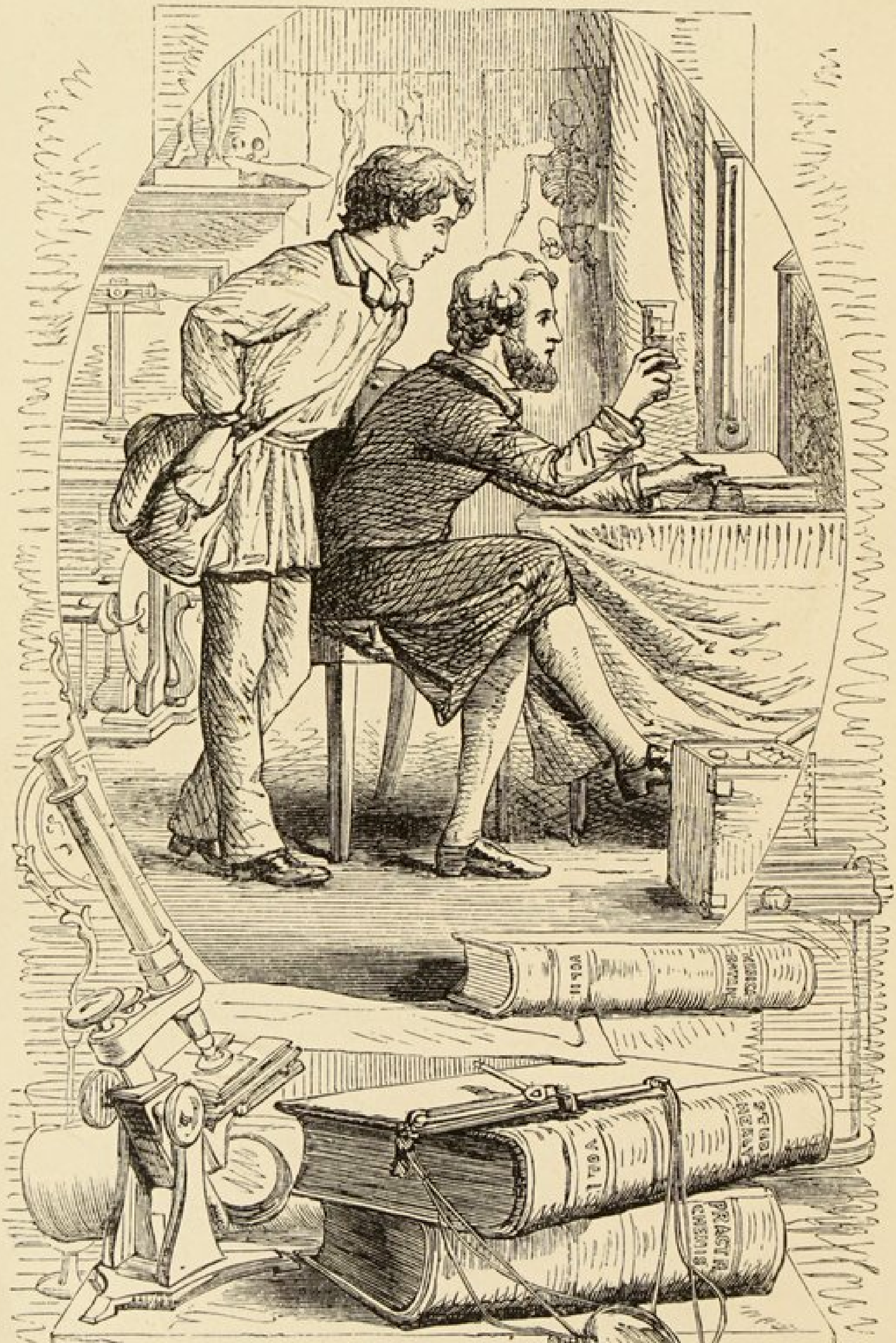
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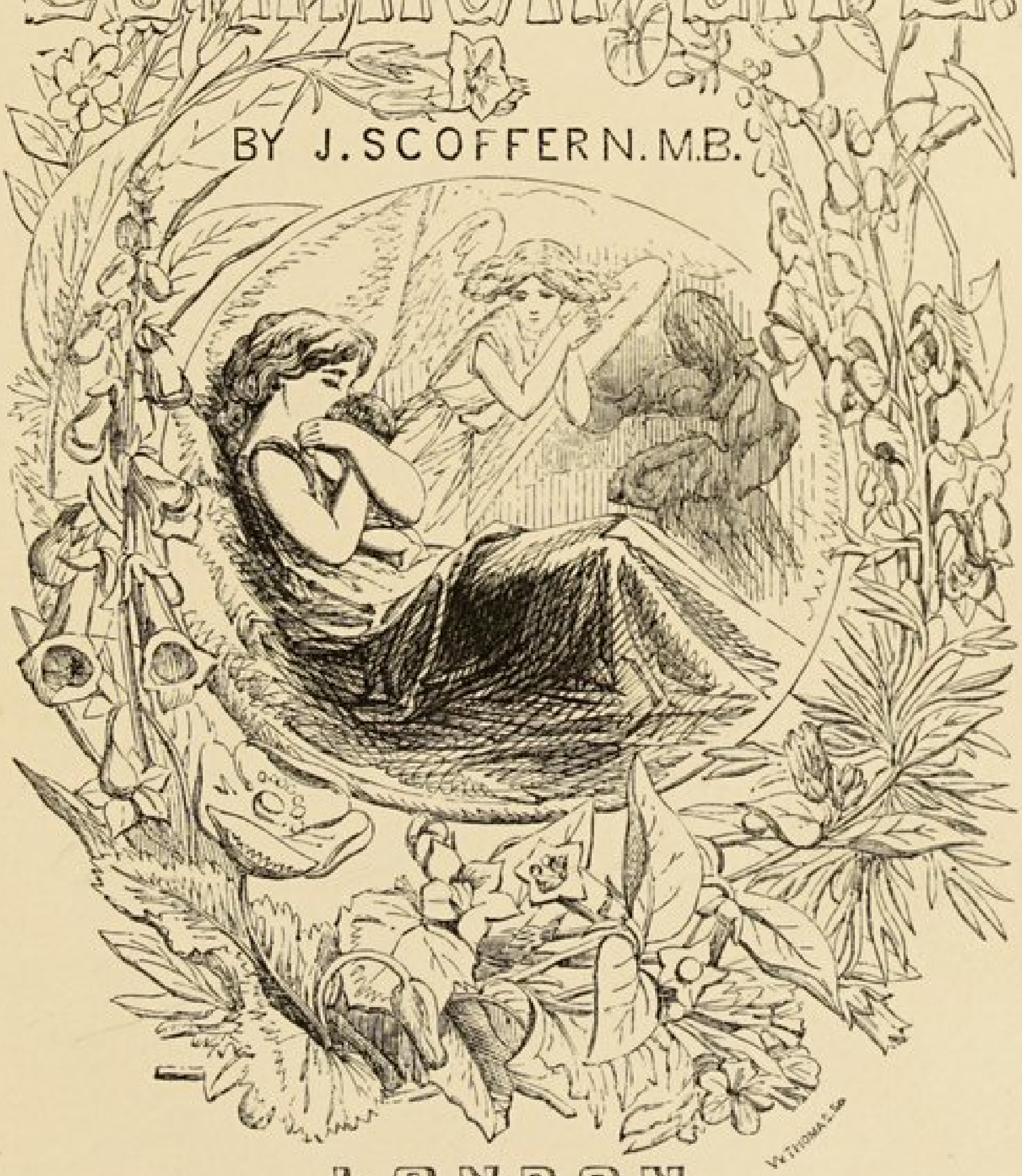
THE PHILOSOPHY OF COMMON LIFE.

BY J. SCOFFERN. M.B.



LONDON.

WARD & LOCK. 158 FLEET St

1857

THE

PHILOSOPHY OF COMMON LIFE;

OR,

The Science of Health.

BY

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AUTHOR OF "CHEMISTRY OF THE IMPONDERABLE AGENTS, AND INORGANIC BODIES;"
"CHEMISTRY NO MYSTERY;" "TREATISE ON METEOROLOGY;"
"THE SUGAR MANUFACTURE AT HOME AND ABROAD,"
ETC. ETC.

LONDON:

WARD & LOCK, 158, FLEET STREET.

MDCCCLVII.

LONDON:
PRINTED BY PETTER AND GALPIN, LA BELLE SAUVAGE YARD,
LUDGATE HILL.

TO

The Right Honourable Sir Benjamin Hall, Bart.,

THE FOLLOWING PAGES

ARE RESPECTFULLY INSCRIBED

AS A

HUMBLE TESTIMONY OF ESTEEM FOR HIS LABOURS IN THE

CAUSE OF PUBLIC HEALTH.

BY HIS

OBEDIENT SERVANT,

THE AUTHOR.

CONTENTS.

PREFACE.

THE following pages are written to illustrate one of the best sentiments which actuate humanity ;—a sentiment which is only begotten under conditions of high moral and material advancement, and to which practical effect can alone be given by co-operative aid; *The sentiment of a common weal, predominating over private, and individual benefit.*

The spirit which actuates schemes of hygiene, imparting to them life and energy, is essentially of this kind. Few are so intrinsically benevolent or pure: few demand more abnegation of private or immediate interests. The conditions, which determine the growth, and regulate the progress of epidemic scourges, are more thoroughly known, than the fear of jeopardising personal interests, suffers many—in their private, or individual capacity, to believe: from which it seems to follow that no amount of private or personal energy, wealth, or benevolence, can be equal to the wants of an efficient system of hygiene. It is only to be accomplished by the dominating force of a government; and it is a purpose to the accomplishment of which, the energies of our own government have been too little directed.

In dealing with the subject of Hygiene (a word for which we seem to have no equivalent of perfect accuracy in the English language), I have ventured to term it the "philosophy of common life." In the restricted space of this little volume it would have been impossible to touch upon all the ramifications of a subject so comprehensive, and so varied. Discriminative selection therefore followed as a duty; hence on the recorded opinion of an intelligent public, for or against the correctness of judgment, wherewith this discrimination has been exercised, the author must be content to rest, in a very considerable degree, the pretensions of his book.

Violations to the immutable laws of public health, may be reduced to the three sources of—ignorance, accident, and crime. From each of these, wells forth a torrent of insidious poisons which undermines our health; and by bringing to bear influences, sure though unseen, curtails our days. With the exception of the case of the adulteration of food and medicines, it has been found necessary, in order to keep within the limits at command, to avoid all consideration of the hygienic evils referable to crime. Nor was there wanting another reason which influenced me in this determination. Whenever the relations of crime to disease are freely set forth, and the veil of hypocrisy which shrouds the subject torn away—some hideous truths will come out; truths which reflective people must be aware of, though, by a convention of spurious refinement, all tracing of causes to effects, in this matter, are left untold. The writer who ventures on this delicate ground must deal plainly with facts, stating them as they are. For this reason I have preferred to deal with the branch of hygiene referable to crime, by itself, alone, hereafter; and I have in the following pages restricted myself to the consideration of things which people of every condition, sex, and age may study with—perhaps, advantage, certainly, without harm. For reasons which are in their proper place explained, the subject of medical quackery has been discussed under the head of "medical creeds." It was no part of my object to discuss the merits of rational systems of medicine; much less to accept the position of family medical adviser, and indicate formulæ of medicines, for this, or that disease;

but I have felt it incumbent on me to guard the public against yielding to the fascinations (for fascinations they must be) of medical mysteries, and reposing faith on homœopathy, hydropathy, or any other of the genus of "pathies," without at least trying to learn, the reason why. The tenets of homœopathy are dealt with in a manner as free from technicalities, and as consonant with the practice of rational, investigation, as the genius of the subject permits. If the picture drawn of homœopathic absurdities, and homœopathic knavery, be somewhat glaring, the fault rests with those who furnished the materials; assuredly not with me.

THE PHILOSOPHY OF COMMON LIFE;

OR,

THE SCIENCE OF HEALTH.

CHAPTER I.

THE HUMAN BODY REGARDED AS A MACHINE.

It has been remarked, and not without cause, that, fortunately, we are not transparent. If the complexity of our mortal mechanism could be seen—the heart pumping, the arteries conveying the stream of life to the farthest limits of the system, the veins bringing back the deteriorated blood, the lungs purifying it and rendering it once again adapted to the purposes of corporeal invigoration—if all these functions, and many others of which the human body is the theatre of action, could be made evident to us, we should move about in anxiety and trembling, fearful of damaging a machine so complex, so wonderfully put together. On the other hand, the position is undoubted that of the vital functions most of us take far too little heed. We crave after health and longevity in the abstract, but too frequently neglect the most obvious means by which these ends may be secured. We endeavour to compensate for our neglect or ignorance of these matters by invoking the physician's aid—not unfrequently counteracting the efficacy of medicine by adopting practices and modes of life in direct antagonism to the most obvious laws of health.

B

An acquaintance with the outlines of anatomy, or the construction of our frames, and with physiology, or the knowledge of their functions, might save us from many evil consequences. Not that the details of either are necessary or desirable; they could not indeed be imparted except to those who had been previously made acquainted with the principles of many other sciences; they could not, therefore, become a part of general education. But the broad features of anatomy, and physiology, can be learned and appreciated by every person. They embrace facts which should be numbered amongst "common things" necessary to the health, and comfort, and well being of all. Independently of the direct benefits resulting from a study of this kind, there are others which, though indirect, are scarcely less beneficial. The human structure viewed in the aggregate is a beautiful machine; every part of which is so admirably adapted to the fulfilment of an end, that by it we see, better than through the medium of any other study, the evidence of Omnipotent design. The eye embodies principles of vision which the optician copies, so far as his means will permit, in the manufacture of artificial instruments: the construction of bones, and especially the bones of birds, suggests to the engineer the most efficient means of combining lightness with strength; anticipating by the time which has elapsed since the first creation of animals, the mechanical principles now recognised and applied in the construction of tubular bridges and iron ships. The human hand alone is a miracle of constructive mechanism, and has been made the subject, by one of our leading anatomists, of a large volume for expatiating on its admirable fitness to ends desired. Propably no study so well as anatomy brings the truth home to an observer, that nothing which exists, exists in vain.

Perhaps an acquaintance with anatomy and physiology has a still deeper claim to our consideration, in the power it imparts of benefiting whole classes and communities of human beings. The wants of man in a civilised condition involve the sufferings of trades and occupations which minister to those wants. The human machine can hardly be restricted to one kind or class of operations without calling into activity a particular set of organs or of functions, to the prejudice of others; or by involving deleterious agencies controllable by proper means. Much of the injury from either may be obviated by proper corrective measures, founded upon an appreciation of the evils at work. A familiar illustration of the latter is afforded by the operation of needle grinding. It so happened that artisans employed in this avocation were placed under influences more uniformly fatal than any other persons whatever. Popularly, the military service is considered to involve the greatest dangers, but the idea is erroneous; thousands of avocations expose those who follow them, regarded in the aggregate, to a shorter average mortality. Needle grinding was one. To find a needle grinder older than forty was rare; to discover one so old as forty-five was a prodigy. The evil long subsisted before the true notion of its cause was suspected. At last the explanation became apparent; the steel dust from the needle points being inspired along with air into the lungs, gave rise to a kind of consumption, which speedily terminated in death. A full appreciation of the cause of injury speedily suggested a remedy in the form of masks of magnetised iron and a powerful draught; the former intercepting the particles of iron already on their way to the lungs, the latter blowing the remaining particles away in another direction.

ANATOMICAL DESCRIPTION OF THE HUMAN BODY.

Even in a book which deals with the subjects of anatomy and physiology in a popular manner, some kind of classification will be necessary, and frequently it is convenient in these popular expositions to reverse the order of scientific treatment. I am disposed to believe, however, that for present purposes, the order followed by the professed anatomist will be the best in this place, that is to say, it will be best to commence with the skeleton, *the bones.* The sight of a human skeleton, to many non-medical people, is suggestive of something repulsive and horrible. The feeling is so little implanted in us by nature, that few people can long ponder over a skeleton and examine its beautiful adaptations, without altogether losing the consciousness of this feeling of horror, and being impressed with the admirable fitness of every part.

The repugnance with which people in general look on a skeleton is mainly traceable to the monkish fiction of the middle ages, which symbolised, under the form of a skeleton, the abstraction of death. It is not a little to be marvelled at that a symbolisation so earthy and material should have been the offspring of Christianity; seeing that the Greeks and Romans, before our pure religion had dawned, symbolised the condition of death more spiritually by the semblance of a pale and beautiful woman. Whatever repugnance the reader may have to the skeleton, I must beg him to get rid of it; for the skeleton, or, at any rate, the bones of which it is composed, will now have to occupy a portion of our attention.

Firstly, looking on the skeleton in the aggregate, the part which most prominently displays itself is the peculiar structure of what is commonly denominated the "backbone." Anatomists term it the vertebral column, and a very expressive denomination too it is; seeing, firstly, that it is columnar, and that the column, instead of being made up of one bone, is made up of no less than twenty-four, all of them capable of more or less motion on each other—they turn on each other, in point of fact: whence, from the word *vertere,* to turn, the propriety of the term vertebral column, or simply the vertebræ, becomes manifest.

The *vertebral column,* or *backbone,* consists, as already stated, of no less than twenty-four bones, no two of which are precisely alike. The bones of the vertebral column when joined together, as in the human body, form a canal, through which passes a soft substance, commonly known as the spinal marrow. Very different, however, is this from ordinary marrow, being in point of fact composed of nervous matter, like that which forms the brain. Sometimes the spinal marrow is described as a continuation or prolongation of the brain, and for ordinary description this view of it may be entertained, though the statement be not anatomically quite true. Let us now contemplate how admirably the vertebral column is formed with reference to its duties and uses. Firstly, it has to be very strong, because a host of muscles are connected with it; the vertebral column, too, has to be pliable, admitting of motion to a variable extent, and towards the head of motion in every direction. Were it not for this facility of motion, the vertebral column might as well have been made up of one single rigid bone at once; but what a position should we have been placed in,—unable to bend our backs, much less our heads! A crocodile made to stand upright would have been scarcely so unwieldy. Now these requisites, so indispensable to the proper functions of the vertebral column, are antagonistic to each other. A problem of greater difficulty could not perhaps be given to the engineer than that of protecting a delicate cord from external injury by surrounding it with a hard sheath capable of omnilateral motion. Yet how completely this problem has been solved by the great Architect of our bodies in the vertebral column may be inferred from the rare occurrence of accidents! Serious injury to the spine is an unfrequent calamity, and the grave character of the kind of injury when it occurs is a sufficient indication of the care which nature must have taken by way of provision against it.

Although every portion of the vertebral column, except the lowest extremity, is capable of some amount of motion, yet as between any two adjacent bones of the column, with two remarkable exceptions, the amount of motion is small. The greater amount of mobility participated in by two vertebræ evidently refer to those which permit the motion of the head. The circumstance scarcely needs to be indicated that the motion of which the head is capable is far more considerable than the motion of the back. Backwards or forwards, or on either side laterally, the head is capable of a motion so extensive and so universal that the presence of what mechanicians term a "ball-and socket" joint seems to be indicated. It is not thus, however, that nature has gained her ends. Had there been a ball-and-socket joint, the quality of freedom of motion would have been indeed imparted, but the first turn of the head to any considerable extent, in any direction, would have been necessarily fatal, inasmuch as the spinal marrow must have been severed, had not some special provision been made against it. The device, therefore, has been adopted of providing two vertebræ, each imparting a different class of motion. The first vertebra is called by anatomists "atlas," because it supports the skull, or head, just as the Atlas of mythology was fabled to support the world. Upon this atlas the skull rests, and suitable provision is made for all the backward and forward, or nodding motion of which our heads are capable, but nothing more. The lateral or rotatory motion is accomplished by the joint which exists between the first, or atlas vertebra, and the second, to which the appropriate term "axis" is applied.

Even in the human being, the structure of the backbone is wonderful; but he who would contemplate the various and seemingly antagonistic functions of a backbone displayed in the most extreme degree of which they are capable, should turn to the skeleton of a serpent. What can be more seemingly free and unconstrained than the motions of a snake as it glides over the surface of the ground, or climbs a tree, or darts its head, with the velocity of a spring unbent, against the prey on which its eye has rested? Still more wonderful is this freedom of movement as displayed by the boas and pythons—large species of poisonless serpents, which crush their prey to death before swallowing it. The bodies of these creatures appear to have a rope-like flexibility to such an extent that the idea of their possessing backbones might be almost deemed impossible. Yet backbones they have, like our own in character, though far more wonderfully constructed, inasmuch as the freedom of motion possessed by them is greater, and the force which they are enabled to apply is tremendous. The backbone of the boa-constrictor is composed of no less than three hundred and four distinct bones, to no less than two hundred and fifty-two of which, ribs are attached. And while on the subject of the ribs of serpents, the fact may as well be noticed that the ribs of these creatures not only serve the proper functions of ribs, *i.e.*, to confine and protect the visceral organs, but they also to a certain extent perform the office of legs.

Scarcely less admirable than the vertebral column of the serpent is that of certain long-necked birds; as an example we may take the swan. Human beings, and indeed all animals which suckle their young, have only seven neck vertebræ; but birds have more: the swan, for example, has no less than three-and-twenty.

Returning once more to the backbone of a human individual, let us view it in the aggregate. Omitting minor points of consideration, such as would be noticed only by the anatomist, let us observe what a veritable line of beauty it makes when viewed laterally. It is bent into three well-marked curves; the largest of these corresponds with the hollow of the back, and its concavity looks backwards; the concavities of the other two look forwards respectively, the upper one contributing to give a graceful curve to the neck; the curve of the lower one not being recognisable, except in the skeleton, because it is lost in the contour of the hips.

BONES OF THE CHEST.

The chest, or thorax, is the cavity which contains the lungs, the heart, and other less important organs. The bony or skeleton part of the chest is suggestive of the rib-work of a ship; and indeed the rib-work of our bodies largely contributes to the formation of the human chest—twelve pairs of ribs, two sternum or breast bones, and twelve vertebræ, or pieces of the backbone, entering into its construction. Glancing at the contour of the skeleton chest, the observer will not fail to recognise its well-marked conoidal form, the apex of the cone pointing to the neck, and the base of the cone corresponding with the lower part of the chest. If the observer be contemplative, he will not fail to propose to himself the question how this bony rib-work can be accommodated to the varying fashion of ladies' waists—rising upwards, or falling downwards, as they are accustomed to do, at the tyrannical dictum of the last ukase from Parisian modistes. Nothing can be more readily demonstrated than this: the smallest part of a lady's waist ought not to begin higher up than the twelfth rib; and if she violate the anatomical dictum by any external skeleton work of whalebone and steel, she can only do so at the expense of rendering herself a monster to the appreciation of every eye educated in accordance with the true principles of beauty. Of ladies who err to any considerable extent in the distortion of their chests by the forced restraint of stays, it may be averred, in more senses than one, that their hearts are not in the right place.

A second glance at the general bony contour of the chest will, perhaps, cause the observer to ask whether some inversion of parts have not occurred. Looking at the human chest, instead of the mere bones of the latter, the notion of a cone is still conveyed, but the apex seems to look downwards. This results from the mass of external fleshy and other covering, more developed in woman than in man, and by the presence of which the beautiful rotundity of bust is given.

BONES OF THE PELVIS.

Omitting for a time the examination of the bones of the head, the next system of large bones which presents itself to our notice is that of the pelvis or hips. The pelvis forms the lowest part of the trunk; it consists of a pair and two single bones, which the general reader will hardly take the trouble to examine individually; neither shall I burden his memory with their anatomical names. The anatomist can readily discover from its general appearance whether the skeleton viewed in the aggregate, or individual portions of the skeleton, belong a male or female subject; but this discrimination would not to a general observer be easy. The pelvis, however, differs so considerably in its general contour, according as it belongs to the male or female subject, that an observer must be careless indeed who is unable to discriminate the sex. The breadth of the female pelvis has reference to the peculiar characteristics, and functions of maternity, which need not be further adverted to.

Glancing downward from the pelvis, we perceive the various bones which go to the formation of the lower extremities. Observe, here, the beautiful articulation of the femur, or thigh bone, with the pelvis: what a complete ball-and-socket joint it forms, and what freedom of motion is permitted! Observe, too, the line of direction of the femur; not a vertical line, which arrangement would expose the trunk to all manner of destructive shocks; but a diagonal line, the upper portion of the femur looking outwards, and the lower portion inwards, in such manner that the knees of a skeleton appear to be placed much closer together than they give the impression of, in the living subject.

Passing downwards in the direction of the feet, we have next to pay attention to the construction of the knee joint, which is composed of three bones and various cartilages, also a delicate membrane lubricated by a sort of oil profusely supplied, and termed "synovia;" it is with the bones of the knee, however, that we are exclusively concerned at the present time. In front of the knee is a concave shell-like bone, vulgarly known as the knee-pan, or knee-cap, but termed by anatomists the "patella." The two remaining bones which form the knee are the tibia and fibula; being, indeed, the two leg bones. The leg is composed of two bones rather than one, chiefly because of the greater space given for the insertion of muscles; there is, however, some slight motion between the tibia and fibula, though very little. The foot is composed of no less than twenty-eight bones; namely, seven bones in the tarsus, five in the metatarsus, fourteen phalanges, and two disconnected bones called "sesamoid." If the bony structure of the foot be examined, it will be seen to constitute an arch; which formation not only imparts a spring-like quality to the lower extremity, thus diminishing the violence of shocks, but the arch is the strongest of all forms that admit of being constructed with a given quantity of materials.

THE UPPER EXTREMITIES.

