*) Denman, Pr. Mid. 105, 106; Dewees, Dis. Fem. 48.

(*r*) *Briggs* v. *Morgan*, 3 Ph. Ec. R. 331.

(*s*) Dr. Denman observed, that a suppression of the menses is one of the *never-failing* consequences of conception, and that he had not met with a single instance to the contrary, Denman, Introd. to Midwifery; and 1 Paris & Fonb. 232; but see id. exception; and Dewees, Dis. Fem. 124 to 127.

until twelve months after parturition, when it will return, notwithstanding the child still continues at the breast.(*s*)

Upon the whole it is concluded, that this secretion serves some useful if not essential purpose in the production or in *the support* of the fœtus; but it is considered that no plausible explanation has yet been given of the mode in which it operates, and that no adequate reason either anatomical or physiological has been assigned for the peculiarity.(*t*) As respects the nature of this secretion, although like blood it is of a red colour, yet it certainly is not pure blood, and as may be most important to the medical jurist to know, it does not in its natural state, like blood, contain any coagulated lymph, nor does it in general *coagulate* or separate like blood into serum and crassamentum, nor does it like blood pass so rapidly into the putrefying fermentation.(*u*) It has, however, been observed by Dr. Paris, that this assertion requires some qualification, because it is well known that when the discharge is superabundant, and attended with great pain, it often comes away in coagula, though in that case there is probably an admixture of common blood.(*x*) The average quantity of the discharge of this secretion varies according to the heat of the climate, even from two to fifty ounces; in this country, it is said by some authors, it is only about four ounces,(*y*) but according to others five or six ounces,(*z*) and is more copious in pale, thin and delicate women, than in the robust; and this generally occupies about three or four days, but is liable to great variation, as from one to ten days, though the intermediate time, from three to six days, is the most usual.(*a*)

In some of the warmest climates, as in Africa, women during this period were considered to be in so improper a state as to be compelled to separate themselves from society and abstain from any interference in domestic concerns,(*c*) and sexual intercourse was forbidden, under pain of death to both the parties;(*d*) and we may remember that the duration of this secretion was considered an excuse for avoiding any locomotion.(*e*) In this country it is considered that, although sexual intercourse during the continuance of menstruation would probably not be productive of any peculiar malady,(*f*) yet that the excitement would probably be injurious to the female.

The *law* supposes that female puberty is established at the age of twelve, but physiologists agree that this secretion does not in general appear in this country till about the age of fourteen,(*g*) or even fifteen, or still later,(*h*) and all agree that it usually continues until the varying ages of forty-four to forty-eight, or even in rare instances to fifty-four or fifty-five; after which time, depending in some measure on the age when it commenced, but generally at forty-five or at latest forty-eight, child bearing ceases.(*i*) It is said to be injurious and improper that marriage should take place on the part of a female before she has menstruated.(*k*)

The *cessation* of the menstrual discharge occasions a change in the *female* system, which, as regards females, is called the *turn of life*, and

(*s*) Blundell's Lect. Mid. 350.

(*t*) Blumenb. Phys. note to page 307; 3 Bost. 35; Denman, Pr. Mid. 104 to 106; 2 Dewees, Mid. 57 to 68.

(*u*) Denman, Pr. Mid. 99; 2 Dungl. Phy. 277 to 283; 1 Paris & Fonb. 187. note (*a*;) but it is said that the discharge has sometimes the appearance of coagulation.

(*x*) 1 Par. & Fonb. 431, 432, in notes.

(*y*) Id. 187; Forsyth, 443.

(*z*) Denman, Pr. Mid. 100, 101; see Dewees, Dis. Fem. 57, 58.

(*a*) Paris & Fonb. 187, note (*a*;) Forsyth, 443.

(*c*) 1 Paris & Fonb. 187, note (*b*.)

(*d*) Leviticus, chap. xx. verse 18.

(*e*) Genesis, chap. xxxi. verse 35.

(*f*) Denman, Pr. Mid. 101.

(*g*) 1 Par. & Fonb. 187, 189, 194, 232; 2 Dungl. Phy. 282.

(*h*) Denman, Pr. Mid. 115; 3 Bost. 36.

(*i*) Denman, Prac. Mid. 115; 1 Par. & Fonb. 257; Dewees, Dis. Fem. 54, 55; G. Smith, 496; *Briggs* v. *Morgan*, 3 Phil. Ec. Rep. 331. It is said to have continued, but in rare cases, till seventy, El. Blum. 537.

(*k*) 5 Good, 157; Denman, Prac. Mid. 99.

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which renders women at that age subject to many diseases, to which some fall victims;(*l*) the breasts then gradually become flaccid, and the fleshy colour of the body diminishes, and the skin forms wrinkles: but that when this supposed dangerous time has passed, her life is even more secure than before, and her mental powers retain their full vigour for a considerable time; and it has been observed, that her decline into the vale of years is distinguished by a steady cheerfulness, which contributes in no small degree to divest the path of its thorns, if not to prolong its duration.(*m*) However, the highest authority establishes that scarcely one of a great number of women suffers more than temporary inconvenience on account of the final cessation of the menses, and that it is not reasonable to think that any disease should be a necessary consequence of the cessation of a discharge which is as perfectly natural as its appearance or continuance, so that in truth there is not at that time of life, viz. from forty-five to fifty, any ground for alarm, or in general any occasion for medicine, peculiar care, or management.(*n*)

The unnatural or premature *suppression of the menses* may take place from many diseases, and on the other hand it will sometimes continue notwithstanding pregnancy. The diseases which produce suppression or irregular continuance are characterized by symptoms now well known to the practitioner, and are capable of relief;(*o*) and there may also be organic obstructions, as by the vagina being closed, and which may be removed by surgical assistance.(*p*) The use of the bath, and active exercise, as dancing, may hasten puberty, and consequently assist this necessary and important secretion.(*q*) The *excess* or profusion, or too long continuance of the menses, is as depressing and annoying a malady as can occur.(*r*) All disorders of this description will more properly be considered in the following part. We shall here merely allude to the very powerful modern remedy called secale cornutum, ergot, or spurred rye corn, which may be found of the greatest efficacy in cases of suppressed menstruation or dangerously tedious labours, and which, although deleterious and poisonous in its nature, yet when used cautiously as a medicine, has relieved and saved the lives of numerous females, who would inevitably otherwise have perished.(*s*) But a very experienced and sensible physiologist has observed that this is a dangerous remedy except in very judicious hands, and should never be used but in great emergencies.

Ages when female power of conception commences and ceases.

The *female* power to procreate usually commences after the first menstruation, but it is supposed may precede it, and even exist pending it.(*t*) The *law*, for the sake of avoiding public inquiries into delicate facts,(*u*) has, by prohibiting intercourse with female infants even with

(*l*) 1 Par. & Fonb. 194, 195; particular diet and attention is then essential; see *contra* Dewees, Dis. Fem. 96, 97.

(*m*) 1 Par. & Fonb. 195.

(*n*) Denman, Prac. Mid. 115; Dewees, Dis. Fem. 96, &c.

(*o*) Id.; Dewees, Dis. Fem. 76; Forsyth's Med. Juris. 383.

(*p*) Forsyth, Med. Juris. 383; 1 James' Burns, 56.

(*q*) 1 Par. & Fonb. 187.

(*r*) See, in general, Denman, Pr. Mid. 112, 113; Dewees, Dis. Fem. 86.

(*s*) Denman, Prac. Mid. 236; 5 Good, 37. In 5 Good, 37, this is described as a very acrid irritant, and from its peculiar tendency to stimulate the hypogastric viscera, seems often, in minute quantities, to prove a powerful emmenagogue; and that for this purpose, an ounce of spurred rye is to be boiled down in a quart of water to a pint, half of which is usually to be taken in the course of the day, both in *obstructed* and difficult menstruation, and continued for three or four days. The like remedy has been recommended by Dr. C. Waller, in his valuable 7th ed. of Dr. Denman's Prac. Med. 236, in cases of *lingering labour;* and, in a recent case, the life of a lady was saved by this remedy alone; see Dewees, Midwif. 608.

(*t*) 5 Good, 100, 101; and see evidence of puberty in women; Dewees, Dis. Fem. 50, 57.

(*u*) See 1 Par. & Fonb. 191. But when necessary for the purpose of justice, the courts cannot shrink from the inquiry, however offensive to natural modesty, consent, under the age of *twelve*, fixed that age as the earliest in this country for sexual intercourse, without allowing in the criminal law any exception, unless in the degree of punishment;(*x*) and by the ecclesiastical law, no woman under twelve, nor male under fourteen, could contract marriage *de presenti*, but only *in futuro*;(*y*) and it is laid down that before these ages of twelve in women, and fourteen in males, they are respectively impuberes and are not bound by matrimonial contracts;(*z*) though it was held that a widow who had been married at seven, and at nine years old survived her husband, was entitled to dower.(*a*) This rule appears to concur with the opinion of physiologists,(*b*) who all agree that the commencement and cessation of menstruation are the two extreme periods beyond which the female is incapable of conception, and that the completion of the age of twelve is the earliest time of *commencement*.(*c*) Dr. Denman and Dr. G. Smith appear to have considered that in temperate regions, and in our own country, menstruation generally happens later, viz. about the age of *fourteen*, and sometimes not until the eighteenth year, and this without any sign of disease.(*d*) But early conception and early marriages, even at or after puberty, are considered injurious and likely to cause degeneracy of the race;(*e*) and high authority states that it is imprudent for a female to venture, at any age, upon marriage before she has menstruated.(*f*)

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The cessation of the capacity to conceive is usually supposed to be from forty-four to the age of fifty.(*g*) But it sometimes occurs, when the menstruation has not commenced till about the age of sixteen or eighteen, that it will continue until even the age of fifty-four or more.(*h*) And instances have occurred of births of children where the mothers have been even under the age of ten years, or older than fifty, and the climate and habits considerably alter the usual periods.(*i*) The most prolific age in women, in this climate, is between the ages of twenty-six and thirty years.(*k*)

Of the crime of rape.

Before the recent enactment in 9 Geo. 4, c. 31, s. 16, 18, the crime of rape and other offences connected with the organs of generation, required the proof of several facts, and in particular of that which would be essential to the procreation of a child: but that act, and the decisions thereon, render it only necessary to prove *penetration*, and the circumstance of the jury, by their verdict, positively negativing emission, will not lessen the offence, so that now it has, in a legal point of view, become less essential than heretofore to inquire into these subjects.(*l*) As, however, questions may arise in suits for divorce as to incapacities, and in questions also of legitimacy, and maltreatment of a patient, we will notice the subject, at the same time referring to the authorities where full information may be obtained.

To complete the crime of rape, some *penetration* must be proved;(*m*) but the least degree will suffice, although not even attended with the

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Sir W. Scott, in *Briggs* v. *Morgan*, 3 Phil. Ec. R. 330.

(*x*) 9 Geo. 4, c. 31, ss. 17, 18.

(*y*) Swinb. s. 7.

(*z*) 1 Hale, P. C. 17; Justin. lib. i. tit. 10, de Nuptues; Dig. lib. xxiii. tit. 2. de ritu Nupliarius; Co. Lit. 103; and stat. Merton, 20 Hen. 3, c. 6; Co. Lit. 30.

(*a*) Co. Lit. 33; 1 Par. & Fonb. 170.

(*b*) 2 Dungl. Phy. 383; 1 Par. & Fonb. 191, 256 to 258.

(*c*) 1 Par. & Fonb. 256.

(*d*) Denman, Prac. Mid. 99; G. Smith, 495; Dewees, Dis. Fem. 55, 56.

(*e*) G. Smith, 496, in note; Dewees, Children, 9 to 12.

(*f*) Denman, Prac. Mid. 99.

(*g*) 1 Par. & Fonb. 258, 173, note (*a*,) and 194, 195.

(*h*) 1 Par. & Fonb. 172, 173, note (*a*,) 257, 258; G. Smith, 496.

(*i*) 1 Par. & Fonb. 256 to 259.

(*k*) Id. 257.

(*l*) See 9 Geo. 4, c. 31; *Rex* v. *Cox*, 1 Mood. Cr. Cases, 337; *Rex* v. *Reekspear*, id. 142; see Ryan, Med. Jur. 159 to 171.

(*m*) 9 Geo. 4, c. 31, s. 18.

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deprivation of the mark of virginity, being the rupture of the hymen; but this subject will be more fully considered when we describe the legal incidents and requisites of the crime of rape, &c.(*n*)

Of the signs of virginity. (*o*)

As regards the crimes of rape and criminal knowledge of females under the ages of ten or twelve, according to the enactments in 9 Geo. 4, c. 31, it is not now essential to prove that the marks or signs of virginity have been destroyed, though some degree of penetration must be proved; thus in a late case, although it appeared that the parts of the injured female were so narrow that a finger could not be introduced; and that the hymen was whole and unbroken, yet it was held a sufficient penetration to complete the capital offence of rape, emission having also been proved (which was necessary, as the law then stood.) (*p*) But still, however, it may be useful, as well to dispel conjugal doubts as for the purposes of medical and judicial inquiry, to state what are considered to be signs of the loss or continuance of virginity. It is necessary, however, to anticipate, that although the *presence of all* the enumerated circumstances may be taken as conclusive proof of virginity, the *absence* of *some* or *many* of them, particularly in full grown females, and whether or not explained by physical causes, are now universally considered by physiologists to be *no* evidence to the contrary.(*q*) And Dr. Paris observes, that we are bound to conclude that there does not exist *any anatomical sign* by which the virginity of a female can be unequivocally determined;(*r*) and M. Capuron, in his Medicine legale relative a l'Art des Accouchmens,(*s*) concludes that no one of the signs is in itself sufficient to establish the fact, nor is the absence of all conclusive against its existence; and that all the most experienced medical observer can do is to show a *strong probability*, which, united to moral evidence of the character and conduct of the party, will amount to inferential proof.(*t*) In Paris and Fonblanque(*u*) is given an extract from the Italian author Tortosa, vol. ii. p. 4, where the signs of virginity are considered at length: and Dr. Paris has himself made some excellent observations, especially as regards the state of the hymen.(*x*) We shall content ourselves by extracting a few remarks from Dr. Farr's work, as regards these subjects, in connexion with medical jurisprudence:(*y*) the signs of virginity, he says, may be allowed to be the fol-

(*n*) *Russen's case*, 1 East, P. C. 438; 1 Russ. C. L. 803; 4 Car. & P. 249; 1 Mood. Cro. Cas. 337; ante, 381.

(*o*) There is a modern article upon the evidence of virginity and the signs of pregnancy, in Cyclop. Prac. Med. tit. Pregnancy and Signs of Delivery; see further, Farr's Med. Juris.; (Cooper's Tracts;) 1 Par. & Fonb. 256, 266, 424 to 440; Forsyth, 494; G. Smith, 409; also Godman, Anat. Inves. 72.

(*p*) 4 Car. & P. 249; *Russen's case*, 1 East, P. C. 438; 1 Russ. C. C. 803; and see *Cox's case*, 1 Mood. C. C. 337; but in *Stewart's case*, noticed in G. Smith's Med. Juris. 410, in note, he was acquitted under the old law, because the signs of virginity appeared.

(*q*) Per Dr. Paris, in Par. & Fonb. 425, note (*a*,) 428, note (*a*,) 431, continuation of note (7) in p. 429, 431, 432, in notes; see also G. Smith, For. Med. 409, 410.

(*r*) 1 Par. & Fonb., but where he adds that midwives and matrons have treated this subject with less diffidence, and have ventured to lay down *fourteen marks* on which to form a judgment, id. ibid. Dr. Paris also observed, id. 429, note (*a*,) that upon entering on the tests of virginity, it is unnecessary to enumerate the many absurd marks related by the more credulous, as indicative of recent defloration, such as swelling of the neck, rings around the eyes, the colour of the skin and urine, or a peculiar scent, &c. See Ryan, Med. Jur. 161.

(*s*) Paris, A. D. 1821.

(*t*) See quotation, 1 Par. & Fonb. 428, note (*a*.)

(*u*) 1 Par. & Fonb. 425, note (*a*.) 26, 27

(*x*) Id. 424 to 440; Godman, Anat. Inves. 72.

(*y*) Farr's Med. Jur.; (Cooper's Tracts;) It will be observed, that in the Ecclesiastical court, and sometimes even in courts of Common Law, the precise medical evidence to establish the impotency of the husband, and that the wife is still *virgo intacta*, may be material; see *Pollard* v. *Wybourn*, 1 Hagg. Eccl. Ca. 725; ante, 378.

lowing:—1st, the lips of the *pudendum* are more prominent and close together; 2dly, the nymphæ are small, of a light rose colour, and do not extend out of their place; 3dly, the *prepuce* of the *clitoris* is small, and does not cover the glands; 4thly, the orifice of the urethra or *urinary passage* is entirely covered; 5thly, the wrinkles of the *vagina* are considerable, and raised above the surface;(*z*) 6thly, the *frænulum* appears before the lips of the pudendum; 7thly, the hymen, being the thin membrane before described, is likewise present,(*a*) and which has been esteemed a *certain* mark of virginity, when other circumstances concur to give it authority.(*b*) It is not, however, by any means absolute even in the youngest subjects; for it may be so concealed in the back of or within the vagina, as not to be perceptible at first sight, or it may have been destroyed by a variety of causes quite foreign to connexion with a male.(*c*) Dr. Paris observes, that since the hymen is liable to such variations in appearance, and to accidental rupture from the slightest causes, its absence *can never be received as evidence of defloration;* and that neither can its presence be considered as an unequivocal proof of virginity, because it is not always ruptured in coitu.(*d*) A *fresh rupture* of it, however, may be perceived, and some remains of it will continue evident for some time(*e*) To this we may add, from Dr. G. Smith, 8thly, that in virginity the vagina itself, in a healthy person, should be rigid and narrow, for the only function it has to perform in the state of celibacy is the transmission of the menstrual fluid from the uterus, for which a very inconsiderable passage suffices; and the natural tendency of the undilated vagina is to narrowness, both from its contractility and the pressure of surrounding parts; this, however, may become enlarged and relaxed from various causes, and there are disorders to which the parts are liable, whose tendency is to render it so:(*f*) 9thly, the effusion of blood during the first act of coition. This in some cases is very considerable, and as has been observed, is liable to be confounded with the catamenia. This was the Mosaic test of virginity always looked for, and if not apparent, subjected the unfortunate wife to liability to be starved to death; but amongst modern physiologists the absence of this incident in the first coition *is not to be considered of any importance*, nor indeed is its *presence* decisive of virginity.(*g*) Dr. Forsyth also has added some observations on other signs or tests of virginity.(*h*) Several authors have also stated the signs or modes of discovering recent or long antecedent delivery, which may be useful in judicial inquiry, either to disprove virginity or contradict pretended delivery; but as the necessity for such very minute investigation is of rare occurrence, a mere reference to the authorities may suffice.(*i*)

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Of impregnation, or conception.

In considering the organs of generation, we have necessarily in some degree anticipated the process of *impregnation*. There are several dis-

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(*z*) Farr's Med. Jur. 26; (Cooper's Tracts;) and see, as to the vagina, 1 Par. & Fonb. 431, in notes.

(*a*) Farr's Med. Jur. 26; see Ryan, Med. Jur. 160.

(*b*) Id.; see also G. Smith, 410, and 1 Par. & Fonb. 429, 430, in note; but as it does not establish that a rape has not been committed, ante, 382, it merely establishes that probably sexual intercourse has not been *voluntarily* permitted or been *frequent;* also 1 Beck, Med. Jur. 74.

(*c*) 1 Par. & Fonb. 431, note; Forsyth, 494, 495; 1 Beck, Med. Jur. 74.

(*d*) 1 Par. & Fonb. 431, in notes, where also it is stated decidedly that the *perfect renewal* of the hymen, after it has once been ruptured, can never happen.

(*e*) Farr's Med. Juris. 26; Ryan, Med. Jur. 161.

(*f*) G. Smith, 409, 410.

(*g*) See observations and authorities in 1 Par. & Fonb. 431, 432, in notes.

(*h*) Forsyth's Med. Juris. 494, 495.

(*i*) See, in general, G. Smith, For. Med. 409, 490; Forsyth, 400 to 408; 1 Par. & Fonb. 249, 254, 256, 424; 3 id. 66;

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puted hypotheses, some clearly untenable, others questionable, and all, as has been observed, obscure and uncertain.(*k*) It seems, however, agreed to be essential that some small portion of that part of the male fluid properly called semen, and containing the living spermatic animalcules, should be injected or absorbed, or in some measure carried into the uterus, or at least so near as to be absorbed into one at least of the Fallopian tubes, which we have seen communicate on each side between the uterus and the ovarium;(*l*) and it is then conjectured that the excitement of such essential fluid produces an unusual flow of blood to the ovaria and parts adjacent, and that then the fimbriæ of the Fallopian tubes embrace the ovaria, where one of the vesicles of which it is composed is protruded from its former position, and bursts, discharging a drop of an albuminous fluid, which is received by the tube, and conveyed into the uterus, and to be there peculiarly acted upon or impregnated by the male semen, and which combination causes the ovum to be there formed, constituting the rudiments and origin of the subsequent fœtus, and is the commencement of conception.(*m*) It has been the doctrine of some physiologists, that a perfect embryo fœtus latently exists in the shape of a germ or ovum in the female, long before the sexual congress, and that the only use of the male fluid is to occasion a peculiar excitement affecting such germ; but the present more approved doctrine is in favour of the supposition that both sexes contribute to the materials constituting the fœtus, though even that doctrine was, before Dr. Blundell's experiment, not considered to be satisfactorily established.(*n*) The frequency of children resembling the father, as well mentally as corporeally, and inheriting their peculiarities and defects, are considered to be circumstances sufficient to establish that male semen forms an essential part of the materials or origin of the fœtus.(*o*) It is certain also, that although there is generally a sensible mutual congress of excitement, yet the influx of the semen and of impregnation may take place without the female even perceiving the operation,(*p*) and that it may take place even from rape, or pending sleep.

After such impregnation has taken place, the membranes produced in the uterus, it has been supposed, form a complete septum or impervious separation from all external connexion;(*q*) the antecedent aperture is closed by gelatinous matter, which, in effect, seals up the orifice of the womb;(*r*) but it has been supposed that it occupies about fifty hours after coition to establish the decided inception of the embryo fœtus.(*s*) After this, and it has been usually supposed that at no time during gestation, can there be any fluid introduced either internally or externally into the uterus, which has been thus closed; so that conception can be occasioned by only one coitus, and not by several, and consequently it would seem that a child cannot have several fathers, nor could there exist

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Farr's Med. Jur. 24 to 27; Ryan, Med. Jur. 159 to 171; 1 Beck, Med. Jur. 72 to 103.

(*k*) 2 Dungl. Phy. 288 to 318.

(*l*) 1 Par. & Fonb. 436; 3 Bost. 39 to 60; a very small minute quantity suffices to complete impregnation, ante, 379; Denman, Prac. Mid. 7th ed. 121, referring to Dr. Blundell's experiments and observations decisive upon this point; and see Dewees, Midwif. 68 to 71.

(*m*) Id. ibid.; 3 Bost. 15, 16, 39 to 60; Brous. Phy. 528 to 531; 1 Par. & Fonb. 231, 232; G. Smith, 481, 482; it seems, however, not quite certain whether the mixture of the fluids first takes place in the ovaria by their absorbing or drawing up the male fluid, or whether it takes place in the uterus, 3 Bost. 24, n. 7; but see id. 28, note.

(*n*) 3 Bost. 52, 53.

(*o*) Id.; 2 Dungl. Phy. 301, 302.

(*p*) *Harmwood's case*, 1 Par. & Fonb. 434, 435; 1 East, P. C. 440.

(*q*) 2 Dungl. Phy. 323; 1 Par. 231; G. Smith, 481, 482; Forsyth, 418, &c.; Dewees, Midwif. 71.

(*r*) G. Smith, 483.

(*s*) 5 Good; 3 Bost. 28, note, 38; 2 Dungl. Phy. 294 to 298.

a case of superfetation:(*t*) but this cannot be a universal rule, for certainly it has occurred that a woman has been delivered of twins, one *black* and the other *white*, clearly arising from *different* fathers, and separate conceptions.(*u*) The general doctrine, however, is that superfetation or a second impregnation cannot occur after a considerable interval, nor is there any direct communication between the system of the mother and that of the fœtus in utero, except that of the umbilical cord, presently described.

It is supposed that the *fœtus* is the only part immediately formed in consequence of the act of coition, but that shortly afterwards, (probably within a fortnight,) for its support there are formed, or at least expanded, other entirely new parts essential for the growth and support of, and ultimate production of the fœtus, viz. the *funis umbilicalis*, more commonly called the *umbilical cord*, the placenta, the membranes, and the waters; all which are incidents of the fœtus, and to be found in the mother only during pregnancy, and which, if continued in the uterus after their temporary offices have been performed, would be baneful to her existence.(*x*)

Parts incidental to the fœtus during pregnancy.

The only medium of connexion between the mother and fœtus is the *funis* or *umbilical cord*, and the *placenta*, into which it is distributed, and which are *temporary appendages* to the circulating system of the mother and fœtus respectively, and preserve such necessary connexion between them.(*y*)

The funis umbilicalis or umbilical chord, or cord.(*z*)

The *umbilical* chord, or cord, arising at the navel of the fœtus and terminating at the placenta, consists of an artery from each of the fœtal iliac arteries of the pelvis of the child, and a vein running to the fœtal liver, twisted spirally, and surrounded by a common integument, and passing to the *placenta*, and which maintains the communication between the fœtus and the placenta.(*z*) It is considered to be a production of such placenta.(*a*) In other words, the change which takes place in the ovum and uterus when impregnated is the production of a membranous envelope, within which the fœtus is contained, and surrounded by a quantity of albuminous fluid, and a vascular connexion is established between the body *of the fœtus* and a part of the envelope, and which constitutes what is termed the umbilical cord and the fœtal part of the *placenta*.(*b*) At the time of birth this cord is usually about two feet long, (though varying from one foot to six,) (*c*) and about as thick as a little finger; but it is sometimes shorter, and occasionally much longer, and if it should surround the neck of the infant after birth should be speedily and with care disengaged.(*d*) It is composed of *one* vein and two arteries twisted about each other.(*e*)

Placenta.

The *placenta*, towards the end of the ninth month, is a circular, vascular and apparently fleshy substance, about six inches in diameter, but varying in different subjects. It is more than one inch in thickness in the middle, and becomes gradually thinner towards the circumference, from which the membranes are continued. It is the principal medium by which the communication between the parent and the child is preserved; but though all have allowed the importance of the office which it performs, there has

(*t*) Denman, Prac. Mid. 460, 461.

(*u*) 2 Dungl. Phy. 323 to 325.

(*x*) Denman, Prac. Mid. 129; 3 Bost. 32, 33; the placenta is probably apparent in the first week, and the amnion and chorion within the first fortnight.

(*y*) Denman, Prac. Mid. 129 to 132; 3 Bost. 32, 33; 2 Dungl. Phy. 346, &c.

(*z*) As to the umbilical cord in general, See Dewees, Midwif 78; Denman, Prac. Mid. 132, 133; 3 Bost. 32; 2 Dungl. Phy. 351.

(*a*) Denman, Prac. Mid. 133.

(*b*) 3 Bost. 32, 33.

(*c*) Denman, Prac. Mid. 133; 1 James' Burns, 159.

(*d*) Blun. Lect. Mid. 49.

(*e*) 2 Dungl. Phy. 352.

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been a variety of opinions on the nature of that office, and of the manner in which it is executed.(*f*)

The placenta consists of two parts, a uterine or spongy parenchyma, derived from the decidua, and a fœtal parenchyma, consisting of a great multitude of exquisitely beautiful knotted *flocculi* that cover the *chorion*, and constitute not only an organ of nutriment but of oxygenation,(*g*) for it is considered that the placenta serves the purpose of *lungs* for the fœtus, and that it performs that office by having its blood brought into close proximity with the arterial blood of the mother.(*h*) The maternal part of the placenta is an entirely *new organ*, or part, formed after coition, and for the purpose of maintaining the ovum and fœtus.(*i*)

The placenta constitutes a boundary to which the supplies required for the nourishment of the ovum are conveyed by the vessels of the parent, and at which they are received only by the umbilical cord, to be transmitted to the fœtus; that which is superfluous being conveyed through the same medium: nothing can thus affect the child directly through the medium of the mother; for it has been ascertained that no injection can be made to pass from one side of the placenta to the other either way.(*k*) During the progress of the ovum and fœtus in utero the fœtus derives its supply of blood from the mother through the placenta, and which, according to the opinion of modern anatomists, purifies the blood, as the lungs do in the adult, for the nourishment of the fœtus.(*l*)

The temporary membranes. (*m*)

The *membranes*, as they are termed, found in the uterus pending gestation, have been variously described, attributable to the time of pregnancy, when the examination has taken place.(*n*) High authority has declared that the investigation of these membranes is of comparatively little importance, at least as regards the practice of midwifery;(*o*) but, as in judicial inquiry the subject may become important, a few observations may be proper. The membranes, properly so termed, are three, viz. the *tunica decidua*, the *amnion*, and the *chorion;* the first of which is the outer membrane; the second the inner; and the last the middle. Dr. Blundell, in his lectures, has very distinctly described these parts.(*p*) The *tunica decidua* derives its vessels from the uterus, and is very vascular. It is divided into two portions, one connected with the uterus, the other with the chorion, the placenta being between the layers. The use seems to be to form a communication between the fœtus and uterus, and also to form a bed for the formation of the placenta. The *chorion* is a thick strong and, except during the first weeks of gestation, transparent membrane; it has few vessels, and these come, not from the uterus, but from the umbilical vessels; the chorion forming, as it were, a part of the child, indeed it seems more essential to its existence than either its legs or arms. In the early months it is covered with a fine production, which is nothing more than minute capillaries for the formation of the vascular part of the placenta. The *amnion* is thin, transparent, and very strong; its vessels are very minute. It gives strength to the ovum, and secretes the *liquor*

(*f*) Denman, Prac. Mid. 133 to 135.

(*g*) As to the placenta, see G. Smith, Med. J. 315; Dewees, Midwif. 77; Brous. Phy. 532, 533; 3 Bost. 32, 33; 2 Dungl. 349, 350. As to the removal of the placenta, see Dewees, Midwif. 192, 436 to 450, and post.

(*h*) 3 Bost. 32, 33; and see Dr. Waller's Observations; Denman, Prac. Mid. 7th ed. 135; G. Smith, 341; 1 James' Burns, 160 to 163.

(*i*) Ibid.

(*k*) G. Smith, 315.

(*l*) G. Smith, 341; Brous. Phy. 535.

(*m*) Denman, Prac. Mid. 7th ed. 135, 136; Dewees, Midwif. 75; 2 Dungl. Phy. 347 to 349.

(*n*) Denman, Prac. Mid. 136.

(*o*) Id. 137.

(*p*) Blun. Lect. Mid. 225, 226.

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amnii. In the early months there are four membranes. The fourth, called the tunica decidua *reflexa*, is formed from the decidua uteri. After impregnation the uterus secretes a gelatinous fluid, and into this vessel passes the secretion, becomes organized, and the rudiments, passing from the Fallopian tubes, push the membrane along with them, forming a second or reflected membrane. This membrane grows only for about two months, and then ceases, and either disappears entirely or nearly so, for it cannot be traced. The reason it ceases to grow is said to be, that during the first week the rudiment would have a tendency to drop out through the mouth of the womb but for this membrane, and that when the fœtus gets sufficiently large to block up the os uteri, the membrane ceases to grow, because it is no longer wanted.(*q*)

The liquor amnii.

The peculiar liquid, termed the *waters*, in the uterus pending gestation, is called *liquor amnii*, because it is secreted by that membrane.(*r*) The quantity in proportion to the size of the different parts of the ovum is greatest in early pregnancy. At the time of parturition in some cases it amounts to, or even exceeds, four pints, but in some individuals it will scarcely equal four ounces. It is usually in the largest quantity when the child has been some time dead, or is born in a weakly state;(*s*) a point to be attended to in judicial inquiries, when the question is, whether the child was dead before delivery? This fluid is generally transparent, often milky, and sometimes of a yellow or bright brown colour, and very different in consistence, variations depending upon the state of the constitution of the parent. It is chemically composed of a small quantity of coagulable lymph, with a little muriate of soda, and the rest water,(*t*) and has been supposed to be a secretion from the internal surface of the ovum, called the amnion; the fœtus is not nourished by this fluid, but it is useful as affording a soft bed for the fœtus, allowing it free motion, and preventing injury from its resting immediately on any part of the mother, and it occasions the most gentle yet efficacious dilatation of the os uteri and soft parts at the time of the parturition, and its discharge in a gush usually precedes that event about a few hours. If this fluid be discharged a considerable time before parturition, as the sixth month, there is usually premature birth,(*u*) though it seems, that in the latter stage of gestation it is not essential to the existence of the fœtus.(*x*)

Particular and successive progress of fœtus from conception to birth.

It may frequently be essential in legal investigation to know the *progress* and the changes the fœtus is found from time to time to undergo; we will, therefore, concisely consider the subject.