From the bones of the lower extremities turn we now to those of the arms and their appendages. It is necessary that the arms should have far greater freedom of motion than the legs; hence, their bones are constructed and arranged on a different type. Instead of a rigid, bony mass, like the pelvis, the shoulder, or rather the bones which constitute it, are movable. Firstly, the bladebone, or scapula, is conspicuous by its flat triangular form, enabling it to slide over the posterior aspect of the ribs. Then there is the clavicle, or key-bone, known popularly as the "collar-bone," attached by its outer extremity with the "bladebone," and by its inner extremity to the upper division of the "sternum" or breast-bone. Simple inspection will demonstrate the amount of motion of which the bladebone and clavicle, viewed collectively, are susceptible; but the extremely free movements of the upper arm are chiefly provided for by the articulation of the humerus, or bone of the upper arm, with the clavicle. The articulation in question is a ball-and-socket joint, the socket of which is extremely shallow, so that a wide extent of backward, forward, lateral, and rotatory motion is imparted to the arm. This extreme freedom of motion, however, is given at the expense of stability: hence, dislocation of the shoulder is an accident of far more frequent occurrence than dislocation of the hip-joint.

As in the case of the lower extremity, it will be seen that the upper arm is composed of one single bone, *i. e.* the "humerus," whereas the fore-arm has two bones. It will also be seen that two bones which constitute the fore-arm are endowed with a large amount of rotatory motion, otherwise the hand would be very ill adapted to the numerous purposes of which it is now capable. Were it not for this power of rotatory motion subsisting between the radius and ulna (the names of the bones of which the fore-arm is composed), the hand would have been a clumsy, rigid member. It might have been planted on the extremity of the fore-arm so as to look upwards or downwards, outwards or inwards; but, in whatever direction planted—there, a fixture it must have remained. By the beautiful contrivance, however, of the rotation of the radius on the ulna, all this rigidity is obviated.

THE HAND.

Each hand consists of twenty-seven bones, which are divided into three series of carpal bones, metacarpal bones, and phalanges. Of these the carpal bones, together with the radius, form the wrist-joint; the metacarpus forms the palm of the hand, and the phalanges the fingers.

BONES OF THE HEAD.

The bones of the head, if we reckon the teeth and four little bones which exist in the ears, are no less than sixty-two in number: what may be termed, however, the bones proper of the head are twenty-two in number. These in their turn admit of division into bones of the skull, and those of the face. If the bones of a young child's head be examined they will be found to be actually separated from each other; but as the child grows into the adult the bones join by a dove-tailed contrivance suggestive of the mode in which the parts of cabinet-work are put together: these junctions are termed "sutures." The bones of the skull and face are named:—

BONES OF THE SKULL.

2 Parietal bones.	1 Frontal bone.
2 Temporal bones.	1 Occipital bone.

BONES OF THE FACE.

2 Cheek or malar bones.	2 Palate bones.
2 Upper jaw bones.	2 Turbinated bones.
2 Nasal bones.	1 Vomer, or ploughshare bone.
2 Lachrymal bones.	1 Lower jaw bone.

BONES COMMON TO BOTH SKULL AND FACE.

1 Ethmoid bone.	1 Sphenoid bone.

COMPOSITION OF BONE.

Having thus sketched a general outline of the bones, mentioned their uses and their names, it will now be necessary to describe their composition and mode of formation. If a bone, no matter from what animal or from what part of an animal, be enclosed in a vessel capable of withstanding fire, and strongly heated until no more volatile matter comes away, the solid which remains behind will be found to have preserved the shape and contour of the original bone; but it will be black, and will have the appearance of a piece of charcoal: in point of fact, a considerable portion of it *is* charcoal, and may be purchased under the name of bone black. Quite certain is it, therefore, that carbon, or the matter of charcoal, must be a constituent of bones.

Nevertheless, that the whole of the black substance thus resulting is not charcoal is abundantly testified by the following simple operation :—If, instead of enclosing a bone in a fire-proof vessel as just described, it be burned in an open fireplace, air being freely admitted, all the carbonaceous or charcoaly portion is removed, and a white mass, still retaining the form of the original bone, remains. To this white mass we may apply the designation "*bone-earth*," reserving a description of the exact chemical nature of this bone-earth until hereafter. Quite certain is it, therefore, that bones contain not only carbon, or the matter of charcoal, but also what we have agreed to term bone-earth; and also a certain material, or materials, which pass away in the state of a volatile product. Let us pursue our chemical investigation of the nature of bone a little further.

If a bone be immersed in weak muriatic acid until nothing more is dissolved, all the bone-earth is removed, and an elastic, gelatinous mass, still retaining the original form of the bone, remains. This white, gelatinous material is, in point of fact, gelatine; if boiled in hot water, it dissolves, and forms a thick, colourless soup, very much resembling that which results from the solution of isinglass in water. Now this gelatine may be, in general terms, described as a compound of the volatile materials which are evolved when bone is burned in a close vessel, and carbon, or the matter of charcoal. These facts will be a sufficient groundwork for our investigations relative to the composition of bone.

It will be perceived, then, that bone is made up of two proximate principles—one bone-earth, the other gelatine; on the due apportionment of which the strength of bones depends, also the adaptation of bones to their numerous uses. Bone-earth imparts hardness and rigidity, whilst the quality of elasticity is given by gelatine. Had they been exclusively composed of bone-earth, they would have been continually breaking; but had they, on the contrary, been made up exclusively of gelatine, then our limbs would have doubled together, deprived of all their strength.

Now, it must be remembered that the bones, like every other part of the body of animals, are made up of elements supplied to them by the blood, and the blood in its turn derives its constituents from the food we eat. If our food were to be altogether deprived of the matter of bone-earth, the bones would be devoid of this material; upon an appreciation of which fact depends a very important physiological principle.

Every person must have noticed the fact that children and young people bear falls, and blows, much better than grown-up persons. The bones of children are very seldom broken; and when this accident does occur, reparation is soon made. The bones of old persons, however, are fractured by the slightest possible causes; not unfrequently by the act of turning suddenly in bed. The difference between the two cases arises from the difference in the relative amount of gelatine, and bone-earth in the bones.

Notwithstanding, however, that it is for a wise and benevolent purpose that the skeleton of young people is more cartilaginous than obtains in after years, this condition of softness may proceed to extremes, and a disease may result, to which the name of rachitis, or rickets, is given. The disease is characterised by a preternatural softness of the osseous tissue, a further consequence of which is crookedness of the bones; which hardening whilst they are still crooked, permanent deformity results. Rachitis is caused immediately by a disordered state of the digestive functions, preventing the due amount of phosphate of lime (the chief matter of bone-earth) from being supplied to the blood; and is primarily caused by bad conditions of air, and of food.

Even when the digestive powers of the child are good, and the air it breathes is pure, and the food it receives is unexceptionable, still crookedness of the limbs—the legs especially—often results from improper treatment. Children in very early life should never be encouraged to walk much; for, though exercise is good for them, the sort of exercise which requires long standing is reprehensible. They should be always supported; or, still better, encouraged to crawl on the floor, until the state of their osseous skeleton is proof against the hardships which the act of walking involves.

MECHANICAL STRUCTURE OF BONES.

It is an unvarying principle of nature to produce effects with the least possible expenditure of material consistent with the amount of strength required: nothing being vainly given or thrown away. This principle is admirably illustrated in the formation of the bones. In some cases, as, for example, the bones of the head, strength is imparted by fashioning them into peculiar arches or curves. In the structure of the foot, by which the whole weight of the body has to be supported, strength is given less by the configuration of each individual bone than by the method of building them together; and in the large bones of the extremities material is saved and strength secured by excavating the centre of the bone, and filling it, in terrestrial animals, with marrow. To birds this lightness of bone, consistent with strength, is of greater importance still: not only do these creatures require to have bones which are exceedingly strong, in order that the enormous strain upon them may be borne, but increased weight would interfere with the necessities of aërial locomotion; accordingly, not only is the material of the bones of birds exceedingly compact, and the walls of the cylinder very thin, but the central space, for the most part, contains nothing more substantial than atmospheric air.

MUSCLES.

A very large portion of animal bodies is made up of the material to which the term flesh, in ordinary language, is applied, but which, in the language of anatomy, is called "muscle." This is the substance which, by its contraction, gives rise to movements, and therefore is a very important part of animal bodies. The structure of muscle is fibrous; even by the naked eye these fibres may be seen, and when examined microscopically the intimate nature of the fibre is rendered evident. Casual observation might suggest the notion that muscle or flesh is composed of masses irregularly formed: this is not so, however,—its material being fashioned into definite individual shapes, to each of which some specific anatomical name is applied. The cause of muscular motion is not known; and, although many theories have been advanced respecting it, none of them are worthy of adoption.

Muscles are usually attached to the bones by means of tendons, in which they both commence and terminate: they are held in position by sheaths, and their tendons are frequently imbedded in grooves. In proportion as muscles are used, so do they become strong and well developed. This result may be seen in the persons of those who are especially devoted to one pursuit and occupation. Blacksmiths and goldbeaters have the muscles of the right arm enormously developed. In dancers it is the muscles of the legs which increase in size, those of the upper extremities being puny and insignificant. The exercise of fencing causes an extraordinary increase of the muscles of the right arm and left leg, as being those most called into operation by that particular exercise. Very few movements have the advantage of exercising all the various muscles equally. Some act inordinately on one set, some on another. The object of well-devised gymnastic exercises is to bring all the various muscles into due operation; hence gymnastics should be regulated by some person conversant with the structure and requirements of the human body.

Very few conditions can be more prejudicial to the health and development and general well-being of muscular fibre than long-continued pressure. This condition is powerfully illustrated by the, alas! too prevalent habit of tight-lacing.

When the physician reads his female patient a lecture on the impropriety of tight lacing, urges her for a time at least to abandon her stays, and solicit health and strength from gymnastic exercise, properly regulated, she plaintively replies that her stays are necessary to her; protests that she could not do without them—that they are a support. Doubtless, a lady who has long tortured herself by the practice of tight-lacing will find her stays a support; she could not relinquish them without a sensation of bending together at first. The muscles of her chest have become debilitated by pressure long-continued; they have dwindled to small dimensions, and their structure has become flaccid. If, however, she were to summon courage at once, these shrunken and flaccid muscles would soon, under proper treatment, assume strength, and, however much the stays might hereafter be resorted to for the purpose of contracting the waist into dimensions which no admirer of beauty in form ever yet considered beautiful, their want would not be felt as a means of imparting strength.

THE BRAIN AND NERVES.

When the physiologist desires to learn the most general form a particular organ, tissue, or substance can assume, he frequently has recourse to comparative anatomy, and sees how the part or organ in question is dealt with in various animals.

In man we speak with propriety of the brain and nerves, seeing that there is a wide distinction, as to locality at least, between the two. As for the brain, it is protected in a strong bony case; whereas the nerves ramify all over the body, for the most part protected as to their trunks, whilst their delicate terminations alone are expanded to receive impressions. In some of the lower animals it is otherwise, the brain and nerves forming one network; and, indeed, in certain animals lower still, the nervous matter is not collected in threads or masses at all, but is distributed all over the body. The nerves of an animal appear like small white threads; but the true physiological notion connected with a nerve is more complex than the mere appearance of the latter would seem to warrant. Each nervous thread, though apparently homogeneous, is not so really, but is made up of different fibres, having different functions, which fibres are merely formed into one thread, because they all happen to be travelling in the same direction.

Considered according to their anatomical appearance, nerves admit of being divided into nerves which are connected with the brain and spinal marrow, and nerves which are not. To the former class belong nerves of sensation and motion; also a third variety, of the nature of which it is not quite easy to give a popularly intelligible description in few words—nerves of the reflex function. The nervous system not in communication directly either with the brain or the spinal marrow is called the sympathetic system, the nerves belonging to which neither preside over sensation nor motion, but impart the necessary vigour to the stomach and other viscera. The two classes of nerves most distinctly recognisable as to their functions by the non-professional reader, are the nerves of sensation and those of motion. The former are divided into nerves of special, and of common sensation. The term special sensation will be seen to be appropriate to those ministering to the special functions of vision, hearing, smelling, and tasting; the remaining nerves of sensation are those which minister to the common sense of touch, a sense not denied to any soft external portion of the body, but more developed in some than in others. In human beings the sense of touch is most delicate in the tips of the fingers and the tip of the tongue. In the elephant, however, the extremity of the proboscis is the part where the sense of touch most prominently resides, and in the cat tribe the part of the face whence grow those long whiskers wherewith these animals are provided. It is a common notion that whiskerless cats are unable to smell; this is an error, they can smell well enough, but they are unable to feel.

The fact may appear strange, that although the functions of the nerves are so various, some ministering to one sense, and some to another—some being devoted, like so many wires of the electric telegraph, to the sending of messages that such and such thing may be done forthwith—that such and such motion may be made,—the fact may appear strange, I say, that all these nerves should be connected with the brain and its sort of offshoot the spinal-marrow. Practically, however, it is wrong to regard the nerves and brain and spinal-marrow after this fashion. Although the brain and spinal-marrow are apparently, viewed in the aggregate, one mass of nervous substance, yet, in point of fact, their anatomy, no less than their physiology, is far more complex. As a great deal of nervous substance is necessary to the purposes of our bodies, and as, moreover, this nervous matter, being exceedingly delicate, has to be protected, nature has thought proper to protect it by a hard, bony case; nevertheless, it does not by any means follow that the brain is not a collection of—if the expression may be allowed—several smaller brains, each having a function of its own.

This latter remark is suggestive of the doctrine of Gall and Spurzheim, subsequently denominated phrenology—a doctrine which, although, like many others, it has been much abused and impressed with the stamp of quackery, is doubtless sound at foundation. That some connection does exist between certain shaped skulls, and corresponding traits of character, mental tendencies, or mental peculiarities, is a fact too unquestioned for comment. To the extent of expressing this, phrenology is correct; but when professors of the science arbitrarily map out the brain, or rather the skull, into regions, and assume the oracular functions of a fortune-teller, they go too far, and bring the science into disrepute.

THE BLOOD.

All animals possess a circulating fluid, to which the term blood may be applied; though in certain of the lower forms of animated beings the material is no longer red.

Composition of the Blood.—Viewed by the naked eye the blood is a homogeneous fluid; but the microscope reveals a far different appearance. This will be presently adverted to, after we shall have detailed a few of the leading chemical qualities of this material, so essential to all the functions of life. A large portion of blood is water; in addition to which there are the proximate principles, fibrine and albumen, certain fatty and odorous matters, and red globules, possessing different form and different size for each animal species, and perhaps for each individual of the same species, though the latter point has not been well demonstrated. About one-fifth of the total weight of the human body consists of blood; whence it follows, that a human adult of average size will contain from thirty to forty pounds, or thereabouts, of blood. Blood is the direct source from which the waste of all the bones and organs is made up; hence the term commonly given to it, "vital fluid," is somewhat appropriate. This term, however, is not to be understood as intended to convey the impression that blood is the peculiar seat of life; indeed, the question of the correlation between life and organisation is too purely metaphysical for being dealt with in a popular treatise of this kind.

Various appearances demonstrate how incorrect it would be to regard blood as a mere homogeneous fluid. Firstly, the separation of blood, when allowed to stand at rest, into two parts, coagulum and serum, proves that it is not homogeneous; secondly, the microscope proves it still more conclusively. Amongst all the wonderful appearances presented by that wonderful instrument, the blood particles are perhaps the most remarkable; especially when blood is microscopically examined whilst yet contained in the circulatory vessels of an animal. For the purpose of this investigation, some transparent living animal tissue must be selected; such, for example, as the web of a frog's foot, or the thin membranous wing of a bat; either of which, when properly arranged on the field of a microscope, enables us to see the blood "*globules*," as they were formerly though improperly termed. They are not globules, however, but discs, and of various shapes and various outlines in different animal species. Whether they differ in size for any two animals of the same species is not quite certain, though the fact seems to be made out by one of our most successful microscopic observers that the blood globules of an animal are subject to change of shape as the result of fright and other emotions of the mind. It has been stated by Mr. Bowerbank, that if an animal be suddenly alarmed, and whilst in that condition a drop of blood be drawn and examined microscopically, each of the particles or discs contained in the blood will be found to present a ragged outline, very different to the well-defined contour which is observable if the animal had been allowed to remain calm. This fact has a physiological significance, though the precise application of it be not known.

The different sizes and forms of blood globules in different animal species afford a probable explanation of the destructive effect resulting from the presence of one animal's blood in the circulation of another animal of different species. The reader will be at no loss to understand that when weakness is the result of mere loss of blood, as frequently happens from wounds and other causes, theory indicates that strength should be imparted by the supply of more blood. Practice is in accordance with theory in this matter, provided the animal which has lost blood be supplied with blood drawn from another animal of the same species. If, however, this condition be violated, the most frightful sufferings, usually ending in death, ensue. Before the microscope revealed to us the fact that blood corpuscles are of different sizes and different shapes for different animals, no probable reason could be assigned for the result; but we have now, at least, a probable explanation in the assumption that the ultimate branches of the veins and arteries are in each peculiar species of the diameter exactly conformable with the particles which are designed to flow through them.

Knowing that there was this discrepancy between the sizes of blood corpuscles in different animals, the impression would naturally be that their size would be proportionate respectively to the size characterising the animals of each particular species. Not so. Far from this relation, the impression once obtained that the smaller the animal, the larger the particles. A large number of experiments seemed to warrant this deduction: it is, however, not correct. If there be a law, physiologists have yet to discover it. I may here mention that the smallest blood corpuscles are found in animals of the deer species.

Colouring Matter of the Blood.—I have already mentioned that iron is found in the blood. It is found, moreover, chiefly in the colouring matter of the blood, from which circumstance the idea does not seem at all improbable which attributed the colouring matter of the blood to iron. Every person knows what is meant by the red stain called *iron-mould;* every person knows that rust of iron is red, and chemists are aware of numerous iron compounds of which red is the prevailing colour. Nevertheless, with all these facts before us, facts which seem to point beyond doubt to iron as the constituent which imparts to blood its characteristic redness, this deduction is by no means placed beyond doubt. On the contrary, one chemist, at least, maintains that he has separated the red matter of the blood from all other principles, and that he finds it to be altogether free from iron. Thus the matter rests.

To those who are unacquainted with the difficulties which beset chemical experiments performed on the products and constituents of living beings, differences of opinion like this will seem extraordinary. The chemist, however, is fully aware of these difficulties, and he, moreover, knows how necessary it is to record facts exactly as he finds them, in their naked aspect, without investing them with characteristics dependent on preconceptions, no matter how much cherished, or how accordant with plausible theory.

RACES OF MAN.

The most casual scrutiny of human beings, as presented in the natives of different regions, shows great differences of external appearance to exist. Perhaps the most prominent characters to an ordinary observer is that of colour; but, though the jet black of the negro, or the tawny red of the American aborigines, be a peculiarity to first strike our attention, it is not one of the deepest physiological significance. Conformation of the head, and more especially the facial bones, is even more expressive to a physiologist than colour, which latter is identical in races which, in other respects, present a close similarity.

Differences between various families of the human race have not unfrequently seemed to present themselves antagonistically to Holy Writ. It is not easy to say why this antagonism ever should have existed, except on the supposition that physiological arguments and analogies were not carried far enough. In proportion as science has advanced, the evidence has still grown stronger and stronger in favour of the origin of the human species from one common stock.

Firstly, as to colour. How can it be, the superficial thinker sometimes asks, that individuals black or red can come from a white stock, or *vice versâ?* Is such an instance ever known? and, if unknown, wherefore should it be assumed? A fallacy lurks here. It is not fair, and it is quite beside the argument, to confine our physiological inquiries to the short space of one generation. If we would inspect analogies, none can be eligible which do not involve the existence of races which have continued to exist through long periods of time. The more we seek analogies of this kind the more evidence do we accumulate in favour of the supposition that man of every variety, however different in structure, stature, or mental endowment, originated from one common stock.

Here it will be necessary, perhaps, to insist upon the truth that human beings are of themselves—alone. They differ essentially from all other animals; not by fine-drawn characteristics, which admit of connecting links. Connecting link there is none. Between the intellectual endowments and capacities of the wildest savage and the most intelligent animal, there stands a gulf so enormous that it must be recognised even by the most unthinking. Between the anatomical characteristics, or, more properly speaking, the anatomical external appearance of man and certain members of the quadrumana, or the monkey tribe, there appears to be, at first sight, a similarity: it vanishes, however, when deeper, more characteristic peculiarities are taken into consideration. The anatomical designation "quadrumana," or four-handed beings, given to the ape and monkey tribe, is expressive of a leading characteristic by which they differ from man. Though they are apparently provided with two hands and two feet like ourselves, yet, really, all four extremities are hands. Although apes and monkeys can for a short period stand erect like man, nevertheless the position is constrained, and cannot be persisted in for any long period consecutively. Even the largest, most man-like species of the apes, the Orang-outang of Borneo, and the Chimpanzee of Africa, progress on all fours when in their native woods. The most striking anatomical distinction between apes and human beings is the general construction of parts which determine in one the erect, in the other the horizontal posture. It is not, however, the only one, though many anatomical characteristics are of a nature to be only appreciated by the student of anatomy and physiology.

Amongst the arguments in favour of the original unity of source of the human species, that based upon a consideration of the capability of individuals of different aboriginal families to perpetuate their species is one of the strongest. It is a law of nature that animals of different species shall not by conjunction propagate a monstrous or hybrid race. Not only does this law extend to animals, but also to vegetables, every horticulturist being well aware that the most skilful exercise of his art is insufficient to make the process of grafting succeed when different species are concerned in the operation. In the animal kingdom, when the species are allied, hybrids are sometimes begotten. The horse and the ass have for their progeny the mule, and the lion and the tiger sometimes, but unfrequently, produce a hybrid partaking of the characteristics of both parents. Thus far does nature sometimes concede; but no farther. The mule is barren, so are other hybrids of parallel relationship. Though one family of individuals may be modified, species remain unchanged, unchangeable.

I need not explain how opposed these facts are to the condition of various aboriginal tribes. Tribes of man of all colours, sizes, and mental endowments, are mutually fertile, and the fertility extends to the furthest generations. Indeed, some curious physiological statements have lately been made, which, if authenticated, will go to prove that women of certain low varieties of the human race are more fertile when mated with individuals of a race above them in physiological and mental characteristics than with individuals of their own. It is testified that, as regards the aboriginal women of the Australian continent, if one of them has once had issue by a European man, she is as the rule unfruitful ever afterwards to men of her own race. If this observation be confirmed by further inquiry, a beautiful provision of nature for improving the human family will at once be evident. That the world's human inhabitants are undergoing a slow but sure and silent change must be obvious to all who have pondered over history, or who watch the progress of events in the restricted span of one human life? War and pestilence, and the slower power of intermarriages between different varieties of man, alter in the progress of time the human characteristics of whole empires. Perhaps no valid exception could be taken to the broad statement that the handsomest races are, in the end, the dominant races, throughout the world. Even restricting our ideas of dominating influence to those of war and conquest, still, as a rule, the handsomest races have been those most pre-eminent. Amongst the ancient peoples, surely, those of Greece and Rome were amongst the handsomest, if they were not the most handsome. Their influence in improving the physique of the human race is permanent and enduring. Wherever a Greek colony was firmly established, there, enduring for thousands of years up to our own times, will be found the impress of their classic type at the present day. The classic beauty of the women of Arles is proverbial, and is attributed to the existence there of a Greek colony. In Germany, too, the physical type of the world's conquerors has been left as an indelible impress by the Romans whereever they made a stand. The contrast between the Roman dark hair and long aquiline nose, and the Gothic flaxen locks, florid complexion, round head, and square-built figure, must have forcibly struck every traveller in Germany observant of these things.

Even when conquering races are not naturally handsome, the tendency of their conquests is, perhaps invariably, on the side of beauty; and by their persistent efforts to obtain for their children handsome mothers, conduce, time being given, as much perhaps to the beautification of the human race as if they had originally been endowed with beauty as their original characteristic. Every Magyar claims for himself descent from the hordes of the terrible Attila, the ugliness of whose physical appearance is testified by historical record; and is abundantly confirmed by observation of the native Mongolian hordes of to-day; yet the Magyars, or true Hungarians, are now a handsome people.

Take, again, the example of the Turks. They, too, it is generally believed (though the origin is not quite undoubted), are from a Mongolian stock. They, too, were originally very ugly, but in consequence of their intermarriage with Circassian girls, persevered in through several hundred years, they may be said to be a handsome people. Viewed under the aspect of a means of improving the physique of the human race, the so-called importation of slave girls from the Caucasus to Turkey has been a boon to humanity. The words slave and slavery, indeed, applied to this traffic and its objects are altogether incorrect. Nothing is more desiderated by the Circassian girls themselves than settling down into married life at Stamboul; and when intercepted on their passage by Russian cruisers, they have been known to jump overboard rather than yield themselves up to their deliverers. Well, indeed, might they act thus rashly if they could get a glimpse of the forced career which the Russian deliverers would open to them. Hundreds of Circassian girls throughout Russia are even less reputably circumstanced than they would have been in a Turkish harem.

In addition, then, to the ordinarily recognised causes for improving the physique of a race, and to a proportionate extent its mental characteristics, for both are unquestionably allied, there is, if the statement already adverted to be fully borne out, another. So much solicitude exercised, care shown in so many ways to perfect the human organisation, almost makes the passing traveller through life's short career regret that he cannot prolong his days, to see the amount of perfection achieved, when the many causes of the Great Designer, all operating to that end, shall have taken effect.

The oneness of human origin having been shown to be consistent with analogies deduced from the mutual fecundity of various human tribes, analogy may be now adduced in favour of the assumption that the different varieties of the human race which at this time exist are as likely to have originated from one common stock, as certain varieties of animals are known to have originated from one common parentage.

The pig furnishes us with a familiar example. All naturalists are agreed that swine in all their varieties originated in the wild boar as the parent stock. This animal is everywhere the same; but how various, how strangely diversified are the children of his progeny. Not only are tame pigs of almost all colours, but other differences exist which might be almost held to amount to specific characteristics. The Chinese pigs have very short legs, whilst the legs of the swine of Brittany are very long. Certain races of pigs have five toes on each foot, whilst a peculiar breed to be met with in Hungary have solid hoofs like a horse. Still even more remarkable are the varieties of the dog. Between the mastiff or wolf-dog and the greyhound, how enormous the difference! Yet they, in common with all other dogs, are believed to have been derived from one primary stock.

If so many varieties of one species can exist as regards quadrupeds, surely it is accordant with philosophy to assume *à priori* that they can exist in man. Experience, too, favours the *à priori* assumption. The Jews are a remarkable example of what climatic and other circumstances may accomplish in the way of modifying a colour. The Jews of Barbary are very dark, some almost black, whilst the Jews of Poland and Russia are almost all extremely fair. The Portuguese, again, who have settled in India, are almost as dark as the Hindoos themselves. Altogether, then, it may be averred that the difficulty which was assumed to exist in referring all the different races of man to one primitive stock, had no real being; that the differences which subsist between different races are not greater than those which we see in different varieties of quadrupeds; that, finally, it is a deduction consonant with philosophy and experience to consider races of man as mere varieties of one species.

Cuvier only recognises three races of mankind—the Caucasian, Mongolian, and Ethiopian. To these Blumenbach adds two others, namely, the American, and the Malay. Members of the Caucasian race possess in the highest degree the elements of beauty. This is not a mere prejudice, but is founded on the immutable laws which preside over and determine harmony of form and grace of contour. The purest type of the Caucasian race is to be seen in the range of mountains extending from the Black Sea to the Caspian. It is characterised by largeness of the facial angle, small mouth, cheek bones not high or conspicuous, and still more individualised by copious hair and beard. The Caucasian race occupies every highly civilised part of the world, except we choose to apply the designation "highly civilised" to China and Japan. Not only are its moral, but its physical qualities superior to those of any other race, and if our globe be destined to exist sufficiently long, the Caucasian race will most probably end by appropriating to themselves the whole of the habitable world.

CHAPTER II.

INGESTA; OR, FOOD AND DRINK.

UNDER the general designation of ingesta may be comprehended all that we take into the stomach, whether in the sense of food or medicine. General usage, however, limits the expression to signify food, and in this sense I shall throughout these pages use it.

The health and bodily well-being of individuals and societies greatly depend on conditions of food; nay, the intellectual characteristic of a nation or an age is intimately associated with the quality of food and drink. The artisan, whose daily occupation consists in one routine of manual labour, is scarcely able to test the soundness of this proposition, but no individual who has to exercise his mental faculties will doubt its truthfulness. The connection of the brain and nervous system with the stomach and digestive organs is most powerful and intimate. The faculty of ideal concentration, and more especially that type of it which concerns the power of invention, is wayward and capricious; it cannot be evoked at will, but has to be solicited by placing the body under favourable conditions. The carpenter or blacksmith, provided his muscular strength remain the same, may determine, by force of will, to perform a certain task. Whether the food he has eaten, or the fluid he has drunk, give rise to sensations more or less agreeable, whether digestion proceed more or less rapidly it matters not, he can still perform his task. Not so the literary man, the artist, the philosopher. With them the soporific agency of a cup of beer too much, the over-excitement of a glass of wine too much, a meal somewhat too generous or too indigestible, will often spoil the most felicitous ideas. He applies himself to his task again and again, endeavouring to gain his ends by the pure exercise of volition; as often he fails, until, in sheer despair, he turns to some more easy pursuit. He walks, he smokes, he engages himself in matters seemingly altogether beneath his cognisance; in short, he sets himself, apparently, to the task of wasting time so resolutely, that a visitor, not conversant with the state of mind to which these observations apply, would perhaps call him lazy. Those, however, who are aware how intimate is the alliance between the thinking faculties and the corporeal organs, more especially those of digestion, will be more charitable.

GENERAL THEORY OF ALIMENTS.

Human beings, as well as other living animals, are subjected to constant changes of substance, so that the whole animal substances are renovated at short intervals, and the elements of our blood, our flesh, nay, even our bones, this year may be the constituents of birds and beasts, or form a portion of the soil, or of plants, and trees, in the year to come. We little think how enormous is this wear and tear of life. Traced out to their fullest details the amount is astounding, but the details in question can only, with propriety, come under the notice of the physiologist. But let us contemplate the wear and tear of the body, as evidenced by the function of respiration, or breathing, alone. We could not select a more expressive instance, because the breath, being totally invisible, passes almost for nothing, except to the philosopher. Well, to anticipate a little (for the function of respiration cannot be dealt with just now), suppose I illustrate this wear and tear of the body, as evidenced by the respiratory function, by asserting, as is perfectly true, that every adult human being during the day of twenty-four hours evolves in his breath, invisibly, no less than thirteen ounces of charcoal. There is not the slightest doubt about it; the circumstances concerned are easily taken hold of, and the results as easily made out,— about thirteen ounces of charcoal are evolved from the human lungs daily through the medium of the breath! Of course in these days, when the chemical schoolmaster has been so industrious, I shall not expect that any reader will take exception to the statement just made about charcoal, and say that it cannot be in the breath *because* it cannot be seen. Were I to meet with such an objector I should simply state that every piece of charcoal which can now be seen was most likely invisible once; the greater part assuredly was, and, diffused through the atmosphere which hovers over us, there are thousands and tens of thousands of tons of charcoal. Undoubtedly the statement just made concerning the charcoal exhaled by the lungs is perfectly true, and its truth may readily be demonstrated by a suitable chemical experiment; but that demonstration would be out of place just now. I merely notice the fact with the object of presently deducing from it certain physiological consequences. Well, if thirteen ounces of charcoal really do come away daily by the lungs, then where does the charcoal come from? and, leaving all other media of wear and tear out of consideration, how long would the best conditioned of us last (best conditioned as to our bodies I mean) if we were to grow thirteen ounces lighter daily, and not supply, by some means, the deficiency? This can only be accomplished by ingesta—what we eat and drink. The charcoal in question comes from our blood, immediately and indirectly from our tissues; it therefore has to be made good.

THE INGESTA CLASSIFIED AS TO THEIR CHEMICAL ELEMENTS.

All the soft tissues of animals, and the soft part of the bones, viewing the whole as an aggregate, are mainly composed of the four chemical elements—carbon, or the matter of charcoal, hydrogen, oxygen, and nitrogen. I say *mainly*, for there are others; and these bodies which would be little suspected, such, for instance, as sulphur, phosphorus, iron. Carbon, oxygen, hydrogen, and nitrogen, however, are the elements to which I purpose directing the reader's attention at this time. It is a principle with nature that no element shall remain at rest. Growing animals and vegetables, if the facts of their growth be reasoned upon, bring the truth just enunciated forcibly home to the conviction of the most unreflective; and fire and decay, and the thousand of disproductive agencies which come on the wing of time, make known the changing course of the chemical elements of the globe. But certain things may appear, at a first glance, to enjoy an immunity from this ceaseless mutation. Mountain ranges, mineral beds, gems locked up in their subteranean cells—all these might seem to be absolved from the fate of change which nature has stamped on the rest. It is not so; the question is only one of time and circumstances, the elements of all must change, though the change be more slow. As concerns rocks, the progress of their change goes on under our very eye, and the observer need not penetrate ideally backwards into the long vista of geological records to illustrate his case. There does not exist a rock, however apparently hard, which, if it could be weighed, would weigh to-morrow as much as it does to-day. There was a time, apparently, in the world's history, before the diamond, the sapphire, the ruby, and other gems were found. As regards the diamond, it has evidently been crystallised out of soft materials, for it not unfrequently contains bubbles of air. Not a gem exists the elements of which are proof against the separative influence of fire under proper conditions applied; and when we reflect that we live and move on a crust under which a central fire of molten liquid burns and glows, a fire which may burst up anywhere, and come forth in volcanic gush, we shall see that, though certain materials may seem to be indestructible, their elements are not absolved from the universal fate of movement to which nature has subjected all earthly things. Action is nature's most striking characteristic. The elements of the world may not form into idle groups: they must all move on.

D

LOSS AND REPRODUCTION OF THE MATERIALS OF LIVING BEINGS SPECIALLY CONSIDERED.

Though elementary change take place in all created things, dead as well as living, yet it is in the latter that we see the energy of change displayed in all its vigour. The reason of this is obvious. Whilst mineral or unorganised bodies are themselves passive, merely suffering the disruptive effects of the chemical agents around them, living beings have a life or activity of their own, and this conflict of vitality with surrounding chemical agents, promotes the rapidity of change—accelerates the motion of chemical elements.

In statements like the preceding, considerable difficulty arises from the inability the writer labours under of using the word destruction. That word is associated with a certain sense that would be totally false and delusive here; no element in nature ever is, or, by operation of present causes, *can* be destroyed. Even fire, that most destructive of agents (limiting our ideas of destruction to changes of condition and form), cannot destroy the elements of which this world and its beings are made up; being merely the agent in the phasis of nature, it attacks these elements as they are crowded together, and obliges them to move on.

Narrowing our ideas of wear and tear to animal bodies, we at once arrive at the consideration of diet, the object of which is twofold; not only to make good this loss, but also to supply warmth to the body; to create that amount of animal heat which is necessary to our very existence. Founded on these considerations, a very simple classification of diet as to its chemical elements may be made; that is, into nutritive diet, or that necessary to make good the wear and tear of life, and combustive diet, or that necessary for generating, or rather producing, the due amount of animal heat. The term combustive diet may, perhaps, fall strangely on the ears of many who have not been accustomed to it when thus applied. Perhaps ideas of spontaneous combustion may suggest themselves, or perhaps those of spirituous drinks. I mean neither, but something which is regarded by many as a veritable case of combustion. Whether we choose to regard it as combustion or not will depend on the precise limitation we agree to extend to the term.

Everybody knows that we employ charcoal in some form or other as the ordinary domestic combustible. The property of burning, or the ability to burn, is a quality more largely participated in by bodies than perhaps some people contemplate. There does not exist a metal—no, not even gold or platinum—which will not, under proper conditions, burn; nay, even water can be made to burn; and, in short, the number of combustible bodies is so all but infinite, that no author duly impressed with considerations for the patience of his readers would attempt their enumeration. It happens, however, that charcoal, amongst all combustible materials, is the only one that we habitually burn. If wood be the fuel employed, the elements of it chiefly concerned in burning is charcoal. If oil or gas, the element chiefly concerned in burning is still charcoal; then, as for coal and coke, they are respectively nearly all charcoal. Finally, charcoal is charcoal, and thus our list is complete.

If we light a piece of charcoal, or any of the varieties of fuel containing charcoal, heat and light are given out, and the charcoal escapes in the form of an invisible gas, which is the result of ordinary combustion. In the human body precisely similar results ensue, with the exception of the evolution of light. Charcoal, caused to unite with oxygen, is made to assume the condition of an invisible gas (carbonic acid gas), precisely as is the case when ordinary charcoal fuel is burned in a fire-place. Precisely similar to the latter case, also, heat is given out; hence the animal heat of our bodies: but, unlike the case of combustion in fire-places, there is no evolution of light. Shall we consider the absence of light as being enough to render the term combustion inapplicable?

or shall we speak of the respiratory function as being one of combustion? It really matters not, provided we clearly understand the limitations involved. There will be a convenience experienced, at any rate, in describing the respiratory function as one of combustion. I shall, therefore, not hesitate to do so.

FOOD MUST CONSIST OF ORGANISED ELEMENTS.

Vegetables, like animals, cannot live without food; but between the food of the two classes of beings there is a most important distinction. The food of vegetables chiefly, perhaps altogether, consists of elements and combinations not endowed with life—combinations which are not organised, and which, therefore, belong to dead or inorganic nature. The food of animals, however, must be that which has been organised, or endowed with animal or vegetable life. Wherefore this is so we cannot tell; but must accept it as an ultimate behest of nature. As charcoal is the ordinary fuel of our homes, so is it the ordinary, nay, it is the only fuel employed by nature for the production of animal heat. A due proportion of carbonaceous food has, therefore, to be swallowed for supporting the combustive or respiratory function. In exacting a supply of carbonaceous food Nature gives us a wide margin. The whole or parts of a vast number of animals and vegetables she gives us permission to use,—starch, in all its varieties, sugar, are good to this end; so are oils and fats. By far the greater number of our articles of food, however, contain a mixed pabulum, not only supporting the respiratory or combustive function, but the nutritive function as well. On one point, however, nature is imperative: she will not allow the stomachs of animals to accept as food any material which has not once been endowed with the quality of life. Whether the food to be given be intended for the respiratory or the nutritive functions, the same imperious law is in force. Were it not for this imperious law, housekeepers might considerably reduce their household expenses; the coal merchant might supply our domestic wants in two distinct capacities, not merely contributing fuel to our hearths, but to our bodies as well. Bread, I suppose, would continue to be used to a limited extent, for the sake of the elements of nutrition which it contains; but assuredly such carbonaceous things as arrowroot, sago, and tapioca might be dispensed with, and their dietetic employment, if employed at all, would involve a sort of expensive luxury only justifiable to the very rich.

Though carbon has hitherto been treated of as a mere element of animal combustion, its utility as an element of food does not end here; on the contrary, it is an element of nutrition also, inasmuch as muscle, commonly called flesh, and indeed all animal tissues, are partially composed of carbon.

DIGESTION CAN NEITHER CREATE ELEMENTS NOR ALTER THEIR NATURE.

Throughout the preceding remarks on the respiratory function, a circumstance has been taken for granted which perhaps had better be adverted to more fully: animal organism, though able to form compounds, cannot form elements. If carbon be wanted in the system, food holding carbon as a constituent must be given; and a similar remark applies to nitrogen, hydrogen, oxygen, or, in short, any element whatever. It also applies to every condition and force, however strong its creative power may be—no element can be created. The full appreciation of this fact in all its bearings is of recent date. A sort of tacit acknowledgment of the circumstance was long ago made, but was not followed out to its legitimate consequences. Not only in the science of physiology, but in agriculture also, has this fact been turned to important applications. On its full appreciation is based what may be termed the chemical, in contradistinction to the empirical application of manures. Formerly manures were given to plants almost at random, little or no heed being paid to the specific requisitions of the vegetables to which the application of manure was made. A better system now is followed: the principle is recognised that the manure should contain the elements which chemical analysis manifests to be in the plant of the kind of that to be nourished. Thus far has agricultural chemistry gone in the direction of improving manures, and it is a great way; but it would seem that one point has been too little heeded or understood—it is this: We have already observed, that in respect of animals Nature is very imperative in her demands that the food ingested shall not only contain certain elements, but that those elements shall be, for animals, in a peculiar state; that, in other words, they shall be in the state of organisation. This precise requisition is departed from in the case of the pabulum of vegetables; but to what extent it is departed from, or in what direction, there is reason to fear we do not sufficiently know. The condition of previous organism is not imperative truly, but there may be other standards and requisitions which it behoves the agricultural chemist to discover.

Remembering well that the animal organism creates no element, the reader will perhaps call to mind certain dietetic fallacies of which he may have been the victim. He may remember, perhaps, when sago, tapioca, and other starchy varieties of food were administered to him under the impression that they were strengthening, and still he derived no benefit from them. Strengthening they undoubtedly are, when administered in due proportion with other wants; but alone, they are so far from strengthening, that by no amount of them could life be prolonged beyond a very short period. They hold no nitrogen; they, hence, cannot make muscle (flesh), nor blood,—nor, indeed, can they make the greater number of animal constituents, except fat; which latter does not contain nitrogen.

The same remarks which apply to starch also apply to sugar; between the two the difference of composition is remarkably slight; hence sugar is unable to support animal life, if administered alone. To some the well-attested fact that Negroes in the West Indies rapidly fatten during the sugar season, notwithstanding the hard work to which they are exposed, because of the amount of sugar which they swallow, will seem incompatible with the statement just made that sugar alone, no matter in what quantity swallowed, cannot for any prolonged time support life. Fat, however, does not confer strength; on the contrary, it frequently becomes a source of weakness. The medical practitioner well knows that, as a rule, fat persons bear the effect of bleeding and lowering medicines very ill; that they are stricken and die under causes which would not have injuriously affected the lean and spare. Fat, indeed, may be regarded physiologically as a sort of animal coal-cellar.

The propriety of this theoretical division of food into combustive and nutritive is borne out by practical observation. Every person must have felt how much less grateful oily articles of diet are in hot than in cold weather, and must have met with statements in the course of his reading of the enormous amount of oily and fatty matters habitually consumed by the natives of cold climates. It is a standing joke against the Russians that they eat tallow-candles; and the joke is not devoid of foundation. An abundance of fatty articles of diet is, to the frozen Russ, something more than a matter of taste—it is a necessity of life. His system craves for fat, as a fuel; without it, he is unable to keep himself warm. For a similar reason inhabitants of cold regions are usually hard drinkers,—of raw spirits especially, alcohol ministering to the respiratory function. Nature, ever cautious and provident, fearing lest our bodies might not be able to obtain the proper amount of respiratory carbon from day to day, accumulates a variable amount of this element in the condition of fat. Accordingly it is when an individual is deprived of food that the first perceptible effect on his system is the loss of fat. Coal no longer coming in day by day, nature attacks the spare reserve of fuel (fat) in the cellar, and burns it up.

Independently of the nutrient matter contained in food, the stomach rebels against the condition of emptiness. According to some physiologists, the sensation of hunger arises from a collapse of the sides of the stomach; whence arises the probable explanation of the fact that certain races, during seasons of scarcity, are in the habit of swallowing material in which no nourishment exists, merely for the sake of obviating this painful condition of collapsed stomach. According to Von Humboldt, the Otomacs, a savage tribe resident on the banks of the Orinoco, appease their hunger for months together by the distension of their stomachs with clay. The traveller does not say that clay is the exclusive article of food; if it be thus, the clay in question must contain organic matter, as is known to be the case with a certain description of clay used in China as food during seasons of scarcity. This material has been described by Stanislas Julien, and has been proved to contain some thirteen per cent. of organic matter. There is something curious, however, about the propensity of clay eating which remains to be made out. Independently of the promptings of hunger, the material is swallowed by certain tribes and certain persons all over the world as aliment. This remark especially applies to the Javanese, the New Caledonians, and many of the tribes of South America.

COLLATERAL CIRCUMSTANCES MODIFYING THE DIGESTIBILITY OF SUBSTANCES.

We have hitherto seen that in order that a substance shall be capable of digestion, it must be organised; secondly, we have seen that its composition must be chemically related to the tissue or part of the system in which nutrient matter is especially wanted. There are other conditions, however, to be taken cognisance of in estimating the digestible and nutrient properties of different bodies. Amongst these, the consideration of first importance is the influence of antipathy or dislike to ingesta. This circumstance is very much neglected in practice: it is too much the habit to regard the chemical array of nutrient elements contained in any particular article of food, and, in accordance with the existence of these, to pronounce dogmatically concerning the nutritive or innutritive qualities of the article of food in question. This doctrine is fallacious. Some persons even in robust health have antipathies as regards certain descriptions of food which the chemist would proclaim to be very nutritive. These antipathies merit respect; for if the stomach rebels against food the process of digestion will not go satisfactorily on. Doubly important does it become to respect these antipathies when they occur to invalids. With the latter, these antipathies assume an energy which a person who has not himself suffered from illness can barely understand. Another consideration, of an importance not inferior to any, relates to the qualities of hardness or softness as influencing digestion. It signifies little that a given substance contains within itself all the elements necessary for nutrition; that the substance is organised, and hence, apparently, the requisitions of nature have been complied with;—all this counts for nothing, if, owing to some peculiarity of condition, the substance in question cannot be dissolved readily in the stomach. Until this solution has taken place, the nutrient function cannot proceed; and, in proportion as the difficulty experienced in digestion is greater, so will be the degree of the uneasiness felt, and the ultimate benefit derivable from the food in question be proportionately less. A familiar illustration of these circumstances is furnished by eggs cooked to varying degrees of hardness. Every person almost is aware of the fact that weak stomachs, or indeed those only moderately strong, cannot tolerate hard eggs; nevertheless, the mere operation of cooking does not alter the quantity, or the ultimate nature of the elements contained in an egg. These elements, or, to speak more correctly, the constituents of the egg which are made up by them, are simply hardened by the process of boiling or frying—nothing more. The strong and healthy stomach makes light of this hardness; but, dissolving the hardened substance readily, the nutritive elements are as readily appropriated. To the stomach of an invalid, however, this hardness is often an insuperable obstacle to digestion. It must be confessed, in relation to the subject of digestion, as interfered with by antipathy, that the latter expression may be found hereafter in many cases of this kind to be incomplete. The discovery may yet be made that the system, by rebelling against certain principles subservient to alimentation, expresses a law, with the intimate nature of which we are not yet cognisant. It is a curious fact that a certain complexity of principles, subservient to alimentation, is necessary to the prolonged existence of life. Of this more will be said hereafter.

COMPARATIVE DIGESTIBILITY OF DIFFERENT BODIES.

A very extraordinary accident supplied physiologists with more complete information on the foregoing subject than could have resulted from the most refined experiments. A man named St. Martin happened to be shot through the stomach, and still continued to live, though the aperture made by the bullet never healed. This accident, so extraordinary in its result, surgically considered, proved of extreme advantage to the physiologist. St. Martin became much sought after by physicians and other persons desirous of ascertaining by ocular inspection the effect of digestion on various articles of food. The substance whose digestive qualities were to be ascertained had only to be thrust into the stomach through the aperture, and similarly withdrawn after having been subjected to the operation of the gastric juice for the desired length of time. As the general result of these experiments, it was found that soft solid aliments were more easily digested than hard solid or completely liquid aliments; that venison is perhaps the most easily digested of all varieties of animal food; and that game in general is more readily digested than the flesh of domestic animals. The flesh of young animals, moreover, was found by Dr. Beaumont to be more generally susceptible of digestion than of the same animals grown up. To this, however, there are a few exceptions. Appended is a tabular view of the deductions of Dr. Beaumont on this interesting subject:—

DIGESTIBILITY OF MEATS.

Articles of Diet.	Mean Time of Chymification.					
	In Stomach.			In Phials.		
	Preparation.	H.	M.	Preparation.	H.	M.
Venison steak	Broiled	1	35			
Sucking pig	Roasted	2	30			
Fresh lamb	Broiled	2	30			
Beef, with salt only......	Boiled	2	45		9	30
—— fresh, lean and rare	Roasted	3	0			
—— steak	Broiled	3	0	Masticated	8	15
Recently salted pork ...	Raw	3	0	Raw	8	30
„ „ „ ...	Stewed	3	0			
Fresh mutton	Broiled	3	0	Masticated	6	45
„ „	Boiled	3	0			
Recently salted pork ...	Broiled	3	15			
Pork steak	Broiled	3	15			
Fresh mutton	Roasted	3	15			
Fresh, lean, dry beef ...	Roasted	3	30	Roasted	7	45
„ with mustard, &c.	Boiled	3	30			
„ „ „	Fried	4	0		12	30
Fresh veal..................	Broiled	4	0			
Old hard salted beef ...	Boiled	4	15			
Recently salted pork ...	Fried	4	15			
Fresh veal..................	Fried	4	30			
Fat and lean pork.........	Roasted	5	15			

DIGESTIBILITY OF CEREAL GRAINS.

Articles of Diet.	Mean Time of Chymification.					
	In Stomach.			In Phials.		
	Preparation.	H.	M.	Preparation.	H.	M.
Rice	Boiled	1	0			
Barley soup	Boiled	1	30			
Barley	Boiled	2	0			
Sponge cake	Baked	2	30	Broken	6	15
Custard	Baked	2	45	Baked	6	30
Apple dumpling	Boiled	3	0			
Corn cake	Baked	3	0			
Corn bread	Baked	3	15			
Fresh wheat bread	Baked	3	30	Masticated	4	30

PROXIMATE PRINCIPLES SUBSERVIENT TO NUTRITION.

The terms proximate alimentary principle, and compound alimentary principle, may be regarded as synonymous, and can be thus familiarly explained. When the chemist has analysed the materials of which our globe and its productions, whether dead or living, are composed, he discovers them to be made up of some sixty-three or sixty-four bodies, which no known power can separate into simpler forms. Thus, for example, if as an illustration we fix on common salt, the chemist can readily separate it into two constituents, one a bright shining metal, to which the term sodium is given; and the other a material which, when obtained separately, occurs as a yellowish irritating gas, termed chlorine; but no chemical power hitherto known can separate chlorine into two or more different constituents. Hence we say that chlorine is a simple body, or an ultimate constituent, or principle; and a remark precisely similar applies to sodium. Common salt, however, is evidently not an ultimate constituent or principle, because of its compound nature; it is therefore said to be a proximate constituent or principle. Take, again, the example of sugar.