The human ovum is at first a dark speck, from which a small filament is given off, as fine as a hair, this being the future umbilical cord; as the embryo grows, it resembles a cheese maggot, having no appearance of extremities; the rudiments of the frame are reversed in the uterus, and, consequently, the head is the lower in situ. When somewhat older, there are, in what afterwards constitutes the more visible head, two light brown specks, the future eyes. In this stage there is a contracted part afterwards established; the placenta is formed very early, and within the *first fortnight* the amnion and chorion. During the first three weeks the spinal marrow, brain, heart, vessels, and the eyes are formed, and very shortly after, the superior and inferior extremities begin, as it were, to bud, and

(*q*) Blun. Lect. Mid. 225, 226.

(*r*) Denman, Prac. Mid. 137; Dewees, Midwif. 76; 2 Dungl. Phy. 348.

(*s*) Denman, Prac. Mid. 137.

(*t*) It is said, of water 98, albumen 1, and muriate of soda 1.

(*u*) Denman, 137, 138; Amer. Cyclop. Prac. Med. tit. Abortion.

(*x*) Blun. Lect. Mid. 228.

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afterwards are established the hands and feet. Before the end of the fifth week all the parts are complete and perfect. The head is very disproportionate in size, and the younger the fœtus the greater is the disproportion, and in general it maintains its inferior position to the last, for which reason in birth the head is usually first presented.(x)

From the commencement of the impregnation or conception, until the end of the *third month*, the embryo is termed an *ovum*, afterwards it is to be called *fœtus* until the termination of the gestation.(y) But the most accurate physiologists use the term *fœtus* indiscriminately during the whole time of gestation.(z)

Third week.

About the *third week* may be discovered the first vestige of the embryo ovum, and resembling in its shape a minute bean or kidney floating in the fluid of the amnion, and suspended by the umbilical cord, which has now shot forth from the placenta. From this substance, or rather through the umbilical cord, which alone affords nourishment and growth to the fœtus, the general figure pullulates, the limbs are protruded, and the face takes its rise.(a)

One month.

From the *twenty-sixth to the twenty-eighth* day after conception the ovum is about the size of a pigeon's egg, and the embryo therein not larger than a common fly. It has been compared about that time to a *tadpole*, composed apparently of two masses, the larger of which is the head.

Fifth week.

At the end of the *fifth week*, or towards the sixth, the abdomen is in contact with the amnion. If the ovum or fœtus be expelled within *six weeks* after conception, it is technically and properly *miscarriage*. If between six weeks and the end of the sixth month, it is technically *abortion;* if *between the sixth month* and some weeks before the expiration of the ninth month, it is technically not abortion, but *premature labour*.(b) But the statute 9 Geo. 4, c. 31, probably to avoid inquiry into the exact age, speaks only of *miscarriage* of a *child*, and concealment of the *birth* of a *child*.

Sixth week and two months.

About the *sixth week* the fœtus reaches the size of a *large bee*, and the umbilicus or umbilical cord is apparent, the twisting of which begins after the second month. A white speck (the vesicula umbilicalis) is observable in the early weeks between the amnion and chorion, near the umbilicus, but after the *third month* this is scarcely visible.(c) We learn that the brain and the spinal cord are not discernible in the earliest part of the life of the fœtus, their place being occupied by a limpid fluid. About the fifth or sixth week after conception, a cavity may be detected, containing a whitish fluid, which may be regarded as the first visible rudiments of the nervous system. In an embryo of nearly an inch in length, and of about the period of nine weeks, the separate parts of the brain begin to be much more distinguishable, the spinal cord and the cerebellum are visible, and the part which is afterwards converted into the corpora quadrigemina acquires a considerable bulk; the cerebrum at this time appears only under the form of a membrane. From this date the development of the brain proceeds with considerable rapidity, so that all the different parts which enter into the composition of the organ in its perfect state may be successively traced, although in most cases bearing to each other a very different relation as to their bulk and their respective situations from what they do at a subsequent period. The most interesting circumstance in this

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(x) Denman, Prac. Mid. 130.

(y) Dewees, Midwif. 85 to 88.

(z) And see Latin declensions, fetus, fetura, "appello feturam a conceptu ad partam." By some authors the terms *abortion* or *miscarriage* are indiscriminately used when the child is expelled at any time before the end of the seventh month.

(a) See Amer. Cyclop. Prac. Med. tit. Abortion, (*Med. leg.;*) El. Blum. 521.

(b) See *supra*, note (z.)

(c) See 2 Dungl. Phy. 352 to 355; 1 James' Burns, 149.

part of the investigation respects the order in which the great divisions of the nervous system came into existence. It would appear, that at the end of the second month the spinal cord and the two anterior prolongations, or peduncles of the brain, form, as it were, the basis to which the other parts are subsequently attached. The cerebrum can scarcely be said to exist, while the cerebellum and the tubercles are little more than layers of membrane, which are connected with the cord and peduncles; no nerves can be observed passing off from any part of the brain or spine, nor can any fibres be detected in them even by the aid of the microscope; they seem to consist entirely of small globules.

Third month and subsequently.

At the end of the *third month*, (until which time the embryo is technically called an *ovum*, and afterwards a *fœtus*, though the latter term is frequently used as the description from the first,) the ovum is the size of a goose's egg, and weighs eight ounces, while the embryo is between two and three ounces in weight, and three inches in length, and the head and extremities have now become distinctly observable, it obtains the name of *fœtus*, (from *fetus*, Latin for young,) which it retains to the end of gestation.(*d*) It is, however, candidly stated by an eminent anatomist that the description of the progress of the ovum before it thus becomes a fœtus is not altogether to be depended upon, and is in some respects conjectural.(*d*) Before the *thirteenth week*, the sex of the fœtus is not readily distinguishable, the female clitoris being so disproportionate as to resemble the penis of the male, a fact which has often created confusion, even at the usual period of natural birth. The head is early covered with down, and the fingers and toes are often furnished with nails by the end of the third month.

Fourth to fifth month.

After the *fourth* month the development becomes more perfect, the lower parts more approximate the upper in proportion. At the *fourth month and a half*, or eighteen weeks, the embryo is about *seven inches* in length, and then the uterus has obtained a size larger than that of a Florence oil flask, and it may be felt through the parietes or sides of the abdomen in women who are not fat or deformed.(*e*)

Of quickening.

It is about this time, or between the end of the *fourth* month, or sixteenth week, and the fifth month, or twentieth week, that the child usually *quickens*, and when the uterus is so distended that it, with its contents the fœtus, in part rises out of the cavity of the pelvis.(*f*) The disturbance, it is said, is not to be attributed to the movements of the child, or as any distinct new period of its existence, but that it is occasioned merely by the uterus rising above the brim of the pelvis.(*g*) Dr. Denman considers the time to be most commonly about the *sixteenth week* after conception, but that it may vary even from the tenth to the twenty-fifth week.(*h*) The motion of the child may be so obscure, or so indistinct, as not to be perceived or regarded.(*h*) It is not unusual for women to have a few drops of blood discharged from the vagina at the time of quickening without any inconvenience, a fact which may assist in judicial inqui-

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(*d*) Tuson, 267; Dr. Granville's Graphic Illustrations of Abortion, &c., may be examined by the student with great advantage.

(*e*) Smith, 484; Amer. Cyclop. Prac. Med. tit. Ages, (*Med. leg.*)

(*f*) 1 Par. & Fonb. 239, 240; 3 id. 89, 90; see Dewees, Dis. Fem. 134. Physiologists and medical practitioners vary, and some say that quickening may occur from the end of the second month to the twenty-second week, though all agree it is usually at the sixteenth or eighteenth week; James' Burns, 174, 175.

(*g*) 1 Par. & Fonb. 240. But is not such rising attributable to the effect and motion of the fœtus? and see Denman, Prac. Mid. 147, describing it as the motion of the child; Dewees, Dis. Fem. 134 to 138.

(*h*) Denman, Prac. Mid. 147; those weeks are, in general, without other exact proof of the time of the last coitus, to be reckoned from a fortnight after the last cessation of menstruation, Denman, Prac. Mid. 175; Dewees, Midwifery, 125.

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ries.(*i*) It has been supposed that there is not any change in the fœtus except that of position, though it is favourable to the mother, because whatever complaint she before suffered, after the time of quickening usually declines or is wholly removed.(*k*) The fœtus being now stronger, and its members more perfect, the motions, previously made feebly and imperceptibly, now become of sufficient strength to communicate a sensible impulse to the adjacent parts of the mother, and to furnish evidence to others, whose business it may be to ascertain the fact of pregnancy.(*l*) And it has been supposed that a woman is not to be considered quick with child till she has herself felt the child alive and quick within her;(*l*) but of course on a plea of pregnancy and quick with child, &c., other evidence than the mother's sensations must be resorted to.

If a woman be convicted of a capital offence, she may plead, or by her counsel, move a stay of execution, on the ground of her pregnancy, and being *quick* with child, upon which a jury of twelve married women *de circumstantibus* will be empannelled and sworn to try "whether the prisoner be with child of a quick child or not;" when they will retire from the jury box along with the prisoner into a private room, and be sworn, to be without meat, drink, or fire, except that of a candle, until they agree upon their verdict. If they bring in their verdict "that the prisoner is not pregnant of a quick child," then execution will immediately proceed, unless the judge, of his own accord, should respite the sentence, as was recently happily ordered by an excellent and learned judge, and the result of which was, that though the jury of matrons had found such verdict on the 22d March, 1833, the woman was delivered of a living, perfect, and mature child within the next four following months, viz. on the 11th July, thereby establishing the error of such verdict.(*m*) Quickening, therefore, instead of marking the period at which the future individual becomes endued with *humanity* or vitality, or elevated to distinct personal identity, is but the sign of a certain advance in the development and aggrandizement of the growing body to a certain pitch, and of its now possessing a *greater* degree of force; and hence it has been contended that there is no ground for the great distinction in criminal punishment, whether or not the child has quickened.(*n*) It is laid down that about the *fourth* month after conception, that stage of utero gestation arrives which enables the medical practitioner, by means of an external examination, to ascertain whether or not a woman be pregnant; for at this stage the uterus may be distinctly felt through the integument of the abdomen.(*o*)

Fifth month.

At the *fifth* month the abdominal seems to predominate over the thoracic part of the frame of the fœtus. At this time also the abdomen of the mother swells like a ball with the skin tense; the fundus uteri now extends about half way between the pubes and umbilicus, and the cervix is sensibly shortened.(*p*)

(*i*) Denman, Prac. Mid. 175; James' Burns, 174, probably occasioned by some rupture or laceration in the vessels, occasioned by the change of position.

(*k*) Denman, Prac. Mid. 148; Dewees, Dis. Fem. 137.

(*l*) This is the *legal* evidence of quickening, per Lawrence, J.; 3 Par. & Fonb. 89, 90; 1 Par. & Fonb. 239, 240; but see doubts as to the time, 1 Beck, Med. Jur. 115; as to the discovery by touch, id. 116. And a jury of matrons have brought in a verdict of not quick, the fallacy of which has been established by the subsequent delivery at maturity within the time. If a woman be found guilty of a capital offence, and be quick, but not otherwise, she may plead her pregnancy in delay of execution, favorem proli, 3 Par. & F. 142.

(*m*) *Rex* v. *Mary Wright*, Norwich, 22d March, 1832. By certain correct information obtained from the counsel, Mr. S. Taylor, and from the accoucheur, it is clear that the child, when born, was a perfect and mature child.

(*n*) Smith, 315, 316; 1 Par. & Fonb. 239, n. (*b*;) 1 Beck, Med. Jur. 200 to 203; post, as to causing miscarriage.

(*o*) 1 Par. & Fonb. 236, where the process of examination is stated.

(*p*) 1 Par. & Fonb. 240; 2 Dungl. Phy. 354.

Sixth to seventh month.

In the *sixth* month the upper edge of the fundus is a little below the umbilicus, and the fœtus acquires a considerable degree of vigour, and it then measures about *nine inches* in length. And from the *fifth* to the *seventh* the fœtus, it is supposed, may be born alive, though still incapable of being reared. (*q*)

The heart is formed before the brain, and the first indication of life in a fœtus is a small beating point, the punctulum saliens, and which afterwards becomes the muscular substance of the ventricles, and from this the large vessels expand; and it is not until some time after that the brain becomes organized. (*r*) But Sir E. Home has established that the rudiments of the brain and spinal cord are visible before the heart. At the end of the sixth month the testicles in the male fœtus begin to descend to the scrotum, though they are not found there till after the eighth. (*s*) In the *sixth* month the placenta and membranes weigh seven or eight ounces, the fœtus twelve or thirteen, and is then eight or nine inches in length, and perfect in all its external parts. (*t*) From the sixth to the ninth month the progress is more rapid.

Seventh month.

In the *seventh* month the fundus, or superior part of the swelling, advances just above the umbilicus, and the cervix is then nearly three-fourths distended. After the end of the seventh month the infant is *perfectly formed*, being deficient only in size and weight, and about, or perhaps rather before, this period the *membrana pupillaris*, (upon the use of which there have been many observations,) disappears. (*u*) It is then capable of being, and frequently is, reared, and of reaching maturity, so that it has been observed that we cannot carry the consideration of *abortion* beyond the seventh month of pregnancy, the child being then on the same footing with one mature; (*x*) and, therefore, between the seventh and the end of the ninth month the too early production is to be termed *premature birth*. It has been observed, that no child born after the termination of the seventh month of pregnancy should weigh less than five pounds avoirdupois, or be less than fifteen inches in length; (*y*) but, according to Chaussier and other physiologists, the length is a more certain indication of the age than weight, and the former has, therefore, given a scale of admeasurement for the more certain ascertainment of the age. (*z*) However, as the length also varies, it seems that no great stress should be laid either on weight or length, in endeavouring to ascertain the age of seven months. (*a*)

Eighth month and upwards.

In the *eighth* month the swelling of the uterus reaches midway between the navel and scrobiculus cordis, the neck itself, being then entirely distended, and at full time the uterus occupies all the umbilical and hypogastric regions, although a short time before delivery it subsides to where it was between the seventh and eighth months. (*b*) As the abdominal tumour advances it assumes a peculiarity; the umbilicus is drawn down, and a *flatness* is perceptible, or imagined to be so, in the abdomen. The tumour is longer concealed in tall women than in those who are short; and it has been remarked, that the pregnant uterus does not rise directly upwards, but generally inclines to one side, most commonly to the right. (*c*) The size and appearance of the fœtus in its different stages

(*q*) 14 Phil. Journ. Med. & Phys. Sci. 41.

(*r*) But see *aliter*, 1 Bost. 237, n. 267.

(*s*) Amer. Cyclop. Prac. Med. tit. Ages, (*Med. leg.*)

(*t*) Id.

(*u*) 2 Dungl. Phy. 355.

(*x*) Smith, 313, 314; 1 Par. & Fonb. 230 to 241; 2 Dungl. Phy. 355. See Scale of Admeasurement to ascertain whether or not a child is seven months old; 2 Dungl. Phy. 356.

(*y*) G. Smith, 337.

(*z*) Id. 339.

(*a*) 1 Par. & Fonb. 101.

(*b*) Smith, 338, 339; 1 Beck, Med. Jur. 115.

(*c*) Id. 484, 485.

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during gestation is well exemplified in different plates by Lizars and other authors.(*d*)

General result of progress of development of fœtus from conception until birth.

It will be observed that the human fœtus, during the progress of development, runs through a series of phases or changes, each of which is found to correspond with permanent conditions of organization in the animal series. At first the embryo is a mere bud or germ, placed in a small vesicle, resembling one of the simplest worms; it soon becomes a small vermiform body, without apparent head or limbs, which is the character of the annelides, in the centre of which the small appearance of the heart is at an early stage visible; in the next step of the change two sets of limbs of the same length are produced, which, with a caudal prolongation, constitute a resemblance to quadrupeds. If the development of the *osseous system* be examined, it will be found at first mucilaginous, then cartilaginous, and finally it passes into the state of true bone; but with sutures in the head, providentially rendering it pliant, or capable of a degree of compression in birth. Again, at the earliest period of fœtal life, the *nervous system* is limited to the nervous cords and their ganglia; at the next step of its progress, the medulla spinalis is first formed, and afterwards the medulla oblongata, together with the tubercula-quadrigemina are distinctly marked, though the brain and cerebellum are still rudimentary, and which are established after the spine. The *cerebral organs* then soon begin to predominate over the tubercula, and their development proceeds until finally the lobes of the cerebrum and cerebellum attain that degree of conformation, which is characteristic of man.(*e*) Dr. Denman has observed, that as regards the practice of midwifery, any attempt to determine the weight, length and dimensions at different periods of utero gestation, varying so greatly in different children, would be of little utility.(*f*) But they may become exceedingly important as regards judicial inquiry.

Successive shape and situation of uterus at different stages of gestation, and at time of labour pains.

The *Uterus*, or rather the *fœtus* it contains, in the progress of pregnancy, changes its size and figure as well as position considerably: we have seen the usual dimensions when unimpregnated.(*g*) Before the end of the third month it has a tendency to dip towards the pelvis, after which period it may be felt to ascend. During the seventh month it forms a line with the navel; in the eighth month, it ascends still higher, reaching midway between that organ and the sternum; and in the ninth month, it almost touches the ensiform cartilage; and then measures *ten or twelve inches* from top to bottom; at the close of which, as though overwhelmed by its own bulk, it begins again to descend, and shortly afterwards, from the irritation produced by the weight of the child, or more probably from the simple law of instinct, it becomes attacked with a series of spasmodic contractions, extending to the surrounding organs, and constituting the pains of labour, which gradually increase in strength, enlarge the orifice of the organ, and protrude and expel the child into the world.(*h*) In about ten minutes or a quarter of an hour after the birth, the uterus contracts very considerably, or the hemorrhage would be fatal;(*i*) but it does not return to near its original size under a month or six weeks; and indeed never returns to the smallness of the virgin state.(*k*) Dr. Paris

(*d*) Lizars, plate viii. and ix. p. 96, &c. and Dr. Granville's Graphic Illustrations of Abortion, &c.

(*e*) Meckel, vol. i. 50; Quain, 26.

(*f*) Denman, Prac. Mid. 13C; see fully, Dewees, Midwif. 84 to 89.

(*g*) Ante, 392; 1 Par. & Fonb. 236, 256; 3 id. 67; 3 Bost. 33; Dewees, Midwif. 80 to 84; 1 James' Burns, 143.

(*h*) See fully, Dewees, Midwif. 143 to 165.

(*i*) 5 Good, 152.

(*k*) 3 Par. & Fonb. 67.

has given a full description of the appearance of the uterus in women who have borne children. (*l*)

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The usual and the utmost protracted time of gestation.

The natural duration of the time of pregnancy or gestation is *thirty-nine weeks and one day*, or *nine calendar months*; (*m*) and the only difficulty or uncertainty in general is the time from which this period begins to run. If there has only been a single coitus, then it is to be calculated from that event; and some women, it is said, from peculiar sensations a few hours after intercourse, can tell when in fact impregnation has been accomplished; some reckon from the usual cessation, or rather non return of the *catamenia*, reckoning from its last appearance, and adding a fortnight; whilst others calculate from the time of quickening, reckoning five months after that event; but as that event does not uniformly take place at the sixteenth week, it has been deemed an uncertain period from which to calculate. (*n*) Dr. Denman observes, that in order to avoid any great error, it is customary to take the middle time, and to reckon forty-two weeks from the last act of menstruation, by which method, if rightly informed as to that event, then no egregious mistake can arise. (*o*) It seems, from high authority. that in giving medical advice on this as upon other subjects to the patient, a degree of deception is admissible and laudable to prevent prejudicial anxiety; and that therefore it is advisable to induce an expectation that the time of labour will not arrive until after the probable period. (*p*) In this country the calculation rests solely on received opinions and a few decisions, but in other countries it is fixed; thus, by the law of *Scotland*, a child born six months after the marriage of the mother, or *ten calendar months* after the death of the father, is considered legitimate. In France the express civil code has placed a limit to our credulity respecting retarded births, and decrees *three hundred days* or *ten* calendar months to be the most distant period at which the legitimacy of births shall be allowed. (*q*) Dr. Paris observes, that the term does not appear to be so authoritively established, but that nature may occasionally transgress her usual law, and that in several tolerably well attested cases the birth appears to have been protracted *several weeks* beyond the common time of delivery; and Dr. Hamilton remarks, that if the character of the mother be unexceptionable, a favourable report ought to be given for the mother, though the child should not be produced till *nearly* ten calendar months after the absence or sudden death of her husband. (*r*) Dr. Smith states, that it is admitted that a woman may carry a child to the eleventh month; (*s*) and that although in this country the usual time of birth is considered to be 280 days after conception, making a period of nine months, of thirty days each, and ten days more; yet that a child may be born nine months and *twenty* days after the death of his father; but where the child was borne eleven months after the death of the husband, and it was proved that the father could not have had intercourse with his wife within a month before his death, it was adjudged a bastard; (*t*) he states that real excess beyond nine months is by no means frequent, and certainly never

(*l*) 3 Paris & Fonb. 67, 68.

(*m*) 1 Beck, Med. Jur. 289; 1 James' Burns, 142, &c.; Dr. Blun. Lect. Mid. 256.

(*n*) Denman, Prac. Mid. 175; Dewees, Midwif. 125; 1 Paris & Fonb. 218, 230, 245 to 448; id. Appendix, vol. iii. 209 to 222; Smith, 492; 266 days according to Morgan, Mech. Prac. of Phy. 282; Farr, 18, the French law allows the probability of 300 days or ten months, 1 Par. & Fonb. 268; so in Scotland, id. note (*a*;) Beck, Med. Jur. ch. ix.

(*o*) Denman, Prac. Mid. 175.

(*p*) Id. 176, 182.

(*q*) 1 Paris & Fonb. 248; Code Civil, livre i. titre vii.; Ryan, Med. Jur. 121 to 125.

(*r*) 1 Paris & Fonb. 245 to 248; see also opinions in Runnington's Ejectment. 1st edit.; 2 Stark. Evid. 138, note (*p*.)

(*s*) Smith, 492.

(*t*) Smith, 492, 493, cites Burns, Justice, tit. Bastard.

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great; and he suggests that, considering the fallacy of a woman's sensation, if any, as to the period of conception, and the very great probability of her having been mistaken in the first instance to the extent of about three weeks, by reckoning conception from sexual intercourse immediately after the last appearance of the *catamenia*, while in reality it may not have taken place until just before they should have appeared again, the erroneous supposition of ten months' pregnancy might be explained at once, added to which, it may occur that the *catamenia* may cease from other causes, and conception may take place during their influence.(*u*) Another author states, that the ordinary time of gestation is *forty-two* weeks, to be commenced in reckoning from the last menstruation, ascertaining the time it ceased;(*x*) but that even *twelve* months is a term allowed by some physicians as what may take place under peculiar weakness or delicacy of health; though he suggests that it is most probable that in all these cases the mother was mistaken as to the proper time of her conception, and has imagined herself to have conceived for some weeks or even months before it actually took place. In the Gardner peerage cause, tried before a Committee of the House of Lords in A. D. 1825, nine calendar months were admitted on both sides as constituting the ordinary ultimate range; though a few singular cases were adduced, in which the pregnancies were supposed to have been protracted at least a month longer.(*y*) But the decision in the Gardner peerage case has been questioned.(*z*) Several cases in our courts have occurred on this subject.(*a*)

How early a child may be delivered so as to live.(*b*)

The expulsion of the ovum or embryo within the first *six weeks* after conception is technically called *miscarriage;* between that time and the expiration of the sixth month, when the child may by possibility live, it is termed *abortion.* If the delivery be soon after the sixth month, it is termed *premature* labour;(*c*) but the criminal attempt to destroy the fœtus at any time before birth, is termed *in law* procuring *miscarriage*, varying as we have seen in degree of offence and punishment, whether the attempt were before or after the child had *quickened.*

It is admitted by Dr. Paris, contrary to the opinion of Dr. Smith, that from the number of established cases, it is possible that the fœtus may survive and be reared to maturity, though born at very early periods after conception, and even under the period of seven months;(*d*) but generally in favour of the life of the mother, charged with the *murder* of so young a child, prematurely born, most medical men agree that offspring born under *seven* months from the time of conception cannot long survive, or at least attain maturity, and that therefore no conviction of murder or concealment of birth ought to take place.(*e*) We may all concur in the wish to save the life of a mother under such a charge; but in a strict judicial view, if there be a mere *possibility* of the child, born alive within seven months, being by extreme care or under any circumstances kept alive for any considerable time, it should seem that the culprit, who deprives the infant of all chance, ought to be held criminally responsible. Many ancient instances are stated of births even at four months and a half with continued life even till the age of twenty-four; and the parlia-

(*u*) G. Smith, 493, 494.

(*x*) 5 Good, 102.

(*y*) Id. 101.

(*z*) By Dr. Duncan, 5 Good, 102, note, referring to Edinb. Med. Jour. vol. xxvii.

(*a*) 1 Rol. Ab. 156; Run. Eject. 1st ed.; 1 Paris, 246, 247; id. Appendix, vol. iii. 209 to 222; see fully on this subject, Dewees, Midwif. 124 to 143; 1 Beck, Med. Jur. 292 to 299; 2 Dungl. Phy. 330 to 332.

(*b*) 14 Philad. Journ. Med. and Phys. Sci. 39 to 44; Farr, 16.

(*c*) 1 Paris & Fonb. 243, 244; 3 Paris & Fonb. 100, 101; 2 Dungl. Phy. 332.

(*d*) Smith, 336, 337; Paris & Fonb. 100, 101; Farr, 8, 16; Forsyth, 426, 427, in note, 428, 429.

(*e*) Copl. Dict. Prac. Med. tit. Abortion.

ment at Paris decreed that an infant at *five* months possessed the capability of living to the ordinary period of human existence;(*f*) and it has been asserted that a child delivered at the age of only five months and eight days may live;(*g*) or according to Beck and others, if born at *six months after conception.*(*h*) But physiologists of the present day consider that a fœtus born *before the completion of the seventh month* has a very slender chance of surviving,(*i*) and insist that no woman ought to be convicted of the *murder* of an infant born within that period.(*k*)

Requisite exercise and regimen during pregnancy.

Whatever may have been the habit of the female antecedent to conception, it is agreed by the best authorities that it is of the utmost importance that, during pregnancy in particular, she should every day take frequent but moderate exercise in healthy atmosphere, as well on her own account as for the due progress of the fœtus. The labouring classes have easier labours, whilst the rich, the luxurious, and still more the indolent, are scarcely able to sustain the ordinary effort of nature;(*l*) but the exercise must be regular and not violent, nor unadapted to the general strength; and extra exertion, especially near the time of parturition, might be extremely prejudicial.(*l*) Sometimes during gestation, if there be rigidity of the abdominal coverings, as sometimes occurs, especially in the first pregnancy, and occasioned by the rapid growth of the uterus, distending the abdomen and causing considerable pain, blood may be taken from the arm, and the abdomen carefully fomented; and leeches may also be applied to remove any inflammatory action,(*m*) and if, probably from convulsion in the child, the pain be excessive, moderate temporary pressure may be advisable.(*n*)

Preparations for delivery, how far important in judicial inquiry.

It would be beyond the scope of this summary further to examine the progress of gestation; but there is one point, which has been considered of great importance in connexion with medical jurisprudence, especially as regards the offences of infanticide and concealment of birth. Dr. Denman observes on the natural anxiety in women, as indeed in all animals, to provide a comfortable reception for their young, when the time for bringing them forth draws near.(*o*) When women have made such preparation, it naturally affords a presumption that they expect their infant to live, and to require a continuance of care, and negatives the presumption of any design to kill or even conceal the birth; and accordingly the proof of such conduct as the preparing clothes appropriate for an infant, is admissible to negative the charge of intent to conceal the birth.(*p*)

Of the *natural labour* and delivery, and accompanying and subsequent treatment.

Although parturition is unquestionably a period of considerable pain and anxiety, yet nature, consistent in all her operations, has provided that it shall not in reality be an operation of actual danger; and when the accoucheur is of ordinary skill, very few deaths occur from mere parturition, and the dangers that sometimes arise are principally in the *after* treatment.(*q*) It will be observed that usually the head and other parts of the child are so adapted to the size and shape of the female pelvis, even when

(*f*) 1 Paris & Fonb. 244.
(*g*) 5 Good, 160, 162.
(*h*) 1 Beck, Med. Jur. 292; 14 Philad. Med. & Phys. Sci. 41.
(*i*) 1 Paris, 244, 245; Smith, 336, 337; 2 Dungl. Phy. 332.
(*k*) Smith, 336, 337.
(*l*) Denman, Prac. Mid. 150, 151; Dewees, Dis. Fem. 140.
(*m*) Dewees, Dis. Fem. 146 to 148.
(*n*) Blundell's Lect. Mid. 246.
(*o*) Denman, Prac. Mid. 179, 180.
(*p*) *Rex* v. *Higley*, 4 Carr. & Payne, 366; and see Sir W. Scott's Waverley Novels, description of Jeanie Deane having travelled to give evidence to save her sister on that ground on such a charge.
(*q*) Perhaps, as regards *mere parturition*, scarcely more than one death in three or four thousand occurs, though including the risks in after treatment, the supposed average is about one in two hundred.

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in a degree distorted, that any serious difficulty in delivery rarely occurs; and moreover, the bones of the head of the child are rarely completely ossified at the time of birth, and by the intervention of the sutures are capable of considerable compression, and sometimes when necessary are in a degree compressed at the time of birth, and subsequently return to their natural extension;(*r*) and further, to facilitate the birth, the bones of the os pubis are supposed sometimes to separate and extend in a small degree, so as for the instant to enlarge the opening.(*r*) In natural labour the weight co-operates with other circumstances; first, to present and protrude the head of the child, (or speaking more precisely, the hind head is supposed to turn towards the pubis, and the face towards the hollow of the sacrum,(*s*) and is usually placed nearest to the aperture, and the other parts naturally and readily follow, without injury to the child or the mother; and by all these co-operating causes, under ordinary circumstances, the delivery is completed, without difficulty or scarcely any assistance, and often without very severe pain, from six to twenty-four hours after the first labour pain has been felt.(*t*) Dr. Denman observes, that with a first child it would not be proper to denominate a labour difficult till it had continued twenty-four hours, if the presentation were natural, and no adverse circumstances should occur.(*u*) If the labour be unusually tedious, the moderate use of the modern remedy of secale cornutum, ergot or spurred rye, may be advisable; for, although in itself a poison, it has a singular effect in facilitating the action of the uterus in expelling the fœtus; and which of late, in cases of this nature, has saved many lives;(*x*) but this is a remedy only to be adopted by the most experienced practitioners, and by them with extreme caution. The incidents of a natural though painful labour have been thus described.(*y*)

When the period for the approach of labour is arrived, the nature of that viscid secretion, which we have seen(*z*) seals up the orifice of the womb, is altered by its losing its viscidity, and all the parts are relaxed and prepared for the transmission of the head. The action of the womb is at first feeble, and accoucheurs have marked the following five stages of a natural labour: First, The womb has suffered no diminution of its size, the membranes are entire, and of course the contractions of the womb are feeble, because before it is allowed to make some contraction, its efforts are not strong. This is a provision for the first stage of labour being slow; soon after, the before described membranes, with the liquor amnii, protrude, and the latter gently dilate the passage, and in this stage there ought not to be any interference, for while the membranes are entire, both the mother and child are in perfect safety: Secondly, the orifice continuing to dilate, and the efforts of the womb increasing, the membranes burst, and the head of the child presses on the orifice, and then the womb having more space, is enabled in a degree to contract, and which contraction is a stimulus to greater efforts, and in a few pains the head descends into the cavity of the pelvis. The orifice is then completely retracted, and there is no longer a mark of division betwixt the womb and the vagina, they are

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(*r*) Denman, Prac. Mid. 7, 8, 21; ante, 386 to 388; but we have seen that the fact of separation is doubted by some. A most experienced practitioner insists that if the separation take place, it is not more than a quarter of an inch.

(*s*) Denman, Prac. Mid. 184; Dewees, Midwif.

(*t*) Id. 183, 184; James' Burns, 1, 2.

(*u*) Denman, Prac. Mid. 238.

(*x*) Denman, Prac. Mid. 7th ed. 236, 237; see Dewees, Midwif. 608 to 624; Blundell, Prac. Mid. 58, 59, who speaks favourably of this medicine, and gives salutary advice to avoid other operations; and see ante, 396.

(*y*) 3 Bell, 473 to 478; see a full account, Denman, Prac. Mid. 188 to 211; 2 Dungl. Phy. 333 to 335, as to the first child being perhaps twenty-one hours, second six, third and the rest four or two; Blundell, Prac. Mid. 43 to 59.