By proper chemical treatment this substance may be separated into three substances, namely, carbon, hydrogen, and oxygen, which are ultimate principles, seeing that neither chemical analysis nor any other power can reduce them to a simpler form. Sugar, therefore, not being an ultimate, must be a proximate principle. Now, common salt exists in various parts of the bodies of animals: hence it may be with propriety denominated an alimentary principle; not so, however, sugar. Though we employ sugar as an article of food; yet sugar, that is to say, the kind of sugar we eat, is never found in the animal body; for this reason sugar cannot be said to be an alimentary principle, though it is a proximate principle subservient to alimentation. The remark that the kind of sugar which we eat is never found in the animal organism requires a few words of explanation. Several bodies known to chemists by the general designation sugar exist; for example, there are sugars of the cane, of grapes, of manna, of milk, and others of less importance. Sugar of milk is necessarily a component of an important animal juice of the female mammalia, or animals which suckle their young; and sugar of grapes is found in the human fluids during the existence of a certain dangerous complaint termed diabetes; but sugar of the cane, such as we buy as an article of commerce, is never, under any circumstances, found in any of the animal tissues or fluids.

Inasmuch as simple or ultimate principles when combined together form compound or proximate principles, so the latter by their combination yield bodies more complex still. Of this kind are the chief materials of the diet of men and animals; for though proximate principles do in some cases constitute articles of food, and of this sugar is an example, yet far more usual is it that what we eat is made up of several of these compound or proximate principles united together. As an illustration, let us take wheaten flour. Every person knows that wheaten flour contains starch: indeed, it is the usual source of the starch employed for the purpose of getting up linen; starch, moreover, like sugar, is a proximate principle. But wheaten flour is evidently not starch, though it contains starch; something enters into its composition besides, and the presence of which most schoolboys, I believe, have chemically demonstrated, without perhaps being conscious that they have performed a chemical analysis. The case to which I advert is simply this: if a little wheat, or, what comes to the same thing, wheat flour, be masticated for a considerable time, all that finally remains in the mouth is a tough glutinous mass, almost like birdlime, and, indeed, termed birdlime by schoolboys in certain parts of England; though real birdlime is a different material. The tenacious mass in question is called gluten, and gluten is, for our purpose, a proximate principle; that is to say, we may regard gluten as a proximate principle, though the chemist can push the analysis a step further, separating gluten into a pair of constituents at least, neither of them ultimate. We need not, however, enter upon such chemical refinements here.

Practically, then, our simple line of demonstration has proved wheaten flour to consist, at least, of two proximate principles—starch and gluten. There are others, upon the consideration of which I need not enter just now, my sole object here being to explain the reason why a consideration of the proximate principles subservient to alimentation should precede the consideration of the more complex articles of food into which they enter. Having premised thus much, let us proceed to take a cursory glance at the chief proximate principles of which alimentary substances, whether vegetable or animal, are made up. Seeing that all articles of food are either animal or vegetable, the simplest division of the present subject would appear to be that which retains the designations animal and vegetable as the divisional characteristic. Practically, however, this plan would be attended with disadvantages: not merely do certain proximate principles belong to both animals and vegetables, of which albumen and fibrine are notable examples, but such a classification, even if that chemical objection were removed, would throw no light on the functional properties of such principles in an alimentary sense. What division, then, will it be proper to adopt? Chemistry and physiology furnish us with a ready answer. The most philosophic division will be into nitrogenous and non-nitrogenous principles. Food which is devoid of nitrogen cannot form muscle or flesh, though it can form fat. Such, therefore, belong to the respiratory or combustive aliments, and, of course, the nitrogenised principles belong to the other category.

STARCH.

This compound has not only a chemical but also a botanical existence: it belongs to what Raspail terms the *organising* bodies. Microscopic investigation reveals this characteristic; for if starch be examined on the microscopic field, it will be found not to be a simple powder, though it appears as such to our unaided eyes; but it will be found to consist of little granules or rather bladders, differing so much in shape and size for each variety of starch, that by the evidence afforded by microscopic examination, a practised observer can positively assert the particular source from which the starch has been obtained. The chief source of starch for laundry purposes is wheat, as I have already remarked; but it is also occasionally made for that purpose from potatoes and from rice. Starch, indeed, is very widely distributed throughout the vegetable kingdom, being found in places where the uninformed would never suspect its existence. How very few, except botanists, chemists, and medical men, would imagine that the peel of oranges and lemons contains starch? Starch is there, nevertheless, as may be demonstrated by a process of chemical testing so easy and so elegant that I do not hesitate to give it. Tincture of iodine possesses the curious property of striking a blue colour with starch, provided the latter be cold, and that neither potash, soda, nor ammonia be present. By means of tincture of iodine therefore, starch may be detected, as I have said, in the rind of oranges and lemons. For this purpose, it is only necessary to cut the rind transversely, and to bring into contact with the surface thus exposed a little tincture of iodine, when a blue colour will be immediately developed. As a general rule, it may be asserted that every variety of starch affords this blue tint, when brought into contact with tincture of iodine. I am aware the chemist might adduce some few peculiar instances of departure from this rule; still, to the extent of the requirements and intentions of this volume, the rule is correct.

Varieties of Starch.—Although this substance is very widely distributed throughout the vegetable kingdom, it is never found in any animal tissue or fluid; hence it requires to be converted into other forms before it can pass into our organism. Not every vegetable holding starch contains this material in sufficient quantity to permit its economical extraction. Next to the fruit, commonly called seeds, of the cerealia, or grain-producing grasses, such as wheat, barley, rice, &c., the vegetable which holds starch most abundantly, at least in temperate climates, is the potato. Everybody knows that the part of this vegetable in which starch exists to any extent is what, in common language, is called the root; though, strictly speaking, the portion of the potato which we eat is no root at all, but what botanists denominate a tuber. The primary object which nature has in view in depositing so great a quantity of starch in the tuber of this and certain other plants, is to furnish nutriment to the plant during its growth; and here the prescience of an all-wise Providence is beautifully manifested. Starch is insoluble; therefore it must be converted into some other form before the growing plant can employ it for the purposes of nutrition. That form is sugar, for it will be seen hereafter starch easily admits of being changed into the form of sugar, termed *sugar of the grape.* Wherefore, then, might not sugar have been given to the potato at once? For this all-sufficient reason: sugar is soluble, though starch is not. Had sugar, therefore, taken the place of starch in the potato tuber, the moisture of the earth would have dissolved it out; but, being in the form of starch, that result is not possible. Little by little portions of starch are converted into sugar, which the growing plant uses as the progress of its growth requires. Various natural causes besides the influence of growth can change starch as it exists in bulbs and elsewhere into sugar. Who is not aware that potatoes by being frozen become sweet? This depends on the change of starch into sugar by the operation of cold; in like manner cultivation under a high temperature accelerates this change, as is found when potatoes are grown in hot climates. In tropical regions starch occurs as a constituent of certain poisonous plants, yet, when the starch is extracted and washed, it becomes as harmless as that obtained from any other source. I will now proceed to indicate the chief varieties of starch employed as food.

Starch of the Cerealia.—Although wheat, barley, rice, and indeed each specific kind of cereal fruit yields starch, which, viewed under the microscope, presents its own peculiar aspect, nevertheless it will suffice here to reckon starch of all the cerealia as belonging to one and the same variety. Starch from this source is not usually extracted for dietetic purposes; not only is its taste not so agreeable as starch from many other sources, but it does not thicken so well; whence it is, for this reason also, less eligible. It is sometimes employed for the purpose of adulterating other varieties, but the fraud may be easily detected by any one who possesses a microscope, and is conversant with the method of using it.

Starch from other Sources.. Arrow-root.—Under the generic appellation arrow-root are comprehended several varieties of starch from widely opposed sources. True or Bermuda arrow-root is the produce of the *Maranta arundinacea*, and is easily recognised from all other varieties by its peculiar microscopic appearance. It is also more agreeable to the taste than any other variety, though it must be a very nice palate to make the discrimination when arrow-root has already been prepared as an article of food. Another kind of arrow-root is the tacca, or Tahiti arrow-root, more common a few years ago than at the present time. It is the produce of the *Tacca coccinea*, and was first introduced to this country under missionary auspices. Besides the varieties of arrow-root just mentioned, there are the Portland arrow-root, as it is called, starch extracted from a species of arum; and British arrow-root, which latter is neither more nor less than common starch.

Modifications of Starch.—By the application of heat, starch readily undergoes modification into a substance having very much the appearance, and many of the characteristics of gum: the term British gum is, in point of fact, applied to it. Much of this substance is prepared for use in various calico printing operations, but it is not in relation to that purpose that we have to concern ourselves with modified starch here, but to consider it in relation to articles of food. Tapioca and sago are both varieties of starch, modified by heat. Both are agreeable and nutritious articles of diet; a short description, therefore, of their origin and manufacture is merited.

Tapioca.—This substance affords good illustration of the circumstance already adverted to, that starch, from whatever source taken, no matter how poisonous that source might be, is always harmless. The starch which after the operation of baking becomes tapioca, originally exists in a very poisonous tree, the *Jatropha manihot.* So venomous is the juice of the tree in question, that the natives of the regions where it grows use it for poisoning their arrows. Nevertheless, when the soluble or poisonous matter has been removed by washing, the resulting starch is innocuous, and, being heated to the requisite degree, becomes tapioca.

Sago is baked or torrefied starch, obtained from many species of palm, but chiefly from the *Sagus rhumphii.* The substance is found imbedded between the woody fibre, from which it can be washed out in enormous quantities.

SUGAR.

General Remarks.—Notwithstanding the external difference between sugar of every variety, and starch, the chemical composition of these substances is identical as to the kind of elements which enter into their formation, and very nearly identical as to their proportions, as will be seen by the appended tabular view, which shows the chemical composition of several non-nitrogenous allied substances. As respects the terms in which their composition is expressed, the chemical reader need not be informed that, instead of designating them as so many compounds of carbon and water, they might have been stated to be composed respectively of carbon, hydrogen, and oxygen. For example: acetic acid, the first body in the list, might have been described as consisting of 12 chemical equivalents of carbon, 9 of hydrogen, and 9 of oxygen; but, inasmuch as in this and in all succeeding cases on the list, the hydrogen and oxygen exist in equal proportions, that is to say, the proportions requisite to form water, it facilitates the remembrance of their composition to represent them as made up respectively of carbon and water; thus distinguishing them from the oleaginous and fatty bodies, which are also composed of carbon, hydrogen, and oxygen, but in which the two latter no longer exist in the proportions necessary to form water.

TABULAR VIEW OF THE COMPOSITION OF NON-NITROGENOUS PRINCIPLES.

Acetic acid	12 carbon,	9 water.
Starch	12 do.	10 do.
Cane sugar	12 do.	11 do.
Gum	12 do.	11 do.
Sugar of milk	12 do.	12 do.
Grape sugar	12 do.	14 do.

The changes which articles of diet undergo during the progress of digestion, and by which they are rendered fit to be assimilated, involve much that is difficult and obscure. In relation to starch, however, in all its varieties, the fact is well made out, that the first step towards its assimilation is conversion into grape sugar, or glucose. The change in question need not, of necessity, occur in the stomach ; it can be effected in the laboratory, by adding to a solution of starch a small quantity of a fluid termed the pancreatic juice, a material formed by a gland termed the pancreas, and poured into the stomach during the progress of digestion.

Varieties of Sugar.—Sugar, as I have already remarked, may be one of several varieties. Thus, there exist sugar of the cane, of grapes, of milk, of manna, of liquorice, and yet others. Sugar of the cane, however, is far more important than any.

Sugar of the Cane.—With the sole exception of corn, there is no article of vegetable diet involving mercantile operations on so large a scale as sugar. At present the amount of it entering into commerce is considerably more than a million tons per annum, about the fourth part of which is produced by the island of Cuba alone. If civilised nations were to be now suddenly deprived of sugar, the loss would be sorely felt. Yet it was next to unknown amongst the ancient Greeks and Romans, minute specimens of sugar only finding their way from time to time to the civilised west, to be regarded with wonder and astonishment as the "Indian salt."

We are indebted to the Saracens for the introduction of sugar into Europe. This refined people established plantations of it in the south of Spain, Sicily, the Canary Isles, and a few other spots, whence, until the discovery of America, the little sugar employed in Europe was obtained. Opinion is still divided on the question whether the sugar cane be indigeneous or not to the New World. It appears to me that evidence is strongly in favour of the negative supposition; and indeed, though circumstances have long led Europeans to regard the West India Islands as the sugar-producing region *par excellence*, this, nevertheless, is rather attributable to geographical and social circumstances than to anything peculiarly congenial in the climate of the West Indies in this respect. The best sugar-producing regions in the known world are the south of China, and the Straits settlements. These are, in all probability, the native regions of the sugar cane, whence it has since spread by the agency of man.

Collateral Sources of Sugar of the Cane.—The remark has already been made that sugar of exactly similar composition to that extracted from the cane is also obtainable from beet-root, maple-juice, date-juice, juice of the stalks of Indian corn, and a few other sources. The two most important collateral sources of sugar are unquestionably date-juice and beet-root; the former supplies much of the sugar manufactured at this time in India, and the latter contributes in no small degree to the present sugar supply of France, Belgium, Germany, Poland, and Russia. The sugar maple, viewed in relation to the world generally, contributes no great amount of sugar; nevertheless it is of importance in this respect to Canada, where the extraction of sugar from maple-juice is pursued by the farmer rather for the benefit of his own family than in a more extended commercial sense.

Sugar of the Grape.—As a commercial article, this variety of sugar is of little importance, though some years since it was used in this country for the purpose of adulterating yellow, moist, or unrefined cane-sugar. As the variety of sugar known by the appellation sugar of the cane may be extracted from many sources, so also may sugar of the grape; indeed, the latter admits of being made artificially, which the former does not. Grape sugar, otherwise termed glucose, differs from cane sugar not only in chemical composition, but in physical appearance, taste, and crystalline properties. It is not so sweet as the former, and, although it is a mistake to assert that it does not crystallise, yet its crystals are soft, sticky, and deficient in the characteristics which permit ordinary sugar to be made into loaves.

The process of making grape sugar artificially was discovered by accident. The process sounds not a little strange to all except the chemical reader, consisting as it does in boiling starch, sawdust, linen rags, or indeed any variety of what chemists term lignine, or woody fibre, with a weak mixture of oil of vitriol and water, for some twenty-four or thirty-six hours. Some years ago, when the practice of adulterating grape sugar by glucose prevailed, the latter was manufactured from potato starch.

Sugar as an Article of Diet.—Though the credit of sugar, as an article of food, is now well established, yet it met for a long time with the most violent opposition. At length came a defender of its virtues in the eccentric Dr. Slare, who one by one valiantly demolished the objections previously brought against it. Sugar before his time had been charged, as by some frugal housekeepers it still is charged, with the crime of destroying the teeth of those who use it; but Dr. Slare's grandfather, who was a great sugar consumer, had a set of new teeth after he had passed the age of eighty-two. But Dr. Slare shall tell his own tale.

Dr. Slare writes thus of his remarkable grandfather, Mr. Malory, of Shelton, in Bedfordshire. "He lived," says Dr. Slare, writing in the year 1714, "an active but sober life. He loved the diversions of hunting, a gun, and a hawk, which he kept himself; he was very regular in his mode of eating and drinking; he made three meals a day, but did only eat flesh at dinner: he drank every morning near a pint of soft ale; he then walked in his orchard so many turns as made a mile; he did the same in the even of his old age; he obliged me to walk fifteen miles with him after he was fourscore, which he did without being weary. He seldom drank wine; but when he did it was canary. He never drank between meals. His eyesight was so good that he could take up a pin from the ground when he was between eighty and ninety. I have seen him kill a single bird with his gun.

"His stomach never failed him to the last, nor did he remember that he was troubled with the head-ache. In his eighty-second year he was observed to be very strong and cheerful, his hair to change somewhat dark; in that year some of his old teeth came out and were found to be pushed out by young ones, which continued to do so until he had a new set of young teeth quite round.

"He lived easy and free from pains or any sickness until his hundredth year, and in that year died of an apoplexy. He delighted in all manner of divertments. He used in the morning to spread honey upon his bread and butter some part of the year—at other times to strew sugar over his bread and butter. He loved to have all his sauces made very sweet, especially with his mutton, hashed or boiled, or any other sort of meat that would bear sauces. He ordered them to be so sweet that to others they tasted luscious.

"The good effect it had upon this old gentleman, my grandfather, together with the pleasant relish I received early in my youth by dieting with him, made me always a lover of sugar, which I have for some years past used very plentifully, especially in my wine, and also in my ale on various occasions. I have made use of dried sugar in powder to cleanse my teeth, and, by rubbing it into my gums, to cure them when sore and swelled; but this happens seldom, except I had neglected the use of sugar for many months. My teeth are at present twenty-eight, the usual complement of most persons; all of them are sound and well fixed in their places: these never gave me the trouble of a toothache.

"I have also used sugar as a snuff many times (according to the receipt above-named), but all other sorts of snuffs I cannot endure, because they dry up the natural moisture, which makes me very uneasy ; but this affects two of my senses kindly, both smell and taste ; does also lubricate the throat, and carry down through the windpipe to the lungs such healing particles as are very differing from the stimulating and corrosive dust of tobacco.

"If any one would be so curious as to inquire more particularly into the state of my health, and demand of me, as a living evidence, to give a faithful account of sugar by my own experience, and how it affected me, I shall then bring in a third case, whereas I intended to represent only two. I do declare that I cannot charge sugar with any one ail or injury that it ever brought upon me; that I was for several winters troubled with a pituitous or phlegmatic cough for three or four months, due to the thick London air; that I made much use of sugar, and sometimes of honey, which did me good, and enabled me to pass the winters more easily ; that the country air immediately relieved me, and in a short time cured my cough. I am, God be praised, free from any disease, have no symptoms of scurvy or consumption, and, though over sixty-seven, yet few will allow of it by my countenance or activity that I present that age, notwithstanding my having indulged myself in such quantities of sugar. I have lived to bury above fourscore fellows of the College of Physicians that were my seniors since my first admission, and a vast number that were my juniors; many of this number were bitter enemies to that most delicious and curious preparation, fine sugar.

"I write without spectacles, and can read a small print, can walk ten or fifteen miles with ease, and can ride thirty or forty miles a day, if need require it. I may justly attribute a great deal of the healthful constitution which I now enjoy to the nourishing and balsamic virtues of sugar. Yet I must not exclude the great benefit of the most excellent Bath waters, which have also lately contributed considerably in removing symptoms of an incipient gout."

"Out of respect to the fair sex," remarks Dr. Slare, "especially those that love their beauty or fine proportions as well, if not better, than their lives, I shall suggest one caveat, or caution, to those that are inclining to be too fat; namely, that sugar being so very high a nourisher may dispose them to be fatter than they really like to be who are afraid of their fine shapes; but, then, it makes them amends by supplying a very wholesome and goodly countenance, and sweetens peevish and cross humours, where they unhappily prevail."

Although sugar is a perfectly harmless article of diet, nevertheless its taste is so agreeable to some palates, more especially of children, that an inordinate quantity is apt to be taken, and general weakness of the digestive powers may supervene. Otherwise it is digestible, and to the extent of generating fat, and other principles subservient to the respiratory function, it is nutritious. Inasmuch, however, as sugar is totally deficient of nitrogen, it cannot contribute towards the formation of muscle; no amount of sugar alone, therefore, is competent to support life. Not, however, to push deductions eliminated from this latter circumstance to an unwarrantable extent, the circumstance must be mentioned that very few, if any, mere proximate principles, whether they contain nitrogen or the contrary, appear competent to support animal life for any lengthened period.

OILS AND FATS.

These bodies admit of primary division into volatile or essential and fixed. The former class comprehend bodies of widely different nature; and as those of them which we swallow are rather to be considered as condiments than aliments, they need not be further adverted to in this place. Fixed oils and fats are, however, all intimately allied by chemical characteristics and other general properties. Many of them constitute important articles of food.

The point has been much agitated by different chemists, whether fat be capable of artificial formation in the animal economy. Some hold one opinion, some the reverse. Looking at the chemical composition of starch, sugar, and indeed the greater portion of those principles of which vegetables are made—considering, moreover, that sugar can be transformed by chemical means into a fatty body, there is strong *à priori* evidence in favour of the hypothesis that the living economy of animal bodies can make fat. This is the opinion of Liebig; but Boussingault, an authority of equal weight with his own, maintains that herbivorous animals eat sufficient fat already formed in their diet to account for all that we ultimately discover in their bodies. In this position, then, the question rests.

As regards the method by which oils and fats are taken into the animal circulation there is some difference of opinion amongst physiologists. If oil or fat be poured into water solution does not take place, but if potash, or soda, or ammonia, be added to the water, the oil or fat readily dissolves and forms a kind of soap. Now the bile and the pancreatic juice are both alkaline, and to the extent of alkali present so will oil and fat taken into the stomach be dissolved. So small a quantity, however, can be practically disposed of in this manner, that the case must be regarded as exceptional, and another explanation is required of the means by which oils and fats enter into the animal economy. The general belief of physiologists is that they are absorbed in that form of existence; that fat enters the absorbent vessels as fat, and is thence deposited in the tissues. Nevertheless, their absorption requires a condition of strength and health to be effected. When the stomach is weak, and the conditions of health are delicate, oils and fats are digested with extreme difficulty. This fact is exemplified by the dietetic use of certain varieties of fish. The statement should be premised that, in respect of the distribution of fat in fishes, there is a marked difference. In the individuals of certain species, and of which the cod-fish presents us with a familiar example, all the oil contained in the fish is localised in one part of the body, in the liver, whence it is extracted for medicinal and other purposes. The individuals of other species of fish, on the contrary, have their oil distributed throughout the whole of their flesh; of this the herring tribe, salmon, soles, and eels, may be adduced as familiar examples. Now it is a matter of the most ordinary cognisance that fish with oily flesh, such as herrings, soles, &c., cannot be easily digested by invalids, whereas the flesh of cod-fish is unobjectionable in this respect. This circumstance helps us to arrive at the deduction that oily principles, though useful to the system, are somewhat indigestible. The fact, like many others dependent on the evidence of animal sensations, is not recognised by a body in perfect health, though readily demonstrated by the system which weakness and disease have sharpened to appreciate collateral indications.

Fat enters as an article of diet into the food of man in all countries and all conditions; though, as regards the sources and the kinds of fat, there is the greatest diversity. We, in this country, promote the formation of fat in animals employed as food, and retain it in our system of cookery. Besides this source of fat, we eat butter, but, on the other hand, consume very little olive or other vegetable oil. With the inhabitants of Italy and Spain it is otherwise; they, as the rule, have no butter, and their butcher's meat is lean, but large quantities of olive oil enter into their ordinary diet. The French consume butter and olive oil in large quantities, but the fat of butcher's meat by no means accords with the peculiar genius of their *cuisine;* it is therefore avoided. In Rhenish Germany, not only does the fat of butcher's meat not accord with their system of cooking, but they have a notion that it is injurious, and frequently relate the most extraordinary tales of people who have been made seriously ill, poisoned, even, in consequence of their having swallowed inadvertently a little fat; yet, inconsistently enough, they deluge their vegetables with fat in the shape of butter; they eat large amounts of oil with their salads; and so indispensable does it seem to them for bread to be lubricated with butter, that persons who are too poor to obtain the latter supply its place with lard. Such are the inconsistencies of popular prejudice. Butter, however, is not pure fat. In addition to fat, it also contains sugar of milk, a principle termed caseine, of which cheese is mainly composed, and certain odorous principles on which much of the superiority of butter as an article of diet depends.

OTHER NON-NITROGENOUS PROXIMATE PRINCIPLES.

The proximate principles which commonly enter into articles of food, and from which nitrogen is absent, I shall not describe individually. Gum (of which many varieties are known), grape-sugar, milk-sugar, pectine, or the gelatinous matter of fruits and vegetables, and a few others, are the chief, if they do not indeed fill up the list. Their individual description need not be given; we therefore pass on to the consideration of organic proximate principles containing *gluten*.

The tenacious material which remains after all starch and bran have been removed from flour, was for a long time considered to be a proximate chemical principle; in other words, the idea obtained that it could not be reduced to more simple form without separation into its elements at once. This, though not quite true chemically, is sufficiently near the truth for popular description. Of all the cereal grains, wheat contains the largest proportionate quantity of gluten, and generally in proportion as the climate under which the grain is produced is elevated in temperature, so is the amount of gluten which results more considerable. For this reason it is that wheat grown in this climate is very ill adapted for the manufacture of vermicelli and macaroni. The tenacity of this article of food depends mainly on the amount of gluten present; hence, flour in which the gluten is deficient is ill adapted to the manufacture.

Starch, as we have seen, is a compound of oxygen, hydrogen, and carbon; it contains not a particle of nitrogen, and therefore belongs to the fuel-supporting, or respiratory class of alimentary bodies. Far otherwise is it with gluten. A considerable portion of nitrogen enters into the composition of the latter; whence bread becomes a real staff of life, capable of ministering to almost every want of the human system. Of late years an article of food known as semola has met with an extensive sale: it is merely gluten pulled out into thin sheets, dried by artificial heat, and ground into small grains about the size of ground pepper.

Nothing can be more illustrative of the fact that something besides the presence of mere elements of nutrition is required to impart nutritive properties, than a circumstance now to be indicated. I should explain that in the ordinary course of starch manufacture, the substance in question, gluten, is fermented away, and consequently lost. Some years since, an inventor thought it would be a profitable speculation to separate the gluten otherwise than by fermentation, and fatten pigs upon it. Looking to the highly nitrogenised composition of gluten, little or no doubt was entertained concerning the profit of the scheme. Pigs were bought in plenty, and the starch manufacture by the gluten-saving process went on apace. But, strange to say, the pigs took the liberty of entering their unanimous protest against a too exclusive adhesion to gluten diet. For a time they were content with it enough, then they pined for change, and they concluded by refusing the gluten diet altogether. The scheme consequently had to be abandoned, and some recompense was sought for the pains which had been taken to prepare starch by removal of the associated gluten, in the preparation and sale of the material "*semola.*"

NITROGENOUS PRINCIPLES SUBSERVIENT TO ALIMENTATION.