(*z*) Ante, 400.

as one canal. The orifice being no longer dilated by the soft and elastic membranes, the head of the child presses full on the orifice, which becomes rigid, and perhaps inflamed, when its dilatation is slow and the labour is tedious; but from the form of the bones, and particularly by the retiring of the sacrum, or rather the os coccygis at its base, (which we have seen may by pressure bend back and give nearly half an inch more space in the cavity,) there is a provision and guard for the soft parts of the mother against injurious compression by the head, and nature usually intends this stage to be short, because if protracted it might become dangerous. There is at this period occasionally some obstruction of urine and fæces, and the vessels of the parts suffer compression: Thirdly, The head of the child, presenting at the orifice of the vagina, forms the next stage, and that sometimes of severe suffering; the head is pushed forward during every successive pain, and recedes again in the absence of pain. An interval of rest precedes this stage; at last the pains return, and the hard head of the child coming to press on the orifice, and the womb coming in close contact with the body of the child, the pains are redoubled in strength. The face of the mother, perhaps before pale and flat, becomes red and turgid, her eyes gleam and are inflamed, the pulse becomes quick and hard, and she looks wildly round on her attendants, losing all reason and recollection; she is frantic, with the most agonizing pain to which the human frame is subject. Now the occiput, being the hinder part of the head of the child, begins to project through the external parts; but nature intends that this also should dilate slowly. The ligaments and os coccygis resist several throes, and direct the head forward under the pubes, when at length, after several pains, it rises, with a *half turn* of the body, and is delivered:(a) the *fourth* stage is the delivery of the body and extremities: the *fifth* stage is the delivery of the placenta, which is expelled by a continuation of the same action of the womb, and is part of the natural process. Then, a flow of the remaining liquor amnii, with some blood, follows, and the child and the mother lie for a time exhausted, the extreme pain and excitement having ceased. The womb generally recovers its powers in about twenty minutes, and then there may be grinding pain in the abdomen, relievable perhaps in a degree by slight and gentle pressure, and the placenta is detached and expelled, or is pushed down into the vagina.(b)

While the membranes are unbroken, the child is safe, *i. e.* there is no danger of the compression of the umbilical cord; but when the membranes have burst, and the liquor amnii has been evacuated, the cord must suffer a degree of compression betwixt the uterus and the child, and there is danger that the cord may fall down before the mouth, until the head has descended into the brim, as the uterus contracts, and, as it were, follows the child, the circulation through the placenta must become somewhat difficult, and the usual function, corresponding with that of the adult lungs, impaired. This must be much more the case when the child is delivered, and the placenta remains in the contracted womb. No doubt nature intends by this that the function of the placenta shall be gradually diminished and not suddenly cut off, that the child may feel occasion for the play of the muscles of respiration, and that the function of the lungs may by degrees supersede that of the placenta. When the child is first delivered, the cord pulsates strongly; when the child cries, the pulsation becomes feeble; at first the child has strong and irregular catches of the respiratory muscles, but presently it breathes more regularly, and cries lustily. At first the breathing only renders the pulsation

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(a) As to this half turn and danger, unless assisted, of the child being smothered, see G. Smith, 365.

(b) 3 Bell, 476; Dewees, Midwif. 192.

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of the cord feeble, but presently such pulsation becomes so weak that it is felt only near the umbilicus, and it ceases when the regular and uninterrupted breathing is established and the crying ceases.

The delivery of the child and placenta is followed by a considerable efflux of blood, and after this there continues a discharge from the uterus, which is called the *lochia*, and the observance of which is one of the most certain signs of recent delivery, when it becomes necessary to ascertain the fact on judicial inquiry. It is like the exudation of blood from an extensive wound, inasmuch as by the contraction of the vessels from which it flows, it becomes serous in a few days and ceases gradually.(*c*) At first it consists of and resembles blood, but soon becomes paler and diminished in quantity as the vessels contract, and turns at last to a whitish colour and serous consistence, and is characterized also by a peculiar odour, which cannot be mistaken by an experienced practitioner.(*d*) This discharge from the womb, after delivery, is no doubt a provision against the injurious consequences which would naturally result if there were a sudden and perfect obstruction of the uterine vessels immediately after delivery. By such discharge, the activity of the vessels is gradually relieved, and afterwards the secretion of the milk in the breasts, and the giving of suck, causes the lochial discharge to cease much sooner than it would do if the mother were not the nurse, constituting, as regards the mother, a strong reason why she should nurse her own child.(*e*)

Of the *birth;* and medical and legal evidence of a child having been *born alive,* in addition to the examination of the lungs. (*f*)

While the child slumbers in the womb, it does not live by breathing, but an equivalent office is performed by another temporary organ, the placenta. At the instant of delivery it is uncertain to observers whether all the organs of the child are in a state adequate to maintain life. There is a short interval between delivery and the substitution of the independent existence of the child, during which the latter is uncertain. In the natural progress towards the latter, spasms and contractions are seen to extend over the infant's chest, the features are working, and the muscles of the face are agitated: at length air is admitted into the lungs, and the blood is there for the first time aerated, and passes towards and into the heart, and if that and the other organs of circulation be perfect, the blood is then circulated throughout the frame, and after a few inspirations and circulations, the child cries feebly at first, but, after successive inspirations, lustily, and thereby evinces not only that respiration has taken place, but also *circulation*, and that the *brain and nervous function* co-operate, and *these events conjointly manifest that in fact the child has been born alive.*(*g*) In a valuable article in the Cyclop. Prac. Med. tit. Infanticide, these indicia of birth are fully investigated, especially as regards the examination of the state of the vessel called the *ductus arteriosus*, and the infantine circulation of blood, beyond mere respiration.(*h*) Such ductus arteriosus, (being the vessel described in the preceding plate, ante, page 127, No. 13, conveys the blood directly from the pulmonary artery into the aorta during *fœtal* life, instead of passing circuitously through and from such pulmonary artery into the lungs, and thence through the pulmonary veins into the left auricle and ventricle, and thence into the aorta, which,

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(*c*) 3 Bell, 477; G. Smith's For. Med. 490; Dewees, Midwif. 204.

(*d*) G. Smith, 490; Forsyth, 402; Fodere; vol. ii. sect. 1; Mahon, vol. i. 166 to 170; Capuron, 124; Hutchinson on Infanticide, 90; Burns, 326; 1 Beck, 137.

(*e*) 3 Bell, 477, 478.

(*f*) See, in general, Cyclop. Prac. Med. tit. Infanticide; and most fully, 1 Beck, 184 to 287.

(*g*) Sir C. Bell's Essay on the Anatomy and Philosophy of Expression, 27, 28; G. Smith, 355.

(*h*) Cyclop. Prac. Med. tit. Infanticide, 689; also, 14 Philad. Journ. Med. & Phys. Sci. 46, 47.

after birth, we have seen is the more circuitous course of circulation.(*i*) This ductus arteriosus is obliterated after birth, and scarcely discernible upon post mortem examination of an adult.(*k*) This is the *natural* description of birth, an event which is not, perhaps, sufficiently defined or known in *law* by any particular fact or facts, whether as regards inheritance, infanticide, or concealment of birth. Grammatically, the term *birth* is the act of *coming into life*,(*l*) but still the stage of the proceeding is not accurately defined, and it may be questionable whether the construction of the term *birth* in some of the statutes has not been erroneous. For the sake of certainty, we would define it to be the arrival of the child at that stage after parturition when its existence and *capacity to continue life separate and apart from the mother*, have been distinctly established, and which consists not merely in *breathing*, but also in the exercise, at least, for once, of *all* the functions essential to the continuance of life, and amongst others principally the *circulation* of the blood, the existence of which, at least *prima facie*, is essential to prove the infant's *capacity to continue life*. When we consider that the object of law is to prevent injuries to infants having capacity to maintain a separate existence, it should seem essential that *such* a capacity should be proved in order to complete the offence of infanticide or of concealment of *birth*, and that, consequently, it is important to prove the existence of that capacity. It is clear that the mere proof of the *breathing* of a child does not necessarily establish a perfect capacity in the heart and blood vessels, or in the brain, to continue the *circulation* of the blood, or the co-operation of the brain, or at least so much of the nervous function as is indispensable to respiration and circulation, and therefore, in criminal cases, other evidence than breathing should be required, and as the *repeated crying* of a child cannot, physically, take place, unless a sufficient circulation of the blood through the lungs has previously taken place and been maintained for a time, it follows that at least *repeated crying* in ordinary cases is the best presumptive evidence of a child having been born alive, and reasonably casts the proof of its want of capacity to *continue* life upon the party, by circumstances showing that the subsequent death was not occasioned by criminal means.(*m*) In a recent case it was considered, that

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(*i*) See plate, ante, 127, No. 13; and see 2 Bell, 31, 42, and plate in the latter; and Quain, 2d. ed. 623.

(*k*) 2 Bell, 43. Before and until the instant of birth, the blood is constantly passing, in fœtal circulation, from the pulmonary artery directly into the aorta, through the ductus arteriosus, which is then about half an inch long, cylindrical, *and equal in diameter to the trunk of the pulmonary artery, and about three times the diameter of the two branches of the pulmonary artery, then about the thickness of a crow-quill;* but after the child has *breathed perfectly*, the office of the ductus arteriosus ceases, and it becomes *diminished as well in diameter as length, and is not thicker than a crow-quill, whilst the two branches of the pulmonary artery having come into use, change their relative proportions, and are respectively thicker than a goose-quill;* and if, in addition to these changes, it further appear that the ductus arteriosus then represents a cone in figure, it may be regarded as a decisive indication of the continuance of the pulmonary circulation, and hence of perfect breathing, and *independent life;* 14 Phil. Journ. Med. and Phy. Sci. 46; 2 Bell, 42, 43, where see plate; and see plate, ante, 127.

(*l*) Johnson's Dict. tit. Birth.

(*m*) Anatomists consider that the fact of *crying* after birth establishes the capacity of a child to maintain an independent existence, for the following reasons: the *act* of *crying* appears to require the active concurrence of three important functions, namely, the respiratory, the nervous, and the circulating. The sound, in crying, is produced through the medium of the air emitted by the lungs, operating on the chordæ vocales, which are brought within the "vocal influence," by the agency of the nervous system. Without circulation, the brain would fail in the exercise of its stimulating power, and the organ of voice would be paralyzed. If, then, the brain, the heart, and the lungs combine in the effort to maintain an independent existence, nothing more can be required so long as this circle or chain of

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the being *born* must mean, at least, that the *whole body* has been brought into the world, and that it is not sufficient to show that the child had *respired* in the progress of birth, and that whether the child was born alive or not depends mainly upon the evidence of the medical attendants, and if they only swear that the child *breathed*, but will not say that the child was *born alive*, then the affirmative of such birth is not established.(*n*) Under the statutes punishing a woman for the *concealment* of the *birth* of her child, it has singularly been held, and the practice is to convict, although it be expressly proved that the child was dead, or, as erroneously called, *still-born*, and this without regard to the time of the previous death, (provided the fœtus had advanced to the end of the seventh month,) so that the term birth is here read as synonymous to *delivery*.(*o*) The evidence in cases of supposed criminal death or infanticide, will be more properly considered in a subsequent part of the work. It may be important in favour of mothers subjected to criminal charges, to refer to the highest authorities, which establish, that, at least, on an average, one child in sixteen, or between that number and twenty, is usually dead before delivery,(*p*) and, when the injurious consequences of shame, remorse, and mental agitation, with poor living, are to be added in the case of illegitimate children, the probabilities of more frequent still-born deliveries are greatly increased.(*q*)

Care of the mother pending and immediately after delivery.

The most immediate attention is usually required to the child, but as the care of the mother should at least be *concurrent*, the steps to be taken with regard to her may properly be first stated. *During the pain of labour*, when feeble, it is a vulgar custom, without regard to the particular case, to give cordials very freely, with the view of accelerating their returns, or of strengthening them, though under such circumstances by such proceeding, Dr. Denman observes, we evidently add to the evil we mean to remove: nor is bleeding of every patient necessary on the accession of labours, and for some it is highly improper;(*r*) but if there be apprehension of fever, or the exertions of the female be vehement, and especially if she be plethoric, then there may be necessity for taking away some blood.(*r*) Every possible care should be observed to avoid any alarm or depression of mind.(*s*) *After delivery*, the mother is generally exhausted and languid; besides the well known appropriate attention to a moderate degree of compressure by Gaitskell's or other bandage or compression around the abdomen, which some consider advisable even

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vitality affords its agency to the physical structure of the body. In *law*, crying is considered the *strongest* evidence of a child having been born alive, but it is not the only evidence, 2 Bla. Com. 127, 128; 1 Coke, 34; Dyer, 25.

(*n*) There is a valuable article on this subject in Cyclop. Prac. Med. tit. Infanticide, 689, 690, &c.; and see *Rex* v. *Poulton*, 5 Car. & P. 329: in that case three medical men were called on the part of the prosecution: the first said—"It frequently happens that a child is born, as far as the head is concerned, *and breathes*, but death takes place before the whole delivery is complete. My opinion in this case is, that the child had *breathed;* but I cannot take upon myself to say that it was *wholly born alive*." The second said—"That death might have occurred when the child was *partly born*, if no medical man was present to assist in the delivery." The third said—"It is impossible to say when the child respired, but there is no doubt from the state of the lungs when they were examined, that it had breathed; children may breathe during the birth."

(*o*) 9 Geo. 4, c. 31, s. 14; *Rex.* v. *Southern*, 1 Burn's Just. 26th edit. 611; *Rex* v. *Cornwall*, Russ. & Ry. Cr. Ca. 336, S. P. 1 Chitty's Gen. Prac. 35, 36; see this point fully examined, post, last part.

(*p*) Denman's Prac. Mid. 302, where it is said that perhaps not less than one in sixteen, or between that number and twenty.

(*q*) Denman's Prac. Mid. 303.

(*r*) Id. 233, 432, 433.

(*s*) Id. 235. See, fully, Dewees, Midwif. 182 to 200.

when the second stage of labour has commenced.(*t*) Many women have been lost by the want of an immediate adequate cordial, and they should never be left alone for an instant for fear of their fainting and want of immediate attention; and death from hemorrhage, either internal or external, even within the first hour, may ensue, that might be prevented by due care.(*u*) With respect to diet and regimen, it had been the invariable practice to adopt that which is termed *antiphlogistic;*(*x*) but the highest authorities recommend suitable diet and refreshment, and a continuance of the ordinary beverages, because those patients fare the best, and recover most certainly and speedily, by whom the least change from their former habits is made,(*y*)

Although the *pains of labour* may be said to cease with the expulsion of the fœtus, yet *after pains* are not only not common for a day or two, but few women escape without them in a degree, and they are useful in expelling what are commonly called the after-birth, as the umbilical cord and the placenta and its membranes, and a few large coagula of blood that usually have formed in the uterus. If the placenta be not naturally expelled within four or five hours at most after the delivery of the child, it is the duty of the medical attendant to remove it by the funis or otherwise, and he should carefully prevent the serious consequence of retention of the secundines, and of violent after-pains, hemorrhage, or flooding or inadequate lochial discharge.(*z*)

Care of the child immediately after delivery.

As soon even as the head has protruded, it is essential to examine whether the umbilical cord (as said to occur in one of ten births,) does not surround the neck, for if it do, it must be carefully removed as soon as practicable, and the child is to be kept for some time as near to the vagina of the mother as possible, without danger of suffocation. This cord, we have seen, is usually about two feet long:(*a*) sometimes, also, a portion of the membrane may be over the face, and which, if it impede breathing, must be speedily removed; sometimes, also, it is necessary to remove sordes or other obstructions in the child's mouth or nostrils.(*b*) In the course of ten or twenty minutes, and sometimes longer, after the birth of the child, the circulation in the funis or umbilical cord having ceased, the funis itself becomes empty and flaccid;(*c*) one ligature is then to be fixed upon it, about three inches from the belly of the child,(*d*) and

(*t*) Id. 7th edit. by Dr. Waller, 205, 466, qualifying Dr. Denman's advice, who, in p. 205, recommends bandaging only after the fifth or sixth day subsequent to delivery. Dr. Blundell, in his Lect. Mid. 51, 208, 209, recommends the application of the bandage soon after delivery, but not before; and the present practice is so; for, until then, the occasional hand pressure of a female attendant, proportioned and directed by the female in labour, is preferable.

(*u*) Blund. Lect. Mid. 51, 208, 209. It appears from Dr. Denman's Prac. Mid. 464, that the practice had been to give, night and day, to each patient, a basin of plain caudle, and which, with tea, toast, and bread and butter, were the usual allowance for three or four days. Dr. Blundell recommends, at least on some occasions, in the first instance some cordial as a dessert, or table spoonful of rum or other spirit, a little sugar, and half a wine glass full of warm water, which affords great relief and comfort, and helps to detach the placenta, and does not in the least induce to flooding; Blund. Lect. Mid. 51.

(*x*) Denman's Prac. Mid. 463; Dewees, Dis. Children, 38.

(*y*) Id. 465, 466; see on this, Dewees, Midwif. 200, 201.

(*z*) Id. 467, 468; as to the treatment, 5 Good, 151 to 156; see the practice as to the removal of placenta, Dewees, Midwif. 437 to 450; and as to the use of secale cornutum, Denman's Prac. Mid. 236; Dewees, Midwif. 608 to 624; and see valuable observations on the *After Pains*, Copland's Dict. Prac. Med. Dewees, Midwif. 194 to 200.

(*a*) 2 Dungl. Phy. 352; ante, 401.

(*b*) Dewees, Midwif. 190.

(*c*) Why to wait that time, 2 James' Burns, 194.

(*d*) Why that distance, Ibid. 192, note (*d*.)

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another at twice that distance, with so much force or tightness as to repress the circulation which might happen to return, but yet not so firmly as to divide it. The navel string may then be cut with a pair of scissors between the two ligatures, and the child may be delivered over to a careful nurse.(e) If, however, the child breathe strongly, cry, and struggle, thereby evincing that it has thoroughly breathed and established its separate existence, independently of the mother, then the umbilical cord may immediately be thus tied and severed;(f) but otherwise it is not to be tied until the cord has wholly ceased to pulsate, unless it should be resolved to apply artificial means to restore the animation of the child,(g) and which are artificial respiration or warm bath.(h) It is usual, shortly after the birth, to give the child a small quantity of plain gruel and opening medicine, as castor oil, and after, about the ninth hour, or indeed, according to the practice of many, immediately after the child has been dressed, it is to be allowed to suck the mother's breast.(i) If the bones of the head, or rather its sutures, have been compressed or displaced in the birth, they require no treatment, because, within a short time after birth, they usually, of themselves, regain their proper position, though if there be inflammation as well as swelling, fomentations and poultices may be necessary.(j) It has been observed, that there can be no doubt that many infants' lives are annually lost from the want of perseverance in resuscitating measures, and even after two hours' apparent death, life has been restored.(k) With regard to subsequent care, Dr. Andrew Combe, in his recent excellent publication on the preservation of health, observes, that it appears from the London bills of mortality, that between a fourth and fifth of all the infants baptized die within the first two years of their existence, and which unnatural excess he attributes to either the neglect to preserve sufficient and equal warmth, or the occasional too light and warm clothing.(l)

Proper size and weight of a child when born at maturity.

A perfect child, born at maturity, should be about one foot six inches in *length;*(m) but, although that is said to be the ordinary length, yet there are not unfrequent instances of the length of twenty-two inches.(n) Its *weight* should be at least six pounds.(o) Dr. Smith has observed, that though a child prematurely born after the expiration of the seventh month, may, by possibility, be reared, yet it cannot be so if its weight be less than five pounds avoirdupois, or if it be less than fifteen inches in length; and that of less weight or length, no person ought to be convicted of its murder;(p) so if a fœtus, at the time of delivery, have not attained the age of seven months whilst in progress in the womb, the concealment of its birth, or, more properly, delivery, ought not to be considered an offence against the statute.(q) Others have stated that the weight of the fœtus at the time of birth, in this country, is from fifteen to four pounds, and sometimes less;(r) but Dr. Clarke calculated the usual and average weight as *seven pounds five ounces and seven drachms for*

(e) Denman's Prac. Mid. 208; 2 James' Burns, 192; Dewees, Midwif. 191; G. Smith, 365, 366, 564.

(f) See Dewees, Midwif. 191; see the reason why, G. Smith, 369.

(g) Dewees, Midwif. 188.

(h) Id. where see the process.

(i) Ibid. 210 to 212; post, 422.

(j) Blund. Lect. Mid. 191.

(k) El. Blum. 529, note (b.)

(l) Dr. Combe's Principles of Physiology, &c. 58 to 62.

(m) Farr, 10; 3 Par. & Fonb. 75; 1 Beck, Med. Jur. 170.

(n) Lizars' Gravid Uterus, 10; 2 Par. & Fonb. 101; 3 id. 101 to 103; Forsyth, 423, 424.

(o) Farr, 10; 1 Beck, Med. Jur. 167 to 171.

(p) G. Smith, 314, 337; 3 Par. & Fonb. 100, 101; but see ante, 410, as to expediting the death where there is the least possibility of life continuing.

(q) G. Smith, 293; Carrington's Crim. Law, Appendix, xxx.

(r) Lizars' Gravid Uterus, 10; 5 Good, 161, 162; 2 Par. & Fonb. 101; 3 id. 101 to 103; Forsyth, 423, 424.

male children, and six pounds eleven ounces and six drachms for females,(s) whilst others have insisted that females usually weigh more than males.(t) It is said that Sir Richard Croft once attended where the child weighed fifteen pounds, and that on the other hand the weight has sometimes not exceeded three pounds.(u)

How to ascertain the age of fœtus at different stages, by examination of its bones.(v)

It has been observed, that some useful knowledge as regards judicial inquiries respecting the age of the fœtus, may be obtained from observance of its *bones and other parts* at different stages before natural birth, rendered material by law, as the age of quickening about the sixteenth week and the age of seven months.(x) Blumenbach observes that the formation of human bone begins after the seventh or eighth week: First of all, the osseous fluid forms its centres in the *clavicles, ribs, vertebræ,* the large cylindrical bones of the extremities, the lower jaw, and some other bones of the face, in the delicate reticulum, of some flat bones of the skull, of the frontal and occipital, but less early the parietal.(y) If the fœtus be of one or two months, or very small, the nails are by no means perceptible either upon the fingers or toes.(z) In a fœtus of five months (after the most important time *in law* of quickening,) the orbits of the eyes are entirely formed into bony sockets, and in one of seven months the small bones subservient to the organ of hearing are so perfect as scarcely to differ from those of a complete child;(z) a child can hardly be called complete, all whose bones and every part are not entirely formed, though age may give some addition to their substance.(a) Dr. Paris has stated M. Beclard's deductions from his examination of numerous fœtuses, namely, that after *two months* have elapsed from the period of conception, the bony *skeleton* is about four inches and three lines in length, that of the spine being two inches: at *three months* the former is six inches and the proportion of the spine as two and two-thirds to six: at *four months* and a half (which we have seen is about the time of quickening) it is nine inches, and the spine four: at *six months* it is twelve inches, the spine being five: at *seven months* and a half it is fifteen inches, and the spine six and one-eighth: at *nine months,* or at the period of birth, it is ordinarily from sixteen to twenty inches in length, or at a medium eighteen inches, and the spine is in the proportion of seven and three-fourths to eighteen.(b) It is said that at birth the cerebellum is as to the cerebrum from one-ninth to one-twentieth, or even less.(c)

Of the sex of the child, family likeness, &c., and by what regulated.

It appears to be conceded that notwithstanding the various conjectures that have been proposed respecting the subject, we are completely ignorant of the circumstances which determine the future sex of the fœtus, though we know that upon the average rather more males are born than females, (as thirteen to twelve,) and some suppose that the sex depends more upon the female than the male, and whilst others consider that it depends on the comparative vigour of the parents.(d) Similar speculations have as fruitlessly been entertained upon the cause of family like-

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(s) G. Smith, 293; Carrington's Crim. Law, Appendix, xxx.; Phil. Trans. vol. lxxiv.; 3 Par. & Fonb. 101, note (a;) 2 Dungl. Phy. 355.

(t) El. Blum. 529, note (d;) 5 Good, 103.

(u) El. Blum. 529.

(v) See, in general, 3 Bost. 36, note; Amer. Cyclop. Prac. Med. tit. Abortion, (Med. leg.) and tit. Ages, (Med. leg.) Lizars, 104 to 117; Forsyth, 423; see fully, 1 Beck, Med. Jur. 162 to 172.

(x) 3 Par. & Fonb. 101 to 103; G. Smith, 339; Quain's El. 45, 46; see also Carrington's Crim. Law, Appendix, xxxi.

(y) El. Blum. s. 642, p. 522; and see Blum. on Bones, p. 1, s. 11 and 111.

(z) Farr's Med. Juris. 9.

(a) Id. 10.

(b) 3 Par. & Fonb. 75, 101 to 103; G. Smith, 339; Farr, 10, as to the length at birth; Amer. Cyclop. Prac. Med. tit. Ages, (Med. leg.)

(c) El. Blum. 532.

(d) 3 Bost. 37 to 39, and notes.

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ness.(*e*) It seems to be the better opinion, that, at least, as regards the production of monsters, they are not to be attributed to the imagination of the mother.(*f*) The consideration of hereditary diseases and peculiarities belongs to the next part.(*g*)

Delivery during a voyage.

There is a point of law that may sometimes arise, and which, at least in long voyages, captains and masters of ships, to avoid rather a troublesome companion without remuneration, should by special contract guard against, namely, that if a pregnant woman be delivered during a voyage no freight is due for the infant.(*h*) In other respects it is a maxim of our law, though with a distinct object, that partus sequitur ventrem.

The medical and legal duty and responsibility of the accoucheur. (*i*)

As parturition is in general a mere effort of nature, we have seen that, therefore, ordinarily all attendants are considered as merely *assisting nature*, and not as performing a surgical operation, and, therefore, unscientific women are allowed in this and other countries, (perhaps as regards the poor of necessity,) to interfere, and Dr. G. Smith observed, that "the duty of an assistant, in the great majority of labours, is not so much to aid or regulate the process as to perform the necessary services towards the *child;*"(*j*) and Dr. Denman appears so strongly to recommend that nature in general be left to herself, that it should be an invariable rule of the medical attendant never even to propose an examination per vaginam, still less any operation, or even interference, but as a matter of absolute necessity; nor then unless in the presence of some attending person;(*k*) and Dr. Blundell, in his Lectures, in order to prevent the risk of hasty interference, even advises, that when an accoucheur is sent for, he should not take any instrument with him, unless he has already been informed that it is a case of difficulty;(*l*) and the circumstance of a surgeon insisting that he could deliver a pregnant woman by electricity was deemed evidence of his insanity.(*m*) Cases, however, may arise when an operation may become essential.(*n*) And if the place of attendance be at any considerable distance, then the accoucheur should be fully prepared for all contingencies; though even then, if it should be essential to perform an operation, not of frequent use or of the slightest risk, he should in prudence obtain the presence and concurrence of one or more professional friends, in order to protect himself from personal imputation and responsibility; for an indictment may be sustainable against an accoucheur for so unskilfully delivering a woman that she died;(*o*) and it has been recently decided, that if by the undue use of the forceps or other instrument a midwife should give a child, whilst in the act of be-

(*e*) 2 Dungl. Phy. 315. In Genesis, c. xxx. v. 37 to 43, we read, that the placing the rods with peeled white streaks in them before the flocks of Laban, at the time the females were impregnated and commenced conception, caused the young to be marked accordingly.

(*f*) Denman's Prac. Mid. 454, 457; Dr. Blundell on the Power of Imagination, &c. 2 Dungl. Phy. 372 to 382.

(*g*) Post; and Cyclop. Prac. Med. tit. Hereditary Transmission of Disease, p. 417.

(*h*) Abbott on Shipping, 4th edit. 277, cites Roccus, note 79; Molloy, B. 2, ch. 4, s. 8.

(*i*) See Dewees, Midwif. *per tot.*

(*j*) G. Smith's For. Med. 364; Denman's Prac. Mid. 303, 304.

(*k*) Denman's Prac. Mid. 180, 303, 304.

(*l*) Blun. Lect. Mid. 43. He advises the young practitioner only to take with him the tracheal pipe, female catheter, tincture of opium, and some book on midwifery, as Aswell's, and he might with justice have added his own excellent instructions.

(*m*) *Dew* v. *Clark*, 3 Addams' Rep. 200.

(*n*) Denman's Prac. Mid. 303, 304; 5 Good, 215 to 221; G. Smith, 229, 384; Coop. Dict. Prac. Surg. 270 to 282; 1 Par. & Fonb. 226, 274; Farr, 12; Tuson, 269.

(*o*) See Indictment, Vet. Int. 231; Trem. P. C. 242; 4 Wentr. 360; and 3 Chitty's Crim. L. 862, 863; 3 Inst. 50; but see next note.

CHAP. X. The Female Organs, &c.

ing born, a mortal wound in the head, although before the child has breathed, and the child be afterwards born alive, but die in consequence of the wound, the surgeon may be convicted, at least, of manslaughter.(*p*) Any attempt here to describe the instrument to be used, or the proceeding to be observed, would be, at least, misplaced, although certainly each may become the subject of legal inquiry.(*q*) It is certain that in cases of difficulty much must depend on manual dexterity and experience;(*r*) and it would be well for the fair sex if male as well as female accoucheurs were under severe penalties prohibited from interfering in labours until it had been certified by authority, not only that they had studied scientifically, but further, that in hospitals they had actually attended and practised in a specified number of labours, and that they possessed adequate skill and practice, and were in the estimation of the party certifying perfectly competent to perform every requisite operation incident to delivery.

Of unnatural labour, &c.

As far as any surgical examination of *unnatural* labours are to be considered in a work of this nature, they should properly be examined in the next part. In connexion, however, with legal investigation, especially as regards infanticide and concealment of birth, it may be fit here to observe that it has been remarked that a woman can rarely be delivered in solitude where there is an unnatural presentation of the child,(*s*) and that in breech presentations the child is frequently lost by pressure on the umbilical cord.(*t*)

Of the breasts and milk.(*u*)

In man and in children of both sexes there is no mark of the breast but the little cutaneous papilla or nipple, surrounded by a zone or disk of a brownish red colour. But at puberty the *female breast* becomes protube-

(*p*) *Rex* v. *Senior*, 1 Moody's Cr. Cas. 346. The prisoner was tried and convicted before Mr. Baron Bolland, in 1832, upon an indictment which charged him with the *manslaughter* of the male infant child of Allen Hewitt and Alice his wife, at Stockport, on the 24th March, 1832, by mortally wounding the said child upon the head with a knife. The prisoner practised midwifery in the town of Stockport, and was called in at about five in the morning of the 24th March, to attend Alice Hewitt, who was taken in labour. At about seven in the morning of that day, the head of the child became visible, and the prisoner being grossly ignorant of the art which he professed, and unable to deliver the woman with safety to herself and the child, as might have been done by a person of ordinary skill, broke and compressed the skull of the infant, and thereby occasioned its death immediately after it was born. It was submitted to the judge that the indictment was misconceived, though the facts would warrant an indictment in another form, and that the child being in *ventre sa mere* at the time the wound was given, the prisoner could not be guilty of manslaughter, and quoted 1 Russ. 424. But the judge did not consider the objection valid, and sentenced the prisoner to imprisonment for one year. All the judges (except Lord Lyndhurst, C. B. and Taunton, J.) considered this case at a meeting in Easter Term, 1232, and held, unanimously, that the conviction was right. But an error in judgment, although occasioning the death of a patient, will not if the accoucheur be an established practitioner, though irregularly so, subject him to criminal responsibility, *Rex* v. *Williamson*, 3 Carr. & P. 635; 2 Stark. Evid. 1067.

(*q*) See description of the fillet, forceps and vectes, &c. Denman's Prac. Mid. 266 to 297, 304, 305; see also Dewees, Midwif. 275 to 297. See the use of a new instrument, suggested by Dr. Arnott, vol. i. El. Phys. 283, 543.

(*r*) 1 Arnott, El. Phys. 543.

(*s*) G. Smith's For. Med. 379, 380.

(*t*) Id. 384.

(*u*) As to diseases of the breast, see Sir A. Cooper's Illustrations of Diseases of the Breast, 4to. London, A. D. 1829. Coop. Dict. tit. Mamma; Dewees, Dis. Fem. 334 to 450. As to nerve-ache of the breast, 4 Good, 221; and as to irregularities in milk, 5 Good, 62 to 68. See an excellent article in Cyclop. Pr. Med. tit. Lactation; and as to the mammæ affording evidence for or against pregnancy, id. tit. Pregnancy, signs of; see also Dewees, Children, 46 to 61.

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rant, and those parts, before in miniature, quickly grow into a firm glandular mass, the shape, rotundity, and firmness of which must necessarily depend much upon the adipose membrane surrounding and intersecting it. The glandular part itself is divided into little masses, which again consist of small granules; and these several subdivisions of the glands are closely surrounded by membranes. The *lactiferous ducts* are gathered together from these smaller granules, and unite into twelve or fifteen in number, of a very considerable size, as they converge towards the root of the nipple. Shortly after childbirth the lochial discharge gradually diminishes, and finally ceases, whilst the uterus takes rest, and even pending the lochial discharge the lacteal fluid is secreted and prepared to pour forth in rapid succession.(*x*) But the secretion of milk is not perfect until forty-eight hours after the birth of the child; and at that time there is considerable excitement of the system, which may last four or five hours, but generally ceases if the child be applied, and the breasts emptied; and it has been recommended that to avoid this febrile excitement the child be applied to the breast as early as possible, not waiting for the flow of the milk; and accordingly, in general the child is allowed to suck after the ninth hour, or, at least, within twenty-four hours after birth.(*y*) When milk is secreted the glands are enlarged, and a remarkable distention of the ducts takes place, for they then become tortuous and varicose, and serve as reservoirs of the milk. Where they pass though the nipple, however, they are again contracted, and open by small pores upon its surface. The *nipple* is of a spongy and elastic nature, and suffers a distention or erection.(*z*) When the nipple is contracted, the lactiferous ducts must be compressed and, perhaps, coiled together, so that the milk cannot flow, or flows with difficulty; but by the sucking of the child the nipple is distended and the ducts elongated, so that the milk flows. There open upon the areola several superficial, or cutaneous glands, which pour out a discharge to defend it and the nipple from excoriation.

Changes in the breasts after puberty and in pregnancy.