Albumen.—I shall treat of albumen and a few other bodies as constituting proximate organic principles, although in the strict language of chemistry they are not considered to merit that appellation. The grounds, however, for refusing them that character will be most appropriately explained hereafter. The white of an egg offers a familiar example of albumen; and the hardening of the material under the application of heat constitutes one of the most important chemical qualities of albumen. Acids, also, like heat, harden albumen; so that, considering the gastric juice of the stomach is acid, the hardening of albumen is a condition that must always precede its assimilation by the animal organism. Albumen not only exists in the white of egg, but in various other portions of living animals. It is also found in vegetables; and until the recent discoveries of Liebig, albumen from this source was thought to be different from that present in animals, whence the distinctive appellation *vegetable albumen* was applied to it. That great chemist, however, has proved, by the most conclusive experiments, that the albumen of vegetables and of animals are chemically identical.

Gelatine.—This name is expressive of something from which jelly may be formed, and is a principle very widely diffused throughout animal bodies. In a former part of this work, when treating of the composition of bone, I mentioned that gelatine entered into their composition. It is also found in cartilage, in muscle, and in various animal membranes. The well known isinglass, for example, is gelatine almost pure. Skin, too, contains much gelatine; indeed, most of the gelatine cakes now sold so commonly as a substitute for isinglass are produced from the skins of animals, especially calves' skins. Every cook knows that calves' feet when boiled down make excellent jelly; cows' feet do not answer equally well for the purpose in question, which circumstance may impress on the memory the fact, that young animals contain more gelatine in their tissues than old ones. Gelatine is an important organic principle considered in relation to food. A casual survey of the numerous articles of diet into which it enters will render the justice of this assertion evident. Jellies, properly so called, and blancmanges, are composed of gelatine as a basis. The liquid articles of diet holding gelatine are still more numerous; the extreme solubility of the substance rendering it peculiarly adapted to this kind of application. In connection with this extreme solubility of gelatine, a curious fact should here be mentioned. It is this: gelatine, though present in many animal solids, is altogether absent in every healthy animal fluid. Unhealthy animal fluids are sometimes found to contain it, but healthy animal fluids never.

Fibrine.—When blood has been drawn from an animal, and allowed for some time to stand at rest, a clot is formed; and if this clot be washed until all colouring matter is removed, a white, matted, fibrous-looking material remains, which is very appropriately denominated, from its physical appearance, fibrine. It is a highly nutritive principle, and constitutes the major portion of the muscular tissue, or flesh of animals. Some idea may, therefore, be entertained of its importance to man as an article of food.

Caseine.—I cannot indicate to the general reader a familiar example of the principle caseine, as I have indicated familiar examples of fibrine, albumen, and gelatine. I must rest content with the statement that it is the principle of which cheese is mainly composed, whence its name. Caseine, regarded as to its chemical composition, very much resembles fibrine and albumen: its most distinctive property is that of forming curd, when brought into contact with rennet, or, what amounts to the same thing, with lactic acid, the agent to which the curd-making power of rennet is attributable. As albumen is found distributed in certain vegetables as well as in animals, so also is caseine. Peas and beans, for example, contain large quantities of this important proximate element of food.

It will be hardly advisable to extend further our examination of organic nutriment proximate principles individually.

The chief of these have been brought before the reader's notice; but there are others, both nitrogenous and non-nitrogenous, to which casual reference may be made. Vinegar, or acetic acid, is a proximate organic principle of some importance as an article of diet, contributing to the support of the respiratory or combustive function. Alcohol is another: some persons would advance the opinion, that the latter principle is a mere stimulus, and in no way contributes to the support of life by ministering to the functions necessary to existence. I think this opinion will hardly bear the test of sound physiological reasoning. The employment of alcohol is unfortunately prone to abuse; but that remark may be applied to any alimentary body. I believe, however, that alcohol, administered in proper forms of combination, and temperately used, is conducive to the bodily and intellectual well-being of man.

The remark was made at page 62 that albumen, gelatine, and caseine were now hardly to be considered as proximate principles. The explanation of the remark is this. The Dutch chemist Mulder advanced the proposition that all these substances are generated primarily from a principle termed proteine, and which can be obtained by chemical means from either of them indifferently. Subsequently Liebig accorded with this opinion, and it may be now offered as having received the sanction of chemists and physiologists. There are some points on which Liebig and Mulder are at variance, relative to this proteine theory. Indeed, a somewhat acrimonious discussion has taken place between them respecting it; but, omitting some minor points of chemical dispute, we are, I think, justified in accepting the statement that gelatine, fibrine, albumen, and caseine are all built up originally from proteine.

MINERAL CONSTITUENTS OF THE ANIMAL BODY.

In addition to carbon, hydrogen, and oxygen, of which the soft tissues of animals are mainly composed, other elements enter into the composition of these substances, and the names of which will fall strangely on the ear of a person chemically uninformed. First, as to quantity, amongst these mineral elements (though the term mineral in such a case I grant to be conventional), is the curious substance phosphorus. Phosphorus, indeed, though it be found in the mineral kingdom—though in point of fact its existence in the mineral kingdom necessarily precedes its existence in animals, only attains the necessary amount of concentration in animal fabrics to furnish a convenient source for its extraction. Phosphorus was first discovered by the chemists Brande and Kunkel in certain animal fluids, and all the phosphorus now used for the numerous purposes to which it is applied is extracted by a chemical process from bones. Bone earth, as I have already stated (page 14), is mainly composed of the compound termed "phosphate of lime," and from this phosphate of lime is phosphorus eventually abstracted. Sulphur, again, is an important element in various parts of the animal body. Not only does sulphur exist in the flesh, nails, and hair, in some form of solid combination, but it is evolved from our bodies in the state of a gas. On this latter circumstance depends the operation of a certain class of hair dyes. It is a property of sulphur, and still more of the gas which contains sulphur, concerning which the remark was just made, to blacken silver, lead, bismuth, and certain other metals and metallic combinations when brought into contact with them. In this way it is that a silver spoon is blackened by contact with the interior of a cooked egg, and for a similar reason is it that a silver mustard spoon is blackened when allowed to remain for some time in contact with mustard; because mustard contains sulphur. Now, there is a certain class of hair dyes which, if brought into contact with the hair wet, and the hair covered with an oilskin cap or a cabbage leaf, so that evaporation may be checked, blackens the hair, although the dye itself be white, or at least not black. The explanation of the result is as follows:—The human skin, and more especially hair, evolve the gas in question, termed by the chemist "hydrosulphuric acid," or "sulphuretted hydrogen gas," which, coming into contact with the dye material (usually a compound of lead, which has been allowed to soak into the hair), blackens the latter.

Both copper and manganese are said to have been discovered as ordinary constituents of blood and muscle. Their presence, however, is not well attested, and the quantities said to have been discovered are so exceedingly small that mistake may well have arisen. Iron, however, exists widely diffused in various parts of animals. From five to six per cent. of the red matter of blood consists of iron, and it can be made to yield up the metal; and the metal can be obtained bodily by very slight exercise of chemical skill. I am at this time in possession of no less than three yards of iron wire, the source of which was human blood.

Now, with respect to all these mineral elements which are invariably found in animal bodies, the important question arises: How they got there? and when arrived there, what are their uses? It is no satisfactory answer to say that these curious elements find their way into the animal organism through the medium of the food. Of course, they *must* do so; but the secret to be discovered is, What form, or condition, or mode of combination is assumed by these elements in order that they may be rendered capable of assimilation? Although so considerable an amount of iron is found in the blood, nevertheless, we know of no condition in which iron can be eaten as a food; and even when preparations of iron are given in medical practice, the conditions which regulate this metal's absorption into the blood are involved in mystery. Notwithstanding the advanced state of chemical science, the peculiar condition or state of combination in which iron exists as a constituent of the blood is still unknown.

Similar remarks apply to the remaining mineral elements found in animal bodies. Sulphur and phosphorus, for example, though universally present, and though they must find their way in the system through the medium of the food, can neither be assimilated as food when taken in their crude state, nor in any form of artificial chemical combination.

Although we are unable to explain the form in which these mineral constituents enter the animal organism, or the conditions which regulate thire absorption, yet chemistry enables us to refer their ultimate sources to very narrow limits.

And here, perhaps, instead of examining the sources of these mineral elements in the human organism, it will be preferable to trace their origin in herbivorous and graminivorous animals; which, seeing that they eat no animal food, present a clearer case for investigation. Let us take, for example, a sheep, the food of which, as to kind, is comprehended within narrow limits. Firstly, as regards iron. The animal could not swallow a blade of grass that did not contain some portion of this metal; in turnips, and potatoes, and clover, all of which may be assumed to constitute portions of the diet of our experimental sheep, there would be still iron. Scarcely less ubiquitous is the presence of phosphorus; but should our sheep happen to feast on turnips, or carrots, or potatoes, the amount of phosphorus taken into the system would receive a large accession. Traces of sulphur, in various states of chemical composition, are to be found almost everywhere in the vegetable kingdom; but, amongst the vegetables which our model sheep would eat, turnips and clover would contain the greatest proportionate quantity of this elementary body. By far the richest in sulphur, however, of all the members of the vegetable kingdom, are certain species belonging to the natural families liliaceæ, cruciferæ, or brassicaceæ, and umbelliferæ. Onions and garlic, which belong to the first of these natural families, contain a large proportionate amount of sulphur in a peculiar state of chemical combination. As to cruciferous plants, or, in other words, those which bear flowers, the petals of which are disposed in the form of a cross, they all, without exception, contain large quantities of sulphur. Mustard, and cabbages, and water-cress, all belong to this family. The reader will now perhaps call to mind a remark I made some few pages back, relative to the blackening power of mustard on silver spoons. As an example of an umbelliferous plant containing sulphur, I may cite the plant which yields the nauseous gum-resin called asafœtida. The similarity of the taste and odour of this latter gum-resin with the taste and odour of onions and garlic, is a matter of notoriety. I have heard of certain epicures who approve of having the bars of a gridiron rubbed with a bit of asafœtida previously to the cooking of a steak upon it. The taste may not be very refined, but it is not so irrational, provided the epicure approve of onions; the fact being that asafœtida, and onions, and garlic, all owe their pungency to modifications of one and the same chemical proximate principle, rich in sulphur, and to which the name "allyl" is applied.

Scarcely less important, though more remote from the immediate subject of this treatise, is the question through what channels, and in what form, do vegetables obtain the mineral—or, to speak in a more extended sense, the ultimate elements which go to the formation of their proximate principles. As to the element carbon, it is believed to be obtained by vegetables exclusive from the atmosphere.

Their nitrogen is believed to be obtained from ammonia decomposed; but lime, phosphorus, and all the mineral constituents which enter into the structure of vegetables must be obtained from the soil; and if not present in the soil naturally, must be furnished in the shape of manures.

Chemistry has been practically applied to the subject of manures with great success within the last fifteen years, but still the exact conditions under which given elements are capable of assimilation by vegetables have yet to be discovered. The successful application of chemistry to the formation of manures is rather to be considered as the result of happy chances, evolved from the following out of remote indications; than the fruit of the application of well-determined laws. A sort of glimmering light has dawned upon this subject, but the source of the light itself, the full appreciation of the laws which regulate the assimilation of manures, is still a desideratum.

CHAPTER III.

FUNCTIONS OF CIRCULATION AND RESPIRATION.

To our own illustrious countryman Harvey the merit is attributable of demonstrating the circulation of the blood. He was led to this discovery by reflecting on certain mechanical appearances presented by the veins of animals. That the veins contained blood in living animals was a fact known from the most ancient times, but the function of the arteries was a mystery. After death these latter vessels are usually found empty; they were, therefore, presumed by the Alexandrine anatomists to contain air; whence indeed the name "artery" was derived.

Hippocrates did not assert that the arteries were devoid of blood; and Galen proved them to contain blood by a simple though cruel experiment. Neither of these philosophers, however, to whom the science of medicine is so much indebted, had the remotest idea of a sanguineous circulation; as the reader may convince himself by a perusal of their works. The honour of demonstrating the circulation of the blood is, at this time, accorded universally to Harvey; but, it would be unjust to the memory of at least one philosopher, Servetus, were we to forget that he was proceeding in a course of experiments which, had he lived, would have led to the anticipation of Harvey's great discovery.

Servetus was a native of Spain, and lived during the early part of the fifteenth century. He was characterised from his youth by a bold, independent spirit of inquiry, which rebelled against the shackles imposed by authority. His first doubts were of a theological kind, and had reference to the doctrine of the Trinity. He emigrated to France, and, applying himself vigorously to anatomical pursuits, he was in a fair course for discovering the circulation of the blood, when he was burned at the stake at the instigation of Calvin; thus furnishing occasion to the witty Portal to remark, that one heretic had destroyed another.

Harvey noticed that the veins were provided with valves, opening in one direction, so that the blood could only flow through the veins in the direction from the ramifications to the large trunks. As for the arteries, he noticed that they were devoid of this valvular structure; and he proved, by ingeniously devised experiments, that the blood must be carried from the heart by means of the arteries, and must be returned to the heart through the channel of the veins. The functions of digestion, circulation, and respiration are so intimately connected, that it is difficult to treat of them distinctively. I therefore propose to discuss them together, commencing with digestion.

When the food has been masticated, and taken into the stomach, the process of digestion commences. By the solvent agency of the gastric juice, which is poured out in abundance so soon as food is swallowed, the ingesta are dissolved and converted into a semi-fluid state. It then passes out of the stomach into the duodenum, where it mingles with the bile and pancreatic juice. The bile, by the exercise of some chemical agency, causes the digested matter to separate into two portions: one excrementitious, and the other nutritive. The latter, termed chyle, is taken up by a multitude of small vessels, termed absorbents; or, with reference to this peculiar case of absorption, *lacteals*, inasmuch as the chyle is white and milky in appearance.

The chief of these chyle-absorbing vessels—the only one indeed, as was formerly believed — is termed the thoracic duct. Let us follow the course it takes. The thoracic duct leads directly from the duodenum to a large vein, the left subclavian vein, where mixture between the chyle absorbed and the blood of the vein is effected. The left subclavian vein transfers its mixture of blood and chyle to a vein larger than itself, and the latter conveys it directly to the heart. The heart consequently next demands our attention.

Though the heart appears, on a casual examination, to be one organ, its function is really double ; and, physiologically speaking, each individual of us may be said to have two hearts. They are placed closely together, it is true, and invested by one envelope. This is a convenient arrangement merely; but the heart is as really bi-partite, and its functions are as markedly double, as if the two functional parts had been situated respectively on either side of the body.

Corresponding with this twofold division of the heart, there is a double circulation. One portion of the heart is concerned in projecting impure blood into the lungs to be purified, and receiving it back again ; whilst another portion has for its function the distribution of purified blood throughout the body, and its reception back again. We will now examine with greater minuteness how these circulations are effected.

Reverting to the thoracic duct, thence to the left subclavian vein, and the large venous trunk which the latter joins, and following the course of venous blood, we at length arrive at the smaller of the two cavities on the right side of the heart. It is called the right auricle; and all the blood which it receives is dark coloured and impure, standing in need of the influence of atmospheric air for its regeneration. From the right auricle the blood now passes into the larger of the cavities on the right side of the heart, and to which the term right ventricle is applied. The walls of the cavity are thick and strong, made up of muscular fibre, and the orifice which permits the entrance of blood from the right auricle into the right ventricle is protected by a valve which only enables the blood to pass in one direction ; it cannot return to the right auricle by the way it departed from the latter.

Having followed the blood into the right ventricle, it is forced, by contraction of the latter, into a large vessel called the pulmonary artery—called pulmonary because it proceeds to the lungs, and differing from every other artery in containing dark-coloured blood. When this impure blood arrives in the lungs, then the chemical changes due to respiration are exercised upon it. We, therefore, will leave the subject of blood—circulation for awhile, and direct our attention to what passes in the lungs. Before doing this, however, it will be well to direct the reader's attention to the fact that the double function of the heart, and the double circulation, are indicated by the course now followed in their discussion. Thus, having commenced with the absorption of chyle or nutritive matter, by the thoracic duct, having then passed on to the transmission of this chyle forward until it reaches the left subclavian vein, thence into the right auricle, from the latter, into the right ventricle, and, finally, into the lungs, we pause awhile in our description of the function of circulation, and branch off to the consideration of the changes which take place in the lungs.

THE LUNGS AND THEIR FUNCTION.

Lungs is the scientific term for what we term, in ordinary language, and as applied to animals, "*lights.*" Any one who has examined the structure of these organs, taken from a sheep or ox, will be at no loss to understand the anatomical construction of his own lungs.

If the proposition were given to mingle, intimately, a portion of liquid with a portion of air or gas, a sponge would perhaps suggest itself as the most ready means of accomplishing this object. Very much resembling the structure of sponge, indeed, is the conformation of the lungs; but the expedients of nature are more delicate and refined than would enter our imagination to conceive. Although it is designed that the blood shall be purified in the lungs by the atmospheric air which is conveyed there to that end, nevertheless, the air and the blood are never brought into absolute bodily contact. To explain in what manner this purification takes place, it will be necessary to preface a few remarks concerning the functions of endosmose and exosmose, or, more simply speaking, the power of transmission of fluids and liquids through membranes.

To illustrate this curious property, the following simple experiment may be adduced; it requires no expensive apparatus, or delicate manipulation: it may be performed by any person:—

Let a glass tumbler be taken and filled with treacle, then let a piece of bladder be firmly strained over the tumbler, and securely tied; this being done, let the glass be completely immersed in a vessel of water, and allowed to remain. After the lapse of some hours, the bladder will be seen to bulge outwards, proving that the bulk of material inside the tumbler must have increased. Now, inasmuch as the treacle has no innate power of expansion under the treatment presupposed, the increase of bulk can only have arisen from the entrance of a portion of water. Further examination demonstrates this assumption to be correct—demonstrates, moreover, that the permeation of the membrane has not been all in one direction; not only does a portion of water pass inwards, but a portion of treacle passes outwards; but inasmuch as the bulks are not equal, there is a bulging outwards of the membrane, as already described.

The example just mentioned is one displaying the functions of endosmose and exosmose as between two liquids. The same functions are also exercised between two gases, and one of the functions may be exercised under certain conditions between a fluid and a gas; that is to say, a gas may permeate a membrane to arrive in contact with a liquid, but liquids cannot or do not usually permeate a membrane to come in contact with a gas.

Without going further into the phenomena of endosmose and exosmose, a consideration which would soon involve us amongst the laws of gaseous diffusion, enough will have been stated to indicate in what manner black venous blood may be purified in the lungs by the influence of atmospheric air without any actual bodily contact between the two. It is purified by undergoing a sort of combustion—so modifying our ordinary preconceptions of combustion, that the evolution of light be considered not a necessity of its existence.

The blood conveyed to the lungs by the pulmonary artery is black and impure; it is highly charged with carbon, not in the gross state of carbonaceous powder, but in some form of combination. I must here, before proceeding farther, take the fact for granted that the reader is aware of the general composition of the atmosphere, that it is a mixture of oxygen and nitrogen gases in the proportion, by volume, of about twenty-one of the former to about seventy-nine of the latter. This premised, it may not be undesirable to state that the oxygen alone is the part of the atmosphere concerned in burning away the carbon of the blood. As regards the nitrogen, the belief universally held good amongst physiologists once, that its function was merely to moderate the power of the oxygen; having therefore a parallel utility to the water contained in a glass of spirit and water: that opinion is somewhat disturbed, though the exact utility of nitrogen is still a mystery. Physiologists would seem to have arrived at the conclusion that one part of nitrogen is absorbed, and another part evolved from the system, at one and the same time. I need not detail the experiments by the performance of which this deduction has been arrived at; simple indication of the deductions themselves will suffice in this place.

Omitting minor points connected with the function of respiration, points which appertain almost exclusively to the physiologist, and regarding the function under its broadest aspect, its two most striking effects will be recognised in the combustion of carbon and the evolution of water. When a piece of charcoal is burned, the gaseous result of combustion is carbonic acid; a gas which proves speedily fatal when the amount present in air, taken into the lungs by respiration, amounts to twelve per cent.

He who can take a comprehensive view of natural phenomena, and pierce by the light of science the mystery in which the phenomena of this world are veiled, is struck with the admirable balance of forces and well-devised compensation which the economy of our globe discloses. No more admirable proof of design can perhaps be adduced than the provision made for guarding against the contamination of the atmosphere by the inordinate accumulation in it of carbonic acid gas. We have seen, already, that when the amount of carbonic acid in the atmosphere amounts to some twelve per cent., the atmosphere thus contaminated proves speedily fatal when breathed. What then becomes of the carbonic acid which is so continually liberated into the atmosphere? The proportions of carbonic acid present in the air are not only singularly constant for the same region, but uniform for different regions; it is clear, therefore, that some compensating power must exist for disposing of the excess of carbonic acid in the atmosphere. That compensation is to be discovered in growing vegetables. The carbon evolved by us, in the form of carbonic acid, is absorbed by them, decomposed, oxygen set free, and carbon incorporated with vegetable tissue or vegetable secretions.

It is an astounding matter of contemplation, when we cast our eye over the dense wood of a forest, and reflect that the bulk of that wood is carbon, to think that the carbon of all that massive wood, nay, of every vegetable on the face of our globe, large or small, from the mammoth pines of California to the grass or lowly moss, has been derived primarily from an invisible atmospheric source! The idea is astounding; the mind staggers under the deduction; yet, test it as we will, the validity of that deduction cannot be impugned. The per-centage amount of carbonic acid in the atmosphere, though it sounds a trivial quantity to the ear, resolves itself into some enormous figures when we come to work them out.

According to the experiments of M. de Saussure, the atmosphere contains, on an average, about four ten thousandths of its own bulk (equivalent to about one thousandth of its own weight) of carbonic acid gas. "It may be asked," says Liebig, "is the quantity of carbonic acid in the atmosphere, scarcely amounting to one-tenth per cent., sufficient for the wants of the whole vegetation on the surface of the earth? Is it possible that the carbon of plants has its origin from the air alone?" This question is very easily answered. It is known that a column of air of 1,427 lbs. weight, rests upon every square Hessian foot (equivalent to nearly six-tenths of a square foot English) of the surface of the earth. The diameter of the earth and of its superficies are likewise known, so that the weight of the atmosphere can be calculated with the greatest exactness. The thousandth part of this is carbonic acid gas, which contains upwards of twenty-seven per cent. carbon. By this calculation it can be shown that the atmosphere contains 3,085 billion lbs. of carbon; a quantity which amounts to more than the weight of all the plants, and all the strata of mineral and brown coal existing in the earth. This carbon, therefore, is more than adequate to supply all the purposes for which it is required. The quantity of carbon contained in sea-water is proportionately still greater.

CHAPTER IV.

THE ADULTERATION OF FOOD AND DRINK.

It is a proposition, almost too obvious for comment, that the quality of ingesta—understanding by this term all substances, liquid or solid, food or medicine, taken into the stomach—has important relations to public and private hygiene.

Now, the word "quality" presupposes the existence, expressed or implied, of a standard of comparison. When the jeweller affirms a specimen to be made of "*standard*" gold, he affirms an identity of composition between the gold in question and that of the current gold coin of these realms as by law established. He means it to be understood that every twelve parts of such gold contain one part of alloy. When the jeweller affirms a specimen of gold to be *pure* gold, he means it to be understood that the gold in question is gold in a chemical sense, without any mixture of alloy whatever.

In the illustrative cases just mentioned there are evidently two standards implied. There is one mentioned by name as *the* standard; namely, such as results from the incorporation of eleven parts of gold with one of alloy; we may still clearly individualise it by the term currency standard: there is another characterised by the idea of absolute chemical purity.

I have chosen an illustration borrowed from the economy of the precious metal, as a prelude to the consideration of quality of ingesta, because it is, more than any other, one to which the popular mind attaches the clearest significance. Though, in relation to ingesta, the words quality, goodness, contamination, adulteration, and others having reference to the idea of a standard, are freely used, not only by the popu lace, but in our legislative assemblies and by scientific men, without any standard for each article in question being expressed, or, it may be, clearly felt; everybody has a perception—current so far as it goes—of what is meant by the goodness or badness of gold. It furnishes an illustration of how much stronger is the love of pecuniary gain than the care of health, that popular ideas in relation to purity and impurity, when the precious metal is concerned, should be so well defined, though the ideas of purity and impurity, in relation to what we eat and drink—our food in health, our physic in disease—should be so wandering, and so vague.

Having already sought an illustration from the practice of the gold assayer, I shall take the liberty of borrowing the two words "betterness" and "worseness" out of his vocabulary. In some respects these words are more expressive than the terms commonly employed to imply rather than define the quality of ingesta. The reader will perceive that the terms "betterness" and "worseness" imply deviation from a standard in two directions, whereas such terms as impurity, contamination, adulteration merely imply deviation from a standard in one direction; and, although the notion of a standard must necessarily be involved for the words in question to be rational, nevertheless, as generally employed, there is no clear idea in the mind of the speaker of the real nature of the standard in question.

Take for example, as an illustration of this vagueness, the mixture of coffee with chicory. The tradesman who effects this mixture will unhesitatingly affirm that the mixture is an improvement upon the original coffee,—that it is better, more conducive to health, more agreeable to the taste, and, *therefore*, more pure. For the sake of argument, let us concede all these propositions of the dealer; and, having conceded them, let us examine the basis on which the idea of betterness or purity rests. It is evidently based on the assumption that coffee mixed with chicory is more beneficial to health than coffee alone. For the sake of argument, let us grant this too.