There is a remarkable sympathy betwixt the womb and the breasts.(*a*) On the first period of the menses, when female puberty is established, the breasts are much distended. In many women, at each return of the discharge, a degree of swelling and shooting pain is felt in them, and the enlargement and shooting pain in the breast, with the darker colour of the areola, are usually marked as the most prominent sign of pregnancy, with the ceasing of menstruation, which is the cessation of the usual excitement and action of the womb, the breasts contract and are absorbed.(*b*)

It has been observed, that the occurrence of the secretion of milk subsequent to parturition is one of the most obvious and remarkable examples of the adaptation of the powers and the functions of the animal to the situations in which it may be occasionally placed.(*c*)

(*x*) 5 Good, 62. It is there stated, that the mother's intercourse with her husband in due time renders her a better nurse to the child, in regard to her milk, than any foreign nurse can be, secluded from her husband. In Leviticus, ch. xii. (see also Denman's Prac. Mid. 463,) regulations were prescribed to the Israelites during which women who had borne children should remain separate and varying, whether the child were female or male. In colder climates there is no express provision, but the period of separation is usually a month, and until the female has returned thanks for her deliverance, or, as commonly termed, been Churched. See the short service in Common Prayer, consisting of an exhortation, the 116th and 117th Psalms, the Lord's Prayer, and other appropriate thanksgiving.

(*y*) Blun. Lect. Mid.. 190; Cyclop. Pract. Med. tit. Lactation, Dewees, Children, 40. In general, the mother's milk sufficiently operates as medicine for the child, id. tit. Education, Physical, 688.

(*z*) 3 Bell's Anat. 479; 2 Dungl. Phy. 336.

(*a*) 3 Bell's Anat. 478, 479; but see 3 Bost. 36, 38, n.; Denman's Prac. Mid. 145.

(*b*) 3 Bell's Anat. 479; G. Smith, 486.

(*c*) 3 Bost. 36, 37, n. 3.

CHAP. X. The Female Organs, &c.

Changes in the breasts during pregnancy and after parturition.

As pregnancy advances, a change is manifested in the breasts, which is generally of a conclusive nature; they enlarge, and the nipples are not only distended, but are surrounded by a dark colour, and this discoloration of the areola, accompanying the enlargement of the mammæ, has generally been considered a strong presumptive sign of pregnancy, though Dr. G. Smith observes, that simple enlargement of these glandular bodies can hardly be relied upon when unaccompanied by other proofs.(*d*) Indeed, whilst some insist that it is impossible for the secretion of milk to take place independently of pregnancy, Dr. Smith and others consider its appearance to be a fallacious, or, at least, not an infallible proof, as virgins sometimes secrete milk.(*f*) However, the secretion of milk seems in general to be the result of pregnancy; for the secretion of milk is accounted for on the principle of revulsion, that is, the blood after the cessation of the menses is determined upwards, in consequence of the connexion that subsists between the breasts and uterus; and hence, although the secretion goes on during the discharge of the lochia, yet, if the menses supervene, the breasts become flaccid and empty, but fill again when it disappears.(*g*)

We have adverted to the positive advantage to the mother and the child arising from the continuance of support from its mother's breast in preference to that of a nurse.(*h*) Upon this subject it has been well observed, that to every feeling and considerate mother, inability to suckle is a serious evil; and, generally speaking, it is an evil of as great a magnitude to the mother herself as to the child; for a free secretion of milk prevents many present and not a few eventual mischiefs. The health of women during suckling is, in most instances, better than at any period of their lives. Their appetite is excellent, their sleep sound and refreshing, their spirits free, their temper cheerful; but to every conscientious mother there is, superadded to all this, a pleasurable feeling of a still higher and nobler kind,—it is a sense of conscientiously discharging the maternal duty,—it is the gratification of beholding the lovely babe to which she has given birth saved from the cold caresses of a hireling, to lie in the warm embraces of her own bosom; to grow from the sweet fountain which she furnishes from her own veins, rich, ample, and untainted; to swell with the tender thrill that shoots through the heart at every little draught which is drawn away from her; to see the cheeks dimple and the eyes brighten, and the limbs play and the features open; and to trace in every fresh lineament a softened image of herself, or one dearer to her than herself. This is a luxury that awaits the mother whose unseduced ear still listens to the voice of nature, and estimates the endearments of domestic life at a higher value than the intoxicating charm of fashionable amusements and midnight revels. Though transported with the present, her comforts do not end with the present; for she has yet to look forward to a term of life in which, when those who have made a sacrifice of maternal duty at the altar of pleasure, are wasting with decline, trembling with palsy, or tormented with the dread of cancer, she will still enjoy the blessing of unbroken health, and sink as on a downy pillow into a tranquil old age.(*i*)

Of the legal or moral impro-

There are some points connected with this subject, and the propriety of marriage, which it may be proper here to notice. It is not necessary to advert to questions of political economy, or of private prudential con-

(*d*) G. Smith, 486.
(*f*) G. Smith, 487; 2 James' Burns, 189; 1 Par. & Fonb. 253, 254.
(*g*) Fordyce, 382, 383, 403.
(*h*) Ante, 414, n. (*e*,) 422, n. (*x*;) 5 Good, 62; Dewees, Children; 48 to 61.
(*i*) 5 Good, 64.

CHAP. X. Of Marriage, &c.

Propriety of marriage in certain cases connected with this subject.

siderations, upon the expediency of marriage before the certainty of possessing funds to provide for children has been secured, subjects so ably discussed by Malthus in his Essay on Population, and other authors on that subject;(k) nor shall we dwell upon authorities to show the expediency of our ecclesiastical law forbidding marriages between certain near relatives, as tending to continue and increase family defects, and otherwise injurious to progeny, vulgarly termed breeding in-and-in;(l) but we will confine our examination to questions strictly physiological and legal.

How young.

With respect to *age*, no female can legally be married before she has attained the age of twelve,(m) nor should she ever marry until after she has menstruated.(n) The best age in man is from twenty-three to thirty-five, although our law permits his marriage at any instant after he has attained fourteen.(o) Early marriages, soon after puberty, in both parties, are considered prejudicial to themselves, and calculated to degenerate the race; and the best authorities recommend marriage not to take place till the age of twenty or twenty-one,(p) or rather not until after the age of twenty-three, because between the age of fourteen and twenty-three there are in proportion more deaths, and the health and constitution are not till then confirmed;(q) and that the husband be even twenty years older than the wife, in order that they may both arrive at the same time to the period when fertility ceases, namely, the female at forty-five when the male is sixty-five.(r) But then it may be objected that the father would scarcely live to watch the education and settling in life of his youngest child, and, therefore, perhaps the age of thirty, recommended by Plato, was preferable to that of thirty-five, prescribed by the Athenian law.(r) And in a country like England, where there is an excess of population from parents under the age of twenty-one, it would be preferable to fix the age of twenty-three as the earliest, especially as by fraud or false swearing a marriage by banns or license after twelve or fourteen may be effected without the actual consent of parents, and which might be avoided by requiring the presence of the parents on both sides in all marriages under twenty-three.(s)

How old.

On the other hand, no male or female should in prudence marry at so advanced an age as to endanger the frequent occurrence of apoplexy, or climacteric disease in the male,(t) or death in child-bed in the latter; and perhaps, if a woman aged more than forty-five, or a male after sixty-five, when the ability to procreate has usually ceased, were wilfully to *misrepresent* her age, the marriage might be set aside, as in cases of actual impotency; though parties aware of the advanced age would not, perhaps, after marriage, be allowed to invalidate it on the ground of impotency, as they must, in that case, be considered to have impliedly waived all right to complain of an event they might have anticipated.(u)

(k) See Malthus on Population; El. Blum. 562, 563.

(l) 1 Par. & Fonb. 168, n. (e.)

(m) This results from 9 Geo. 4, c. 31, s. 17, and previous enactments.

(n) Dewees, Children, 9 to 12; Denman's Prac. Mid. 99; ante, 395.

(o) 1 Par. & Fonb. 172, in notes.

(p) Dr. Combe's Principles of Physiology in preserving Health, 185, 315.

(q) Id.; G. Smith's For. Med. 496, in note; 1 Par. & Fonb. 172, note.

(r) 1 Par. & Fonb. 172, n. (c.)

(s) *Rex* v. *Jacobs*, 1 Chitty's Gen. Prac. 53, 54. The marriage acts in this respect clearly require revisal. In France, a son under twenty-five, and a daughter under twenty-one, cannot contract marriage without the consent of the father and mother, or, if the latter refuse, of the former. Code Civil, livre i. titre v. pl. 148.

(t) Amer. Cyclop. Prac. Med. tit. Ages; Coop. Dict. Prac. Med. tit. Climacteric Decay; and see Dr. Rush's account of the state of the body and mind in old age, in Med. Inquiries and Observations, vol. ii.; El. Blum. 537.

(u) See *Briggs* v. *Morgan*, 3 Phill. Ec. Rep. 331; and *Norton* v. *Seton*, id. 147 to 164.

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In *this* country, however aged the parties may be, if there be no deception, their marriage will be legal, although all power of procreation be passed;(*x*) and our liturgy even prescribes the omission of the prayer for procreation when the woman is past child-bearing at the time of her marriage; and instances have been known of persons subject to hereditary defects purposely delaying marriage until the possibility of child-bearing has ceased, and then from mental attachment having married. It would seem, that although parties marry after the female power of child-bearing has ceased, and therefore could not object on that account, yet the husband might, nevertheless, seek a divorce on the ground of the impotency of the wife; and it may be supposed that the wife would have the same right, in such a case, to complain of the impotency of the husband.(*y*)

Mental or corporeal defects.

Idiotcy or *lunacy*, at the time of marriage, constitutes as well a moral as a legal incapacity to marry, there being no mental ability to contract, and if either be proved to have existed at the time of the ceremony it is ipso facto void; and precludes either party from deriving any benefit therefrom;(*z*) and although it was formerly held otherwise, the issue of such a marriage would be illegal;(*a*) and, therefore, in a late case, administration to the effects of a wife was refused to the husband, on the ground that his marriage had been illegally contracted when his alleged wife was non compos;(*b*) and a marriage de facto, solemnized under circumstances of clandestinity, inferring fraud and circumvention between a weak mind (although not strictly an idiot) and the daughter of his trustee and solicitor, was pronounced null and void, and the pretended wife was condemned in costs.(*c*) Defects, when of a serious nature, ought to constitute a legal, as unquestionably they do a moral, objection to marriage, and hence it is necessary to ascertain what diseases are not transmissible from ancestor to children, although it is believed there is neither rule nor decision invalidating a marriage in respect of the discovery that either party is subject to any such defect.(*d*) Congenital deafness and dumbness are decidedly of this nature, and where either of the parents has been thus affected, their children very usually are born and continue the same, and therefore marriage, in such cases, should be avoided.(*e*) As diseases may be hereditary, so *multiplicity of children* is usually hereditary, a result certainly, in prudential marriages, to be taken into calculation.(*f*)

(*x*) In *Brown* v. *Brown*, 1 Hagg. Rep. 524; and see 1 Par. & Fonb. 172, 173. In France, a man above eighty, and a woman above fifty, cannot marry without license from the sovereign.

(*y*) *Brown* v. *Brown*, 1 Hagg. Rep. 524; ante, 378.

(*z*) 1 Bla. C. 438; 15 Geo. 2, c. 30; 51 Geo. 3, c. 37.

(*a*) 1 Bla. C. 438.

(*b*) *Browning* v. *Reane*, 2 Phil. Ecc. Cases, 69.

(*c*) *Portsmouth* v. *Portsmouth*, 1 Hagg. 355; and 1 Roper, 338.

(*d*) 1 Par. & Fonb. 174, 175.

(*e*) Dewees, Children, 13, 14; 1 Par. & Fonb. 173 to 175; G. Smith's For. Med. 524, 525.

(*f*) 5 Good, 148.

CHAP. XI.
SECT. I.
THE SKIN.

CHAPTER XI.

OF THE INTEGUMENTS, NAMELY, SKIN, HAIR, AND NAILS, AND THEIR FUNCTIONS.

THE INTEGUMENTS. (*a*)

THE external coverings of the body are technically called the integuments,(*a*) (from the Latin *tegere,* to cover,) and consist of the Skin, Hair, and Nails.

I. THE SKIN.(*b*)

The great importance of the *skin,* as regards health, has been demonstrated by Dr. Bateman, in his Synopsis of Cutaneous Diseases, and by Dr. Andrew Combe, in his recent valuable publication on the Principles of Physiology, applied to Education and the preservation of Health, 1st, as an organ of *secretion,* an *exhalent* of waste matter from the system; 2dly, as a joint regulator of the *heat* of the body; 3dly, as an organ of *absorption;* and 4thly, as the seat of sensation, and part of the organ of touch.(*c*) Dr. Combe observes, that the true skin is so abundantly supplied with blood and nervous power, that for practical purposes it may almost be regarded as composed of vessels and nerves alone, so that scarcely a part of the frame can be found where the point of a needle could be inserted without puncturing a vessel and drawing blood, and transfixing a nerve and causing pain; and that, therefore, the skin may be truly considered as a net-work of blood vessels and nerves of the finest conceivable texture, and that considering the vast extent of the whole surface of the skin (estimated to exceed, in a man of average size, 2500 square inches,) a very large surface of the nervous matter, as well as of the blood, is constantly present or in circulation near the surface, and as exposure to heat or cold, moisture or dryness, greatly affects the nervous matter, and accelerates or retards the circulation of this large mass of blood so exposed near the surface, hence it may be readily anticipated, that the due care of the skin, and due regard to the atmosphere to which it is exposed, must be of the utmost importance as regards health.(*d*)

(*a*) Conv. An. Econ.

(*b*) See, in general, 3 Bell, 211 to 220; Lectures on the general Structure of the Human Body and on the Anatomy and Functions of the Skin, by Thomas Chevalier, F. R. S. &c. Lect. vi. vii. London, A. D. 1823; Bateman's Prac. Synopsis of Cutaneous Diseases; El. Blum. 552; 1 Horner, Anat. 351 to 366; Cazenave & Schledel, Dis. of Skin; 5 Good, 366 to 473; Dr. Combe's Physiology, &c., to the different functions or offices of the skin, p. 19, &c. The latter work is particularly deserving of the student's attention, as the best description of the skin and its offices or functions.

(*c*) Dr. Combe's Principles of Physiology, &c. 29.

(*d*) Id. 28, 29.

CHAP. XI. Sect. I. The Skin.

The *Skin* is the outward covering connecting the parts together, protecting them from injury, and preventing the too powerful impression of external objects. It performs several offices, and has distinct parts for each, namely, for absorption, secretion, and the senses of touch and feeling.(*e*) All parts of the skin are supposed to be composed of infinitely small globules of the same dimensions as those of the cellular tissue.(*f*) The skin is commonly regarded as only one external coat; but anatomists have properly divided it into *three distinct layers*, or rather distinct organs, each of which possess peculiar structures; the principal of which are, *first*, the *Epidermis*, sometimes called *cuticle*, and sometimes *scarf skin*, being the outer layer; *secondly*, the *Rete Mucosum*, being the middle layer; and, *thirdly*, the *Cutis Vera* or *True Skin*, being the internal layer, and sometimes called the *Corion*.(*g*)

First, Epidermis or external skin.

First, The *Epidermis* is the *external covering;* it is a thin semitransparent body, adhering uniformly to the parts on which it is laid, but capable of being distinctly separated from the same, as will be perceived where a blister, by throwing out a small quantity of fluid from the parts beneath, raises such scarf skin, and makes it apparently separated from the skin beneath: it does not possess any blood vessels or nerve that can be detected; it exhibits no mark of sensibility, and seems to have but little connexion with the vital powers of the system; it is frequently destroyed from various accidents, and is quickly re-produced without causing any material derangement or any sensible change in the functions of the subjacent parts,(*h*) for the parts below have a power of throwing out a material which soon, when in a healthy state, hardens into this particular substance.(*h*) But, it has been observed, that when a portion of the skin has been destroyed or removed, that growing anew does not repair the part so perfectly as it previously existed,(*i*) a circumstance which may assist in judicial inquiry relative to identity.

As the cutaneous *perspiration* (which is of two descriptions, perceptible perspiration and insensible perspiration,) (*k*) issues from the greatest part of the surface of the body, and absorption is also constantly proceeding through the skin, it follows that this epidermis must be furnished with *pores* or passages of some kind for its transmission, though anatomists in general admit that they have not been able to detect them.(*l*) As far as its chemical composition has been examined, it seems to consist almost entirely of albumen.(*m*) The epidermis serves to moderate the effect of external impressions, and especially pain, and in a degree protects the next coat, which is exceedingly sensible of pain.(*n*) It serves also to modify as well absorption as secretion or exhalation.(*o*)

Secondly, The middle skin or rete mucosum.

Secondly, The next coat or part of the skin is technically called the *Rete Mucosum*, or sometimes the *Corpus Mucosum* or Mucous Network. This is the *middle* layer, and immediately under the epidermis, and notwithstanding the disputes on the subject, appears to exist as well in Europeans as in Negroes, and the only difference is, that in the latter,

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(*e*) Dr. Combe's Principles of Physiology, &c. 51.

(*f*) 3 Bost. 247.

(*g*) 1 Horner, Anat. 353.

(*h*) 1 Horner, Anat. 359 to 364.

(*i*) Conv. An. Econ. 16; Lizars, 117; and as to *granulations* and forming new parts, Coop. Surg. Dict. titles Cicatrization, Excoriation, Granulations, and Suppuration, post, 426.

(*k*) Dr. Combe's Physiology, 30.

(*l*) 1 Bost. 58; Dr. Combe's Physiology, 23; see observation, Conv. An. Econ. 7, 8, in favour of the supposition of actual pores, and of the transmission of perspiration and other fluids, though not perceptible, but see 1 Dungl. Phy. 74; and as to *sweat* or *perspiration*, and diseases of, 5 Good, 366 to 373; and as to the secretion of sweat, ante, 234, and 5 Good, 366.

(*m*) But see 1 Dungl. Phy. 211, 212.

(*n*) Quain's El. 31; Conv. An. Econ. 7, 8.

(*o*) Dr. Combe's Phys. 23, 24.

CHAP. XI. SECT. I. THE SKIN.

it is dark. It is a stratum of soft matter, disposed in the form of fibres, crossing each other, or, according to others, merely a thin layer of pulpy matter, without any distinct reticulated structure. It is not thicker than the cuticle or epidermis. From all that is known regarding this mucous coat, it may be viewed generally as merely a thin soft covering placed between the outer and inner skin, to protect the nerves and vessels of the latter, and give them their requisite softness and pliancy.(*p*)

Colour of skin, and its cause.

This stratum of skin is the seat of the colouring matter of the skin.(*q*) In the Negro it is black; in the Chinese yellow; in the aboriginal American of a copper colour; in the Albinos either white, or this middle skin is entirely wanting; while, in the European, it possesses different shades of red and olive, more or less approaching to whiteness.(*r*) The skin of the Negro has a peculiar velvet-like softness, and is lubricated by an oily secretion; and it therefore has been sarcastically observed, that however much Europeans, in the plenitude of their Christian-like and benevolent opinions, may have doubted whether Negroes are men, or have souls, there never has been a difference of opinion as to whether Negresses are women.(*s*) The scarf skin of the Negro is but very slightly darker than that of the white. The seat of colour is, in fact, this thin layer called the rete mucosum, which is interposed in the Negro as well as whites, between the scarf skin and the cutis or true skin, and such dark colour does not descend deeper, for the true skin and the parts below are of precisely the same colour both in whites and blacks.(*t*) It is more difficult to discover, by the countenance of a Negro, the emotions of his mind; and, consequently, less easy, in examining him as a witness, to detect alarm or confusion when he prevaricates or mistakes the truth; and this difficulty gave rise to the unfeeling taunt of the Spanish Americans, when they objected—" How can those be trusted who know not how to blush?"(*u*)—forgetting that although the sense of shame might not be so perceptibly demonstrated to others, yet the Negro is internally fully as capable of the impression as the white. The dark colour of the skin of Negroes has been attributed by Blumenbach and others to the influence of the sun upon the surface of the body; but Dr. Bostock and others deny that to be the cause.(*x*) Some have supposed that the dark colour in the Negro was provided as a protection against the excessive heat of the sun in the climates where Negroes are found; and though Dr. Combe has observed that as black is a known absorbent and radiator of heat, this cannot have been its utility;(*y*) yet it has been recently demonstrated, that the negro skin is a more active organ of dessuration than the white.(*z*) The children of Negroes are equally black in whatever climate they are born, and their complexion is not altered by any number of generations; but colour is dependent upon the parentage, and hence we find that after three or four successive stages, the original colour, whether white or black, is almost entirely obliterated by the union of parents from different varieties.(*a*)

Thirdly, The third or inner

Thirdly, Under the corpus mucosum lies the third layer, technically and commonly called the *Cutis* or *Cutis Vera* or *True Skin*, or as it is sometimes termed, the *Corion*, and which, with its principal components,

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(*p*) Dr. Combe's Phys. 26, 27; but see 1 Horner, Anat. 356 to 359.

(*q*) Id.

(*r*) 1 Bost. 63, 64; 3 id. 230 to 232; Conv. An. Econ. 9, 10; 5 Good, 467; Dr. Gordon's Anat. 244; Edin. Med. Journ. vol. xviii. p. 247; 2 Dungl. Phy. 462 to 479.

(*s*) El. Blum. 561; Westminster Review, A. D. 1826.

(*t*) Conv. An. Econ. 8, 9.

(*u*) Id. 10.

(*x*) 1 Bost. 64; 3 id. 230 to 234; Dr. Combe's Phys. 26, 27.

(*y*) Dr. Combe's Phys. 26, 27.

(*z*) Copl. Dict. Prac. Med. tit. Climate, where see a further valuable explanation.

(*a*) 1 Bost. 64; but see 3 id. 230 to 235.

CHAP. XI. SECT. I. THE SKIN.

blood vessels, and nerves, constituting the organs of touch,(b) is dispersed over the body, though more perceptible in the finger. It is a body of considerable thickness, tough, flexible, extensible, and elastic, of a dense texture, composed of a number of small fibres or plates closely interwoven and firmly united together. Its external surface is compact and smooth, while the internal is more loose and irregular; it is connected to the parts below it by the cellular texture, and it passes into that substance by almost imperceptible degrees. Besides this, the proper basis of the cutis, there are numerous *nerves*, *blood vessels*, and *absorbents*, which are dispersed over every part of this layer, and render it so acutely sensible.(b) This is the seat of sensation and touch, and the instrument of two very important functions, absorption and exhalation, as presently described.(c) The sensibility of this true skin differs very much in its different parts, but, in its general extent, it may be considered as possessing the most acute degree of any of the structures of which the body is composed, and it is accordingly observed in surgical operations, that the most severe pain is experienced during the division of the skin.(d) Its external surface, when examined by a microscope, is found to be rendered unequal by little eminences or projections called *papillæ*, and each of them is supposed to contain the small branch of a nerve, of which they constitute the ultimate ramification, and seem to be the immediate and principal seat of the organ of *touch*, as well as of all the other sensations which reside in the surface of the body.(e)

skin, called cutis vera, or true skin, or corion.

The *blood vessels* referred to, render the skin one of the most vital parts of the body, subject to a variety of diseases, and ultimately connected with various functions, especially of those of animal temperature, secretion, and absorption.(f)

With respect to the *texture* of this true skin, it seems to be the same with that of membranes generally.(g) It is composed of threads or fibres, which are short, interwoven, and closely adhering together, the external part being more dense, and the interior gradually passing into the cellular texture. It contains pores, passing in a winding course to the surface.

The *papillæ* in the true skin contain the ultimate termination of the *nerves*, and are the immediate seat of the sensations and of touch, which reside in the skin. In all parts of the body it is found that the sensibility of the nerves resides principally, if not entirely, in their extremities, where they are either divided into extremely minute filaments, or spread out into a thin expansion. Besides the nervous filaments, the *papillæ* are supposed to contain each of them a minute branch of an artery and a correspondent vein, together with an exhalent and an absorbent; at least it is certain that the skin is the seat of an extensive system of exhalation and absorption, although it may be very difficult to determine the actual termination of the vessels, or the exact apparatus by which these functions are performed.

With respect to the *properties* of the cutis, considered in its most extensive relation, we may conclude that in addition to the mechanical qualities before noticed, it possesses those immediately dependent upon nerves and blood vessels, but that it is without contractility, which is exclusively attached to the muscular fibre.(h)

(b) Conv. An. Econ. 13, 14; Dr. Combe's Phys. 27.
(b) 1 Bost. 67; 1 Horner, Anat. 353 to 356.
(c) Dr. Combe's Phys. 27.
(d) 1 Bost. 67.
(e) Id. 1 Horner, Anat. 353.
(f) 1 Bost. 67, 68; 1 Dungl. Phy. 79.
(g) See ante, 22 to 29, as to membrane and *cellular tissue;* and Dr. Copland's Dict. Prac. Med. tit. Cellular Tissue, where see the numerous diseases, &c. affecting the *cutis.*
(h) 1 Bost. 69; Conv. An. Econ. 14.

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With respect to the *chemical* composition of this proper cutis, its fibrous part, which constitutes its proper substance or basis, is composed of *albumen*, like the other membranous bodies, and it has intermixed with it a quantity of matter of a different chemical nature, which we may suppose to be a compound of jelly and mucus.(*k*)

The skin has a certain elasticity in young and middle life, but it is not annexed to nor does it contract with the muscles situate below it; and hence it forms various folds, which in the countenance particularly, give a certain variety of expression. It is connected to the parts below by a sort of net-work called cellular membrane or cellular tissue, and by a perplexing variety of names, and this being soft and extensible, admits of the easy motion of the skin over the parts below.(*l*) It becomes more rigid as we advance in life; the adhesion is more firm, and hence the depressions are produced which form wrinkles, particularly in thin people.(*l*) The skin of mankind, though very delicate, is yet capable of being tanned and converted into leather.(*m*)

Diseases of the skin.

The diseases of the skin are very numerous, and have formed the subject of consideration in numerous works.(*n*) They will be further noticed in the second part of this summary.

Injuries to the skin.

Although we have seen that all parts of the body are constantly removed, and other materials deposited in lieu, and there is an extraordinary capacity of reproduction to supply injuries, yet it seems that the skin constitutes an exception. For though if a portion of the skin be cut out, or taken off, the part will heal, and if the skin be brought together very correctly, the cut portions will unite so as that hardly any mark will remain, yet the *mark*, or *scar*, or *eschar*, as it is technically called, is a part without skin, and is, therefore, more liable to injury than before the accident, because less supported. The small-pox and cow-pox, in the marks which they leave behind them, afford an exemplification of the same thing. There is in each of these diseases a slight destruction of the skin in the pustule, or vesicle, which is not filled up or repaired.(*o*) Cuts, wounds, and other injuries, will be considered in the following part of this work. The law has made a most important distinction between a bruise, however violent, and a cut or wound; for under the 9 Geo. 4, c. 31, s. 12, certain stabbing, cutting, or *wounding*, is a capital offence; but to bring a case within the enactment the *continuity* of the skin must be broken, though it is not essential that there should be an *incised* wound, and the offence is complete where the skin has been divided, even by a hammer.(*p*)

The functions of the skin.

Dr. Combe has demonstrated the very important *functions* of the *true skin*, and the necessity for attention to the same as regards health; *first*, as an organ of *secretion* by exhalation; *secondly*, as an organ of *absorption; thirdly*, as co-operating with the lungs in *regulating the temperature or heat* of the body; and, *fourthly*, as the seat of *sensation* and *touch*.(*q*)

(*k*) 1 Bost. 70; Conv. An. Econ. 22, 23.

(*l*) 1 Horner, Anat. 352. This admits of the curious operation of extending the skin of the forehead over a false nose.

(*m*) Conv. An. Econ. 20.

(*n*) See the distinct and able treatise of Dr. Bateman. Practical Synopsis of Cutaneous Diseases; and Cazenave and Schledel; 5 Good, 336 to 438; Copl. Dict. Prac. Med. tit. Cellular Tissue; Coop. Dict. Prac. Surg. titles Cicatrization, Excoriation, Granulations, Herpes or Shingles, Nævus or Moles, Suppurations, Wart, Whitlow.

(*o*) Cazenave & Schledel, Lizars, 117; ante, 427; Copl. Dict. Prac. Med. tit. Disease. In a judicial inquiry respecting identity, the observance of this truth may assist.

(*p*) *Rex* v. *Withers*, 1 Mood. C. C. 294; 4 Car. & P. 446, S. C.

(*q*) Dr. Combe's Principles of Physiology applied to Education; chap. ii. p. 21 to 58, and all the subsequent chapters.

CHAP. XI. Sect. I. The Skin.

1st, As a secreting organ.

When examining the function of *secretion* we cursorily noticed perspiration as one of the eight principal secretions.(*r*) Insensible perspiration, as well as sensible, termed sweat, removes from the system the larger proportion of useless materials, and at the same time keeps the skin soft and moist, and thereby fits it for the performance of another of its functions, viz. as the organ of the external sense of touch.(*s*) Dr. Combe has collected the authorities respecting the average quantities in each twenty-four hours of the constant *secretion* through the skin, (in addition to visible perspiration of sweat, which is only occasional, and usually appearing only when the body has been in very active exercise, or during sleep,) and which is termed *insensible perspiration*, or exhalation of superfluous secretions in the form of *vapour*, whilst the body is in a quiescent state, and in a moderate or ordinary atmosphere. The average of insensible perspiration appears to be *in weight* about thirty-three ounces in the course of twenty-four hours, and, in fact, exceeds in weight even the united excretions of the fæces, and urine from the bowels and kidneys; and it is calculated that *five out of every eight pounds of substance, whether meat or drink, taken into the system, are passed out of it again by the skin, leaving only three to pass off by the bowels, the lungs, and the kidneys.* Whilst this natural process is duly proceeding without check, the bowels and the kidneys are proportionally relieved of a part of the office of secretion which would otherwise be thrown upon them. But if the process be interrupted, then the bowels and kidneys, in order to retain the body in health, have an injurious increase of employment. Hence it is justly concluded, that it is of the very utmost importance to health to maintain the regular and equal performance of this natural function of the skin. Hence the danger, not only of *checked perceptible perspiration*, as one of the most powerful causes of disease and death, but the great importance of avoiding every cause of checking even *insensible* perspiration in the most quiescent state. The same learned author clearly demonstrates the baneful consequences of any such check in either case, and the necessity for more attention to this function than has usually been afforded,(*t*) especially as regards cleanliness of the skin, and the use of water and rough or coarse towels in cleansing the surface, and gently stimulating the skin to a healthy glow.(*u*)

2d, As an organ of absorption.

With respect to the *second* function of the skin, that of *absorption*, it is no less important than cutaneous secretion. Not only many external matters, calculated to *nourish* the frame, but also numerous *injurious* substances may be absorbed, at least if placed in contact with the skin, and still more if rubbed in or brought into contact with the inner layer, or the true skin, as is verified by the ordinary operation of inoculation or vaccination,(*x*) and the common laxatives, such as rhubarb and croton oil, may be administered by rubbing the same in through the external skin.(*y*) It has even been supposed that marsh *miasmata*, and other poisoned air, may be absorbed through the skin, though generally it has been considered that the injurious consequences of such air are produced by inhaling.(*z*) Dr. Combe entertains the former opinion, and insists on the necessity, therefore, of warm woollen dresses when persons are exposed to marsh and moist air, so as to avoid exposing the pores of the skin to such absorption.(*z*) But as regards absorption, one of the greatest dangers arises from suffering the secretions that have approached the surface

(*r*) Ante, 234.

(*s*) Dr. Combe's Principles of Physiology, 40; and see Copl. Dict. Prac. Med. tit. Climate.

(*t*) Dr. Combe's Principles of Physiology applied to Education, 29 to 36; and see illustration, 32 to 36.

(*u*) Dr. Combe's Principles, &c. 81.

(*x*) Id. 45; and see ante, 227, as to cutaneous absorption.

(*y*) Dr. Combe's Principles, &c. 46.

(*z*) Id. 49, 50.

CHAP. XI. SECT. I. THE SKIN.

and are about to be exhaled, from being checked, and then again absorbed. Thus when perspiration is brought to the surface of the skin, and confined there, either by injudicious clothing, or by want of cleanliness, there is much reason to suppose that its residual parts are again absorbed and act upon the system as a poison, of greater or less power, according to its quantity and degree of concentration, thereby producing fever, inflammation, and even death. The fatal consequences which have repeatedly followed the use of a close waterproof dress by sportsmen and others, and the heat and uneasy restlessness which speedily ensue where proper ventilation is thus prevented, seem explicable only on some such principle.(*z*)

3d, As an organ assisting in regulating the heat of the frame.

We have already adverted to the *third* office or function of the skin, viz. its co-operating with the lungs in *regulating the heat of the body;* and whilst probably the *heat* is caused or created in the lungs(*a*) the skin principally assists in *diminishing* the heat, according to the existing requisites.(*b*) Dr. Combe has fully described this cooling process through the skin, occasioning an evaporation in weight equal sometimes even to two pounds in a couple of hours,(*c*) and refers to Dr. Thomson's and Dr. Davy's work to show that when a European lands in a tropical climate the standard heat of his body will be raised two or three degrees, febrile symptoms occur, requiring great temperance, and the avoiding any cause of excitement of the vascular system and the use of aperient medicines, and from which the necessity for regimen in extreme heat in our own climate will be apparent.(*d*)

4th, As an organ of sensation and touch.