What follows? Next comes the chemist or the microscopist; he submits the mixture to the scrutiny of analysis, and finds it not to be that by the name of which he purchased it. He asked for coffee; he finds not only coffee but chicory; and not only chicory, but certain articles, it may be, wherewith the chicory dealer has "bettered" his staple—"bettered it" according to his own conscience no doubt, for consciences occasionally lean to the side of interest. Perhaps the chicory "improver" can hardly afford to keep a conscience: at any rate, it must be a very unobtrusive conscience to sanction the admixture of baked horse-beans and parched beans, roasted mangold wurtzel, and powder of decayed coffin lids to chicory as improvements.

The practical issue is this:—Owing to a want of agreement concerning the basis of judgment—owing to the standard never having been defined, the chemist and the dealer are respectively placed in the most antagonistic positions.* The latter considers his staple bettered—the former pronounces it to be deteriorated. Supposing the assertions of each party to have been *bonâ fide* made, the divergency of opinion will have arisen because of the divergency of standard of comparison. Unquestionably, the chemist, speaking in his scientific capacity, is truthful to the letter when he pro-

* Not all chemists, however, have accepted a chemical standard in the matter of adulterations. One chemical professor, who gave evidence before Mr. Scholefield's Select Committee on Adulterations, seems to hold opinions of purity, impurity, adulteration, &c., more vague and undefined than any held by the public. The gentleman in question admitted that, in respect of gin, after the publican had weakened it with water, and subsequently reproduced the semblance of strength by the incorporation of other materials, no injury was committed on the public by the sale of such result. He maintained that the article ultimately sold was sold at a fair price, and therefore was not an adulterated article. Such was the testimony given by the Professor of Chemistry to the Pharmaceutical Society and colleague to the late member for St. Albans. Surely this is loose morality, to say the least of it.

nounces every particle of a substance not being coffee as an impurity, when present in a substance obtained under the name of coffee; and, indeed, were the mixture of coffee and chicory, or other adventitious substances, alone concerned, the present investigation into the meaning of terms would have so little practical value that we might have omitted it; but the remarks now being made apply to all cases of so-called adulteration, and contamination, whatever, in some of which the consequences of arguing upon the basis of terms ill understood, will be soon rendered evident.

The chemical basis of definition has been so extensively adopted by those gentlemen who have lately disturbed the composure of English society by published accounts of what we eat and drink, that it is desirable to scrutinise it. Firstly, it is clear that by adopting the rigid nomenclature of chemical science, we are driven either to use words in an absolute sense, or qualify this departure from the absolute by such explanations as would confuse all except scientific men. For example, if it were possible to distil the whole bulk of water contained in a well, the distilled result would be distilled or pure water. Now, let us suppose that by some chance a minute quantity of arsenic, say a grain, were to fall into and be dissolved in, the total amount of water; the chemist undoubtedly could find the arsenic: he would be justified in pronouncing the water impure; he would be able to state the kind of impurity. But how different would be the notions begotten in the chemical from those begotten in the popular mind! The chemist would be aware that not a sample of pure water can be found in all nature; all water is contaminated, chemically speaking, with something or other; the contaminations usually being numerous. If the chemist should happen to be a physiologist as well,—he would also be aware that when man by his science separates from water its impurities and renders it absolutely pure,—such water is no longer good to drink.

Not even the presence of arsenic, to the extent presupposed, would disturb the chemist's mind. He would be aware that iron is a frequent constituent of potable water; and he would not forget the circumstance that, so far as experiments have gone, all waters containing iron also contain arsenic. But in what a different spirit would the statement be popularly received! Impure water, and the impurity arsenic! The sound of the latter word would be enough to give rise to serious results in the nervous system of many an old lady.

I deprecate, as much as the most alarmed old lady who ever perused the reports of the "Lancet commissioner," the crime (for it is nothing less) to which his investigations were directed; but I take exception to the rigid chemical standards, and for reasons which will be further explained by and by. Meantime, let us cursorily examine the pretensions of the standard of definition set up by the trader. He unquestionably, in many instances, has no better plea for the mixture of extraneous substances than the pecuniary gain of the thing. I believe, however, in the majority of instances, the ratiocination is not quite so simple. The publican who adds water to his beer and spirits, for example, need not shock his susceptibilities by mentally calling himself a rogue. By no means. He must get his profit; honest people, he argues, do not buy and sell, and live by the loss. The article he sells is the best he can afford to sell for the money; besides, drunkenness is an evil which cannot be too deeply reprobated. Water is harmless—nobody doubts that; and he doesn't call the addition of a harmless thing an adulteration. By adding water he lessens the total amount of drunkenness, and thereby is a benefactor to his race. By a train of reasoning something like this, the publican, it may be, has justified to himself the addition of water; yet Boniface cannot find it in his heart to say that the spirit and beer thus doctored are better for the doctoring. Notwithstanding the separate reasons by which the addition of water has been justified, satisfactory though they be, when taken one by one the term "better" is withheld until a semblance of the qualities has been imparted which the water had taken away. The semblance of alcoholic strength is given to spirit by capsicum and oil of vitriol; the diminished alcoholic strength of beer is counterfeited by cocculus indicus; and defective body by treacle, liquorice, &c. Then, finally, can we marvel that the publican says he has "bettered" his spirits and beer, if the chemical professor of the Pharmaceutical Society expresses a similar opinion before a Parliamentary Committee?

If the cases of the innkeeper and of the coffee-dealer afford a true exponent, as it is maintained they do, of the chief ideas on which popular notions of the adulteration of food are based—it will be seen that the foundation of these ideas is a notion of fitness or adaptability. A substance is considered better, because it is better adapted to fulfil some object desired; better calculated to promote health, for example. The tradesman, however, is not the source from which society, if rational, will be content to accept these ideas of fitness.

There is yet another idea of bettering, or improvement, which is sometimes to be found, latent if not expressed, in the popular vocabulary. It relates, however, more to the case of medicine than of food, and involves the notion of strength. In their origin, the practices which arise from its adoption are not dishonest; but the practices themselves are detrimental: they may prove fatal. As an example, the following case may be cited: it is hypothetical, granted; but its existence, as tending to illustrate a principle, may be assumed. Let it be supposed that a druggist, instead of dispensing a prescription in which prussic acid occurs with the prussic acid of the English pharmacopœia,—and which is usually a compound of prussic acid and water, in the proportions of ninety-eight parts of the former, and two of the latter,—uses real or absolute prussic acid,—then the most dire consequences would follow. Yet the druggist will, according to the chemical standard, have furnished a purer article than that presupposed by the pharmacopœia. This is, I own, an extreme case; one that could hardly occur; but the assumption of extreme cases is often the best method of testing a principle. The assumption is a fair type of the plea of "bettering" often set up by the manufacturer and vendor; when rendered amenable to the scrutiny of the chemical and microscopical examiner.

These remarks, though not intended to palliate the numerous deteriorations of vended products, and especially those of food and medicine, demonstrate, it is presumed, that until some well-recognised standard shall be indicated and received, the greatest confusion will not fail to beset every investigation of the subject at issue. The chemist, by the too rigid application of his standard, will arrive at conclusions intelligible to himself, but creative of the greatest misconception in the public mind; for the advantage and instruction of which the investigation was entered upon.

The first step towards the removal of this confusion must consist in bringing to bear a well-understood rule of morality: rendering it incumbent on the vendor to supply that for which he is asked, and paid for. A commercial standard having once been agreed upon for each particular article, no practical deviation from it should be allowed on any pretext. Stringent legislative supervision will be a necessary preliminary to the accomplishment of this. In a despotic country, such supervision would not be difficult; but in a country like ours the interference would be a task of no small magnitude. Until such preliminary means have been taken, it is as well the public should be made aware of the exact state of the matter. Whilst yielding all proper deference to the revelations of chemistry and the microscope, it is well that people should not be alarmed by vague testimony concerning adulteration, and impurity; sometimes the result of scientific address, pursued in a too exclusive sense; but not unfrequently determined by that sort of scientific special pleading which results from the influence of retaining fees or private interests, on rivals, who, knowing the exact limits of truth, know also well how to mislead the public, and yet steer clear of absolute falsehood.

In the subsequent remarks on specific adulterations, I shall understand the words "adulteration," and "contamination," to be identical in sense, as meaning deviation from a standard; no matter whether such deviation have been made designedly or incautiously; whether effected with the object of remuneration, or for the avowed purpose of conferring strength or so-called "purity" to each article in question.

BREAD.

This article of food, not improperly called *the staff of life*, is subject to frequent deviations from purity of acknowledged standard. Some materials are added for the mere purpose of swelling the bulk of product; others have reference to improvement of the visible quality of the product,—such, for example, as imparting whiteness, sponginess, &c.

Substitution of the Flour of other Cerealia.—Brown bread permits the addition of a large variety of cereal meal and husk, such as that of barley, rye, maize, &c.; but white bread is not so tractable in this respect. The chief cereal substitution in the latter is rice; not so much with any object of immediate increase of weight from the mere addition, as because rice flour is exceedingly hygrometric; thus causing the dough to absorb, and to retain, an amount of water larger than the corresponding amount absorbed, and retained, by wheaten flour. The usual heat of a baker's oven is not competent to drive away much of this water; it therefore remains and adds to the weight of the bread; without—I need scarcely indicate—contributing to the nutrient powers of the latter.

Substitution of Powder from other Sources than the Cerealia.—The addition of meal of pease and beans is a somewhat common means of adulteration in second-class bread. The addition is often defended by the miller and baker on the plea that the bread is rendered better thereby. But if there be a question of betterness or worseness in the matter, interested parties cannot form an adequate tribunal for determining it. If the question of such admixture had been adequately discussed and legislatively permitted, then, and not till then, it should be competent for the manufacturer to vend the article.

Potatoes.—The practice of mixing potato mash with bread stuff has, I believe, been greatly misapprehended. So far as my experience has gone in this matter, the potatoes added, instead of being designed as a means of conferring a fictitious increase of bulk, have been used as a ferment; for the potato mash is invariably, so far as I have seen, allowed to pass into the state of fermentation before it is added to the bread stuff.

Miscellaneous Vegetable Matters.—Some years ago a patent was taken out for the substitution of flour paste instead of water in the bread-making operation; it being found that the resulting bread acquired a considerable increase of weight thereby. The explanation is obvious: by boiling together flour and water an intimate combination of the two results—so intimate that the heat of the oven is not strong enough to evolve a great quantity of the water used. I need not state that the process is reprehensible, for the reason that the increase of weight resulting in this manner is not commensurate with any increase of nutritive property.

I have reason to believe that tapioca has been employed for the purpose in question. In the year 1854 professional application was made to me by a French capitalist, who had advanced money to a countryman of his to carry out a process of bread manufacture, attended, according to the statement of the inventor, with most surprising results. He professed that by adopting his invention one hundred and fifty or one hundred and sixty pounds of bread by weight could be made from the amount of flour which under the old process would only yield one hundred. This result was intelligible enough to the chemical mind; not so, however, *another* statement set forth by the inventor. He maintained that the whole excess of weight was due to some mysterious development of gluten. I explained to the capitalist that the proposition was equally rational with a familiar exemplification of perpetual motion that I had met with; namely, the proposition of a baker getting into a bread basket, and lifting himself up by the handle. The inventor was angry, the capitalist was incredulous; so little *would* the former and *did* the latter understand the foundation and practice of chemical ratiocination. However, further discussion of the matter was avoided by my proposing an *experimentum crucis.* The Guardians of the Marylebone Workhouse agreed that the operation might be tried on a large scale on their premises, and that a chemical analysis of the resulting bread should be made. A considerable amount of bread was accordingly prepared in the establishment of the Marylebone Workhouse. Some of the bread was prepared according to the French method of using very thin dough, some by the ordinary English, or "*stiff dough*" method. In both cases the increase in weight was very great; but in the former much greater than in the latter case. This single fact was sufficient to furnish a clue to the nature of the increase of weight; it could have been due to nothing else than the absorption and fixation of water. Nevertheless, all parties appeared satisfied—the Guardians of the Poor were especially satisfied—and the result of analysis was triumphantly awaited. In presenting specimens of the bread for analysis, I stipulated—that mixed with them should be other specimens of bread prepared in the ordinary manner; and that none of the specimens should be individualised to me otherwise than by number; the correspondence of each number with its specimen being merely known to the parties employed to give out the specimens. By analysis there was not the least difficulty in distinguishing the new, from the old sort of bread. Excepting the trivial amount of fixed material constituting the hygrometric substance added to the Frenchman's bread, the sole increase of weight was due to the presence of water hygrometrically fixed. Analysis was, of course, incompetent to demonstrate the exact substance added, but I believe it to have been tapioca.

Bone earth.—Amongst the substances had recourse to for imparting whiteness to bread and increasing its weight, bone earth is conspicuous. The circumstance does not require to be indicated that bone earth confers no nutritive quality whatever: on the contrary, being quite indigestible, it impedes the progress of digestion.

Chalk.—This material has sometimes been added to bread, but still more frequently to biscuit material. The objects of its addition are obviously those of contributing weight and whiteness at the expense of digestibility.

Lime.—Lime water, or aqueous solution of lime, has of late been recommended on the authority of Liebig in the manufacture of bread. This great authority states that not only is the appearance of bread improved by the addition of this material, but that certain good properties are conferred on the bread which it would not otherwise possess. Liebig states that the too exclusive use of bread is apt to produce certain unhealthy states of the human system; and, speculating on these, he is induced to believe they may result from a want of lime in the body. The validity of the speculations set forth in this matter by the great German chemist, however probable, can only be sanctioned after subjecting them to adequate medical scrutiny. Thus much, however, is clear: the amount of lime present in lime water is so small that it cannot be made subservient to any perceptible amount of increase of weight in the bread; or to any practical alteration of the constitution of the latter. The benefit it confers, if benefit at all, must be attributed to collateral influences. Whilst on the subject of lime-water bread, we are led to reflect on the general vagueness of popular notions relative to adulterations, and to the necessity of controlling them by definitions, if we would avoid being drawn into error. If the presence of lime in bread be found, after adequate deliberation on the subject, to improve the sanitary qualities of bread, and the presence of lime to the extent demonstrated beneficial be legalised—it would henceforth be regarded as one of the normal constituents of bread; and its presence would not be considered in the light of an adulteration. Until, however, such amount of deliberation has been given to the subject, the authority of no one name, however great, should be sufficient to authorise an illegal addition.

Alum.—This substance, by the exercise of a chemical agency not at all understood, imparts whiteness to bread, and to inferior bread materials the physical appearance at least of those which are better. Important questions now arise. Is the incorporation of alum with bread, in the quantity necessary to produce the end desired, justifiable? Should alum be altogether prohibited in the manufacture of bread, or should it be permitted within certain limits? Until deliberation has been given to these questions the subject of aluminised bread cannot be justly dealt with. A popular clamour has grown up against it, out of which the elements of truth have not yet been evolved. On the one hand, the baker has been judged according to the strictest rules of chemical analysis, and he has been unsparingly vilified if only the minutest traces of alum have been discoverable in his bread; on the other, advocates claiming some pretensions to the character of scientific men have been found to assert that the largest amount of alum ever put into bread is not detrimental to the bread in any sense. Thus the dispute on the subject of aluminised bread may go on *ad infinitum* until the primary question be deliberated on and determined, whether alum ingested within a given limit be injurious, and if injurious, the limit specified.

The argument, that alum present above a given limit in bread is injurious, only embodies a fallacy; the same remark would apply to common salt.

Sulphate of Copper.—This material, ordinarily known as blue vitriol, operates on bread similarly to alum. It has not been much, if at all, used in this country for the purpose in question; but in Belgium its employment once became so prevalent that the government interfered to check it. Whatever objections may be against the use of alum, they still more strongly apply to sulphate of copper. The latter agent, however, cannot be mixed with bread above certain proportions without imparting blueness, and otherwise destroying the quality of the bread.

Flour of Diseased Cereal Grains.—There is a very potent medicinal agent called ergot of rye, which is endowed with poisonous qualities when swallowed in larger than medicinal doses. Ergot of rye originates in a certain fungoid growth which establishes itself in the grains of rye, altering their colour from white to black, and enlarging them to three or four times their natural dimensions. In localities where rye bread is much used, the prevalence of ergotism, as the condition is called, on which the ergot depends, gives rise to frightful disease. Without any apparent cause, the limbs of people mortify, wither, and drop off, terrible suffering supervenes, and death follows. No other grain is equally subject with rye to the condition of ergotism; but all cereals are liable to it.

Corn of all kinds is liable to be deteriorated by yet other natural causes. Various diseases, such as smut, blight, mildew, &c., attack the grain, and the resulting flour is prejudiced to a proportionate extent; never, however, to so dangerous a degree as the results of ergotism. The members of the grass family (botanically termed graminaceæ) are characterised by a general quality of harmlessness; there are, nevertheless, grasses which are naturally poisonous. Amongst the latter, the grass termed *Lolium temulentem* is conspicuous; its seeds, or, more properly speaking, its fruits (for what we term the seeds of wheat, barley, rye, &c., are really not seeds, but fruits) are naturally poisonous, and when mixed with flour, of which bread is made, they have been known to give rise to dangerous consequences. When treating of the injurious bodies sometimes found in bread, or more comprehensively speaking the injurious variations to which bread is subject, I must not forget to indicate a statement recently made to the effect, that the German yeast, now so commonly employed by bakers, is not perfectly innocent. The charge made against this substance, however, has, I am bound to say, never been fully substantiated; but the statement, like every other bearing upon the important subject of public health, is worthy the fullest experiment and deliberation.

BEER.

According to the evidence adduced before the late parliamentary commission, beer is never tampered with originally by the manufacturer; but the retail dealer alters its composition to so great an extent, that, to obtain beer from the publican, as brewed, must be regarded as an exception.

Whatever the nature of the contaminating materials added by the publican to beer may be, they are added at once; nevertheless, we had better treat of them as consecutive, inasmuch as there is a well-defined chain of causation for every contaminating material added. Let the reader first be made acquainted with the fact that, according to evidence tendered before the committee above mentioned, the publican retails beer at or below the price which he originally paid for it to the brewer. This circumstance, if true, is sufficiently expressive of what takes place. The publican must expand the volume of the beer he sells to get his profit. Well, he adds water, flattering himself that water is no contamination. This done, however, the beer tastes poor, and thus it is deficient in what is termed body, and the proportionate amount of alcohol is so much diminished that an experienced beer drinker would not fail to detect something wrong. What next does the publican do? Now follows a very elaborate manipulation. More than one person's genius is required to make passable the watered beer; accordingly the publican has recourse to one of the class termed brewers' druggists—the class might, with greater propriety, be termed the publicans' beer doctors. Colour is soon imparted by treacle or liquorice; but strength is not such an easy matter. The legitimate method of adding strength would, of course, consist in the addition of alcohol to a proportionate extent with the alcohol practically taken away by the operation of watering. Alcohol, however, costs money; it is too dear: therefore, a substitute for it must be found. The stupefying narcotic seed known as cocculus indicus serves the purpose. It is unable to bring about the genuine condition of drunkenness, but a sort of spurious inebriation which passes muster; a beer-drinker, who manages to intoxicate himself to the degree most congenial to his habits, and to which he is accustomed by the usual amount of beer, fancies he has been taking the genuine liquid, and that nothing on the score of strength remains to be desired. Still the process of beer doctoring is not complete: some final essays of genius are required. The beer, for example, does not froth well—it has no head, and perhaps it is not bitter enough. Well, the heading quality is imparted by copperas (sulphate of iron or green vitriol), and bitterness can re dily be imparted by quassia. Strychnine is said to have been used for the latter purpose; but I apprehend the statement is altogether without foundation. It would be too dear, which is an all-sufficient argument against its adoption for the purpose in question. Whilst treating of the adulteration of beer, the circumstance should not be forgotten that the ingenuity of the publican is circumscribed within a narrow compass as regards his power of adulterating ale. Owing to the light tint of this variety of malt liquor, the limits of adulteration to which it can be subjected are comparatively narrow.

ADULTERATION OF SPIRITUOUS DRINKS.

Before treating of this subject, it will be desirable to remember that all spirituous drinks are mixtures of alcohol, water, certain flavouring, and—in the case of brandy, rum, and, to a less considerable extent, whisky—colouring agents. Frequently the medical practitioner will be requested by the patient to express an opinion concerning the relative purity of brandy, rum, whisky, or other variety of potable spirit. The question thus put is totally unintelligible without the expression of an acknowledged standard of composition for each of these spirituous drinks. The teetotaller and the habitual spirit-drinker would regard with very different ideas the notion of impurity in this case. The former would consider alcohol, in its absolute or chemical sense, the highest degree of impurity, whereas the latter would attach a similar idea to water.

It is astonishing to reflect on the bias which preconceived notions respecting the physiological agency of alcohol on the human system, have imparted to the testimony of numerous individuals, bearing upon the admixture of bodies with potable spirit. Even a professor of chemistry could not find it in his conscience to designate, when examined before Mr. Scholefield's committee, as a contamination the admixture of water with gin, as practised by the publicans. No one doubts that dram-drinking is a fearful bane; one that every well-disposed member of society would wish to see abated; but surely no good can accrue from that tampering with the fountain of truthfulness, which is involved in perpetrating a fraud. To supply a thing under a feigned name is to enact a practical lie, and an acted lie is no better than a spoken one. Between a falsehood acted and a falsehood spoken there is the following similarity. Neither can exist in an isolated state: numerous other falsehoods must be in reserve to support the first. Take for an example what occurs in the adulteration of gin. The publican begins by adding water; but water lowers the strength. The next step consists in adding fictitious strength, which is accomplished by mixing certain pungent materials (usually capsicum) with the spirit. The palate of the gin-drinker is in this manner deceived; and when almond oil and oil of vitroil, in due proportions, are added, to impart a certain peculiarity of beading (usually considered to be an index of alcoholic strength), the process of deception is complete enough to mislead the unwary dram-drinker. The art of manufacturing factitious spirits has arrived at an extreme degree of excellence, and is not invariably adopted from unworthy motives. Inasmuch as all potable spirits are mixtures, in certain proportions, of alcohol with water, flavouring, and, it may be, colouring materials—it should seem theoretically possible to produce a potable spirit otherwise than from its usual source. For example: inasmuch as brandy is a compound of alcohol, water, brown colouring matter, and a peculiar flavouring matter termed œnanthic ether, all of which can be obtained separately, it should seem possible to manufacture brandy. How well this is accomplished is testified by much of the artificially produced British brandy; and our neighbours the French have proceeded in the same direction still further of late years. Since the grape crop has failed, large amounts of British alcohol, produced of course from the fermentation of grain, has been exported into France, there to be manufactured into brandy, and reimported into this country as the natural brandy of the grape. If the original alcohol could be obtained quite genuine to begin upon, there is no reason wherefore the brandy thus prepared should be inferior to that resulting from the fermentation of the grape. In practice, however, this is very difficult, if not altogether impossible to accomplish. Alcohol from each peculiar source obstinately retains traces of associated flavouring and odorous matter. That obtained from corn retains traces of a disagreeable fluid, to which the term corn spirit, or, chemically, "fusel oil," is familiarly applied; that from grapes, by the agreeable smelling substance known as "œnanthic ether." This explanation accounts for the circumstance that the French and Italian spirituous perfumes are in general superior to our own. Our perfumers have for their solvent liquid alcohol flavoured with the disagreeable corn-spirit, whilst our neighbours work under no such disadvantage, their spirit having been obtained from the fermentation of grapes; and therefore the only extraneous flavour and odour it manifests are those dependent on the agreeably smelling œnanthic ether.

COFFEE.

During the wars consequent on the French Revolution, when the commerce of our present allies was crippled, and France could with difficulty obtain colonial products, various substitutes for coffee were produced. Amongst these, the only one which attained celebrity, and became generally adopted, was the roasted and powdered root of the endive or chicory. So far as its sanitary merits go, the qualities of chicory are unobjectionable; notwithstanding various statements made to the contrary. Whether its mixture with coffee produces a beverage more or less agreeable than pure coffee to the taste, is altogether a matter of opinion; therefore, opinion ought to rule.

There appears no reason to interdict the use of chicory to chicory drinkers; even though the root should be employed unmixed with coffee, as is the practice in the neighbourhood of Manchester, and certain other parts of England. All who know what pure coffee is, and can appreciate the delicate flavour of that substance, need only whisper to himself a Spanish proverb—to the effect that "some tastes deserve whippings"—and let the chicory drinker, and the chicory dealer alone. There is every reason, however, wherefore a person who asks for coffee should obtain what he asks for. To violate this rule is to enact a falsehood. There are many reasons too for objecting to the practice, now legalised, of permitting the grocer to vend a mixture of chicory and coffee, in any relative proportion, at his pleasure. It would appear from the testimony of Mr. Phillips (the chemist, attached to the excise department of the inland revenue), given before Mr. Scholefield's committee—that it is legal for the grocer to sell a mixture of coffee and chicory, even though coffee be asked for; except the purchaser indicate his desires by some such specific formula as "pure coffee," or "coffee without chicory." I believe that the delicacy of palate necessary for appreciating the flavour of pure coffee is comparatively rare; and that the high-coloured, harsh-flavoured beverage resulting from chicory and coffee mixed, finds most general approval. Considering, then, the difference in price between chicory and coffee, the former being only worth some fourpence per pound, the introduction of chicory is a boon, provided the consumer be allowed to reap the benefit of the profit which accrues on the difference. Grocers and coffee-dealers have frequently been actuated by more expansive motives. Not content with allowing the chicory-loving part of the community to drink their chicory, they have endeavoured, by more than one device, to increase its sale. One ingenious person took out a patent for metamorphosing powdered chicory into the form of coffee berries. Others discovered that tin plate canisters retained the aroma of powdered coffee far better than paper. Attached to the discovery in question were certain collateral peculiarities. People could not break open a canister for the purpose of trying the quality of coffee within. Moreover, the canisters might be packed according to a sliding scale, chicory nearly pure at the bottom, coffee nearly unmixed with chicory at the top, on the principle, one may suppose, of gradually accustoming the palate to the transition from coffee to chicory. As to the detection of chicory, there are numerous methods. The most unfailing testimony of its existence is the microscope, of course; but nearly as certain, is the test of cold water, which chicory powder immediately tinges of a ruddy colour; though coffee powder similarly treated scarcely imparts a perceptible shade of tint. However, he who cannot detect the presence of chicory by the taste alone may continue to drink it; thus increasing the amount of pure coffee to be drunk by those who know how to appreciate it.