The *fourth* function or use of the true skin is its office of *sensation* and *touch.* Every part of the skin, however remote, is provided with filaments from the *nerves of sensation,* in order that we may become immediately sensible of the presence and action of external bodies. If any part were destitute of this property, its texture and vitality might be destroyed without our consciousness of the fact, whereas, in consequence of this provision of sensitive nerves, no object can touch the skin without our being instantly made aware of its presence and properties.(*e*) We have seen that certain parts of the skin in particular appear to be more immediately destined for the exercise of the sense of *touch,* as the hands and tongue in man, and those parts are usually endowed with a much greater number of nerves than any other part of the surface.(*e*) The nerves of sensation and those of touch, are monitors to avoid greater danger; for if we were not by these warned by a degree of pain, as of numbness in cold, we should remain inactive, and soon lose the powers of life, or by remaining too near or too much surrounded by fire or boiling fluid we might be destroyed by other means.(*f*) The nervous influence is principally ascribed to the brain, from the circumstance of the large mass of nervous substance collected and consolidated in the head; but it has been observed, that the nervous matter spread out on the surface of the body, about, as we have seen, 2,500 square inches, for the purpose of sensation, is so great that many anatomists consider it as even exceeding the mass of the brain; and hence Dr. Combe observes, its reverse influence might be expected to be, as it actually is, of much importance to health, as is exemplified on exposure to intense cold, or excessive heat; and hence the great importance of strict care and regimen as regards the skin, so intimately connected with this expanded surface of nervous mat-

(*z*) Dr. Combe's Principles, &c. 48, 49.

(*a*) Ante, 112.

(*b*) Dr. Combe's Principles, &c. 41.

(*c*) Id. 43; and see Copl. Dict. Prac. Med. tit. Climate.

(*d*) Dr. Combe's Principles, &c. 43 to 45.

(*e*) Id. 52; and see ante, 306, 309, as to nerves of sensation.

(*f*) Dr. Combe's Principles, &c. 53, 54.

ter.(*g*) Dr. Combe remarks that literary men often suffer severely from excess of action in the brain and deficiency of activity in the nerves of the skin and remoter organs,(*h*) and we may add that hence they frequently experience the tic doloureux in the forehead, which the labouring classes rarely suffer. These are only to be removed by exciting the nervous and vascular functions of the skin, and diminishing those of the brain.(*h*)

CHAP. XI. SECT. I. THE SKIN.

II. THE HAIRS.(*i*)

Hair, may be regarded as a vegetation from the surface of the body. Each hair has a distinct and separate origin in a vascular pulp, constituting a bulbous root, which is contained in a capsule or covering, lodged either wholly in the body of the skin or in part beneath it; in other words, it proceeds from a kind of bulb or root, situate below the *cutis vera*,(*k*) through which and the middle layer of skin, (where it has been supposed to take its colour in part,) (*l*) it passes and projects beyond the external surface. Like the nails, it grows or increases in length, not at the external extremity, but from the root, gradually pushing or shooting forwards the previous production.(*m*) It consists essentially of an external tube and an internal pulp. The tube is very delicate and is entirely filled with the pulp. This vascular pulp provides for the continued growth of the hair. It is not well settled whether the hair itself is hollow or solid, though the former is the better opinion, as well as the supposition that the tube itself contains a small quantity of the pulp, to which it owes its nourishment, and is a sort of cellular structure within it.(*n*) Some anatomists have supposed that hair is possessed of a bristled texture, and it has been recently discovered by Dr. Goring that a hair viewed on a dark ground is seen to be indented with teeth, somewhat resembling those of a coarse round rasp, but extremely irregular and rugged, and these all incline in one direction like those of a common file, namely, from the origin of the hair towards its extremity.(*o*) Next to the bones, hair is said to be the most indestructible of the constituents of the body. It differs considerably in different individuals in its thickness, namely, from $\frac{1}{300}$ to $\frac{1}{700}$ of an inch in diameter. It consists principally of an animal matter, united to a portion of oil, which seems to contribute to its flexibility and cohesion. Besides which there is another substance of an oily nature, from which the specific colour is derived, and there are also small portions of iron, manganese, sulphur, and phosphate and carbonate of lime. The animal matter, which constitutes nearly the whole bulk of the hair, is said to be a species of mucus; but others designate it as being chiefly albumen, united to a small quantity of jelly. Vauquelin, who gave an elaborate analysis of hair, has considered that its colouring is destroyed by acids, and suggests that when it has suddenly changed its colour, and become white, in consequence of any great *mental agitation*, it is owing to the production of an acid in the system; but Dr. Bostock observes, that such an idea seems very hypothetical, and that it is more probable that the effect depends upon the sudden stagnation of the vessels, which secrete the colouring matter, while the absor-

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(*g*) Id. 55 to 57.

(*h*) Dr. Combe's Principles, &c. 56.

(*i*) See, in general, 1 Bost. 71 to 74; 3 id. 280; El. Blum. 554; 3 Bell, 210; 5 Good, 449 to 460; 1 Horner, Anat. 369 to 373; 1 Dungl. Phy. 77; Amer. Cyclop. Prac. Med. tit. Alopecia; Convers. An. Econ. 11, 27.

(*k*) See a plate of the bulb and parts of a hair, Convers. An. Econ. 28.

(*l*) But see 5 Good, 459.

(*m*) Johnson's Dict. tit. Hair, citing Quincey.

(*n*) Conv. Anim. Econ. 27; see a sketch of hair and bulb, id. 28.

(*o*) Dr. Goring's observations on the texture of the hair; and 3 Bost. 280.

CHAP. XI. SECT. II. THE HAIRS.

bents continue to act and remove that which already exists, and that as the colour of the hair seems to depend upon a peculiar kind of oil, and as there is often a correspondence between the colour of the hair and the skin, it has been supposed that the colouring matter of the corpus mucosum must in like manner be of an oily nature; but this seems to be mere conjecture.(*p*) It seems agreed that there are no blood vessels in the hairs, excepting in the bulb, nor have they any sensation.(*q*) But others observe, that particular large hairs, at least in animals, are supposed to have at their origin a plentiful supply of *nerves*, which makes them useful in feeling, as in the whiskers of a cat.(*r*) Indeed the pain produced in drawing a hair from its root sufficiently evinces its origin to be in a sensible part.(*r*)

The growth of hair after death is denied, and the existence of the distinct disease called plica polonica has been questioned;(*s*) but from an interesting modern account of that disease in the Cyclopedia Prac. Med. there seems to be no doubt of its existence as a distinct disease, although it is increased by the habit of the natives.(*t*) It is a common expression to pull or draw a hair out by the roots;(*u*) but it has been remarked that the proper expression should rather be *from* the roots, for the hair is in that case only separated from the bulb, which is left to grow again or produce another hair, contrary to the vulgar supposition.(*x*)

The circumstance of the hair changing to gray is attributable in general to defective nourishment and suppressed secretion, and depends not only on the absorption or removal of colour from the hair itself, but also in the cessation of that influence on the body of the hair, by means of which its colour is maintained.(*y*) Passions or distresses of the mind have an extraordinary influence in producing this change at an earlier than natural period. But it is denied that the change of colour is attributable to the production of an acid; though it is admitted that there is much obscurity in that subject.(*z*) The early occurrence of grayheadedness is not, it is said, to be regarded as evidence of the absence of general strength, but merely as a peculiarity of the part connected with the production of colour, and nothing more.(*a*) The use of the hair has been questioned,(*b*) although as regards the head it certainly constitutes a small degree of protection. At all events, it is highly ornamental, and on that account a jury awarded 50*l*. damages against overseers for compelling a female pauper to have her hair cut off.(*c*) From the article referred to,(*d*) the necessity for cleanliness in the hair, in regard to health, will appear, and in many maladies it may become essential to adopt a particular regimen as respects the hair. It has been disputed whether it is injurious to health to suffer the hair to grow to great length, but concluded that it is not. Dr. Parr, indeed, asserted, that suddenly cutting off long hair had been injurious, and attended with every appearance of plethora, while very thick hair might occasionally weaken by the undue warmth and perspiration it occasions.(*e*) In affections of the head and brain, it seems, from attention to the cases that have occurred relative

(*p*) 1 Bost. 74. See observations on negro skin, Copl. Dict. tit. Climate.

(*q*) 1 Bost. 74; 5 Good, 450.

(*r*) Conv. An. Econ. 27; but see 5 Good, 460, in notes.

(*s*) 1 Bost. 73, 74.

(*t*) Cyclop. Prac. Med. tit. Plica Polonica.

(*u*) Convers. An. Econ. 26, 27.

(*x*) Id. 29.

(*y*) Id. 30, 31; Amer. Cyclop. Prac. Med. tit. Ages.

(*z*) Convers. An. Econ. 30, 31.

(*a*) Id. 84, 85.

(*b*) 1 Bost. 74.

(*c*) *Forde* v. *Skinner*, 4 Car. & P. Rep. 239.

(*d*) Cyclop. Prac. Med. tit. Plica Polonica.

(*e*) 5 Good, 450.

to plica polonica, that relief may be afforded by due regard to this integument(*f*)

III. THE NAILS.(*g*)

The *Nails* at the end of the fingers and toes are considered as parts of the integuments, and are obviously placed there to defend the extremities from injury, and they greatly assist the fingers in the power of prehension. They were formerly erroneously supposed by some anatomists to be actually a production of the epidermis; but they are now considered to be continuations of the cuticle.(*h*) Nails belong to the scarf skin, and separate with it, and like it they have neither blood vessels nor nerves, and may be cut or bruised without pain.(*i*) They differ, however, from the cuticle in structure; for they are formed of plates of longitudinal fibres. closely compacted, and begin or spring from a square root, a little beyond the last joint of the fingers and toes,(*k*) and their length or growth is not at the external extremities or points, but at and from such root.(*l*) They are chiefly composed of albumen, with different proportions of jelly and mucus.(*m*) It is said, however, that the nails are of a nature similar to scarf skin, and firmly fixed to it, and that they are formed from the skin, and lodged in a doubling of it, and they consist of thin transparent plates.(*n*) If uncut, they would grow and curve over the ends of the fingers, until they assumed a pointed form;(*n*) and the superior Chinese let their nails grow on purpose to distinguish themselves from mechanics, who of necessity are obliged to cut their nails to enable them to work. In the natural state the nails are without sensation, and they possess no visible blood vessels, but, under certain circumstances, they are subject to a species of inflammation, and then become acutely sensitive. The painful sensation in this case appears to proceed, not from any nerves that are distributed to the organs themselves, but from the increased bulk of the part as produced by the state of inflammation pressing upon and irritating some contiguous nerves.(*o*)

(*f*) 5 Good, 452 to 454; Cyclop. Prac. Med. tit. Plica Polonica.

(*g*) See, in general, 3 Bell, 209, 210; 3 Bost. 71; 1 Horner, Anat. 366 to 369; 1 Dungl. Phy. 78; Convers. An. Econ. 34.

(*h*) Id. ib.

(*i*) Dr. Combe's Phys. 25.

(*k*) 3 Bell, 210; 1 Horner, Anat. 367.

(*l*) Ibid.

(*m*) 1 Bost. 71.

(*n*) Conv. An. Econ. 34.

(*o*) 1 Bost. 74.

CHAP. XII. Of the different Ages, &c.

CHAPTER XII.

OF THE DIFFERENT AGES IMPORTANT IN FACT AND LAW.

The different ages of mankind are important as well in physic as in law. It is one of the most important considerations of physicians and surgeons, at least with reference to some defects, diseases, and injuries, to ascertain the *Age* of the patient before administering medicine or performing operations.(*a*) In the two recent publications of Dr. Copland and the Cyclopedia of Practical Medicine,(*b*) some very valuable observations will be found on the interesting subject of age, not only in describing the state of the frame, but also the incident diseases, and appropriate regimen, at each stage of life. It will be observed, that the division of time by the number *seven*, has in many respects been marked as well in nature as by custom and law. Dr. Copland, in his excellent work, has observed that the ancients believed that very important changes actually took place in the economy of man at certain periods, the first being the seventh year, and the subsequent epochs answering to the same number, or to numbers resulting from the multiplication of three, seven, and nine into each other, as the twenty-first, the forty-ninth, the sixty-third, and the eighty-first years; the two last being called *grand climacterics*, as the life of man was supposed to have reached its allotted term.(*c*) But it is now considered, that the renovation and formation of new parts in lieu of old, is *constantly* taking place rather than any particular change at the end of each seven years, as formerly supposed;(*d*) but still, an examination of the ancient doctrine will account for many of the present divisions of time, as well in fact as in law. It will be observed, that the fœtus, if born at or after the age of *seven months* from the time of conception, may be sufficiently established in its functions to live; at the age of *seven* months after birth, first dentition appears; at the end of *seven years*, second dentition takes place, and at that age the law supposes the possibility for mental faculties to be established in a certain degree, whilst under that age there is a total legal incapacity to commit crime. At twice seven or fourteen, male puberty and various corporeal and mental abilities are supposed to exist; and at three times seven or twenty-one, perfect mental capacity is considered established. Solon divided life into ten septenaries: in the first was dentition or falling of the first teeth; in the second, pubescence or puberty in males;(*e*) and Brown observes, that women are menstruent, and men pubescent, at the age of twice seven, is accounted a punctual truth.(*e*) So a practice of one of the superior courts for seven years may even govern the construction of a statute;(*f*) and after the lapse of seven years since a person has been heard of, a

(*a*) Copl. Dict. Prac. Med. titles Ages and Fœtus; Amer. Prac. Med. titles Ages, and as to old age, Dr. Rush's account of Body and Mind, vol. i.; El. Blum. 521 to 529; Thompson, 118; as to variation in *pulsation* at different ages, see ante, 135.

(*b*) Copl. Dict. Prac. Med. tit. Ages; and Amer. Cyclop. Prac. Med. tit. Ages.

(*c*) Copl. Dict. Prac. Mid. tit. Climacteric Decay, Black's Student's Manual, tit. Climacteric.

(*d*) Amer. Cyclop. Prac. Med. tit. Ages.

(*e*) Johnson's Dict. tit. Pubescence; Brown's Vulgar Errors; and Black's Student's Manual, tit. Climactcric.

(*f*) Tidd's Prac. Introd.; and *Tyson* v. *Thomas*, M'Clel. & Young's Exch. Rep. 127.

presumption of his death may be properly admitted;(g) (though there is no presumption in *law* in such case as to the exact time when the death happened, and as to which a jury must form their own opinion upon the particular facts;(g) and even bigamy may be excusable:(h) again, apprenticeships were required to be for seven years;(i) though Dr. Adam Smith observes, that so long a term is unnecessary as regards instruction in a trade;(i) and leases are usually for seven, fourteen, or twenty-one years, or for the latter, determinable at the end of the first seven or fourteen; so the punishment of transportation is usually for seven or fourteen years; and at thrice seven, or the age of twenty-one, in most countries, and by our law, males as well as females are completely competent to manage their property: and five times seven or thirty-five has generally been considered the preferable age for the marriage of males; nine times seven is the grand climacteric; and ten times seven or seventy, is the supposed limit of life.

Medical authorities arrange the subject of *Age* under six principal periods, as Infancy, Childhood, Boyhood, Adolescence, Adult Age, and Declining or Old Age, with subdivisions, as, 1st, that of *Infancy*, which is again divided into the period between birth and the commencement of the first dentition; 2dly, that of *childhood*, extending from the completion of the first to the completion of the second dentition; 3dly, that of *boyhood* or *girlhood*, from the seventh or eighth year to the commencement of puberty; 4thly, that of *adolescence*, commencing with the first appearance of puberty, and extending to adult age; 5thly, *adult* age, which again is divided into the two epochs, first of early adult age, from twenty to thirty in females, and from twenty-four to thirty-five in males, and secondly, mature age or confirmed virility, estimated at from thirty to forty or forty-two in females, and from thirty-four to forty-eight in males; 6thly, *declining and old age*, and which are divided into four epochs, as declining age, green old age, advanced old age, or ripe old age, and decrepitude or second infancy, and each of which periods has its incidents, defects, and diseases, and requires particular medical and moral treatment.(k) We will attempt to give a graduated scale of ages, more especially as they are important in connexion with *legal* subjects, and these may be arranged under two heads; first, *before* birth, and secondly, *after* birth and during life, and shortly after death.

I.—OF THE FŒTUS FROM THE TIME OF CONCEPTION UNTIL BIRTH.

1. Where there has been only a single coitus, conception is dated from that event; but in general the nine calendar months or thirty-nine weeks and one day, being the usual time of gestation, are calculated from a fortnight after the cessation of the last catamenia.(l)

2. The fœtus is technically termed an ovum or embryo till the end of the third month; afterwards, till the end of the sixth month, it is termed a *fœtus*. If expelled before the end of the sixth week, the event is medi-

(g) *Doe* v. *Nepean*, 5 Bar. & Adol. 86; 2 Nev. & Mann. 219, *S. C.*; 2 Stark. Ev. 261.

(h) 2 Stark. Evid. 261; 1 Jac. 1, c. 11, sect. 2.

(i) 5 Eliz. c. 4, altered by 54 Geo. 3, c. 96; see Smith's Wealth of Nations.

(k) Copl. Dict. Prac. Med. tit. Ages, tit. Climacteric Decay; Amer. Cyclop. Prac. Med. tit. Ages. As regards the last period of declining age, there is an excellent article by Dr. Roget, tracing the effects on all parts of the frame, and the intellectual faculties, Cyclop. Prac. Med. tit. Age. The well known seven ages of Shakspeare, and Mrs. Thrale's beautiful illustration of the attachment to life in old age, in her three warnings, need only be alluded to.

(l) Ante, 409; Blundell's Lect. Mid. 256; but in Denman's Prac. Mid. 174, it is stated to be *forty weeks* or ten lunar months. See Dewees, Midwif. 124 to 143.

cally termed a *miscarriage;* but if expelled or delivered between the sixth week and the end of the sixth month, it is medically termed an *abortion,* not the premature birth of a child.(*m*) If delivered after that time, and much before the expiration of the nine calendar months, it is a *premature child;*(*m*) but the statute 9 Geo. 4, c. 31, uses no other terms than *miscarriage* of a child, and concealment of the birth of a child, whatever may be the age of the fœtus, and whether or not it be quick. The term miscarriage importing the not carrying the child in the womb until the expiration of the proper time, is obviously most comprehensive.

3. *Quickening* takes place between the sixteenth and the twentieth week, and most commonly about the sixteenth week: *before* that event, an attempt, "by administering to the mother poison or other noxious thing, or using any instrument or other means, with intent to procure the *miscarriage,*" is only a misdemeanor, transportable for not more than fourteen years, or three years' imprisonment, &c. by 9 Geo. 4, c. 31, s. 13.(*n*)

4. *But after quickening,* such attempt is punishable capitally by 9 Geo. 4, c. 31, s. 13. After quickening, found by a jury of matrons, upon a plea of pregnancy, the execution of the condemned mother is to be suspended until after delivery; and even if the jury should find the woman not quick, a judge will sometimes suspend the execution.(*o*) This distinction in the English law respecting the higher punishment, depending on the discovery whether or not the child had *quickened* at the time the means to destroy it were adopted, has been condemned by all foreign jurists, and by the medical authorities of our own country.(*p*)

5. If the delivery be between six months and a half, and before the end of the ninth calendar month, it is medically termed *premature birth,* not miscarriage. The child may possibly live, though born before the seventh month, but the probabilities are against its attaining maturity.

6. If at the time of the delivery the fœtus appear not to have lived to the full age of *seven months* in the womb, the mother, it is said, ought not to be convicted of *concealing the birth of a child,* under 9 Geo. 4, c. 31. (*q*)

7. Nine calendar months, or thirty-nine weeks and one day, is the usual time of gestation, and in general to be calculated from the fourteenth day after the last catamenia.(*r*)

8. Ten lunar months, with a few days beyond, is the utmost extended limit for legitimate birth. Dr. Hunter, however, stated that he knew a woman who had been delivered of a child fourteen days later than the nine calendar months, and stated his belief of two more having been delivered above ten calendar months from the hour of conception.(*s*) In case of a posthumous son, the demise may be laid on the day of his father's death, though before his birth, as his title relates back to that event.(*t*)

II.—Birth and afterwards.

9. *Birth* is established not merely by proof of breathing, but also of at least one circulation of the blood through the *lungs,* as well as the larger circulation, thereby showing that respiration, circulation, and the brain or *nervous function,* are adequate to sustain an independent existence, at least for a time; crying violently or frequently is evidence of birth, be-

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(*m*) Ante, 404.
(*n*) Ante, 404, 406.
(*o*) Ante, 406.
(*p*) See authorities Par. & Fonb. 239; 3 id. 9; Beck's Med. Juris.; ante, 402.
(*q*) Carr. Crim. Law; Ap. xxx; G. Smith, 337, 339; ante, 403.
(*r*) Ante, 409, 437; 2 Stark. Ev. 138, n. (*p*.)
(*s*) Ante, 409, 410; Co. Lit. 123 b; 2 Stark. Ev. 136 to 138, n. (*p;*) and see post, second part.
(*t*) Bul. N. P. 105; 5 Stark. Ev. 138.

cause it establishes the existence of all the three functions, but it is not the only evidence.(*u*)

10. If the delivery and birth be occasioned by the Cæsarian operation, the child will inherit to the mother; but the father cannot be tenant by courtesy unless the child be born in the life-time of the mother.(*x*)

11. If the child be *born alive*, so as to have established a separate existence, and instantly afterwards die, the father may be tenant by courtesy; and subsequent killing is murder; and even an injury previous to delivery, causing the death subsequently to such delivery, may be murder or manslaughter.(*y*)

12. In case of superfœtation or twins, primogeniture depends on actual proof which of the two children was in fact first delivered, and not on any fixed rule in our law.(*z*)

13. At seven or eight months old, first *dentition* begins, and the child may be weaned.(*a*)

14. At twelve months, the child begins to stand and rest erect on its legs.(*b*)

15. From birth until the end of the seventh year, *mental capacity* is gradually developed, and most of the ordinary ideas, gestures, expressions, and tones of voice are acquired by imitation during that time, and by repetition have become so deeply impressed as not to be readily afterwards effaced, and, therefore, it is important that the child should be placed in such society only as will afford the best examples. Dr. Barlow has observed, that even at the earliest age of infancy the moral laws are not to be disregarded; and those laws pronounce that moral feelings, no less than the physical powers, acquire force by exercise, and that the surest way of weakening those which, when tending to excess, (as in the case of an irritable temper in a child) tend to evil, is to consign them as much as possible to quiescence. Great care is, therefore, necessary not to arouse angry passions in infancy, nor before the other moral feelings, and the intellectual powers by which they are in later years controllable, have become perfectly, or so strongly developed, as to be available in counteracting the influence of passion or bad temper. This principle is applicable to every period of life, and the interesting stage now under discussion should have the full benefit of it.(*c*) *Under seven years* an infant is in law considered incapable of committing *any crime*;(*d*) from that age till fourteen, criminal responsibility (except as to rape or sexual crime) depends on actual mental capacity, though the presumption is still in favour of the infant. As regards *evidence*, an infant under seven may be a *witness*, if he be sensible of the obligation of an oath, but he ought to be examined as to his competency before he goes before a grand jury.(*e*) and if he be not competent the trial may be postponed;(*f*) but neither the testimony of a child without oath, nor evidence of any statement which he has made to any other person, is admissible.(*g*) The ancient rule was, that an infant under seven could not be examined as a witness under any circumstances;(*h*) but it has been observed that such rude and inartificial rule of measuring capacity by years was overruled in the case of *Brazier*, where it was unanimously held by all the judges, that a child of *any age*, if capable of distinguishing between good and evil, might be

(*u*) Ante, 414 to 416; Dyer, 25; 1 Coke's Rep. 34; 2 Bla. Com. 127, 128.
(*x*) Co. Lit. 29; 2 Bla. Com. 127, 128.
(*y*) Ante, 415, 420.
(*z*) See cases cited *Doe* v. *Nepean*, 5 B. & Adol. 91.
(*a*) El. Blum. 523; see Dewees, Children, 187.
(*b*) Id.
(*c*) Dr. Barlow on Physical Education; Amer. Cyclop. Pr. Med. tit. Ages.
(*d*) 4 Bla. Com. 23.
(*e*) 1 Stark. Ev. 93, 94.
(*f*) Id.
(*g*) Id.; *Brazier's case*, Leach, Cr. C. 237; *Rex* v. *Tucker*, Phil. on Evid. 19.
(*h*) Stra. 700; Hale, P. C. 634, 635.

CHAP. XII. Of the different Ages, &c.

examined upon oath.(*i*) The law also makes another distinction as to the age, viz. that if in a prosecution for a rape, or rather carnal knowledge, if the prosecutrix be an infant of *tender years*, the *whole* of her account recently given seems to be admissible, because it is of the highest importance to ascertain the accuracy of her recollection.(*k*) But upon an indictment for an attempt to commit a rape upon an *adult*, the *particulars* of the complaint made by the prosecutrix recently after the injury are not admissible in evidence.(*l*)

16. At seven commences *pueritia*, or *boyhood* or *girlhood*, and also termed puerility, and continues till the age of twelve in females and fourteen in males; second dentition, or shedding of the temporary or milk teeth, usually commences at the age of seven.(*m*)

17. Under eight and above sixteen no infant is to be apprenticed to a chimney-sweeper, and if he be, no settlement is conferred.(*n*)

18. Before the age of nine no infant is to be bound as a parish apprentice;(*o*) and the 3 & 4 Will. 4, c. 103, for the regulation of factories, prohibits the employment of children under nine years, except in mills for the manufacture of silk.

19. The carnal knowledge of a female infant under the age of ten years is a capital offence;(*p*) and this although the hymen be not broken, and although emission be negatived.(*q*)

20. The maliciously, either by force or fraud, leading or taking away, or decoying or enticing away, or detaining any child under *ten* years, with intent to deprive the parent or parents, or any other person having the lawful care or charge of such child, or with intent to steal any article upon or about the person of such child, and the receiving or harbouring such child, is transportation for seven years, or imprisonment with hard labour, with an exception in favour of the father of an illegitimate child.(*r*) This enactment has been objected to as limiting the crime to the subtraction of a child so young as under ten years of age.

21. Carnal knowledge of a female between ten and twelve, even with her consent, is a misdemeanor, punishable with imprisonment and hard labour.(*s*)

22. At the age of twelve a female has, in legal consideration, attained puberty, and is consequently considered by law competent to marry;(*t*) but properly even later than the age of fourteen should have been fixed by law instead of twelve.

23. Males at *twelve* years old may take the oath of allegiance.(*u*)

24. Under the age of *thirteen* certain hours of work are prescribed in factories and mills, namely, not on an average more than eight hours per day, (excepting in manufactories of silk, in which ten hours are allowed.)

(*i*) *Brazier's case*, Leach, Cr. C. 237; *Rex* v. *Powell*, id. 128; 1 East, P. C. 443; 2 Stark. Ev. tit. Rape, 699. But such reasoning would tend to establish that an infant under seven might also be guilty of *crime*.

(*k*) *Brazier's case*, East, P. C. 443; 2 Stark. Ev. tit. Rape, 700.

(*l*) Per Holroyd, J., in *Rex* v. *Clarke*, 2 Stark. Rep. 241; 2 Stark. Evid. tit. Rape, 700, but who adds *sed quære*.

(*m*) El. Blum. 524. The twenty milk teeth drop out, and second dentition of thirty-two permanent teeth begin, and then is the time for due attention to their removal, &c. This continues till about twelve in girls, and fourteen in boys, when the age of *puberty* or *adolescence* commences, and when (besides the other important circumstances presently noticed) the adult teeth are usually perfected, 1 Par. & Fon. 184, 185; Bell on Teeth; Dewees, Children, 200, 203.

(*n*) 28 Geo. 3, c. 48, s. 4; 8 B. & Cres. 466.

(*o*) 56 Geo. 3, c. 139, s. 7.

(*p*) 9 Geo. 4, c. 31, s. 17, 18.

(*q*) *Rex* v. *Russen*, 1 East, P. C. 438; 4 Car. & P. 249; *Rex* v. *Cox*, 1 Mood. Cr. C. 337; *Rex* v. *Reekspeare*, id. 342, overruling *Rex* v. *Russell*, 2 Mood. & M. Cases N. P. 112, coram Taunton, J.

(*r*) 9 Geo. 4, c. 31, s. 21.

(*s*) Id. s. 17, 18.

(*t*) 1 Bla. C. 436; Russ. & R. Cr. C. 48.

(*u*) 1 Bla. Com. 463.

Between the age of thirteen and eighteen not more than twelve hours work per day are allowed.(*x*)

25. Under the age of *fourteen* both sexes are *presumed* not to have been guilty of *any* crime, but proof of sufficient knowledge between good and evil makes them liable for offences; so that, unless great weakness of intellect appear, they are liable to criminal punishment for crimes of commission after the age of seven, but in no case for a rape or sexual crime under fourteen.(*y*)

26. *Female* puberty is menstruation and when the breasts become more fully developed, and though *in law* supposed to occur at the age of twelve, and which is sometimes the case, (*ut supra*,) it most usually is not, in fact, till about or after fourteen.(*z*)

27. *Adolescence*, or puberty, is in law supposed to exist at the age of twelve in females, and at fourteen in males, and at this time the teeth of second dentition are supposed to be complete.(*a*)

28. Males after fourteen are competent to marry with consent, or by banns not prohibited;(*b*) but before the age of twenty-one consent of parents is essential, or is implied to have been given by publication of banns not prohibited. A marriage by license cannot be obtained without affidavit of the full age of twenty-one having been attained by both the parties;(*c*) but if the affidavit be false in that respect, the marriage will nevertheless be valid.(*d*)

29. A male or female, after attaining the age of fourteen, may appoint his or her own guardian; and may make a will of personalty, although not of realty until the age of twenty-one has been attained.(*e*)

30. Both sexes, between the ages of fourteen and twenty-one, are liable to be punished for crimes and offences of *commission*, but not for crimes or offences of *omission*, excepting indictments for not repairing a *highway* or bridge where the liability was *ratione tenuræ*.(*f*) They are not liable to be *sued* on contracts, excepting for necessaries. But an apprentice is compellable to serve until twenty-one. Between the age of fourteen and twenty-one is considered the most important time for parents and preceptors to observe the moral, religious, and intellectual attainments of youth.(*g*)

31. The abduction of a female, under the age of sixteen, without the consent of parents, is a misdemeanor, punishable with imprisonment.(*h*)

32. After the age of *seventeen*, a male or female might formerly have acted as executor, though not as administrator; but now he cannot *act* as executor before he has attained twenty-one,(*i*) though if an infant even under seventeen be named executor jointly with an adult, he must in an action be joined as a co-plaintiff.(*k*)

33. Under the age of *eighteen*, no person is to work at night, nor more than twelve hours a-day;(*l*) and it should seem that as the full strength, health and constitution, are not settled till about the age of twenty-three, even so many hours' labour should not be allowed until after that age.(*m*) Eighteen is the earliest age for service in the army; and it has been

(*x*) 3 & 4 Will. 4, c. 103, ss. 1, 2, 8; 4 Wm. 4, c. 1. Twelve hours are much too long, post, 461.

(*y*) Ante, 382, 383, 440, 441; 2 Stark. Evid. tit. Infant, 407.

(*z*) El. Blum. 524.

(*a*) 1 Par. & Fonb. 184, 185.

(*b*) 1 Bla. Com. 436; Russ. & Ry. C. C. 48.

(*c*) 1 Bla. C. 437, 438; 2 Phil. 222, 440.

(*d*) *Rex* v. *Jacobs and others*, Chitty's Col. Stat. tit. Marriage, 727, n. (*a*.)

(*e*) 1 Bla. Com. 463.

(*f*) 4 Bla. C. 22, 23; 2 Stark. Ev. tit. Infant, 407; 1 Hale, P. C. 20 to 22.

(*g*) Amer. Cyclop. Med. tit. Ages.

(*h*) 9 Geo. 4. c. 31, s. 20.

(*i*) 1 Bla. Com. 463.

(*k*) See cases, 1 Saund. Rep. by Patteson and Williams, 291, i.

(*l*) 3 & 4 Wm. 4, c. 103, s. 1, 2.

(*m*) Dr. Combe's Physiology, Health, 315 to 317; and see Cyclop. Prac. Med. tit. Education, Physical.

CHAP. XII. OF THE DIFFERENT AGES, &c.

clearly shown that that age is too early by five years, and productive of many deaths, and always injurious to the individuals and occasioning useless loss and expense to the state.(*l*) Until the age of *twenty-three*, growth continues, and *strength* is not completely established. The same principle should be applied to marriage and to *all* laborious employments.(*l*)

34. Males and females, after attaining the age of *twenty-one*, are *sui juris*, and may perform every act,(*m*) unless where property has been expressly given, not to be enjoyed until a subsequent age. They may marry without consent of parents, by license on affidavit of both the parties being of age.(*n*) If apprenticed when under twenty-one, he may, in general, avoid the same on attaining that age, after a reasonable notice;(*o*) and under a Marine Mutiny Act, 4 Wm. 4, c. 4, s. 40, &c. an apprentice cannot be claimed by the master after that age. After the age of twenty-one, and until that of *sixty*, males are liable to serve as jurors.(*p*) After the age of twenty-one, no one can be deemed a poor *child* within meaning of stat. 56 Geo. 3, c. 139.(*q*)

35. A person is completely of age after the first instant of *the day before* the twenty-first anniversary of birth day, though forty seven hours and fifty-nine minutes short of the complete number of days, counting by hours;(*r*) and this mode of calculating age and time is applicable to all the other ages before or after twenty-one.