TEA.

Most persons are aware of the evil repute into which the sloe has fallen for a reason embodied in the couplet—

"Porto and China now farewell, for we've the sloe divine :
Its leaves make all the tea we sell, its fruit makes half our wine."

Whatever may have been done formerly, I believe at this time the sloe to be an unjustly vilified plant. The adulterations of tea can be managed in a far more dextrous way; and as for the adulterations of port wine, I believe the elder tree has much more to answer for than the sloe. Nevertheless, establishments having for their object the manufacture of spurious tea from the leaves of other than the tea plant were not at one period unknown to the lynx-eyed exciseman. No such establishments, however, I believe, exist in the British isles at this time; indeed there is no reason wherefore they should exist, when we consider how much more easy it must be to make fictitious teas, from leaves of the actual plant, already exhausted. This practice once was common, and there is too much reason to imagine it is not yet obsolete. By far, however, the most considerable amount of tea adulteration takes place in China by the dextrous hands of the Celestials themselves. These expert rogues—in whom the imitative faculty is so strongly developed that their artists will even depict each small-pox indentation on the face of a sitter—experience no difficulty in palming off upon the "outer barbarians" adulterated tea. Not only do the Chinese fashion tea dust into the appearance of dry tea leaves, but they make black tea more black, and green tea more green, by artificial facings; these not always of unobjectionable quality in a sanitary sense. An increase of blackness is imparted to black tea by a coating of plumbago: an increase of greenness and also a lustrous sparkle, are imparted to green tea by a mixture of talc-powder, turmeric, and Prussian blue. The latter is ominously suggestive of that justly-dreaded poison prussic acid. Prussic acid can be made from it indeed; nevertheless there is no parallelism between the poisonous qualities of the two; Prussian blue being a comparatively inert substance. Nevertheless, it enables a low quality tea to be palmed off for one of better quality, to say the least of it; and I may insist upon the fact that, although Prussian blue is hardly to be regarded as a substance to which the appellation poison can be justly given, nevertheless, it is so much indigestible matter—so much dead weight taken into the stomach.

The public is chiefly indebted to Mr. Warrington, of the Apothecaries' Hall, for a determination of the methods by which the adulteration of tea in China is effected. "I examined the article of tea some years back," says Mr. Warrington. "In 1844, rather accidentally than otherwise, I was drawn into the examination more as a point of chemical interest; two samples of green and black tea were brought to me by an excise officer, who had made a preliminary seizure in the neighbourhood of Kennington. He wished to know if those were genuine teas. I requested him to get further information as to the identification of the samples with the bulk of the teas, and he was to see me again. The samples lay before a window, and one day seeing the sun upon the surface of the green tea, I was very much surprised with the varying tints. I then examined it microscopically, and I found the whole of this tea was faced with a colouring material. On calling at one of the large tea warehouses and mentioning what I had observed, they said immediately, 'Have you examined the unglazed tea?' I was very much struck with the term 'unglazed.' I asked them what they meant by unglazed tea? They said, 'We have two kinds of tea in the trade; what is called glazed tea and unglazed tea.' I said, 'I should wish very much to see a sample of the unglazed tea.' They then showed me a sample which had no green colour at all; it was of a dull slate colour. On examining that I found no turmeric, and a very small quantity of Prussian blue; there was still a quantity of sulphate of lime upon the surface."

The Chinese do not stand alone in their practice of tea adulteration. The operation is conducted in England, and, as it would appear, by certain wholesale dealers. To this end teas of good quality are mixed with others inferior in quality to their own, or with a material not the produce of the tea plant at all, except the presence of refuse dust of tea leaves can warrant that consanguinity. The material in question is prepared in China by the mixture of gum, brown earthy matters, and a little tea dust together, fashioning them into the external appearance of tea, and drying the product. This compound material is never consumed by the Chinese themselves: they know better. It is made exclusively for the delectation of us outer barbarians, and appropriately denominated "lie" tea. Perhaps the reader of this will consider that there is the germ of honesty in this designation. The Chinese manufacturer of lie tea, at all events, seems to consider that one sort of falsehood is enough at one time. He enacts a falsehood when he makes lie tea, but he speaks truth in calling it by its proper name.

There was formerly much more lie tea imported than at present. Our tea falsifiers tried to evade the tea duty by importing it under the lower scale of duty of a manufactured article. The excise would not permit that, so the current of trade in this respectable article has been to some extent impeded. Nevertheless this branch of commerce is not quite extinct, and it would appear that the wholesale tea dealer is the person who habitually has recourse to the adulteration in question.

Very naturally the ideá might occur to tea consumers that, inasmuch as every chest of tea is lined with metal foil, no adulteration of the contents could take place, except at the hands of the retailer. It appears, however, from evidence given by Dr. Normandy, that there is no security of this kind. " A large tea dealer," this gentleman testifies, " met me one day in Fenchurch-street, saying, ' Doctor, I want you to come with me and see what beautiful seams the lead of tea chests are closed with.' The tea chest, as it comes from the warehouse, is closed, and there is only a hole, about the size of the hand, cut into the metallic sheet inside the chest, for the purpose of taking out a sample. He accordingly showed me how beautifully and cleverly the metallic sheets in which the tea is packed are soldered together. It should be known that the seemingly unbroken appearance of the sheet of metal, in which the tea is tightly packed, is no criterion of its not having been tampered with. Through the aperture which is made in the metallic sheet, for the purpose of taking sample, the whole of its contents are emptied on a clean floor, and the tea is then mixed with whatever composition it may be thought fit to add, and worked up with teas of an inferior quality, or which, by themselves, would be unsaleable. I saw there a room, which was perfectly clean, boarded with very clean boards, and there were heaps of teas piled up against the wall; there was a rope against the wall, which served the following purpose :—The mixture of teas, and of magnesia, being made on the floor, as just stated, then the question comes, how the same quantity can be re-introduced into the original chest from which it was taken. It is done in this way: a small quantity of tea is put in the chest; a man puts his foot within the chest, through the hole, grasps the rope against the wall to steady himself, and, by a series of jerks, he succeeds in packing it up tight; and so he goes on with another layer, and the process is repeated until the chest is eventually filled up as tight as if it had not been touched. This I know from personal observation."

I must, however, devote no more space to the subject of tea sophistication; and shall dismiss it with the passing remark that persons who drink tea without the addition of cream and sugar cannot tolerate any of these tea adulterations. Cream and sugar tend to mask the real flavour of tea; still more difficult is it to discriminate the delicate flavour of tea through the collateral taste imparted by such things as rum and vanilla. These additions, however, are for the most part confined to Germany, where the tea employed does not admit of being made worse by any ordinary process of ingenuity. Being a great tea drinker myself, and always without cream and sugar, my palate, in respect of good flavour, is somewhat critical. The best tea I am able to procure is that sold by the Messrs. Horniman as unglazed tea. This tea, both green and black, is unattractive in appearance, but excellent to the taste.

MILK.

A great deal has been said and written concerning the impurities contained in milk, especially that sold in the metropolis. Unquestionably a great portion of the milk sold here is not the lacteal fluid of the cow, but no more objectionable liquid than water is commonly added. The statements about sheep's and horses' brains have no better foundation than the brains of alarmists. Milk is, however, frequently contaminated from a natural cause. The disgusting habit of herding cows together in large ill-ventilated stables, in the heart of the metropolis, is provocative of disease, whereby the milk is rendered impure. Since railway communication between the country and the metropolis has been so well developed, the practice has arisen of buying large quantities of milk from the home counties, and there seems no reason wherefore the practice should not be exclusively followed, to the extinction altogether of the sources of London milk.

WATER.

Although no extraneous substances are ever added to water for any reason analogous to those which lead to sophistications of other fluids; nevertheless, water, chemically speaking, so invariably contains extraneous bodies in variable amounts and of varying kind, that its consideration ought not to be omitted here.

The remark has already been made that water never exists pure in nature, and if pure water be obtained chemically, it is no longer adapted to the dietetic wants of man. How alarming, then, would the statement of some chemical sanitary commissioner have fallen upon the public ear, if testifying to water, according to the absolute chemical standard, he had reported that—out of many thousands of samples of water examined by him, not one solitary sample was found to be pure! The rejoinder may be made that what we conventionally understand as pure water is not water chemically pure. Granted. But the same remark may be made as regards every other article of ingesta pronounced impure, or contaminated, by reference to a chemical standard; and this being so, we recognise the necessity of adopting a practical standard for each body submitted to the analyst's scrutiny.

Division of Water into Hard and Soft.—Certain natural waters do not readily form lather with soap, but curdle the latter, and impart an astringent sensation to the skin; hence has arisen the term "hard water," as applied to these natural varieties. Soft waters, on the contrary, are those varieties with which soap readily lathers, the best example of which amongst waters naturally occurring is rain water.

Speaking generally, it may be averred that the softness of water is directly proportionate to its approach to chemical purity; nevertheless, the quality of softness would be conferred by the addition of an alkali, such as potash, soda, or ammonia. Hard waters owe their hardness to the presence of earthy and metallic salts of various kinds and various proportions for each kind of hard water. Whenever mineral agents are contained in water to such an extent as to unfit it for ordinary dietetic purposes, the term "mineral water" is applied. That mineral waters are of various kinds, and are, therefore, endowed with various medical properties, is a fact so generally known that it need not be further adverted to.

To ascertain the exact nature of the earthy or metallic salts on the presence of which the hardness of any particular water depends, of course demands a chemical analysis; but an approximative judgment, which is usually sufficient for general purposes, may be arrived at by what is known as the "*soap test.*" Spirit of wine saturated with as much soap as it is capable of dissolving is the soap test in question. If a little of this test be added to water absolutely pure—that is to say, water carefully distilled—there will be no curdiness visible; neither will there be any perceptible curdiness if rain water be substituted for distilled water; but adding it successively to other specimens of water, each of which contains more earthy or metallic salts than the one preceding, increased degrees of curdiness will result. A little practice soon enables the operator to arrive at sound conclusions relative to the amount of that class of impurities in water, on the presence of which its curdiness depends.

Water extremely soft—although the best adapted for tea and coffee making, for washing purposes, and for the boiling of vegetables, is not pleasant to drink. Every inhabitant of this metropolis knows how agreeable London pump water is to drink. Nevertheless, chemically speaking, it is far less pure than the water supplied by any of the public companies.

Action of Water upon Lead.—So many accidents have occurred from the impregnation of water with lead, and the subsequent application of such poisoned water to dietetic purposes, that it becomes necessary to point out the circumstances which determine, or prevent, the solution of this metal. These circumstances have been so thoroughly investigated, that the chemist can predict from an examination of a given sample of water whether it can, or cannot, dissolve lead; whether, therefore, it may or may not with propriety be transmitted through leaden pipes, or stored in tanks of the same metal. Absolutely pure water does not dissolve lead when brought in contact with it; but this statement must be received in a very guarded manner. By absolutely pure water, I mean water which does not even contain atmospheric air dissolved in it. Now, water thus deprived of air can only be obtained by ingenious chemical means; and to keep it free from air is a matter of still greater difficulty. Practically, then, we may consider that it does not exist, and ignore it altogether.

Water which is free from all collateral substances, *except* atmospheric air—in other words, ordinary distilled water—dissolves lead with such rapidity, that, to store it in leaden tanks, or pass it through leaden pipes, would be to change it into a deadly poison. Rain water, and many varieties of waters from terrestrial sources, are also too soft to admit of their coming into contact with lead without prejudice; but water having the quality of hardness in only a trifling degree, suffers no prejudice from lead for however long a period it remains in contact with the metal.

COCOA.

Between tea and coffee on the one hand, and cocoa on the other, there is the following difference as regards the preparation adapting them to be the food of man. The active principles of the two former are exhausted by infusion or decoction, yielding a perfectly soluble result. Cocoa, however, is but partially amenable to this treatment. Some portion of the cocoa admits of being dissolved by a process of long-continued boiling, but not all which we desire. Hence, if it be determined to consume cocoa as a drink, we must have recourse to suspension of its insoluble particles. This may be, to some extent, accomplished by assiduous stirring or milling; but even then the insoluble particles thus stirred up speedily subside. If, however, some tenacious matter, such as starch, be incorporated with the cocoa, and the mixture boiled, the naturally insoluble particles of the cocoa are more completely suspended. It is necessary to be aware of the property of cocoa just mentioned, in order fully to appreciate the value of many statements offered respecting the adulteration of cocoa. Clearly, if starch were the only admixture, and if it were admixed in proportions best calculated to promote the result indicated, the common notion attached to the word adulteration would not apply. Otherwise, it might be affirmed that chocolate is adulterated cocoa, for chocolate and the so-called soluble cocoa are mere varieties of the same class of product.

Dr. Hassall, when testifying to the adulteration of cocoa before Mr. Scholefield's select committee, in the year 1855, said that the conclusions arrived at by him, in respect of cocoa, were that eight samples only, out of the fifty-six examined, were genuine; that sugar was present in forty-three samples, the amount forming from five to in some cases as much as nearly fifty per cent. of the article; that starch was detected in forty-six of the samples, the quantity present varying from five to nearly fifty per cent., and consisting either of wheat, potato flour, sago, meal, &c., or mixtures of these in various proportions. The conclusions to be deduced from the examination of the analysis of the above fifty-six different samples of cocoa were as follows:—that out of the ten samples of flaked cocoa which were incinerated, six contained earthy colouring matter; that one of the two samples of granulated cocoa yielded a coloured ash; that two of the three bromas contained earthy colouring matter, and that out of fourteen samples of soluble cocoa earthy colouring matter was discovered in thirteen; that five of the fourteen homœopathic cocoas contained coloured earth; that the two roll cocoas were free from earthy colouring matter; that earthy colouring matter was present in seven of the nine samples of rock cocoa examined; that the ash in one of the two cocoa pastes incinerated was coloured; that of the twelve samples of chocolate, in powder and in cake, examined, earthy colouring matter was present in four; that out of sixty-eight samples of cocoa and chocolate submitted to examination, twenty-nine were free from admixture with earthy colouring matter, while the remaining thirty-nine samples all contained coloured earthy substances in greater or less amount.

SUGAR.

This material of food may be regarded under the two practical aspects of lump sugar and moist sugar. The former is clearly defined, but the latter includes bodies from various sources, and is not so precisely demarcated.

It is obvious that if lump sugar be tampered with at all, this must be done by the manufacturer during the process of making the loaves. As well might the dealer in eggs try to introduce impurities into them, as the retail dealer try to introduce materials into a sugar-loaf once made.

It was testified by a scientific witness, during the late committee on adulterations, that he had found saw-dust in lump sugar, on one or two occasions, in rather considerable quantities, and he hazarded the opinion that these particles of saw-dust might have been added to the sugar whilst in solution, and for the purpose of facilitating the crystalline process. This is altogether an error. If the witness had ever seen the process of sugar boiling conducted, he would have discovered the extreme fallacy of the assumption. Not only would the presence of saw-dust in the vacuum pan embarrass, if not altogether destroy, the efficiency of that delicate instrument, but the presence of saw-dust in sugar-loaves would be fatal to the processes of drainage and liquoring, to which they are subjected for the purpose of freeing them from all adherent colouring matter. The saw-dust discovered by the analyst, he may be assured, was altogether an exceptional case, and, when it found its way into the sugar-loaf, the manufacturer must have suffered in pocket. Dr. Hassall has also found animal matter and lime in lump sugar. Of the discovery of these bodies I entertain no doubt; but their quantities are so infinitesimally small that they can only be called impurities by comparison with the rigid chemical standard to which I have already adverted more than once, as being altogether deceptive when used as the standard of purity for articles of food, drink, and medicine.

Moist Sugar.—Beyond the mixture of two or more varieties of moist sugar together, I do not believe that the practice of moist sugar adulteration is at all prevalent now. Some years ago, when the import dues on sugar were higher than they are at present, moist sugar was occasionally contaminated with glucose, or grape sugar, artificially prepared. A manufactory for the preparation of this glucose, or grape sugar, existed some years ago at Bow; but it exists no longer; and I believe there is no other. Indeed, granting the mixture of glucose with moist sugar to the extent necessary to insure a remuneration adequate to the desires of a dishonest tradesman, so much glucose would have to be added, and the resulting mixture would acquire such bad properties to the eye, and taste, and touch, that the method of adulteration in question could never have been very promising. At present the retail dealer limits himself to the mixture of many sorts of colonial moist sugars together; a practice which can hardly, I think, be termed an adulteration, even accepting the word in its most indefinite sense; or, what is less defensible, he mixes colonial moist sugar with a material produced in refineries, and sold under the names of "pieces" and "bastards." These latter products resemble colonial moist sugar to the eye, but may be distinguished from them by a certain clammy feel; and still more distinctively by an abominable animalized odour, attributable to the blood of animals, often putrid, employed in the refinery operation.

Amongst the impurities which have been discovered in moist sugar, the little insects called "sugar-mites," or "sugar-acari," have been prominently noticed. Unquestionably they are disgusting little things; but it would go hard with us, I believe, if every article of diet were to be excluded, into the composition of which some sort of animalcules enter. In order to avoid the impurities which exist in brown or muscovado sugar, Dr. Hassall advises that white or refined sugar be exclusively substituted. Notwithstanding, however, the ugly little sugar-acari, there is a peculiar flavour in the superior kinds of moist sugar, so agreeable to some palates, that they would prefer it to lump sugar, even were it only obtainable at the price of the latter.

Treacle and Molasses.—These terms, although sometimes regarded as synonymous, are, in strict language, distinct; the former being uncrystallisable refuse of refineries, the latter the uncrystallisable refuse of the colonial sugar manufacture. Having regard to their composition, treacle may be said to be a mixture of uncrystallisable sugar-products, mixed with odorous matter of putrid bullocks' blood; and molasses, a mixture of uncrystallisable sugar-products mixed with the juice of rats, cockchafers, and centipedes; all which creatures and others beside, get into the tanks used for collecting molasses by the drainage of sugar casks. Thus much having been premised, as to the constitution of treacle and molasses, it will be seen that the problem of making them more impure than they are, would be somewhat difficult.

CAYENNE PEPPER.

This well known material is not, properly speaking, pepper in any sense; that is to say, it is not a member of the pepper family, but the powdered fruit of various species of capsicum, all belonging to the natural family of "*solanaceæ.*" Capsicums are externally of an attractive red colour, but the colour of the powder which they yield is dull; to remedy this latter quality, various processes of admixture have been frequently adopted, all of them very objectionable. Sometimes the ground capsicums are mixed with red lead and vermilion, both substances very injurious; but, in what is called the "soluble cayenne," the process of contamination is carried still further. The process of manufacture for the so-called soluble cayenne is as follows:—A strong decoction of capsicums being made, and evaporated to the consistency of a thick extract, common salt mixed with vermilion or red lead are added, and allowed to become cold. The salt crystallising, converts what would be else a mere pasty extract into the appearance of a crystalline mass, and the necessary redness is imparted by the vermilion, or red lead, as the case may be. Neither of the colouring matters is soluble; therefore the term "soluble cayenne" is somewhat a misnomer. The only objection that can be urged against the so-called soluble cayenne is the presence of injurious colouring matters; were these omitted, the result would undoubtedly be a great improvement in the mere powdered capsicum, the insolubility of which often gives rise to unpleasant sensations; as when, for instance, a grain of cayenne pepper, not yet exhausted of its pungency, attaches itself to the tongue or mucous membrane (lining membrane) of the tongue or throat.

PEPPER.

No one of the spices has been more extensively made the subject of adulteration than this. Accepting the testimony of Mr. Phillips, a chemical examiner of the Inland Revenue, the substances commonly found by him mixed with pepper are rice, sago, potato starch, linseed meal, chillies, husks of red and white mustard seed, wood, wheat-bran and flour, oat flour, and ground gypsum, or crystallised sulphate of lime. The stock material, according to the same gentleman, for adulterating pepper is the husk of red and white mustard seeds, and linseed meal warmed up with chillies. During the examination of the gentleman whose name has been just quoted, Mr. Phillips, on the subject of pepper, the want of agreement as to the just acceptation of the word adulteration was strikingly illustrated. He was asked by Mr. Moffatt—whether he considered the things added more prejudicial than pure pepper? thereby begetting the notion that the quality of nocuity is a condition necessary to the existence of an adulteration. "They are decidedly not pepper," interposed the chairman of the committee. Certainly not: and this violation of truthfulness is the first source of adulteration.

OTHER SPICES.

It would occupy too much space were I to detail seriatim the deviations from normal standard to which each separate spice is subjected. Nutmegs are especially amenable to fraudulent tampering. Whilst Mr. Gladstone was Chancellor of the Exchequer the nutmeg planters of the Island of Singapore memorialised the government relative to a fraudulent substitution of wild for cultivated nutmegs. There is a great deal more in this substitution than the uninitiated may perhaps suppose. The wild nutmeg, although analogous in appearance to the nutmeg of commerce, is destitute of aroma and flavour, and is entirely without value as an article of trade. There is a difference between the import duty of the two, a difference which is clearly to be reprobated. If, contend the memorialists, the so-called "wild" nutmeg, now admitted, is a different article from the cultivated one, and of inferior value, its admission at a lower rate of duty offers great facilities and a strong temptation to the perpetration of fraud upon the British consumer; seeing that no such distinction between the two is known in the retail trade. The British consumer, therefore, does not reap any advantage from this lower rate of duty; and the British planter is injured by his highly taxed produce being displaced in the market by this inferior article, the importers of and the dealers in the wild nutmegs being the persons who most largely profit by the difference in the duty. Cultivated nutmegs are never procurable at the place of production at less than six times the price of the wild variety, which latter, though nearly resembling cultivated nutmegs in shape, are almost void of aroma and flavour. Cultivated nutmegs, too, are not devoid of contaminations. Perforations occasioned by the ravages of insects are stopped, and they are frequently strewed with lime externally to give them a better aspect. The plea advanced for the use of lime is preservation of the nutmeg. It may be that the plea is just: if so, some determination as to this matter should be arrived at and sanctioned. Until this is done, any lime found on nutmegs cannot be otherwise regarded than as foreign matter.

The purchaser again is frequently deceived as to cinnamon, for which cassia is so often substituted. In samples of the material professing to be powdered cinnamon, Dr. Hassall discovered not only powdered cassia, but baked wheat flour, sago, East India arrowroot, and potato starch.

TOBACCO.

The British legislature once permitted, under "Baring's Act," the adulteration of tobacco; anything was allowed to be added, except the leaves of trees, herbs, and plants.

The tobacco-using public owe no thanks to the legislature for having rescinded this permission, which was not withdrawn until it proved unremunerative to the revenue. It was never contemplated, states Mr. Phillips, in his evidence, that the trade would exercise the amount of ingenuity they did. The law thought it was impossible to get the foreign substances in to the extent that the tobacco manufacturer succeeded in doing, namely, often to as much as 70 per cent. At the present time the only extraneous addition permitted by the legislature to tobacco is water; of which the dealer may cause the tobacco to absorb as much as he can. Other ingredients, however, are often found in tobacco, such as malt commings, ochre, treacle, sugar, and other varieties of saccharine matter.

MEDICINES.

I shall not further discuss the composition of individual articles of ingesta. My object in treating of it has not been to indicate the chemical and microscopical means of effecting the necessary discriminations; satisfied that this would have been too difficult for any but the scientific reader to undertake; to whom such description would be unnecessary. I have endeavoured to keep in view the object of controlling to some degree the public mind on the important subject of the purity of ingesta. I have endeavoured to show that, whilst the tampering with articles of food and medicine for the purpose of gain, and irrespective of all consequences, is fully conceded, and the baseness of that proceeding deprecated as fervently as any sanitary commissioner could wish—nevertheless the sentiment conveyed to the public mind by many of these revelations has been deceptive in the extreme; and that the amount of deception will increase until a series of practical standards has been devised for each particular article examined as to its purity or impurity.

Still more important is it that a standard should be fixed on and scrupulously maintained for each one of the medicinal ingesta. Medicines admit, in relation to our subject, of the division into chemicals and mixtures; all vegetable and animal products coming under the latter category, as well as the mixtures effected by artificial agency. For the chemicals, of course, there is a natural standard—that of chemical purity. Hence, no more is required to be said concerning them; but medicinal mixtures are in the greatest state of disorganisation. Not only do they vary as to strength for every nation (a matter not to create wonder), but they differ for England, Ireland, and Scotland, if made according to the prescribed formulæ of their respective Colleges of Physicians. The prussic acid of Scotland is about twice as strong as the prussic acid of England, and the Irish prussic acid still stronger. What terrible effects may arise from a patient changing his abode from England to Scotland or Ireland, and carrying with him a prescription ordering prussic acid, and written in England! Nor is this all: almost every druggist has peculiar formulæ, which he prides himself upon as superior to corresponding formulæ of the national pharmacopœias. Perhaps, intrinsically, they *may* be superior; in many cases doubtless they are superior, amongst other things, in their greater concentration of potency in smaller space. But this intrinsic superiority may mean death! Departure from a standard of composition recognised and presupposed, is hence an unmitigated evil.