36. Forcible abduction of any woman, possessed of certain property, with intent to defile, marry, &c., is a misdemeanor, and transportation for at least seven years, or imprisonment for four years.(*o*)

37. *Twenty-three years* is the earliest age when men should serve in the army, or be employed in any very laborious occupation, because until that time growth and advancement in strength of body are in progress, and not fully established.(*t*)

38. No person is to be admitted a Deacon before he shall have attained the age of twenty-three years complete; and no person shall be admitted a Priest before he has attained twenty-four complete.(*u*) But the power of granting a faculty or dispensation, as regards deacons of earlier age, is saved by the statute.(*x*)

39. Thirty-five was considered by the Romans, Athenians, &c., as the best age for men to marry.(*y*)

40. About the age of forty-five sexual desires are supposed to have become more capable of control, and, therefore, if a man, having attained near that age, marry a woman of fifty, he cannot, perhaps, complain of her impotency.(*z*)

41. After forty-five, or at all events after fifty, usually women cease to menstruate or bear children; but in England may afterwards legally marry, upon full disclosure of age, though marriage might perhaps be void, if she were incompetent.(*a*)

42. After the age of sixty, men are not bound to serve on juries, &c.(*b*)

(*l*) Dr. Combe's Physiology, Health, 315 to 317.

(*m*) 1 Bla. Com. 463.

(*n*) 4 Geo. 4, c. 76, s. 10.

(*o*) See cases, Burn, J. tit. Apprentice, VIII. (2;) when not, id. ibid.; and *Rex* v. *Bedwardine*, 5 B. & Adol. 175.

(*p*) 6 Geo. 4, c. 50, s. 1.

(*q*) *Rex* v. *Bedwardine*, 5 B. & Adol. 169.

(*r*) 1 Bla. Com. 463; *Herbert* v. *Torball*, 1 Sid. 162; 1 Keb. 589; Raym. 84, *S. C.* 1 Salk. 44; Chit. Gen. Prac. vol. i. 766.

(*s*) 9 Geo. 4, c. 31, s. 19.

(*t*) Dr. Combe's Principles of Physiology, Health, 315 to 317; ante, 441.

(*u*) 44 Geo. 3, c. 43; *Roberts* v. *Pain*, 3 Mod. 67.

(*x*) See Burn's Ec. L. tit. Ordination.

(*y*) Ante, 424; 1 Paris & Fonb. 172, note (*c*.)

(*z*) Per Sir Wm. Scott, in *Briggs* v. *Morgan*, 3 Phil. Ec. Rep. 231, 232, *quære*, ante, 378.

(*a*) *Brown and Brown*, 1 Hagg. Rep.; but see *Briggs* v. *Morgan*, 3 Phil. Ec. R. 331, 332.

(*b*) 6 Geo. 4, c. 50, s. 1.

43. The age of sixty-three is the first *grand climacteric*, and is supposed to be a critical age, and has been ably described by Sir Henry Halford, with its incident *climacteric disease*, which occurs between the ages of fifty and seventy-five, but more frequently about sixty-three.(*c*) At this age sometimes, as in Westminster, men are expressly exempted from serving as constables.(*d*)

44. After sixty-five men *usually* cease to procreate, but there are some exceptions.(*e*)

45. *Seventy years* are the scriptural limit of life, though there are, especially of late, many exceptions, and it is supposed that the average of old age has of late increased, though on an average only one in 15,000 reaches 100 years; nor is the age of eighty-one (the *second* grand climacteric) often attained.(*f*)

46. The survivorship of two or more is to be proved by facts, and not by any settled legal rule of law or prescribed presumption.(*g*)

47. In case of the death of an ancestor, who was tenant in fee, before midnight of the day when rent becomes due, the heir and not the executor is entitled to the rent.(*h*) But if a tenant for life die on the rent day, his executor is entitled to the whole rent, as well at common law as by the express terms of the statute, 11 Geo. 2, c. 17, s. 15.(*i*) If he die before the rent day, then by the terms of that act there is to be an appointment of the rent between the executors and the remainderman, unless there has been a lease pursuant to a leasing power, in which latter case the remainder will be entitled to all the rent growing due.

48. An heir may lay the demise in ejectment on the day of the death of his ancestor.(*k*)

49. There is a legal presumption of death after a person has not been heard of for seven years;(*l*) but the time of the death, when material, must be proved by express evidence, depending upon the particular circumstances of the case.(*m*)

50. Within fourteen days after death in general, decomposition has so advanced that identity cannot be discovered, excepting by some strongly developed peculiarity;(*n*) but in a drowned body adipocire is not produced until five or six weeks after the death, a fact exceedingly important to be kept in view in some judicial inquiries relative to the time of death.(*o*)

(*c*) Med. Trans. College of Physicians, vol. iv. 316; and see Amer. Cyclop. Prac. Med. tit. Ages; and Copl. Dict. tit. Climacteric Decay; 1 Paris & Fonb. 182.

(*d*) 31 Geo. 2, c. 17, s. 13; Burn, J., Constable.

(*e*) Ante, 385.

(*f*) 3 Bost. 272, note; Dr. Combe's Principles Phy.

(*g*) *Doe* v. *Nepean*, 5 B. & Adol. 91, 92; G. Rmith, 510, and infra, n. (*m*,) 2 Stark. Evid. 261.

(*h*) *Duppa* v. *Mayo*, 1 Saund. Rep. 287, 288 c. note 17.

(*i*) 11 Geo. 2, c. 19, s. 15; 1 Saund. Rep. 288 c. note 47, and note (*z*;) *Norris* v. *Harrison*, 2 Madd. 268.

(*k*) 3 Wils. 274.

(*l*) *Doe* v. *Nepean*, 5 B. & Adol. 86; 2 Starkie's Evid. 261, 688.

(*m*) *Watson* v. *King*, 1 Stark. Rep. 121; 2 Stark. Evid. 261.

(*n*) G. Smith, 505.

(*o*) See cases cited by Dr. Male in his Elements of Juridical or Forensic Medicine, 2d ed. 101; and 3 Paris & Fonb. 23 to 25.

CHAPTER XIII.

OF THE ESSENTIALS FOR THE CONTINUANCE OF HEALTH AND HAPPINESS, AND HOW SECURED BY LAW.

The circumstances essential to the continuance of *Health* and *Happiness* are properly subjects of this part of the work relating to the functions of the human frame, whilst in a *healthy* state, and these have ever received the anxious attention of the common law and legislature. It might naturally be expected that every individual would of his own accord observe the precautions essential to secure the two great desiderata of health and happiness; but experience has established that very many individuals will not, unless *compelled*, observe these measures, however obviously conducive to their own welfare; and there are many sordid individuals, who, unless prohibited, would sacrifice the lives of thousands in manufactories and mines, by exposing them to injurious atmosphere and excessive labour. Hence we find it continually necessary to introduce new enactments, not merely for securing temperance, but for compelling cleanliness and the prevention of contagious disorders, &c. A concise examination of all matters connected with these important subjects is essential, because it is now well established that "*health is more frequently undermined by the gradual operation of constant, though unobserved injurious causes, than by any great and marked exposures of an incidental kind*," and is more effectually to be preserved by a judicious and steady observance of the organic laws in *daily* life, than by exclusive attention to any particular function, to the neglect of all the rest, and that cæteris paribus, the highest health and greatest vigour will always be on the side of those who make the nearest approach to the fulfilment of such *organic laws*.(a)

Although it was an ancient maxim, "*sanis omnia sana*," that is, "to the healthy all things are healthy," yet experience has established that, to conduce to the *continuance of perfect health and happiness*, not only temperance but several other circumstances are essential: as, *first*, an appropriate atmosphere: *secondly*, cleanliness in such atmosphere and in residence and person: *thirdly*, appropriate dress: *fourthly*, appropriate diet, as well food as drink and regimen respecting the same: *fifthly*, due digestion: *sixthly*, due education: *seventhly*, labour of body and mind: *eighthly*, exercise of body and mind and recreation: *ninthly*, due rest and sleep: *tenthly*, healthy habits: *eleventhly*, moral conduct, reflection, quiescence and pleasure of mind. It is agreed that all these tend to longevity and calm composure, especially in the eve of life. Volumes have been written on these important subjects,(b) but scarcely regarded until too

(a) Dr. Andrew Combe's Principles, &c. 311, 313.

(b) See Dr. Johnson on Indigestion; Dr. Combe's Principles of Physiology ap-late, and when by excess or want of care the body and mind have become so enfeebled as to be incapable of medical relief. Man in general seeks only *present enjoyment*, and cannot relish *didactic* or *moral improvement:* he is culpably regardless of his own true interests or even those of his children. In infancy and youth we observe and imitate the habits of others, without inquiring whether they be wholesome or injurious, and hence many of the disorders which we experience are attributable to the want of due care rather than to excess.(*c*) As regards legislation on these subjects, it has been a general sound maxim not to interfere with individuals in their care of themselves, but merely to guard them against injuries from *third* persons, and with the latter view the statutes relative to apprentices and factory children were passed; but it will be found that in many other instances it has been necessary for the legislature to enact laws compulsory on individuals to take care of their own health, lest that of others should be injured, as may be observed in all the modern regulations for the prevention of cholera,(*d*) and there are many more instances in which it would be better for society if the legislature would still further interfere. It is proposed in the following pages to arrange the physical and legal view of the subjects under the beforementioned heads.

First, Atmosphere and air, heat and cold, dry and damp air,(*e*) and of nuisances to the air.

When examining the principal functions of life, namely, respiration and its organs, especially the lungs, we necessarily took a concise view of the temperature of man,(*f*) and the nature and composition of atmospheric air, and how powerfully it influences as well in renovating the blood passing through the lungs,(*g*) and thence into the brain and throughout the body, as in maintaining the temperature of the blood of man almost uniformly at 96 to 98°, according to Fahrenheit's thermometer, although the medium temperature of the atmosphere may be only about 50°, or in England 52°, or may be much higher or much lower in other countries and on hills or in valleys. The influence of atmosphere upon health is regarded by physicians as of primary importance. It explains, among many other facts, the connexion of temperature with the rise of fevers and other pestilences, the powerful remedial efficacy of hot and cold bathing, changes of climate, and still more of regulating the temperature of air breathed by invalids, the protection by clothing and the ventilation of houses, &c.(*h*) Perhaps the most striking instance of the extraordinary consequences of atmosphere or climate is that of *Cretinism*, where merely as a consequence of dwelling during infancy and childhood in deep, narrow, moist, and malarious valleys of the lower Alps, and in Switzerland and of the Pyrenees, where the air is stagnant and the solar beams are intercepted by the mountains, the whole frame is stunted, deformed, and degenerated,(*i*) whilst the same race of men, inhabiting the adjacent mountains, are perfect and healthy. But besides this more striking consequence, there are even others more extensive, though more gradual consequences of bad air in numerous districts of

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plied to Health and Education, &c.; Sir John Sinclair, &c.

(*c*) See Dr. Combe's Principles of Physiology, 311, 312, which with Dr. Johnson on Digestion, and Cyclop. Prac. Med. tit. Dietetics, and tit. Education, Physical, should be read by all heads of families.

(*d*) See 2 Wm. 4, c. 10, 11, 27.

(*e*) See, in general, Dr. Johnson on Indigestion; Dr. Combe's Principles, &c.; Copl. Dict. Prac. Med. tit. Climate, tit. Diseases, tit. Arts and Employments; Cyclop. Prac. Med. tit. Air, tit. Artisans; Amer. Cyclop. Prac. Med. tit. Acclimatement.

(*f*) Ante, 113.

(*g*) Ante, 109; G. Smith, 33, 34.

(*h*) 2 Arnott's El. Ph. 93; Dr. Johnson in his treatise on Indigestion, p. 56, evinces the causes of the difference in health in those residing in a pure country air and those residing in a crowded metropolis.

(*i*) See Copl. Dict. Prac. Med. tit. Cretinism, and 2 Gibson, Surg. 254, and authorities referred to, id. 260.

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our own climate, and it is the duty of every individual and of legislators to provide against such consequences.

The natural unconfined atmosphere.

As regards *unconfined natural atmosphere*, it is of various descriptions, much depending on local situation, as whether it be mountainous or hilly, or low or marshy, or dry and exposed. The most generally healthy atmosphere is that which is moderately cold and dry, and commonly called bracing; the next in degree of health is dry, but not so much exposed; the third is moist or damp air, but still warm, open and freely circulated, and preferable for invalids, especially in pulmonary complaints. The most prejudicial air is that which is not only humid, but also cold, close, and vulgarly termed muggy.(*k*) A warm and humid atmosphere dissolves and accumulates the specific causes of disease, such as animal and vegetable effluvia; assists their operation, and favours a rapid transfer of electricity from the earth's surface, and the change in the condition and the accumulation from it in the air resulting therefrom.(*l*) The latter air is injurious, not only in passing through the lungs, but also as being absorbed through the pores, and rendering it advisable to protect from such absorption by an entire covering of warm woollen dress.(*m*) It is principally from residence in districts, where the damp but cold or muggy air is found, that fevers and other illness prevails; and in such districts, if the legislature cannot venture to prohibit the erection of houses for residence,(*n*) yet they might with propriety interfere to secure due drainage, width in streets and ventilation, by requiring the construction of proper sewers and cesspools, and prohibiting narrow alleys, on the same principle of preservation, that, under the building act, the thickness of certain walls in the London district is compulsory, to prevent injury by the extension of fire. It is a disgrace to such a metropolis as London, that, in some of the most marshy and unhealthy districts, almost innumerable ill-constructed houses in narrow streets and alleys have been suffered to be built with open ill-constructed drains; and hence in those districts it was established that the recent cholera and fevers were principally prevalent. It is obvious, that every prudent person, before building or hiring a house for his own residence, should consult the most intelligent persons whether the situation would be healthy, and not only as regards atmosphere, as with reference to the spring and other waters, and if persons, regardless of the health of others, should build houses for residence in populous but unhealthy districts, there is no reason why the legislature should not impose wholesome compulsory regulations as to structure, &c. With regard to jails, the legislature has humanely afforded powers to justices, when the site of a jail appears unhealthy, to build a new jail in a better situation,(*o*) and accordingly we find most of our modern jails constructed in more healthy situations than the cottage of the honest labourer.

Cold.

Long exposure to *very cold air* is more or less injurious. In general, however, with adequate clothing and food, man, at his usual temperature of 98° Fahrenheit, may retain it even in an atmosphere that would freeze

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(*k*) Copland's Prac. Med. tit. Cretinism, and tit. Disease, and tit. Climate; 1 Par. & Fonb. 105, 120, 116, 352. In Copl. Dict. tit. Climate, is a description of the best parts of the united kingdom, and particular parts for different descriptions of invalids, especially of the objection to towns where the use of coal fires is prevalent, and the salutary effect of the south coast, south-west coast, and the west of the island.

(*l*) Copl. Dict. Pract. Med tit. Disease, and tit. Asphyxy. Amer. Cyclop. Prac. Med. tit. Asphyxia.

(*m*) Dr. Combe's Principles, &c. 49; Cyclop. Prac. Med. tit. Artisan.

(*n*) There are many ancient instances of prohibitions against building in certain districts, see some collected in 1 Par. & Fonb. 348 to 350, note (*a*;) 2 Stowe's London, 436, &c.

(*o*) 4 Geo. 4, c. 64, s. 50.

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mercury;(*p*) but any degree of temperature below 52° to an Englishman is injurious, as repelling cutaneous secretion and absorption; and intense cold causes a tendency to sleep, which, if indulged during the exposure, would terminate in death.(*q*) Its effects upon animals, removed into a climate colder than that to which their skin and hair, or other covering, was adapted, may be more fatal than to man, when he has the means of adding clothing or artificial heat in proportion to the degree of cold.(*q*) We know that Bonaparte's celebrated bulletin admitted that in one night, when the thermometer of Reaumur stood at 19° below zero, 30,000 horses perished from that cause. Cold in inferior degrees and longer continued, acting on persons imperfectly protected by clothing, &c. induces a variety of diseases, which destroy more slowly, occasioning many of the winter diseases of England.(*r*) But a moderate degree of cold, as the atmosphere of England, is generally more conducive to health and mental vigour than a warmer climate.(*s*)

Heat.

Within the tropics man is subject to the continued operation of a high temperature, which excites the nervous function and vascular action, notwithstanding the provision with which nature has furnished his integuments in order to moderate the animal heat.(*t*) When death is attributed to intense heat, it is conjectured that the mode in which life is destroyed is that the heat acts by destroying the muscular energy of the heart and diaphragm.(*u*) Intense heat is as injurious to the vigour of the body as it is to the mental energies. In sleep great care is to be observed that the temperature should be moderate, not higher than 60° Fahrenheit, and an infant should sleep in a cradle, and not with its nurse, who is at least two degrees of higher temperature.(*x*)

Light and sunshine.

We constantly perceive in vegetation the injurious consequences of obstruction of light and sunshine, rendering that vegetable, which would naturally be a dark green, of a pale or straw color, and generally weak and unproductive. The exclusion of light and sunshine are not less detrimental to the health, and indeed to the growth of mankind. The vital depressions and disorders ultimately resulting from the protracted exclusion of light, are sufficient proofs of the beneficial influence of the sun's rays upon the frame.(*y*) Hence there can be no doubt that a residence in a narrow street, with lofty houses, in a northern aspect, or otherwise, rarely admitting the direct rays of the sun, would be injurious as well to the mind as the body, especially of the young.(*y*)

Nuisances to *unconfined* atmosphere.

It having been universally agreed that all putridity and corruption, and all humid states of the air, greatly increase the risk of infection,(*z*) the common law therefore so far interferes to preserve health, that it punishes criminally, or by action, all persons who *occasion* or neglect to remove from their houses or property a *nuisance* either by unwholesome vapours, or even by unpleasant stenches, although not unwholesome, affecting the unconfined air near to the houses of others, or to a public way.(*a*) Courts

(*p*) 2 Arnott's El. Phy. 118; G. Smith's For. Med. 40, 56; 2 Par. & Fon. 13, 16, 59.

(*q*) 2 Arnott, El. Phy. 119; Dr. Combe's Principles, &c.

(*r*) 2 Arnott, El. Phy. 119; Copl. Dict. tit. Climate, tit. Cold; Amer. Cyclop. Prac. Med. tit. Acclimatement.

(*s*) Copl. Dict. tit. Climate, 343, 344.

(*t*) Id. 345.

(*u*) 2 Par. & Fonb. 63.

(*x*) Cyclop. Prac. Med. tit. Education, Physical; Dewees, Children, 110.

(*y*) Copl. Dict. tit. Disease, and see Dr. Combe's Principles, &c. 69, 70; Cyclop. Prac. Med. tit. Anemia. It has, however, been decided *not* to be indictable to heighten a house so as to darken a street, 1 Ld. Raym. 737.

(*z*) 1 Par. & Fonb. 98, 105, 120, 122, 126, 332, 352; 2 Good, 62.

(*a*) 1 Par. & Fonb. 330 to 355; 2 id. 111, post, last part.

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of equity exercise a common law jurisdiction, by injunction, to prevent the erection of a public or private nuisance to the air.(*b*) And numerous ancient and modern, principally local acts, have been enacted in aid of the common law, the provisions of which will be fully considered in the concluding part of this undertaking.(*c*) The commissioners of sewers have also extensive jurisdiction as regards the cleaning of water-courses; and the statute 2 Wm. 4, c. 10, empowered the privy council to issue orders at any time to prevent the spreading of cholera in England: but still there is not in England any sufficient general *permanent* regulations, giving *summary* powers to compel the removal of nuisances, a subject well deserving the immediate interference of the legislature.

Of disinfections or prevention of the injurious consequences of bad air.

A new term of late has been introduced, with a view to give a scientific appearance to the new inventions for purifying infectious or foul air, or correcting the sources of contamination, and includes every description of ventilation, and the creation of new descriptions of air and other means of prevention, and the adoption of which may, when contagious disorders prevail, be of great utility.(*d*)

Change of air or climate, and travelling.

To those who can afford the time and expense, the mere effect of judicious *change of air*, and more especially the change of *climate*, even in cases when the general air surrounding their residence may be healthy, is of singular utility.(*e*) In general, as regards change of air, the remedy in disease is resorted to when it is too late;(*f*) and as any change is an advantage denied by pecuniary circumstances except to a few, therefore it is the more important to enforce regulations to secure the continuance of a wholesome atmosphere to the poor, and ready access to recreation, in the neighbourhood of those places where they can best gain their daily bread, without encouraging any disposition to roam. Dr. Johnson, in his Treatise on Indigestion, describes the advantages of *travelling*, and even particularizes the tours to be pursued, and best modes of enjoyment.(*g*) Great as generally is the effect of mere change of air from one place to another, and residence at the latter for a time, that of *successive* changes of air, by removing from one place to the other, is still more favourably influential; and therefore an experienced physician has recommended that mode of establishing health, as preferable to all others, showing also what is the proportion of daily exercise to be undergone in travelling.(*h*) Dr. Copland observes, that during the period of boyhood or girlhood, viz. from the seventh or eighth year to the time of puberty, about fourteen, as well as at an earlier age, frequent changes of locality and of air, especially from one healthy and open situation to another, particularly when the latter is progressively more salubrious, are peculiarly beneficial both in promoting the development of the frame, and in removing diseases, especially those of a chronic kind, or which affect the digestive and assimilating organs; but that during advanced convalescence from these and febrile diseases, the benefit derived from change of locality is most remarkable.(*i*) Some valuable suggestions respecting change of air will also be found in another work.(*k*) It has been justly observed that the English migrate as regularly as rooks, even to foreign climes, and spend their money amongst strangers, instead of benefiting

(*b*) See cases collected, Chitty's Gen. Prac. vol. i. 727 to 729.

(*c*) Post, last part.

(*d*) Cyclop. Prac. Med. tit. Disinfection, 621.

(*e*) Johnson on Indigestion; Clark on Climate; Copl. Dict. titles Climate and Disease; Cyclop. Prac. Med. titles Air and Change of Air; tit. Alteratives.

(*f*) 3 Good, 220.

(*g*) Dr. Johnson on Indigestion.

(*h*) Id.

(*i*) Copl. Prac. Dict. tit. Age.

(*k*) Cyclop. Prac. Med. tit. Air, change of.

their own country or examining our superior manufactures and natural curiosities, evincing a disorder called *Oikophobia*.(*l*)

Of confined air or atmosphere.

With respect to *air confined* in buildings, rooms, or mines, still more attention is required. Instant death may be occasioned by introducing noxious gases without adequate ventilation, as where persons have fallen asleep in a lime-kiln or in a green-house, or by not admitting an adequate supply of fresh air, as occurred in the black hole at Calcutta,(*l*) or by the explosion of foul air in mines.(*m*) Those, however, are cases of comparatively rare occurrence: but there are constant daily injuries to health from the want of due ventilation of confined air in theatres, manufactories, rooms, and other buildings, and in mines. We have seen that in all confined places, as hospitals or rooms, at least 600 cubic feet of atmospheric air should be secured in their structure for each person;(*n*) and bed chambers are in general much too small or confined for healthy continuance in them for eight or nine hours; and the temperature should not be higher in a chamber than 60 degrees of Fahrenheit's thermometer, and attention to which should be secured by constantly ascertaining and averaging the heat by a thermometer suspended in the room.(*o*) All too close rooms are injurious, as predisposing to catarrh and asthma, at least as regards those individuals who sometimes leaving them, are then exposed to a lower temperature, the danger and injury being in the sudden change.(*p*) Dr. Copland observes, that whilst the *external* atmosphere of England is cold, dry, and invigorating to the healthy frame in a state of activity, yet by the use of stoves, which overheat the air of the apartments, without renewing it so rapidly as is requisite to the wants of the economy, such air in-doors is close, warm, and depressing; and the frequent alternation from the one to the other, or the constant residence in the latter, is injurious even to those in health, and causes diseases of the thoracic and abdominal viscera;(*q*) hence the old Spanish proverb, which has been thus translated—"If cold wind reach you through a hole, go make your will, and mind your soul." Dr. Arnott has strongly observed upon the baneful results as regards the health of the English, and suggested some valuable improvements in the construction of confined rooms and modes of securing a constant supply of a healthy atmosphere.(*r*) The consequences of bad atmosphere to miners;(*s*) and to artisans in different manufactories, has been demonstrated by Dr. Copland, who observes that the hurtful influence of confinement and of insufficient ventilation, is great in proportion to the youth or early years of those who are thus circumstanced. In the majority of factories, artisans are congregated in great numbers, necessarily confined during the greater part of the day in the same apartment, which being usually warmed by artificial heat, as by pipes conducting heated air or steam, have not the air received with that rapidity which necessarily obtains in apartments provided with the fire-places in common use. The consequences are, that those confined in them breathe an impurer air than

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(*l*) Black, Student's Manual, tit. Oikophobia.

(*l*) G. Smith, For. Med. 40, 54, 218 to 222; 2 Par. & Fonb. 48 to 55; Dr. Combe's Principles, &c. 192 to 195.

(*m*) The use of Sir H. Davy's safety lamp in mines ought to be imperatively enjoined; 2 Arnott, El. Phys. 107; 2 Par. & Fonb. 99, in note; 3 Good, 146; 4 id. 414.

(*n*) Ante, 109, 111.

(*o*) Cyclop. Prac. Med. tit. Antiphlogistic Regimen.

(*p*) Cyclop. Prac. Med.; 2 Good, 142. Hence, miners, who seldom quit their mines, and butchers, who are constantly in the open air, are generally free from consumption; but as to mines, see 3 Good, 146, &c.

(*q*) Copl. Dict. tit. Climate.

(*r*) 2 Arnott, El. Phy. 113, &c.

(*s*) As to mines, see 3 Good, 146; 4 id. 414; Copl. Dict. tit. Arts and Employments.

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under ordinary circumstances, and experience the debilitating influence occasioned by an increased quantity of carbonic acid gas and animal effluvia.(*t*) Persons who have the control over mines and manufactories ought to be *criminally responsible*, as they undoubtedly are *morally*, for the consequence of not adopting measures to secure due ventilation and temperature in these places.(*u*) It is singular that the use in mines of the safety-lamp of Sir H. Davy, and other inventions, has not been imperatively enforced;(*x*) and it is still more extraordinary, that although the legislature have recently taken so much pains to regulate the *hours of labour* of factory children, and even descended to particularize as regards lime-washing and white-washing,(*y*) yet there is not a clause for regulating the *temperature of the air in the rooms* in which they are to be immured for so many hours as are still permitted.(*z*) If from the nature of the process it be essential that the surrounding atmosphere should be of an improper temperature, then none but adults above the age of twenty-three(*a*) should be employed; and even adults should not be employed in confined atmosphere for nearly so many hours as they might be if working in the open air; and the building should be so constructed that they should repeatedly be admitted to a proper graduated fresh air. To the great credit of the proprietors, many of the large manufactories recently erected in the metropolis have raised roofs, with openings near the top of from three to four feet, through which the excessive heat of the forges and furnaces below evaporates, and a constant succession of salubrious air is supplied. Similar construction should be universally enforced.

The imperative necessity for ventilation in hospitals and jails has been frequently demonstrated; and it is obvious, that whatever powers of imprisonment the municipal laws may afford, it would be against the principles of law as well as morality, to endanger the health of the prisoner; and as regards hospitals, it would be against the very object of their structure not to provide adequate air for every patient;(*b*) and we have seen, that at least 600 cubic feet of air should be provided for each patient.(*c*) The air of the penitentiary, improperly built in an unhealthy district at Milbank, certainly was for a time considered unhealthy, but afterwards another cause of the temporary disorder was discovered.(*d*) To the great honour of the legislature, we find a modern enactment regulating the plan and construction of jails, and which is particularly careful in requiring the situation to be healthy, and that each cell shall be dry and airy.(*e*)

Particles of dust, &c. inhaled.

But there is danger to health not only in the closeness of manufactories and mines, but also in many cases from peculiar dusts or other small particles arising from the process being inhaled into the lungs, occasioning consumption and other injuries, and which it has been suggested might be prevented by the use of the damp bag or other process collecting and withdrawing such particles, and preventing injuries to the manufacturers.(*f*)

(*t*) Id.; see also Cyclop. Prac. Med. tit. Artisans; 1 Arnott, El. Phys. 113 to 117, to the same effect, with suggested improvements; and see Dr. Combe's Principles, &c. 193 to 195.

(*u*) See observations in 2 Par. & Fonb. 99, note (*a*.)

(*x*) Id.; Copl. Dict. tit. Arts and Employments; see 2 Arnott, El. Phys. 107.

(*y*) 3 & 4 Wm. 4, c. 103, s. 26.

(*z*) Id.

(*a*) Copl. Dict. tit. Arts and Employments.

(*b*) 1 Par. & Fonb. 125, 351; 2 id. 113, 115.

(*c*) Ante, 111.

(*d*) 3 Good, 315; but Dr. Latham himself informed the author, that subsequently it was ascertained that the disorder which prevailed there for a time was principally attributable to too much soup diet, co-operating with other causes.

(*e*) 4 Geo. 4. c. 64, s. 49.

(*f*) Copl. Dict. Prac. Med. tit. Arts and Employments; Cyclop. Dict. Prac. Med. tit. Artisans.

Dr. Combe has, in his recent work, very clearly demonstrated the great importance of *cleanliness* as regards health. This may be examined either as regards the *residence*, or the *person*, or the *dress*. The former, as affecting the atmosphere by noxious or unpleasant vapours, is in effect part of the subject we have just examined. The gradual decline of the dysentery in this country is a remarkable proof of the benefits which have ensued from our improvements with respect to cleanliness and ventilation.(*g*) As regards the interior of buildings, the late act for regulating factories, 3 & 4 Wm. 4, c. 103, s. 26, enacts, that the interior walls, except such parts as are painted, of every mill or factory, or building, where the process of manufactory is carried on, shall be lime-washed, and the ceilings of all rooms, which have rooms or lofts above them, and all ceilings which are plastered, shall be white-washed once every year, unless permission to the contrary in writing be granted by an inspector.(*h*) The act for regulating jails contains also many provisions for securing the cleanliness of the building;(*i*) and the like regulations should be observed by private individuals with respect to their buildings, not only to secure their own health, but that of their horses and cattle.(*k*) With respect to the cleansing of privies, cesspools, and drains, excepting in some local acts, and pending the orders of the privy council under the act for the prevention of cholera,(*l*) there is not any adequate summary remedy; but if the nuisance be injurious to the public, the proceeding must be by indictment; and if it merely prejudice an individual, he must proceed by action, the expense of which may be ruinous.

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Cleanliness in dwellings, and in person and clothes.

But it is principally with reference to *personal cleanliness*, that its powerful influence upon health has of late been demonstrated. We have seen how great are the absorptions, and still more the *secretions*, through the skin, exceeding even those of the bowels and kidneys, and how injurious are any checks to such absorption or secretion.(*m*) Hence, on the one hand, the great danger and numerous deaths from the inexpressible folly of bathing infants daily in cold water, even in winter, and freely exposing them to open air, or to currents from open doors or windows, with the absurd view of hardening their constitution;(*n*) and on the other hand, the salubrious effects of daily washing, even at that early age, with tepid water, and frequent change of clothing, but loose and easy.(*o*) The temperature of the water should be very gradually lowered, until at length cold water can be safely applied.(*p*) In youth and mature age the frequent use of cold water, or cold bathing, ought to be observed, unless they should immediately afterwards experience chilliness, when they are to use tepid water until they can bear it cold, and in all cases either cold, tepid, or warm baths, or sponging with diluted vinegar, or friction of the skin, or vapour baths, especially under the arm-pits and round the feet, should be daily observed, with the use of a flesh-brush or hair-glove, so as to keep the surface and pores of the skin clean, and to produce a glow and facilitate cutaneous absorption and secretion, so essential to health.(*q*) Dr. Combe observes, that the warm, tepid, cold, or shower

(*g*) Par. & Fonb. 88, note (*a*,) to 104; observations on the increase and decrease of different diseases, by J. W. Heberden, jun. M. D. London, A. D. 1801.

(*h*) 3 & 4 Wm. 4, c. 103, s. 26.

(*i*) 4 Geo. 4, c. 64, s. 49.

(*k*) And see 1 Par. & Fonb. 142, as to white-washing.

(*l*) 2 Wm. 4, c. 10.

(*m*) Ante, 431; and Dr. Combe's Principles, 34, 35, 48, 70, 71; Cyclop. Prac. Med. tit. Education, Physical.

(*n*) Dr. Combe's Principles, &c. 58, 59.

(*o*) Id. 61, 62; Cyclop. Prac. Med. tit. Education, Physical.

(*p*) Cyclop. Prac. Med. tit. Education, Physical.

(*q*) Dr. Combe's Principles, &c. 58 to 88, 70, 71 to 75. The use of the warm bath is powerful. It is said that it will even hasten puberty, 1 Par. & Fonb. 187, note (*c*.) It will frequently resuscitate a still-born child, when at the heat of 98 or 100 Fahrenheit, Dr. Blundell's Lect. Mid.

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bath, as a means of preserving health, *ought to be in as common use as a change of apparel*, for it is equally a measure of necessary cleanliness.(*r*)

The truth of this doctrine has become so well established that it has been recently enacted, that even jails shall be so constructed as to have warm and cold baths, or bathing tubs, with adequate allowance of soap, towels, and combs, introduced into such parts of the prison as may be best adapted for the use of the several classes.(*s*) And yet every one who has, especially in the summer, attended the country courts of justice, or who has seen the interior of cottages in warm weather, is sensible how disregardless are the lower orders of society in the observance of personal cleanliness; and, perhaps, those who benevolently in the winter bestow warm clothing on the poor, could not perform a more meritorious charity in the summer than in affording each person a round towel and an adequate quantity of soap, with a change of flannel waistcoats, to be worn next the skin in the hottest weather. The dangerous illnesses incident to checked perspiration would thus be avoided.

The ventilation of beds and bed clothing is also considered of great importance to health. A flannel waistcoat next the skin, changed or aired every day, is exceedingly salubrious. For this reason a practice common in Italy has been recommended as meriting universal adoption. Instead of beds being made up in the morning the moment they are vacated, and while still saturated with the nocturnal exhalations, which before the morning become sensible even to smell in a bed-room, the bed clothes are thrown over the backs of chairs, mattresses shaken up, and the windows thrown open for the greater part of the day, so as to secure a thorough and cleansing ventilation. This practice, so consonant to reason, imparts a freshness, which is peculiarly grateful and conducive to sleep, and its real value may be inferred from the well-known fact that the opposite practice carried to an extreme, as in the dwellings of the poor, where three or four beds are often huddled up with all their impurities in a small room, is a fruitful source of fever and bad health, even where ventilation during the day and nourishment are not defective.(*t*)

Cleanliness in clothing is also of essential importance, and where any contagious disease is prevalent, the wearing apparel and bed clothing that have been in contact with the diseased person should be *burnt*, and not merely cleansed.(*u*) Lord Chesterfield, in his advice to his son, remarked that it is in respect of perfect cleanliness and daily change in every article of linen that a gentleman should always distinguish himself from the labourer and mechanic, rather than in the unnecessary change of variety and number of the articles of his dress.

Thirdly, Dress.(*x*)

There is no subject upon which the medical profession so much complain as injurious to health as *dress*, whether it regards *infants* or *young women*. Dr. Combe has made some valuable observations on the injurious consequences of too much heat and clothing, and too close an atmosphere as regards *infants*, and the necessity for a loose and easy dress at that age, both to allow free circulation through the vessels and the insensible perspiration to have a free exit instead of being confined to, and held in contact with, and absorbed by the skin, as often happens till it give rise to irritation;(*y*) moreover, as Dr. Barlow has observed, the process of being dressed is irksome to most infants, causing them to cry, and exciting as much mental irritation as they are capable of feeling. Their dress

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53; Amer. Cyclop. Prac. Med. tit. Asphyxia.

(*r*) Dr. Combe's Principles, &c. 70, 71.

(*s*) 4 Geo. 4, c. 64, ss. 19 and 49.

(*t*) Dr. Combe's Principles, &c. 68, 69.

(*u*) 1 Par. & Fonb. 142.

(*x*) As to improper dress being the cause of diseases in general, see Copl. Dict. tit. Diseases, 4 Good, 240, 241, 347.

(*y*) Dr. Combe, Prin. &c. 60 to 63.

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should, therefore, be so constructed as to render the operation as brief as is compatible with the ablutions required, and with the necessary adaptation of the garment to their several purposes.(*z*) On the other hand, he demonstrates the absurd practice of clothing children in winter or cold weather with a dress light and airy, and the baneful consequences of that practice.(*a*) So that a general principle or rule should be observed in infants and youth, namely, to put on clothing in kind and quantity sufficient in the individual case, on the one hand, to protect the body effectually from what is termed an *abiding* sensation of cold, however slight; and on the other, to prevent an *abiding* sensation of unpleasant heat or pressure; at all events these should be so when in a quiescent state of inactivity;(*b*) and always to avoid too sudden changes, on a principle considered when examining habits.

With respect to youth, and especially girls, the highest medical authorities have endeavoured, although generally in vain, to convince mothers how frequently improper clothing is a cause of spinal curvature and other diseases; and they have pointed out numerous instances of injurious consequences.(*c*) But principally it has been demonstrated, that the tight lacing of the waist, and the want of adequate covering of the neck and breasts of young females, is banefully prejudicial; the former occasioning the very general crookedness of females, if not positive curvature of the spine, and the latter causing pulmonary disorders.(*d*)

Medical men in general concur in recommending the use of flannel next the skin, changed, or rather aired, for the purpose of cleanliness, every day.(*e*) As an antidote or prevention to dangerous cutaneous absorption in marshy, moist and unhealthy districts, a complete clothing of this article, or woollen clothing, to prevent checked cutaneous absorption or secretion, has been strongly recommended;(*f*) and perhaps the laudable benevolence evinced to the poor by donations of clothing during winter, might with great advantage be extended to the gift of a change of thin flannel waistcoats, with course round-towels, in the heat of summer.(*g*)

Our present laws do not *directly* interfere with dress, though anciently we had regulations to prevent persons of inferior rank assuming to dress like their superiors, as in the enactment prohibiting the wearing piked shoes,(*h*) and that prohibiting persons beneath the degree of a lord from wearing the skirts of their dresses indecently short in the king's presence, most of which enactments were repealed by 1 Jac. 1, c. 2, s. 25. In more modern times there have been enactments relative to burying in woollen, for encouraging the manufacture of that article, but these also have been repealed;(*i*) nor in regard to health is there any regulation respecting dress. There are, however, some enactments, principally of a revenue nature, favouring the consumption of articles of dress of British manufacture, by prohibiting or imposing high duties upon foreign articles.(*k*)

(*z*) Cyclop. Prac. Med. tit. Education, Physical, 687.

(*a*) Id.; and Dr. Combe's Principles, &c. 63; Dewees, Children, 242 to 245.

(*b*) Dr. Combe's Principles, &c. 62 to 65.

(*c*) Copl. Dict. Pr. Med. tit. Disease, 562.

(*d*) Id.; Dr. Combe's Principles, &c. 65; Dr. Barlow's Observations, Cyclop. Prac. Med. tit. Education, Physical; and see 1 Good, 461; 4 Good, 239, 240.

(*e*) Dr. Combe's Prin. &c. 66 to 68.

(*f*) Id. 49, 50.

(*g*) Id. 66 to 81.

(*h*) 3 Inst. 199; 4 Bla. Com. 171.

(*i*) 54 Geo. 3, c. 108, repeals the 30 Car. 2, st. 1, c. 3, and 32 Car. 2, c. 1.

(*k*) See Burn's Justice, tit. Excise, sub. tit. Linen Cloths, Silks, Cottons, and Calicoes; and see repealing act, 1 Will. 4, c. 17; *The Attorney General* v. *Delano*, 6 Price, 383; and see decisions, 1 Chitty's Commercial Law, 179 to 196, 520 to 539, 589 to 591, and 689.

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As regards absurdity or extravagance in dress, there is no enactment or legal restraint excepting that by the common law a married woman cannot, without the express consent of her husband, subject him to liability for articles of dress inappropriate to his rank and fortune,(*l*) and infants can be sued only for *necessary apparel*, which is a relative term, depending on the actual and not the assumed rank or ability of the infant.(*m*)

Parents, and particularly mothers, should reflect whether much of the future moral conduct of their children is not intimately connected with *dress*. Indulgences during youth in the habit of dressing beyond the rank or pecuniary means of the parents, or even in any station in a useless expenditure, is the undoubted origin of much vanity, self-conceit, and ruinous extravagance in after-life. Hence the numerous instances of haughty, uncontrollable, and extravagant wives, and of young men of similar absurdity, becoming idle, and assuming ideal consequence, with a reckless disregard of contracted debts. A most experienced judge remarked, that during forty years' professional observance of the numerous defences by husbands and by infants of actions for the extravagant or unnecessary apparel of their wives or themselves, he had found that such defences were generally followed by matrimonial discord, and frequently adultery or divorce; and out of several hundred infants few instances had occurred of the individuals, after such a defence, having become honourable or useful members of society. Courts of law must uphold such defences, yet in general domestic happiness and the character of the infant defendants have not survived the contest. Parents who permit early extravagance ought to consider themselves responsible for all the results. Youth might readily be taught that even surplus of permanent income had better be bestowed in well considered cautious acts of benevolence, or reserved for future occasion, than be wasted on any article of superfluous dress, which generally leads to corresponding ruinous extravagance in other departments of life. The gratification incident to such self-control would far outweigh any momentary gratification which the looking-glass might afford, at the expense, perhaps, more frequently of the ridicule than of the envy of others, and which envy indeed it would be injudicious to excite.(*n*) As regards the practice of youth studying fashion with so much attention, we may remind them that Gulliver tells us that the worst clothes he ever wore were constructed on abstract principles. On the other hand, however, youth should not be suffered to be utterly regardless of dress and appearance; for if they be so when young, they will probably be slovenly, if not dirty, when aged.

The legislature have evinced a just and humane consideration of the feelings of persons imprisoned upon charges of crime, by prohibiting, before they have been convicted, the compulsory wearing of any prison dress, unless his own clothes be deemed insufficient or improper, or it be necessary that they shall be preserved for the purposes of justice, and even then the dress is not to be party-coloured, but plain.(*o*)

Fourthly, Appropriate diet or food and drink.

We have considered the necessity for a constant and even more frequently than once a day a supply of nourishment to repair the constant waste of the system, and have concisely examined the senses of hunger and thirst, with a general view of food and drink, and the organs of digestion and assimilation;(*p*) a few observations remain to be here intro-

(*l*) 5 Bing. 28, 187.

(*m*) *Hands* v. *Slaney*, 8 T. R. 578.

(*n*) Young men should remember the reproof of the absurd fashion started at one of the colleges, of young collegians dressing in calf-skin waistcoats, when one of the heads of the college remarked, "I observe you are *bound* in *calf*, I should be better pleased if you were *well lettered*."

(*o*) 4 Geo. 4, c. 64, s. 17.

(*p*) Ante, 196 to 199; Cyclop. Prac. Med. tit. Dietetics; 2 Par. & Fonb. 67.

duced. Food may be considered with reference to abstinence and repletion, and quality and quantity. With respect to abstinence, such are the provisions of our poor laws, as well with regard to settled as casual paupers, and such the extent of our charitable institutions, that few indeed need suffer death merely from positive privation whilst in a state of health. But, not unfrequently, deficiency of nutritious food, more especially if accompanied with indulgence in ardent spirits, occasions death when disease attacks the frame; we therefore find the legislature particularly anxious to prevent excessive indulgence in spirits, which is banefully injurious to the poor, who live upon a scanty pittance of nutritious food. But upon the whole, more injury to health arises from *habitual repletion* than from abstinence. A few general rules have been laid down as judicious to be observed by the healthy, and indispensable to those who are invalids. *First*, with respect to the kind or quality of the food. *Secondly*, its due mastication. *Thirdly*, the quantity of food. *Fourthly*, the contemporaneous drink. *Fifthly*, the times of beverage. *Sixthly*, the following rest. (*q*)

1st. *With respect to the kind of food*, we have seen that nature has provided that man shall be omnivorous, the better to enable him to pass from one country to another, and so that by degrees he may be enabled to live upon every description of food, whether animal or vegetable, according to the climate in which he may be found; (*r*) and that in general that climate produces a description of food best adapted to its temperature, as rice, dates, fruit, &c. in the warmer regions, and animal food in the temperate or colder climates, where more nutritious diet is required; so that if man remove from one temperature to another, he finds it necessary gradually to adopt the food of the country where he is abiding. In general, with respect to the kind of food, scarcely any formal directions are required, because, from the earliest age, parents, preceptors, and associates either instruct or afford an example which we naturally follow; but sometimes bad example, as regards *quantity*, is not only extravagant but injurious. (*s*) Moreover, the capacities for digestion vary so much in different individuals, that in general, each, before he attains maturity, has learnt by experience what food is best adapted to his stomach, and should, as regards *quality* as well as quantity, avail himself of such experience. (*t*) Several able physicians (*u*) however, for the use of the healthy as well as invalids and persons of weak stomachs or digestions, have stated, in an ascending scale, and under nine heads, the most digestible and nutritious beverages, and which have been approved, excepting that it is insisted that flesh of full grown and older animals is more digestible and nutritious than that of young animals. (*x*) Costiveness is very often caused by the use of indigestible food, as heavy, or imperfectly leavened, or adulterated bread, new cheese, nuts, cucumbers, &c. (*y*) The importance of not living entirely on salted meats and the occasional intermixture

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As to *abstinence* and death from starvation, see Copl. Dict. Prac. Med. tit. Abstinence, tit. Appetite; G. Smith, 56; 2 Par. & Fonb. 67 to 69, 110; Amer. Cyclop. Prac. Med. tit. Abstinence.

(*q*) See a concise analysis of Mr. Abernethy's rules, stated in Dr. Johnson on Indigestion, 138, 139; post, 460.

(*r*) Ante, 198; 1 Good, 4.

(*s*) It is singular how far habit influences voracity; we frequently see whole families of voracious appetites, entirely attributable to the absurd encouragement and example of parents.

(*t*) Dr. Johnson on Indigestion; and see Cyclop. Prac. Med. tit. Dietetics.

(*u*) See Dr. Johnson on Indigestion; 2 Bost. 362 to 377; 3 id. 340; 1 Good, 149 to 151; El. Blum. 325; and a *very valuable* article, Cyclop. Prac. Med. tit. Dietetics; see the local regulations and prohibitions, Leviticus, chap. xi.

(*x*) Dr. Johnson on Indigestion.

(*y*) Copl. Dict. Prac. Med. tit. Constipation.

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of fresh vegetable food is too well known to require authority;(*z*) and, on the other hand, the use of a considerable quantity of salt with fresh meat and vegetables have been so established, as even to induce the legislature to withdraw the tax upon that article.(*a*) But meat, fish, and eggs, when approaching towards putridity, are agreed to be injurious and dangerous;(*b*) and although an exception in favour of venison and game verging on putridity has been supposed to be allowable,(*c*) it may be questionable whether that exception should be admitted.(*d*) Great danger of inducing dysentery, especially when the stomach or digestion is weak, arises from eating confectionary, ices,(*e*) flatulent herbs, cucumbers, melons, salads, or unripe or subacid fruits.(*f*)

Perhaps, with these few exceptions, the ancient maxim of Celsus "*sanis omnia sana*" is true; and, indeed, many are of opinion that a frequent change of food, whilst in a healthy state, tends to strengthen the stomach, and is therefore conducive to permanent health.(*g*) But in a weak stomach a great variety of food may produce diarrhœa.(*h*) During childhood, adolescence, and puberty, mixed diet with a portion of animal food is recommended; but there should be a diminution of the latter if there be a tendency to plethora.(*i*) With respect to the quality of food, man has not, like many animals, any power of distinguishing merely by flavour what is healthy, and therefore it would be dangerous to trust to taste as regards any unknown substance.(*k*)

It would be beyond our limits to attempt to enumerate all the various articles of natural production that by accident or design may become intermixed with proper food and be deleterious.(*l*) It must suffice to observe, that our common law(*m*) and our statutes(*n*) punish all injurious adulterations. But still, from want of care in cooking utensils, and from design, principally in the intermixture of wines, health is very frequently in a small degree injured;(*o*) though, unless the poisonous infusion be very powerful, by habit they become less noxious.(*p*)

All medical advisers observe, that slow and complete *mastication* of the food is of the very utmost importance, because when we eat too fast, without adequate mastication, we not only do not assist the subsequent digestion in the stomach, but send the food in too large masses, and introduce larger quantities than the gastric juice can at once combine with, and thereby larger quantities will be propelled through the pylorus

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(*z*) 3 Good, 318 to 322; 3 Bell, 272.

(*a*) Cyclop. Prac. Med. tit. Dietetics; 2 Bost. 375; Stevens on the Blood, 13, 14; 1 Par. & Fonb. 90; 5 Geo. 4, c. 65; 6 Geo. 4, c. 81, s. 111; and Burn's Just. tit. Excise Salt.

(*b*) G. Smith, 207, 208, 214; 2 Par. & Fonb. 449; Copl. Dict. Prac. Med. 522.

(*c*) Id. ibid.; 1 Good, 16; ante, 188.

(*d*) Copl. Dict. Prac. Med. Diarrhœa.

(*e*) A singular case has recently occurred of a gentleman in full health, at all times when he ventures to eat even a small spoonful of ice, immediately feeling a distracting pain in his head, as if perforated by a bullet.

(*f*) 2 Good, 417.

(*g*) Cyclop. Prac. Med. tit. Dietetics, and tit. Disease; Dr. Johnson on Indigestion.

(*h*) See Copl. Dict. Prac. Med. tit. Diarrhœa; Cyclop. Prac. Med. tit. Dietetics.

(*i*) Per Dr. Barlow, Cyclop. Prac. Med. tit. Education Physical.

(*k*) 4 Good, 202; ante, 306, n. (*s*.)

(*l*) Mushrooms, when poisonous, and the antidotes; 2 Par. & Fonb. 203, 425, 428, 433; Ryan, Med. Jur. 250.

(*m*) *Rex* v. *Dixon*, 3 M. & S. 11; 31 Geo. 2, c. 29, s. 29, 30, as to adulteration of bread.

(*n*) See several statutes, 1 Chitty, General Prac. 42.

(*o*) As to adulterated food in general, see 1 Chitty, General Prac. 42; 1 Par. & Fonb. 74, 374, 375; 2 id. 250, 265; G. Smith, 214, 215. Culinary utensils should be tinned, and the copper not in communication with the food or water in which it is boiled; 2 Par. & Fonb. 288, 289; 3 id. 11, 12. Nor should milk be placed in leaden vessels, id. ibid.

(*p*) G. Smith, 66, 67.

without having been adequately acted upon by the gastric juice, and become injuriously oppressive and irritating in the intestines. (*q*) Sufficient has been said upon the process of mastication in a preceding page. (*r*)

The *Quantity*.—With respect to the *quantity* of food, it has been observed that no person is in danger of starvation who can take and digest even so small a quantity as a pint of good gruel in the twenty-four hours; (*s*) and hence, if it were not for the prejudicial indulgence in ardent spirits, few in the most abject state of poverty would die from hunger, although they would not, upon such low diet, evince great muscular strength or nervous energy. But the principal cause of illness, corporeal as well as mental, is *repletion*, by which the due action of the stomach is impeded. (*t*) There is no subject respecting which the members of the medical profession have more zealously evinced their integrity than this, for they are constantly, against their own interest, writing and prescribing temperance, and demonstrating the corporeal and mental injuries resulting from repletion.

In infancy and during childhood, adolescence, and puberty, as the growth and expansion of the frame, together with the constant waste are to be supplied, it is agreed that comparatively more nutriment is admissible than in the adult, but the excess should be rather in the frequency of the meals than in quantity at one time, for large meals overload the stomach and lead to prejudicial indigestion; so that, instead of three meals a day, (the quantity recommended to adults in the earlier period of life,) there may be properly five, or food may be taken as frequently as natural appetite may excite. The food should be mixed, and less of animal nourishment taken if there be a tendency to plethora. (*u*)

As regards *adults*, Mr. Abernethy observed, that "man in civilized life, having food at command, and finding gratification and a temporary hilarity and energy to result from the excitement of his stomach, eats and drinks an enormous deal more than is necessary for his wants or welfare; he fills his stomach and bowels with food which actually putrifies in those organs; he also fills his blood vessels till he oppresses them and induces diseases in them as well as in the heart." (*x*) Hence the melancholy frequency of dyspepsy and hypochondriasis. (*y*) The simple rule which every one ought to follow is, that, after eating a meal, there ought not to be any conscious excitement or sensation induced in the stomach by the presence of food or drink, and it has therefore been a maxim "to feel we have a stomach at all is no good sign," (*z*) and whenever our food or our drink induces much sensible excitement in the system, or is followed by much inaptitude for mental or corporeal exertion, we may assure ourselves that we have transgressed the rules of temperance in some degree, and are laying the foundation for disorder; and when the food produces any sensation of *discomfort* in the stomach, as a sense of distention, whether attended or not with a degree of depression of spirits or irritability of temper, *indigestion*, or rather morbid sensibility, has actually commenced, however slightly, and if the irritation of too much

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(*q*) Dr. Johnson on Indigestion; Cyclop. Prac. Med. tit. Dietetics.

(*r*) Ante, 180, 181.

(*s*) Dr. Johnson on Indigestion. But from the proceedings in *Rex* v. *Justices Yorkshire*, 2 Bar. & Cres. 286, it should seem that mere bread and water are not sufficient nourishment to sustain the health of a prisoner.

(*t*) Arbuthnot on Aliments.

(*u*) Cyclop. Prac. Med. tit. Education Physical, 688.

(*x*) Mr. Abernethy's System, 76.

(*y*) See description of this melancholy morbid sensibility, leading to suicide, and remedies, Dr. Johnson on Indigestion, and Fletcher on Influence, &c. *per tot.*

(*z*) Dr. Johnson on Indigestion.

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food or drink be continued, positive indigestion and disease may ensue.(*a*) But perhaps a similar rule will be more readily understood and applied. Every adult should cease to continue eating or drinking *before natural appetite has been fully satiated*, and then he will afterwards actually enjoy the result, and benefit from what he has taken. There is a moment when the relish given by the appetite ceases, and a single mouthful beyond that quantity oppresses a weak stomach; and Dr. Paris observes that he who eats slowly and carefully, and attends to this feeling, will never overload his stomach; but that such indication may not deceive, let him remember to eat slowly and to masticate thoroughly.(*a*) Far more frequently by the quantity of our food is the stomach irritated and its nerves rendered morbidly sensible, than by the quality.(*b*) It has therefore been contended that, in legislation, instead of merely prohibiting excess in drinking, it would be well to introduce regulations preventing excess in eating, at least on successive days, and to revive the ancient statute, which prohibited more than two courses, or other irritamenta gulæ, with a host of "*entremets*" and "*hors d'œuvres*," excepting on particular grand occasions,(*c*) or at least to repress the practice by heavily taxing such indulgences. It has however been remarked, that an *occasional* excess, like occasional abstinence, may not be injurious;(*d*) and it is only continued and excessive indulgences that in a healthy frame lead to any baneful consequences. And we submit that the best general principle is not to legislate upon this subject.

The *fourth* rule is, that the admixture of a large quantity of drink with the food greatly impedes digestion, not only by over-distending the stomach, but also by diluting too much of the gastric fluid,(*e*) and although Mr. Abernethy's rule, not to take any considerable quantity of liquid during the meal, or before four hours after it had elapsed,(*f*) has been questioned in its general application to healthy persons,(*g*) yet the present practice of avoiding the drinking large quantities of beer or water during the dinner, but confining the liquid to a few glasses of wine, is considered healthy, as not only stimulating but assisting in moistening the food without neutralizing its utility, or too much distending the stomach or bowels, as is the case when much beer or water is taken during the meal.

Fifthly.—With respect to the frequency of meals, and the intervals between each, Mr. Abernethy recommended, at least for persons of weak stomach or digestion, three meals in the course of the day, with six hours between each, or four meals in the day when the stomach is still weaker in digestion.(*h*) But before full growth has been attained more frequent meals, even as often as natural appetite excites, may be proper in preference to large meals at a time.(*i*)

Sixthly.—If the party be weakly, he should avoid exercise for an hour or two after the meal, so as to facilitate digestion; but such rest is not essential where the party lives temperately and is in health.(*k*)

(*a*) Dr. Johnson on Indigestion.
(*a*) Cyclop. Prac. Med. tit. Dietetics.
(*b*) Dr. Johnson on Indigestion.
(*c*) 10 Edw. 3, stat. 3; 4 Bla. Com. 171; and see Cyclop. Prac. Med. tit. Dietetics.
(*d*) Cyclop. Prac. Med. tit. Disease.
(*e*) Id. 13; but see Cyclop. Prac. Med. Dietetics.
(*f*) Mr. Abernethy's rules for dispeptic patients, as analyzed in Dr. Johnson's Indigestion; and see post, 460.
(*g*) Cyclop. Prac. Med. tit. Dietetics, per Dr. Paris.
(*h*) Dr. Johnson's Indigestion, citing from Mr. Abernethy's rules; post, 460.
(*i*) Cyclop. Prac. Med. tit. Education, Physical.
(*k*) Id. tit. Disease. A medical friend recently tried an experiment alluded to in the old books. Two dogs were fed copiously: one was immediately hunted, and the other suffered to rest; in four hours after taking their meal both were killed; and in the stomach of the dog that had rested the food was found nearly dissolved, whilst the food in the stomach of

Drink.

With respect to *liquid* aliment it has been observed, that as the introduction of solid aliment into the stomach is essential for the purpose of furnishing materials for the repair of the different *textures*, so a supply of liquid matter is necessary to replace the *fluids* which are constantly ejected from the body during the exercise of its numerous functions, and therefore the drinks ought to be considered as real aliment.(*l*) The nature and relative value of every liquid aliment have been described in some modern publications, to which it may suffice to refer.(*m*) Water in small quantities is considered the best general beverage, especially for those who drink much wine after dinner;(*n*) whilst beer in moderation is salubrious to those who take little wine and much exercise;(*n*) and a small quantity, as a table spoonful, of brandy, mixed with a glass of water, appears to be recommended for invalids.(*o*) It has been insisted that no liquid should be taken otherwise than in small quantities, during or immediately after eating;(*p*) but Dr. Paris observes, that the quantity of liquid to be taken at meals should depend on the description of food, and on the sensation of the individual, though it seems agreed to be improper to drink immediately *before* a meal.(*q*) We cannot particularize the proportions for every meal, but it appears to be agreed that for those who *breakfast* soon after they rise, without any considerable intervening exercise, a liquid breakfast is the best; whilst the supper immediately before retiring to rest should be a *light* repast.(*r*)

Excess in the quantity of drink is considered not to be so prejudicial as that in eating, because from the very nature of the former ingesta it is soon discharged from the stomach, and from the body altogether, by the various outlets, whilst with respect to substantial food not duly digested, the stomach and the bowels long remain oppressed and irritated, and the consequence is, that a gastric and constitutional irritation, much worse than mere stimulation from liquids, is kept up for a long time after each immoderate or ill-digested meal.(*s*) Still, however, the use of undiluted ardent spirits, or quantities of wine in excess, are rapidly injurious, especially affecting the lungs, brain and liver, and inducing numerous other disorders, particularly amongst those who have scanty food,(*t*) and the pyloric orifice of the stomach has often been found indurated in dram drinkers;(*u*) whilst, on the other hand, the indiscreetly drinking cold water, or taking an ice, when in a state of heat and perspiration, has frequently occasioned immediate death.(*x*) A small quantity of tepid water with a spoonful of brandy infused is the safest beverage whilst in that state. As it has been discovered that in cider and wine, lead or other deleterious matters are frequently infused to prevent acidity or improve flavour or appearance, great care is essential in examining all these beverages, especially before they are taken freely.(*y*) But as to the quantities as well as qualities of drink, it has been observed, that the animal

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the other appeared scarcely to have undergone any change.

(*l*) Cyclop. Prac. Med. tit. Dietetics, by Dr. Paris, where see an enumeration and consideration of every description of drink.

(*m*) Id. ib.; Mr. Abernethy's rules; Dr. Johnson on Indigestion, post, 456.

(*n*) Dr. Johnson on Indigestion; Cyclop. Prac. Med. tit. Dietetics; but care is essential to discover its qualities, 1 Par. & Fonb. 91, 330, 350, 351.

(*o*) Dr. Johnson on Indigestion.

(*p*) See Mr. Abernethy's rules; Dr. Johnson on Indigestion, and post.

(*q*) Cyclop. Prac. Med. tit. Dietetics.

(*r*) Id.

(*s*) Dr. Johnson on Indigestion.

(*t*) 2 Par. & Fonb. 58, 60, 433 to 439; 1 Par. & Fonb. 293; G. Smith, 42, 43, 58, 59; Dr. Park's Inquiry, 323, 324; and it has recently (in A. D. 1834) been established that at the Lunatic Asylum, at Hanwell, in Middlesex, out of eighty deaths seventy-two were caused by diseases of the lungs or brain, brought on by the immoderate use of ardent spirits.

(*u*) Dr. Johnson on Indigestion.

(*x*) G. Smith, 57, 58.

(*y*) 2 Paris & Fonb. 340, 344, 345, 348,

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functions are so much influenced by *habit* that the operation of food, and, indeed, of all descriptions of ingesta, is most remarkably modified by habit, so that by it even poisons become comparatively innoxious; and thus it is that immense potations of spirituous liquors may gradually be borne, but if the increase should be too great, the sensibility of the stomach may at length occasion even a single glass to produce violent and fatal irritation.(*z*)

Mr. Abernethy's rules of diet.

Dr. Johnson has thus analyzed Mr. Abernethy's rules for diet, to be observed in dyspeptic cases and hypochondriasis,(*a*) and which Mr. Abernethy considered would be salutary and expedient to be observed also by the healthy to preserve or continue health. 1. The food should be of the most nourishing and readily digestible kind. 2. The quantity taken at a meal should not be more than it is probable the stomach will perfectly digest. 3. The meals should be taken at regular periods of six hours three times a day; and when the stomach can digest very little food they may be taken four times in the twenty-four hours. 4. Every meal of food should be reduced to minute subdivision and pulpy consistence by mastication or otherwise, and suffered to remain in the stomach unmixed with liquids, in expectation that it will be dissolved by the juices of the stomach. 5. Drink should be taken four hours after each meal, allowing that time for its perfect digestion, and two hours for the conveyance of liquids from the stomach before the pulpy food be again received. 6. The drink then taken should not contain fermentable substances. It should be boiled water, which may be flavoured with toast, or prevented from producing a qualmish state of stomach by pouring it upon a trivial quantity of powdered ginger. "But it is not meant by these rules to debar persons from taking a small tea-cup-full of liquid with breakfast, or a glass or two of wine with dinner, if it seem to promote the digestion of their food."

Extent of legal duty to provide requisite food, and restrain excess.

As connected with medical jurisprudence, we may here observe, that when it is a *legal duty* to provide proper food, the mere omission, though unconnected with imprisonment or other external injury, may, when it has a tendency to positive injury, or even bodily distress, be the subject of criminal prosecution, where the sufferer is an infant or incapable of providing for himself; and even an indictment for murder if death ensue, or for a misdemeanor when ill-health only ensues, may in some cases be sustained; as against parents, parish officers, and jailors neglecting, contrary to their respective duties, to provide sustenance.(*b*) But if there be no *legal* duty to provide sustenance, then a party, however *morally* guilty of a crime in withholding it, is not indictable; as where a person

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263, 435, 436; G. Smith, 245; 1 Paris & Fonb. 74; Adulteration of Beer, &c. 1 Paris & Fonb. 377, 378, 380.

(*z*) El. Blum. 56, 58; and see 3 Bost. 169 to 173.

(*a*) Dr. Johnson on Indigestion.

(*b*) 1 Chitty's Gen. Prac. 34, 35; *Self's case*, 1 East, P. C. 226; 1 Leach, Cr. C. 137, 163, S. C.; *Rex* v. *Ridley*, 2 Camp. R. 650; *Rex* v. *Gould*, Salk. 381; *Rex* v. *Friend and wife*, Russ. & Ry. Cr. Cas. 20; *Rex* v. *Meredith*, Russ. & R. C. C. 46; 2 Paris & Fonb. 110.(*a*) As to the obligation of *parents and relations* and *parish officers* to supply food, and mode of enforcing performance, see Burn's Justice, Poor, iii.; of the relief and ordering of the poor, 26th ed. 163 to 250. *Casual* poor, or *any one* standing in *immediate* want, must be relieved by the local officers, wherever the pauper may be, without regard to legal settlement, or they are indictable, id. 234; *Rex* v. *Meredith*, Russ. & Ry. C. C. 46; *Rex* v. *Booth*, id. 47; *Rex* v. *Warren*, id. 48. So parish officers must support an illegitimate child without regard to the liability of the parents, and without any order of justices, *Hays* v. *Bryant*, 1 Hen. B. 253. If after a justice's order of maintenance it be not provided, then clearly an indictment is sustainable, *Rex* v. *Moorhouse*, 4 Dougl. 388; Cald. 554, *S. C.* But, semble, there is no reason why the parish, to which the pauper belongs, should not be compellable to reimburse, MS. Burn, Poor, 234; 4 Bla. C. 197, n. 15. B.

had an idiot brother, who was bed-ridden, in his house, and left him in a dark room, without sufficient warmth or covering, it was decided that such inattention was not sufficiently criminal in law to sustain an indictment, because he was under no *legal* obligation to *clothe* his brother.(*c*) It might be desirable that natural benevolence and charity should in these cases be legally enforced, by compelling every one capable of doing so *instantly* to relieve his distressed fellow creature, affording him an *immediate* summary remedy for reimbursement against the parish officers, as in case of a casual pauper who breaks his leg.(*d*) Parochial relief in the shape of food or money is only to be afforded to those who are willing but unable to work.(*e*) But parish officers are compellable to find work for paupers, and feed or remunerate them in return, and if they cannot find work they must still feed them.(*e*) Persons imprisoned under criminal process or sentence must be offered work, or be adequately fed and provided with proper clothing and bedding.(*f*) But if a prisoner, even before trial, be able, but refuse to work, according to the prison regulation, he is not entitled under the 4 Geo. 4, c. 64, s. 17, even to bread and water;(*g*) and there are regulations respecting the food and maintenance of persons imprisoned on civil process which prevent death from starvation,(*h*) and those who are able to purchase beyond the mere prison allowance are protected from extortion by jailers, &c.(*i*) *Drunkenness* is punishable in the ecclesiastical courts, and by a penalty recoverable before a justice of the peace.(*h*) But further regulations have become essential.

Fifthly, Due digestion, natural or assisted by artificial means.

We have in a preceding chapter taken a full view of the function of digestion and its organs.(*k*) We then saw that digestion is the process by which food received into the stomach is rendered pultaceous, and by which the nutritious parts of the food are in a degree assimilated with the blood and carried through the absorbent vessels into the thoracic duct, and thence into the subclavian vein, and there intermixed with the returned blood from the veins, and then passed into the right auricle of the heart, whilst the residue is carried off from the system as waste. Digestion is principally performed in the stomach by the influence of the gastric juice, but in a healthy state it is completed in the small intestines.(*l*) The operation of perfect digestion we have seen is usually performed between three and six hours after the meal, depending as well upon the description of the nutriment as the state of the stomach; but usually, at the expiration of five or six hours, the stomach should be

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(*d*) See observation, 2 Par. & Fon. 111.

(*c*) *Rex* v *Smith*, 2 Par. & P. 449.

(*e*) 43 Eliz. c. 2, s. 1; *Rex* v. *Justices Yorkshire*, 2 Bar. & Cress. 286.

(*f*) 4 Geo. 4, c. 64; 5 Geo. 4. c. 85; see notes, 2 Bar. & Cres, 286; 5 Dowl. & Ry. 510; *S. C.* Burn's Jus. tit. Gaol, 26th ed. 993 to 1053; Tidd's Prac. 9th ed. 372, 373.

(*g*) *Rex* v. *Justices Yorkshire*, 2 Barn. & Cres. 286. But it must be confessed that although that decision may be correct upon the construction of the statute, yet the law thereby declared is repugnant to general principle, which supposes that every man shall, before trial, be presumed innocent. It is a strong position, that any man upon a mere charge of crime, which may turn out malicious, shall be compelled to work at a treadmill or starve, nor is there any analogy between the case of a person at large, who, as Best, J. observed, has no claim for maintenance, unless he will work, and a person *imprisoned* against his will; and it is submitted that every person who is imprisoned, should, before trial, be fed, at least on bread and water, without being *compelled to* work with other prisoners at so degrading an employment.

(*h*) Burn's jus. tit. Gaol, 26th ed. 993 to 1053; Tidd's Prac. 9th ed. 372, 373.

(*i*) 32 Geo. 2, c. 28; Tidd's Prac. 9th ed. 229 to 231, 372, 373.

(*j*) Burn's Ecc. Law, tit. Drunkenness, 21 Jac. 1, c. 7; Burn's Justice, tit. Alehouses, xiii. xiv.; Par. & Fonb. 88, 89.

(*k*) Ante, 171 to 221; see Copl. Dict. Prac. Med. tit. Digestive Canal.

(*l*) Ante, 191.

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emptied.(*m*) If the stomach be weak, or the meal in excess, the digestion will be still longer protracted; and a sense of indigestion will be perceived, which if not relieved, or if successively repeated, will soon become one of the most melancholy disorders.(*n*) The larger intestines retain the refuse of the food and the secretions a much longer time, and the frame may be continued in a healthy state if there be a discharge of the fæces once in twenty-four hours;(*o*) we have seen that evacuation through that channel is much less than the cutaneous secretion.(*p*) But if the digestion in the stomach or the discharge of the fæces be protracted much beyond these periods, the frame becomes disordered, and a state of habitual indigestion or constipation prevails. Many are the works on the proper treatment to be observed, and amongst others, none more deserving of attention than that of Dr. Johnson.(*q*) Regimen by reduction of diet here becomes essential, but the avoidance of purgatives is in general recommended,(*r*) and lavements or injections are preferred. Habitual indigestion, if not relieved, leads to dyspepsy, nervous irritability, mental despondency, hypocondriasis, madness and many other ailments of body and mind.(*s*) It is therefore scarcely necessary to observe the necessity for moderation and reduction of diet to avoid the malady and for obtaining the earliest and best advice as regards the appropriate remedies, when it has appeared.

Sixthly, Due education.

Some observations have already been made on this subject.(*t*) It is scarcely necessary to suggest that even at the very earliest development of mental intelligence the mind should have the *best example* constantly presented for its observance and imitation, and when bad temper appears during infancy, it is not to be increased by excitement or attempts to correct it, at least until the powers of reasoning have been developed,(*u*) and the education throughout from infancy to manhood should be adapted to the natural capacity of the child, and if there be apprehension of the development of any hereditary mental defect, the education and habits should be so selected as to avert the predispositon.(*x*) The usual hours of education and crowded acomplishments are decidedly injurious to the health of females, though less so to boys, because it is the proper practice to allow *them* more exercise and vigorous relaxation.(*y*) Whilst it is admitted to be impolitic by public general measures to attempt to *compel* education, yet in no country are there so many voluntary establishments, with the laudable view of offering gratuitous education as in England,(*z*) and in the act for limiting the hours for children to work in factories and mills, there is an imperative clause compelling a part of the day to be devoted to the due instruction of the children, the legislature thereby evincing their full sense of the expediency of educating the children of the labouring classes.(*a*)

It would be beyond our limits to give even an outline of the whole course of education of either girls or boys; but it may be observed that it in general is too much for display and too little regard is paid to morals or principle. Dr. Barlow, in his excellent observations on Physical Education, has observed that it is a great mistake to conceive that education

(*m*) Ante, 191; Johnson on Indigestion.
(*n*) Id. ib.
(*o*) Ante, 210.
(*p*) Ante, 431.
(*q*) Dr. Johnson on Indigestion.
(*r*) Id. 27, 90.
(*s*) Id. ib. *per tot;* and see 2 Paris & Fonb. 144 to 146; 4 Good, 57.
(*t*) Ante, 363; see, in general, Cyclop. Prac. Med. tit. Education Physical.
(*u*) Per Dr. Barlow, Cyclop. Prac. Med. tit. Education Physical.
(*x*) Cyclop. Prac. Med. tit. Insanity.
(*y*) Cyclop. Frac. Med. Education Physical; Dr. Johnson on Indigestion.
(*z*) Ante, 366.
(*a*) 3 & 4 Wm. 4, c. 103.

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advances in proportion to the hours in the day, and the number of days devoted to it. Under the system of education which prevails, years are wasted in pursuits, which ought not to occupy a tenth part of the time, if their value were rightly estimated or the real powers of the mind were properly directed.(*b*) We have seen that the art of memory, and we might add of all mental advancement, is attention, and hence the necessity of exciting and continuing mental attention, whilst we attempt to instruct youth, and which can never exist, unless a lively interest be excited in proportion to the early development of the mental faculties. Hence the absurdity of tormenting an infant mind with dry and unconnected letters and passages from the dead languages,(*c*) the ultimate utility of which he cannot then perceive or appreciate sufficiently to command adequate attention, when the same days and hours would animate, cheer and expand his mind, if they were employed in interesting and instructive works in his native language. The ignorance of most young men and women of the history even of their native country (in reading which they would have acquired and retained the recollection of instances of noble or base characters, presenting to them examples for imitation or avoidance) is indeed lamentable. When the zest for knowledge has towards the age of puberty been established, then would more properly be demonstrated the value of classical attainments to boys, and of French and Italian to girls, a few hours' pursuit of which during the remaining years of scholastic education, would be more availing than the ten years' usual study at a grammar school, since the advancement of mind would then have informed the youth of the necessity for those attainments to enable him to cope with men of learning instead of borrowing from mere translations. On the other hand, from the age of puberty the necessity for attention to didactic works instead of novels, may be adequately impressed so as to form the moral character, at present too little regarded.

Moreover, to improve the mind, young women as well as men should, at the age of puberty, be assisted in forming a common place book, in which they should afterwards insert their own analysis of the best instances of character, and melancholy consequences of vice, with short extracts from the compositions, and references to fine works from which these have been culled. The formation of these analyses and extracts would compel the mind to take a more particular and accurate view of what has been read, and will consequently more deeply impress the memory with the point, and form a constant resource for reference and improvement, assisting not only in the composition of interesting letters, but even in superior essays.(*d*) But above all, as it will be admitted that the object of education is to fit human beings for maintaining their social relations, and performing all their several duties in life,(*e*) we submit that

(*b*) Per Dr. Barlow; Cyclop. Prac. Med. tit. Education Physical, ante, 363, 364.

(*c*) Dr. Barlow justly observes that many of our classical books, *which mere boys are condemned to read*, require not only mature intellect, but also considerable knowledge of the world, for their comprehension, Cyclop. Prac. Med. tit. Education Physical. It is perfectly absurd to employ children as it were in spelling the best authors at an age when they are wholly insensible of the beauty either of the ideas or the composition, and are taught hypocritically to pretend to admire what they do not understand, much less feel. See the recent work by Captain Head, called "Bubbles from the Brunnens of Nassau," and Lytton Bulwer's "England and the English."

(*d*) There are some quaint but excellent observations on the utility of common placing, in Roll's Abridgment, Preface, which, though more immediately applicable to the law, will yet be found useful to all students; and see North's Life of Lord Keeper Guildford, vol. i. 20. At first an alphabetical arrangement, or, at least a more simple outline, than that of Locke, would be preferable.

(*e*) Cyclop. Prac. Med. tit. Education Physical.

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during the last two or three years of pupillage, the principal relative duties of life, whether domestic or public, should be gradually taught, and the just principles upon which they are founded fully explained, and afterwards a course of written questions, in the nature of exercises, should be stated, and the pupils required to give their answers or opinions in writing, with the grounds upon which they are founded, and with references to any applicable instances or authorities in history or didactic works; and the examination of these should be so arranged as to prevent the possibility of borrowed answers, and call forth the actual result of the pupil's own research and mind. Pupillage ought not to be considered complete until a degree of originality in the mind of each pupil has been evinced, at least on the most important of the questions on propriety of conduct. In these exercises, however, the judicious remark of Dr. Barlow should be kept in view, namely, that although the minds of the young should be exercised in all the faculties by which their social condition in after life is to be maintained, yet in this pursuit some attention should be given to the natural order of their development, for some precede others in activity, and become more quickly matured. As objects of laudable example, it may be well to examine these in public, but to spare the feelings, and prevent the risk of injury from intimidation on the part of those who are less able, they should be examined in private until they feel themselves competent to press for more public examination.

By pursuing a meliorated system of moral education, it may, perhaps, be hoped that in England may be averted the melancholy consequences of demoralization which we have seen M. Esquirol has imputed to the youth of France.(*f*)

As regards the duties of religion, it is essential that they should be early inculcated, as well as morality. The directions of the parent on this important subject with respect to particular tenets, should be strictly observed, as it is of essential importance that there should be no family disunion upon this subject. But it is a main point in education, to inculcate the just principles of toleration, so as to prevent youth from despising or treating with contempt, persons of a different faith, but regard all alike as brothers. Courts of law and equity always consult these principles; and, therefore, where, from want of express directions in a will, a suit in Chancery was instituted, and it appeared that the father was a Presbyterian, and he had appointed a clergyman of the Church of England and two Presbyterians the testamentary guardians of one of his children, and the former thinking it his duty to inculcate church principles, and the latter two their own; the Chancellor decreed in their favour, the other relations of the child being Presbyterians, and the presumption being that the testator must have intended that the child should be educated in the same tenets.(*g*)

Upon the subject of religion and study, and the due employment of the day, Lord Coke observes, "Nunquam prosperè succedant res humanæ ubi negliguntur divinæ, wherein I would have our student follow the advice given in these ancient verses, for the good spending of the day:

> Sex horas somno, totidem des legibus æquis,
> Quatuor orabis, des epulisque duas,
> Quod superest ultrò sacris largire camænis."(*h*)

In other words, six hours for sleep, the same to the study of the law, four hours for prayer, two for eating, and the remaining six for singing praises. But this latter precept rather savours of the conceit of the times,

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(*f*) Ante, 371. (*g*) *Storke* v. *Storke*, 3 P. W. 51.

(*h*) Thomas's Co. Lit. vol. i. p. 4.

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and is not to be taken as literally to be observed, for it affords no time for general reading or for exercise or reflection, the latter of which unquestionably is of the greatest importance as regards all mental, moral, and religious improvement; indeed, it would be well if every educated individual, especially in early life, would devote a few minutes each day to retracing, comparing and reflecting upon his conduct and attainments of the preceding day.(*i*)

Seventhly, Labour of body and mind.

Moderate labour, the necessary lot of the greater part of mankind, when of a healthy nature, and in the open air, and accompanied by a contented mind, may be regarded as beneficial and conducive to the due exercise of the functions of life, as exercise for pleasure taken by the affluent; but if excessive or ill-requited, it is injurious and debilitating to the mind as well as the body.(*j*) The degree of labour which can be borne with impunity has of late been much discussed; and it is admitted, that severe labour is not only baneful to infants and youth,(*k*) but also is injurious to adults,(*k*) especially some employments in bad atmosphere, and long-continued digging, especially ditching, which frequently among country labourers occasions hernia. An erroneous estimate was the basis of the recent factory act, which supposes that after attaining the age of *eighteen*, the individual is capable of bearing, in a confined atmosphere, continuous labour for twelve hours during six days in the week, but which, especially in a confined atmosphere, and even allowing thereout one hour and a half for meals, must be injurious to growth, which continues until the age of twenty-three or more.(*l*) Mr. Ferguson, in his able speech on that bill,(*m*) demonstrated that twelve hours was too much labour for a person of that age; and Dr. Combe, in his recent publication, has clearly shown that no one under the age of twenty-three years should be employed in active service in the army, and that very few who are enlisted at an earlier age, live till the age of twenty-three, and if they live, they are most of the time in an hospital,(*n*) a truth which ought practically to occasion many alterations in our municipal regulations. We have seen that less labour should be enforced or even allowed in confined atmosphere than when exposed to an open and salubrious atmosphere. To secure that the labour of infants in factories or mills shall not be greater than they can without prejudice endure, every child under the age of *thirteen* must appear in person before a surgeon or physician, and the latter must in a prescribed form certify that the child has been examined by him, and is of the ordinary strength and appearance of a child of nine years, &c. according to the fact.

It is also clear, that whilst moderate exercise of the mental faculties is actually conducive to the growth and strength of the brain and to mental happiness,(*o*) yet, on the other hand, excessive mental labour leads to mental debility and even insanity.(*p*) As regards the law, there is not, except in the case of apprentices, any positive compulsion to labour, unless it be part of the punishment prescribed by statute after conviction of some crime or offence, when not only criminal courts, but justices of the peace, in many cases, have the power of sentencing to *hard*, but still regulated labour. However, paupers and persons imprisoned on a charge

(*i*) For an outline of proper education, and all education and attainments, see Arn. El. Phy. Introd. *per tot.*

(*j*) Copl. Dict. tit. Arts and Employments; 1 Par. & Fonb. 89, 90, 126, 127.

(*k*) Cyclop. Prac. Med. tit. Artisans, Diseases of; ante, 449.

(*l*) 3 & 4 Wm. 4, c. 103, ss. 2, 6.

(*m*) In the House of Common, 26th Feb. A. D. 1833.

(*n*) Dr. Combe's Principles, &c.

(*o*) Cyclop. Prac. Med. tit. Education Physical.

(*p*) Copl. Dict. Prac. Med. tit. Cranium, and tit. Disease.

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of crime, even before trial, are not entitled even to bread and water, if they refuse to labour when able to do so.(*q*) The first principle is to remunerate the labourer in ascending scales, according to his skill, activity and general conduct; that principle has been lost sight of in the Labourers' Employment Act, 2 & 3 Wm. 4, c. 96, and hence there is at present a disgraceful supineness in the ordinary labourer, excepting in time of harvest.

Eighthly, Exercise and recreation.

Exercise differs principally from labour in its being in general voluntary and less systematic than labour. It is, perhaps, more essential to the young than to the adult, though it is of the utmost importance to all engaged in sedentary professions. It has been truly observed, that the education of females is generally defective in not allowing adequate exercise, or rather that free and *unrestrained exercise* which is so essential to the vigour, as well of the mind as of the body.(*r*) For this reason, gymnastic and all exercises which excite and elate the mind, are to be preferred to the solemn and systematic walk of school girls in pairs, as if they were following a funeral or entering Noah's ark, to be there immured.(*r*) For the same reason athletic and active games and exercises are to be preferred and encouraged for boys. Dr. Barlow has written so powerfully upon this subject, that it may be hoped his suggestions will tend to a melioration of the system in general pursued at girl's schools, which, with the injurious regimen of sitting upright on benches or forms without backs or other support to the back, occasions curvature in the spine, crookedness, blanched aspects, shadowy forms, and sickly constitutions, and an incapacity to encounter the duties and dangers of after-life, to which of necessity they must be exposed.(*s*) He then gives the carte or programme of a boarding-school for young ladies, which exhibits *only an hour's exercise*, consisting of a walk arm-in-arm on the high road, and that only when the weather is fine at the particular hour allotted to it, in contrast with nine hours at school or tasks, and *three and a half* at optional studies or work, and states the result, that after forty girls had been at school two years, they were all more or less crooked, and with impaired health.

With respect to the description of exercise and recreation Dr. Combe has very ably demonstrated, that, even as regards exercise, unless the mind concurs, and there is a degree of mental hilarity contemporaneous, there will be but little benefit, and in particular the recreations, many of which he suggests, should be of the most pleasurable and athletic or gymnastic description;(*t*) and he lays down certain principles, as, *first*, that exercise, to be beneficial, ought always to be proportioned to the strength and constitution, and not carried beyond the point, easily discovered by experience, at which waste begins to succeed nutrition, and exhaustion to take the place of strength; *secondly*, that it ought to be regularly resumed after a sufficient interval of rest, in order to ensure the permanence of the healthy impulse given to the vital powers of the muscular system; and, lastly, that it is of the utmost consequence to join with it a mental and nervous stimulus.(*u*)

With respect to adults and dyspeptic patients, walking is to be preferred to riding, unless, being in a weakly state, it may be important to cheer the mind with the view of numerous objects, or an extent of coun-

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(*q*) *Rex* v. *Justices of Yorkshire*, 2 Barn. & Cress. 286; ante, 461, n. (*g*.)

(*r*) Cyclop. Prac. Med. tit. Education Physical; Dr. Johnson on Indigestion.

(*s*) Per Dr. Barlow, Cyclop. Pr. Med. Education, Physical; Dr. Combe's Principles, &c. 110 to 114.

(*t*) Dr. Combe's Principles, &c. chap. iv. v. and vi. *per tot.*; and see Fletcher on Influence, &c. 234, 235.

(*u*) Dr. Combe's Principles, &c. 125.

try, with but little fatigue, in which case horse exercise may be adopted.(*x*) Exercise, whether of body or mind, is the great antidote to all cases of dyspepsia and hypochondriasis when taken in moderation; but few will take regular exercise, mental or corporeal, without some distinct pursuit, which those who are retired have not,(*y*) and hence the necessity in these cases to invent an appropriate pursuit.(*z*) Above all, travelling exercise from place to place appears most salubrious.(*a*) But nocturnal exercise in dancing, commencing about the hour of eleven at night, and terminating about six the next morning, exactly reversing the proper hours of rest, has induced the observation that the drawing-room is the antechamber of the grave;(*b*) and hence the duty of parents to limit the indulgence.

The legislature has so anxiously provided for the health even of prisoners in custody on criminal charges, whether before or after conviction, as to enact, that "all prisoners shall be allowed as much air and exercise as may be deemed proper for the preservation of their health."(*c*) And it is to be hoped that ere long every town and village in the kingdom will have, at the public expense, one or more well adapted open spaces in the most airy and salubrious situation close in its vicinity, sufficiently large and adapted and regulated for every description of exercise and lawful game, so that the poor and middle ranks of society may readily enjoy innocent recreation, and be enticed from their resorts of intoxication.(*d*) The factory regulation act contains provisions for the recreation of children working in factories and mills as regards playgrounds, evincing the intelligence and humanity of the legislature in providing not only for the health but the education and recreation of such labourers.(*e*)

Ninthly, Rest and sleep.

As regards *sleep* it would be beyond our limits to inquire with particularity into its physiology, which has formed the subjects of many works.(*f*) The quantity of sleep is to be measured by constitutional strength and state of health. The average time should be nine hours in youth, and from seven to eight hours during mature age. By habit, health may be continued for years even upon five hours' sleep, but great injury, even paralysis, may thence ensue to the nervous system; and although Lord Coke, as we have seen, considered six hours for rest sufficient, seven hours are preferable.(*g*) The importance of avoiding improper heat in the surrounding atmosphere during the hours of rest has been demonstrated;(*h*) and it has been shown that as the natural temperature of infants is about two degrees under that of the mother, they should sleep in cradles, or, at least, separate from the nurse, unless in very severe cold weather; and it will be observed from the programme of a young lady's boarding-school education, that she is usually allowed from nine to ten hours' sleep during the night, and which time of rest is perhaps unobjectionable.(*i*)

(*x*) Dr. Johnson on Indigestion; Fletcher on Influence, &c. 234, 235.

(*y*) Id. 72, in notes.

(*z*) Dr. Fletcher on the Influence, &c. 234, 235; and ante, 365, 366.

(*a*) Ante, 448, 449.

(*b*) Dr. Johnson on Indigestion.

(*c*) 4 Geo. 4, c. 64, s. 20.

(*d*) See the proceedings in Parliament in sessions of 1833; and 1 Par. & Fonb. 348, 349, n.(*a*.)

(*e*) 3 & 4 Will. 4, c. 103, s. 9 and 24.

(*f*) See authorities observed upon 3 Bost. 248 to 261.

(*g*) A gentleman of robust constitution and regularly temperate, after many years' study, at length by habit and severe regimen was able for three or four years to proceed with only from four to five hours' sleep, but, at length, he by paralysis lost the use of his legs, entirely attributable to undue subtraction of sleep.

(*h*) Cyclop. Pr. Med. tit. Education Physical, and tit. Antiphlogistic Regimen.

(*i*) Id.

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With respect to the temperature of bed-rooms, which are usually too small for so many hours' confinement in an insufficiently ventilated place, we have seen it should in general be about sixty degrees Fahrenheit, or a few degrees above the temperature of the natural external atmosphere;(*k*) and it has been strongly objected that the usual small rooms, with bed curtains surrounding, is exceedingly injurious,(*l*) and the quantity of clothing and surrounding warmth should be sufficient to prevent an abiding sense of chill or coldness; and in general in fever or other illness the most experienced physicians require the immediate removal of the trimmings at the sides of the bed, which retain foul air and interrupt the free circulation. It seems also to be agreed that rest on horse-hair mattresses is preferable to a feather bed, as preventing excessive or wasteful perspiration, and in the navy especially, mattresses constructed of that material, have been found preferable to cotton or other materials, as less affected by damp. For the health and comfort of persons imprisoned even on criminal charges, the 4 Geo. 4, c. 64, s. 18, provides, that every prisoner shall be provided with *suitable bedding*, and that every male prisoner shall have a separate bed, hammock, or cot, either in a separate cell or in a cell with not more than two other male prisoners. It is by securing such due rest and regular habits that it is usually found the health of persons who have been imprisoned for some time is rather improved than injured by the confinement.

In disease, or its approach, the security of bodily as well as mental rest, has ever been regarded as of the greatest importance;(*o*) but the regimen in those cases will be more properly examined in the next part. It has been observed, that literary men should rise early, and be content with sufficient but not too much sleep; and it would be better for them to subtract one hour from sleep and bestow it in active out-door exercise.(*p*)

Noises at night, disturbing sleep, are nuisances at common law, actionable if they affect only one or two persons, and indictable if injurious to several, either inhabitants or passengers;(*q*) and many local acts now contain express provisions against blowing horns and making noises annoying to the neighbourhood; and it is principally in respect of the injury by disturbance and alarm in the night, that burglary is visited with capital punishment.

Tenthly, Particular habits.

It is of the greatest importance to a physician to acquire an accurate knowledge of the previous habits of his patients, in order to adapt the remedies to the nature of the cause, when it can be discovered, as well as to the disease itself.(*r*) But we will here confine our observations to the general influence of habits on health, and as they may become important in legal inquiries.

With respect to *habits* injurious to health, as they frequently become the subjects of inquiry in actions upon life policies, the subject is important to be understood as well by lawyers as by members of the medical profession; and parents would do well to consider them before they fix the employment of their children. They may be classed under two heads, as first, those so absolutely pernicious that no circumstances can

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(*k*) Ante, 449.

(*l*) Dr. Combe's Principles, &c. 195.

(*o*) Cyclop. Prac. Med. tit. Antiphlogistic Regimen, and see 4 Good, 123, 124, &c.

(*p*) Copl. Dict. Prac. Med. 124.

(*q*) *Rex* v. *Smith*, 2 Stra. 704; 1 Par. & Fonb. 351; and see *Street* v. *Tugwell*, M. T. 41 Geo. 3; 2 Selwyn's Ni. Pri. 1006, where, although the jury found that the noise of pointer dogs during the night was no nuisance, the judge held that it was otherwise in point of law.

(*r*) Dr. Combe's Phys. 37; 3 Bost. 169; 4 Good, 434, &c.

prevent the prejudicial consequences; and secondly, those which by long practice become less noxious. Of the former are certain arts and employments which have been arranged under three principal classes, as *first class*, confinement and insufficient ventilation, undue exertion, and sedentary habits; *second class*, undue exertion of particular parts, and insufficient exercise of other parts, or unnatural or contrained positions in different employments, and bad temperature and moisture; *third class*, embraces those causes which consist of material molecules, and which coming directly or mediately in contact with the body, in the state either of vapour or of minute disintegration, penetrate the organs and disorder their functions, such as mineral molecules, vegetable molecules, animal molecules, and mineral and vegetable molecules, acting mechanically. The prejudicial effect of these upon health are fully examined in the works referred to.(*s*)

In life insurances it is usual to introduce a warranty or stipulation as to the habits of the person whose life is to be ensured, "and that he is not engaged in *any occupation*, nor accustomed to *any habits* prejudicial to health." This stipulation is so comprehensive, and affords so much latitude in defence, that it is obviously essential for the person effecting the policy, to make the most particular inquiry into the exact occupation of time and habit of the person, and not only in writing to represent the whole to the ensurers, but also endeavour to qualify such warranty; for otherwise, although himself wholly free from fraud or misrepresentation, he may lose the benefit of his security. Thus, an ensurance effected on the life of the Earl Marr, for the security of Sir W. Forbes & Co., was endangered by the subsequent discovery that he was in the habit of taking two or three ounces of opium each day, which Dr. Christison considered highly prejudicial to health.(*t*)

The second description of habits, or those which by long usage become either less noxious, or not so at all, are so various as to be almost incapable of enumeration, and depend much upon the previous strength of the constitution which they assail. Great is the power of habit;(*u*) and we have seen that it frequently occurs that persons who have long resided in a neighbourhood surrounded by offensive stenches, injurious to others, will continue healthy, and be so reconciled to it that they will declare it to be no nuisance;(*x*) and we have seen that adulterated and deleterious articles of beverage, by habit may become in a degree less noxious.(*y*) It is partly on this account that it is a rule, at least in advanced life, not suddenly to change a habit, especially as regards diet, "ne subito muta assueta quia assuetudo est altera natura," or in other words, not suddenly to change a habit, or give up an indulgence as regards diet or drink, although originally baneful, because habit is second nature; and many instances are upon record of the fatal consequences of a sudden change of habit, especially as regards a hasty reduction in stimulants, as wine, spirits, &c.(*z*) In judicial inquiries, evidence as well of local as individual habits, such as a person being left-handed, will frequently have decisive weight, and in doubtful cases, therefore, requires minute investigation.

(*s*) Copl. Dict. Prac. Med. tit. Arts and Employments; Cyclop. Prac. Med. tit. Artisans. See further as to dangerous trades, 2 Par. & Fonb. 457; 3 id. 8; anemia in mines, from loss of sun and air, Cyclop. Prac. Med. tit. Anemia; 2 Par. & Fonb. 355; snuff taking, id. 419; painter's colic, id. 355, 1 Good, 160. As to habits dangerous to apoplectic persons, G. Smith, 35, 36, Cyclop. Prac. Med. tit. Apoplexy.

(*t*) See the case in the Lancet, 28th January, A. D. 1832, p. 614 to 617; and see G. Smith, 181.

(*u*) See, in general, 3 Bost. 169.

(*x*) Ante, 305; and see 1 Par. & Fonb. 341, note (*a*;) 347, 348.

(*y*) Ante, 456, 459; G. Smith, 66, 67.

(*z*) Copl. Med. Dict. tit. Climacteric.

CHAP. XIII. CONTINUANCE OF HEALTH AND HAPPINESS.

Eleventhly, Quiescence and pleasure of mind.

In considering the temper, passions, emotions, affections, and mental feelings, and the mind and intellectual faculties,(*a*) with conscience and the soul,(*b*) we attempted to show how important are each to health, independently of any religious regard to a future state, and we ventured to suggest that in some respects our law is defective, at least in not affording full security against the numerous injuries from third persons, by which each of these is constantly assailed.(*c*) We have seen that the exciting as well as the depressing passions will not only greatly increase disease, but will frequently actually produce it; and where there is a slight defect which in a quiescent life would be unimportant, as aneurism of the aorta, or in one of the auricles or ventricles of the heart, the same may, by excitement, occasion sudden death.(*d*) In infancy and the early stages of life, we have seen that tranquillity of mind is absolutely essential to health, and that as soon as the mind begins to be developed, the government of the passions is of the greatest importance towards attaining the ends of physical education.(*e*) From puberty until towards an advanced age, the perfect health and happiness of every one, whether rich or poor, is more influenced by his own moral conduct, and by anxiety and mental distress, than by any external circumstances. The affluent, sensible that many of his afflictions are the result of the want of self-control, has little solace in reflection, and suffers deeply; whilst the poor, who patiently submits to his humble lot in life, is cheered and supported in his privations by the sense of that due submission, and the assurance that he is acting a consistent part in life. At declining age, which includes from forty or forty-two to fifty-two in the female, and from forty-eight to sixty in the male, the feelings, emotions, disappointments, and anxieties of life manifest more fully their effects upon the internal organs as well as upon the external aspect.(*f*) It is then too late to retrace misspent days, and too late to expect advancement in life, if not already obtained; then, therefore, principally prevail all morbid reflections leading to hypochondriasis and self-destruction, unless the mind has been duly cultivated to prevent such a state of affliction. Towards the age of sixty-three, the predisposing cause of climacteric disease is very frequently mental anxiety and suffering, the corroding influence of which, it has been truly observed, will eventually sap the foundations of the most robust constitution.(*g*) To secure mental composure in the eve of life, let every one, ere it is too late, remember the dying and memorable exclamation of Cardinal Wolsey, "Had I but served my *God* as diligently as I have served my *king*, *He* would not thus have forsaken me in my gray hairs."

So sensible are physicians of the melancholy consequences of evil tidings, and of fear or anxiety, or indeed of any depressing passion, that it is considered by them a duty not only to prescribe quiescence of mind and mental repose,(*h*) but even to conceal danger when perhaps the mere apprehension of death might occasion it, leaving it in general to the most cautious relative to communicate the necessity for preparing for the event.(*i*)

(*a*) Ante, 310 to 372.
(*b*) Ante, 367 to 372; Cyclop. Prac. Med. tit. Disease.
(*c*) Ante, 310 to 372.
(*d*) Ante, 312 to 323, 364, 369; 1 Par. & Fonb. 127, 314, note (*a*,) 351, 352; 363; 2 id. 26 to 30, 44, 110, 127; 3 id. 14, 145.
(*e*) Per Dr. Barlow, Cyclop. Prac. Med. tit. Education Physical.
(*f*) Amer. Cyclop. Prac. Med. tit. Ages.
(*g*) Per Dr. Roget, Cyclop. Prac. Med. tit. Ages.
(*h*) Cyclop. Prac. Med. tit. Antispasmodics, per Dr. Barlow.
(*i*) See observations of Sir H. Halford, Med. Gaz. 600 to 603; G. Smith, 537; 3 Bell, 90; Lizars, preface, ix.

CHAP. XIII. CONTINUANCE OF HEALTH AND HAPPINESS.

In his recent publication, Dr. Combe has demonstrated how exceedingly important it is, as regards health as well as productive labour, that pleasure, or at least composure of mind, should concur and co-operate with the labour of the body, as well in healthy employments of business as in exercise and recreation, a truth most important to be kept in view in legislating upon all subjects relative to the employment of the poor and securing their contentment;(*k*) and from the absence of such co-operation, it is clear that the agricultural labourers, in their present depressed and ill-rewarded state, do not perform much more than half the work as when they were liberally paid in money and received no parochial relief.

The legislature of late, in various proposed enactments, has evinced a humane desire to compensate, or rather mitigate, the privations of the poor, incident to their station, by securing to them a degree of pleasure and quiescence of mind that would result from the enjoyment of innocent recreations; but as regards all classes of society, it will be found that our system of education, as well as our municipal regulations, are exceedingly defective, in the absence of due measures to secure quiescence of mind, and the want of adequate punishment for many mental injuries of the most injurious description.

(*k*) Dr. Combe's Principles of Physiology applied to the Preservation of Health.

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