It is, however, very hard to deal with this subject. Many druggists possess valuable recipes for mixtures, substances the composition of which analysis cannot disclose, and if it could, the disclosure would be a kind of robbery. It is to be desired that these mixtures were legalised by collegiate approval, and entered into the pharmacopœia. But who is to remunerate the present proprietors?

Amongst these beneficial things I, of course, do not include quack medicines. I would not, however, be understood to join in the cry now prevalent for putting quack medicines down. They subserve benevolent purposes in the scheme of British home policy; by ridding society, to some extent, of weak-minded people. Very weak-minded must those indeed be to swallow quack medicines: far more weak-minded than the manufacturers or their household; who are no sooner ill, than they call in some regular practitioner. The widow of a late very celebrated genius in the pill line, is an excellent patient of a friend of mine. I am not enabled to say of my own knowledge, that the late husband was an unbeliever in the virtues of the home product, but I have heard so. If this be true, I do not envy his dying moments. What thousands of murders must have come crowding on his mind! How terrible his remorse! The remembrance of murder by the thousand must be oppressive, even though the murder be of fools.

The empirics who in this metropolis profess to cure all diseases by means of pills, are, however, many shades less reprehensible than another class who, after the manner of their superiors, devote themselves to a special class of maladies. These men, almost without exception, are Jews; belonging to one clique. Few, if any of them, ever received a medical education, or are, in the slightest degree, acquainted with medicine. They realise enormous sums by pure intimidation; and, for the most part, their victims are individuals of weak minds, whom really nothing ails, with the exception of strong nervous excitement. Many of these Jew empirics are much addicted to horse-racing. When away, their servants assume a professional air, and supply medicine for the patient to begin upon. To this end bottles of almost inert mixtures are sent to the empiric by a druggist, and are distinguished from medicines of greater potency, by wrappers of peculiar colour. With this temporising medicine, the servant—not known of course to fill that capacity—manages to secure the patient; after having exhausted him of any money he may have had on his person; and obtained a guarantee for a much larger sum.

DRUNKENNESS.

Although an enactment to interdict absolutely the use of alcoholic liquids would be no less impossible socially, than physiologically unadvisable, nevertheless, it is not easy to overrate the bad consequences of habitual excess in their use. Very different is the degree of proneness to intoxication manifested by different races of men. This does not seem to be altogether dependent upon climate, as is illustrated by the Jews. This race, in our own time, are distinguished for their sobriety, whether they be the denizens of temperate climates, or inhabitants of the torrid zone. The quality, too, could seem to have been predominant amongst them from all antiquity, if we are to judge from the fact that the Mosaic law nowhere awards any specific punishment for this vice. The code of Draco punished it by death. Nor were the provisions against its occurrence less stringent at Sparta, though more humane; Lycurgus interposing the effectual measure of destroying all the vines. Pittacus, king of Mytelene, taught a salutary lesson to the dispensers of modern law who palliate crime when committed under the influence of drunkenness. He awarded double the amount of punishment which would have been inflicted on the transgressor had he been sober. Zaleucus, the Locrian king and legislator, took a medium course in respect of wine, permitting its employment by the aged and infirm, but by none else, under pain of death. Imperial Romans worshipped the ruddy god only too much; but at an earlier period the Romans were a sober race. An ancient law in force amongst them only permitted the use of wine to males over thirty years old, interdicting its use by females altogether. Every one knows that Mahomet prohibited alcoholic drinks, though the prohibition is now so entirely neglected in some Mussulman countries, that they number the most depraved of drunkards. This is especially the case in Morocco, and is not unfrequent in Turkey and

Hindostan. Drunkenness has, on many occasions, been the subject of especial edicts in France, and a still greater number of indirect restrictions in the way of fiscal impediments. By an edict of Francis I., promulgated in 1536, drunkards convicted of the first offence were committed to prison on a diet of bread and water; a second offence rendered them liable to be flogged privately; a third, to the same kind of castigation, publicly administered; and another similar offence, to amputation of the ears, followed by banishment. Notwithstanding all these cruel edicts, and many others which might be added to the list, drunkenness, in no age of the world, or amongst any one class, has been controlled by such means. The vice springs from a combination of social causes, which have to be probed and controlled, if governments desire that its prevalence should diminish. Violently repressive measures here, as in perhaps all other cases of social evil involving human passions, and sentiments, are employed on a wrong assumption. They fail to recognise the distinction between conditions intrinsically base, and those the evil of which is a consequence of their over development and exaltation. Alcoholic liquors are confessedly ingested because of the stimulus they give to mental perceptions, and the general power, both mental and physical, which they impart; enabling the recipient to exercise a strength which he could not otherwise put forth; and acquit himself better than might be otherwise possible of the duties which existence involves. A stimulating power of this kind is not of the nature of evil: its adoption, or the adoption of an equivalent, is an instinct of humanity:—one which legislation cannot suppress, if it would, and ought not to suppress, if it could.

CHAPTER V.

POISONS IN RELATION TO HUMAN BEINGS.

THE readers who, glancing at the title of this chapter, imagine that I am about to open a catalogue of horrors, and minister to diseased imaginations, had better at once shut the book. Even though an author might have the bad taste to admire as a literary subject, the melo-dramatic element of poisoning—especially secret poisoning—he might well pause before incorporating that element with the literary structure of a book; in calling to memory the sickening frequency with which this has already been done.

As there is no one amongst us who may not at some time or other in life be exposed to the chance of poisoning, as the result of accident or design, it will be well to present the reader with such an outline of the nature of poisons as shall enable him to determine the fact of their administration, and to provide suitable antidotes.

What is a poison? What do we mean by the term? As systematic writers themselves are not agreed on this point, and even in their large treatises they leave the ideas which attach to poisons in considerable uncertainty, I shall not be expected to be more explicit here. To define a poison as being that which, taken into the mouth and swallowed, causes death, would be obviously incorrect. Jugglers have often died in consequence of recklessly swallowing knives; yet our common notions of the word poison would be assuredly violated by including knives amongst the list. Nay, persons have before now died as the result of swallowing large pieces of meat, but not by the most liberal acceptation of words could we ever consent to call meat poison? Furthermore, what shall we say concerning the puncture of a rabid dog's tooth, or the bite of a serpent, or the thrust of a poisoned arrow?

Like the definition of many other ideas, we must leave that attaching to the word "poison," open to the charge of a certain amount of vagueness. Practically, no one is the worse for this. Often, when philosophic subleties fail, and distinctive barriers break down,—that working resultant of many observations, to which we give the name of "common sense," comes in to the rescue. It is so here.

Presuming, then, that the reader who meets with the word "*poison*" either in these pages or elsewhere, will never be embarrassed by the circumstance that no one yet has strictly defined what a poison is—he has to be informed, at once, that poisons are usually divided into the three classes, of acrids or irritants, narcotico-acrids, and narcotics. If this triple division of poisons were merely subservient to some philosophical purpose, it need not be mentioned here. There is, however, a popular meaning attached to the triple division, as the reader will presently see; and as the specific characteristic of each poisonous class is brought under consideration, the perception will arise that, numerous though poisonous substances be, the chance of fatal poisoning, either the result of accident or design, will be exceedingly remote if people exercise a few obvious precautions.

Acrid or Irritant Poisons.—The poisonous bodies comprehended within this division are endowed with certain marked properties, which the term acrid or irritant expressively sets forth. They all destroy the tissues wherewith they come in contact. They all cause intense pain; which, however, notwithstanding its intensity, never destroys the power of the reasoning faculty; the victim's consciousness remaining unimpaired to the last.

The most extreme examples of an acrid poison are furnished by the mineral acids, oil of vitriol, spirit of salt, and aqua fortis. The poisonous quality of these bodies seems to be entirely dependent on their corrosive action, as is evidenced by the fact, that an amount of oil of vitriol, or aqua fortis, or spirit of salt, which would infallibly kill if administered pure, would produce no fatal, or even deleterious effect, if diluted to the necessary extent with water. Oxalic acid is another example of an acrid or irritant poison, but its action differs from the mineral acids just treated of in the following particular:—Oxalic acid, no matter how considerably diluted, is always injurious. This kind of influence is clearly not due to the corrosive character which it possesses when strong, but to some ill-understood associated influence. Nearly all metallic compounds belong to the extensive division of irritant or acrid poisons; which, therefore, comprehends preparations of mercury, copper, zinc, silver, gold, and arsenic: many of these, however, are so unlikely to occur as poisons, that I shall pass them over. Perhaps we might be justified in apportioning all metallic compounds, except those of lead, to the division of irritant or acrid poisons. Lead compounds hold a sort of indeterminate position.

Now, as regards the relative probabilities for the administration of poisons, it is clear that the administration of all, even supposing them all equally procurable, is not attended with equal facilities. One determined on suicide, need only be limited in his use of a poison by the amount of facility with which it is procurable; and his own unbending will. However odorous, or nauseous, or corrosive, or irritating a poison may be, one contemplating suicide, and holding such poison, may destroy his life by its administration, if his will so be; but for obvious reasons no poisonous body, which strongly challenges the senses, is eligible as a means of secret murder; and, when the senses are affected beyond a certain limit, the administration of these poisons to an adult, is next to impossible, I say *to an adult*, for the fact is too patent for comment, that any substance, however corrosive or strongly odorous, may be administered by force to children of tender years. Amongst the records of infanticide, there are many cases of murder effected by pouring boiling water down the child's throat; and child murder by the administration of the mineral acids is far from uncommon.

The fact had better be recorded at once that, contemplating the facilities wherewith poisonous bodies may be administered, distinctions should ever be drawn between the laity and medical men. Individuals of the latter profession have the opportunity of administering poisons of almost any kind; should they so will: but this is fortunately an exceptional case.

There is one body numbered amongst the class of irritant or acrid poisons—and I think only one—which is sufficiently devoid of taste, smell, or odour to be adapted to the wants of the murderer. That substance is arsenic, or, more properly speaking, white arsenic; termed by chemists "*arsenious acid;*" pure arsenic being a resplendent metal, very much like steel in aspect, and, it may be, devoid of all poisonous qualities. Perhaps an author would not be considered justified by certain sections of the public in thus conspicuously pointing out the qualities of white arsenic, if the populace had anything further to learn in respect of its administration. Fortunately, the Act of Parliament, commonly known as "The Arsenic Act," impedes the operations of many a would-be murderer. White arsenic may not now be sold, except it have been coloured, and rendered nauseous by the presence of some innocuous material. Let the murderer by arsenic lay the following consolatory unction to his mind:—The poison is as indestructible as adamant. The corpse may decay; the coffin fall to dust; hundreds, or thousands of years may pass; but underneath the mound of earth, in the spot where the corpse was laid, there is the arsenic. Like a Nemesis, the poison is ready to come forth in the chemical laboratory at any time, and bear testimony against the murderer. A knowledge of this fact would surely cause an evil-minded person to reflect on consequences, before finally committing himself to the murder of a victim by arsenic.

There is the following peculiarity in all that relates to the discrimination and the treatment of poisoning. No time exists for reading up a case, and putting our knowledge together. Whatever is done, should, to be efficacious, be done at once. There are details of many branches of learning which it would be unwise to commit to memory; time being given to discuss, to read, and reflect. It is not so with cases of poisoning:—here time emphatically is life. A case of poisoning discriminated, and treated at once, the patient is saved: neglect this for a minute or so, and the patient dies. Inasmuch, then, as the reader who would desire to be useful in the treatment of poisoning, must commit to memory certain things, it is of great consequence that we aggregate these things into a shape convenient for carrying about.

Directing our attention now, especially to the class of irritant poisons, let us reflect on the evidence which would be likely to transpire. And here let me impress on the reader the fact that much may be deduced from the demeanour of the patient, and from a knowledge of his or her domestic relations. A person who has swallowed an irritant poison by way of suicide will be less garrulous, less apt to give information, or afford any clue, than a person who has taken poison accidentally, or to whom it has been administered purposely by one, whose aim is murder. Moreover, a poison swallowed to the end of suicide, will in all probability not have been taken during a meal. Meantime, the investigator looks about; he tries to discover some glass, or phial, or other vessel; he examines the dress of the patient for spots or discolourations. If he finds a phial or other vessel, or observes a spot, and if on applying the tongue to either he tastes a sourness, he has at once resolved the case sufficiently for the application of a remedy. He is sure that a sour acid has been given (remember some acids are not sour); what kind of sour acid he may not know at this stage, nor does it much avail that he should know. Whatever the kind of sour acid, the same treatment is indicated. Chalk or whiting should be mixed with milk and administered copiously. If neither be forthcoming, a portion of the white wall or ceiling may be substituted. Whatever the kind of sour acid, nothing more can be done at the present stage. The stomach pump is not eligible in any of these cases, even were it at hand, and a medical man to use it. If the sour acid should happen to be oxalic acid, the treatment here indicated will almost assuredly save the patient's life, if administered somewhat early. If either of the strong mineral acids, the case is not so promising. Surely the reader, by remembering the few facts here detailed, will be at no loss to discriminate a case of poisoning by either of the sour acids; yet he will be surprised when informed that occasionally this diagnosis is not made out by medical men. A case once occurred in my own practice of the following kind—but I should premise the statement that the medical practitioner to whom the mistake occurred had never been thoroughly educated, and was therefore practising illegally:—A message was brought to me one morning early, requesting that I would at once call, to meet a practitioner in consultation, relative to the case of a girl who was assumed to have swallowed poison; but the evidence of the kind of poison could not be satisfactorily brought home. On arriving at the bedside the medical gentleman in attendance announced that, according to the best of his judgment, the poison swallowed had been opium, in some shape. Wherefore? Because certain black stains were visible on linen articles of the poor girl's clothing. But oil of vitriol was far more likely to have caused those spots than opium. Another glance manifested a red spot on a black *fichu* which the poor girl wore about her neck—a third glance—and there was a phial, and by the phial a cup. The bulk of the contents had been drained, but there was still a moisture, and this moisture when tasted was intensely sour. Not a moment was to be lost; chalk and milk were administered copiously, but all in vain; the poor girl died on the third day. No wonder; for during a clear half hour previous to my arrival she had been drenched by warm water in order to wash the stomach clean of opium; and, notwithstanding her intense state of agony, she had been obliged to perambulate her chamber supported by two persons, under the impression that if let alone the opium might cause her to sleep. Poor thing! she died of course. There are, indeed, very few cases of absolute recovery after oil of vitriol, or any of the other mineral acids, may have been swallowed in a concentrated state. Nevertheless, this was a case of promise, had it been taken in time. The poor girl had not purchased the vitriol of a druggist in its original concentrated state; but of an ironmonger, who was in the habit of considerably diluting it with water.

The narcotico-acrid poisons are, as their name sufficiently indicates, substances which partake of the nature of both acrids and narcotics. They consist for the most part of bodies from the vegetable kingdom: such as tobacco, belladonna, monk's-hood, &c., and the active chemical principles of either. The pungency of these bodies renders them ill-adapted to become the agents of murder; but certain members of the division have acquired an evil notoriety in consequence of their being swallowed accidentally. The berries of atropa belladonna, or deadly nightshade, present a tempting appearance to unexperienced eyes; nor are they sufficiently disagreeable to the taste to carry with them their own protection in this respect. Accordingly accidents, especially to children, occasioned by swallowing these berries, are not of unfrequent occurrence in spots where the plant itself is found. Happily, these localities are few.

It is of less consequence to be made aware that a certain specified poison of this class has been swallowed, than any one of the class; because the treatment in all cases will be precisely similar. There is no place for chemical antidotes here; at any rate, their power is of a very inferior kind. Everything depends upon freeing the stomach from the poisonous body swallowed, with the least possible delay. To this end, an emetic, promoted by copious draughts of warm water, should be administered; and the circumstance should be borne in mind, that the ordinary emetic, composed, as it usually is, of tartar emetic and ipecacuanha, is ineligible; not only because of its depressing tendency, but because of its promoting the absorption of any poison which may not be expelled from the system by the direct operation of the emetic.

Whenever an emetic is proper in the treatment of poisoning, almost the very best, if not quite, is a teaspoonful of mustard, stirred up with warm water; and its action promoted by copious draughts of the latter. Probably the medical man would substitute for mustard, an emetic of sulphate of zinc (white vitriol), in the dose of from a scruple to thirty grains. The action of this body may, upon the whole, be something quicker than that of mustard, administered as described; but very little: and it has the disadvantage of not being procurable in families on the moment when required.

Although the discrimination of the actual poison amongst the class last described is of minor importance as compared with the class of irritants or acrids, nevertheless some few points may here be indicated, as characteristic of particular narcotico-acrid poisons. The most prominent symptom indicative of belladonna, either swallowed or absorbed through the skin or mucous membrane, is enlargement of the pupil. The smallest appreciable fragment of any soluble salt of "atropine"—the active principle of belladonna—dropped into the eye, causes the dilation of the pupil at once, and the effect does not cease until after five or six days. The brilliancy of the eye is then to an observer much increased; whence arose the custom in Italy of ladies employing the juice of the plant as a cosmetic, and hence the term "*belladonna*" (beautiful lady), is said to be derived. The practice of using this substance as a cosmetic is most reprehensible, although the power of dilatation which it exercises over the pupil is taken advantage of in the performance of certain surgical operations upon the eye.

Monkshood (*Aconitum napellus*), and indeed every other known species of aconite, depends for its activity upon aconitine, a very terrible poison, which belongs to the class of narcotico-acrids, and the most prominent symptom of which is destruction of sensation; power of motion remaining unimpaired. The species of aconite which possesses the deleterious active principle in the strongest degree is the *Aconitum ferox*, as it is botanically called; a plant which grows in Nepaul, towards the base of the Himalaya range. During the period of war between ourselves and the Nepaulese, the wells of the enemy were frequently poisoned with roots of the *Aconitum ferox*, and numerous deaths resulted in consequence. Many examples have ocurred at home of accidents from the swallowing of monkshood root by mistake for the root of horse-radish. So different are the two vegetables in all respects, that it is a marvel how the error of substituting the one for the other could ever arise. The assurance that it has arisen, should admonish us against permitting the growth of monkshood in kitchen gardens. This very deadly plant is merely ornamental, and consequently can answer no good purpose amongst culinary vegetables.

We lastly have to enter upon the consideration of the remaining, or narcotic class of poisons—so called from the word "narke," stupor, on the assumption that the condition of stupor is their most salient characteristic. Opium, and its chief narcotic principle, "morphia," are the type of this class. Henbane is an example; hemlock another. The characteristics of narcotics, however, are so distinct amongst themselves, that recent authors on poisons have felt the necessity of splitting up the tribe of narcotics into various subdivisions, an alteration which—though it be perfectly justified in a medical point of view—does not require the general reader to be conversant with it.

Opium, either in its solid condition, or as morphia or laudanum, has frequently been made the chosen poison of suicide. It is impossible to indicate any minimum fatal dose for opium, or any of its compounds, or its alkaloid, morphia. There is no poison to which the animal organism can be accustomed and rendered tolerant to an equal degree. One fluid drachm of laudanum is usually considered to be a very large dose even for an adult; yet professed opium eaters consume enormous quantities without a fatal issue supervening. I myself have known a young girl, about sixteen years old, swallow, during the day of 12 hours, half a pint of laudanum. Though opium, or its derivatives, or associates, be frequently employed as agents of self-destruction, they present inconveniences to the murderer, on account of their taste and smell.

As regards the symptoms of poisoning by opium, or its active principle in any form, they are tolerably evident even to the non-medical observer. The great point in respect to this poison is to be able to effect its diagnosis from intoxication by alcoholic bodies. The following characteristics being remembered, the diagnosis between the two will in general be easy:—Firstly, if a person be intoxicated by some alcoholic drink to insensibility (dead drunk), his breathing will be loud, stertorous, or snoring, and the peculiar odour of the alcoholic liquid swallowed will be discoverable in the breath. Moreover, the pupil of a drunken person's eye is usually dilated; whereas in poisoning by opium the pupil is contracted. This, taken in connection with the history of the case, will generally furnish sufficient indications.

It is of the first importance in a case of poisoning by opium that the patient should not be allowed to sleep. An emetic of mustard and warm water should be given if possible; but if the state of unconsciousness be so far advanced that the power of deglutition is lost, reliance must be placed on tickling the fauces, or internal part of the throat, with a feather, and applying with as little delay as possible the stomach pump. Any violent shock to the nervous system may be applied here with advantage. Strong smelling salts or liquor ammoniæ held to the nose; shower baths, or the pumping of cold water upon the head; may all be had recourse to with benefit.

Proceeding now to summarise the few circumstances relative to the subject of poisons which should be impressed so deeply on the memory, that their traces will never be obliterated, they are as follows:—

If a poison strongly challenge the senses of taste or smell, it is not likely to have been administered for the purposes of murder, except under peculiar circumstances.

If severe pain in the stomach, vomiting, purging, &c., come on after a meal, poisoning is to be suspected. Administer an emetic of mustard and water:—procure medical advice.

If it be determined that poison has been swallowed, and that it is sour—it is one of the sour acids—the antidote to all of which is chalk, or whiting, beat up with milk rather than water, but with water if milk be not at hand; administer it copiously.

If symptoms of poisoning come on, and can be traced to the swallowing of a substance which is not sour, but has a strong metallic, or, as it may be described, a "coppery" taste, the poison will most likely be a compound of mercury, copper, or zinc. Beat up the whites of five or six eggs with water, and administer the mixture by way of antidote; this being done, give an emetic of mustard and water, as just recommended.

If poisoning result from the swallowing of any vegetable substance, there is no reliable antidote in the proper sense of the term antidote; that is to say, there is no body which, by combining with the poison, can form a third and innocuous body. The treatment, therefore, will consist in removing the poison, by means of an emetic and the stomach-pump, from the system with all due speed.

If symptoms of colic and general stomach disorder come on subsequently to the swallowing of a body which had a sweet metallic taste, probably the material swallowed is acetate or sugar of lead. Epsom salts will be the antidote. Generally, however, lead poisoning is of a chronic form, not dependent upon the administration of one large dose, but many small doses, swallowed day by day over a long period of time. For the most part this slow lead poisoning depends on the swallowing of water contaminated with lead, or on the absorption of lead through the skin. In this way plumbers and house-painters often suffer from lead colic, and lead paralysis, which supervenes to the former, or, it may be, accompanies it. A remarkable symptom of slow lead poisoning is the formation of a black mark on the gum at the root of each tooth.

I need not remark that the popular outline of poisons and their antidotes just given has no pretension to scientific completeness, or scientific arrangement. In curtailing it, I was actuated by the conviction that any fuller exposition of things which *might* be written would involve forgetfulness, on the part of the general reader, of things relative to poisons, which, to be of use, *must* be remembered. For this reason I have thought well not to mention more than one antidote, or scheme of treatment, for any one poison, or group of poisons; and I have altogether omitted to mention certain antidotes which, either from their doubtful efficiency, or the difficulty of procuring them, would have perhaps confused the reader's memory, and have displaced the recollection of other antidotes of easy accessibility, and unquestioned value.

Similar motives have induced me to forbear describing processes for the discovery of poisons. This is always an operation requiring care and delicacy even on the part of the professional chemist. It is totally beyond the powers of the non-chemical reader.

Secret Poisoning.—This dreadful crime has prevailed at certain historical periods, and amongst certain races, with all the characteristics of an epidemic disease. Murdering by poison secretly administered would appear to beget a sort of fascination—a *sentiment*, which, so far from evoking qualms of conscience and remorse, urges the perpetrator to the commission of fresh crimes. Taking a general retrospect of the crime of secret poisoning throughout all ages, we arrive at the conclusion that the chief adepts of this horrible art have been women; women, too, not always—perhaps not generally—of low social grade and deficient education; but not unfrequently high in rank, gentle in aspect, mild in disposition; and, to all outward appearance, moral, and religious.

Solitary examples of secret poisoning occurred, there can be little doubt, in all ages, but history has furnished no particulars of the crime organised and perpetrated on large numbers until the first half of the fourth century; when, at Rome, numerous ladies having acquired the art, banded themselves into an association, having for its object the destruction of disagreeable husbands. During many years the murderous practices of these lady-poisoners remained undiscovered; but they were divulged at length by a female slave. This occurred A.D. 331, and exemplary punishment followed the discovery; no less than 170 of the female poisoners being executed. Writers on poisons have hazarded many speculations concerning the nature of the secret poisons of the ancients. The use of hemlock was common—so was the use of aconite: probably these vegetables constituted the chief reliance of ancient secret poisoners. The most celebrated era of secret poisoning, however, had not yet dawned. It was reserved for the Italians of the latter part of the middle ages—the Borgias and the Medici—to bring the detestable crime into a sort of fashion, and to get rid of persons obnoxious to them without compunction. Nor were these practices confined to Italy alone: here in England, during the reign of our second

Charles, the crime of secret poisoning was common enough; nor in that era of general profligacy did the memory of the crime weigh very heavily on the conscience of those who perpetrated it. Still more renowned than the Borgias and the Medici in the annals of secret poisoning are the names of Tofana and Brinvilliers, who lived during the latter part of the 17th and beginning of the 18th centuries. The former acted like the modern Italian bravo, in so far as she plied her ministry of death for money: the victims of the poison (the celebrated *Aqua Tofana*, or *Aqua di Napoli*) being chiefly husbands of whom their fair partners had become tired. Very extraordinary accounts of the potency and extraordinary qualities of the "*Aqua Tofana*" have been handed down to posterity. That these accounts are overstrained there can be little doubt. The impunity with which Tofana pursued her murderous course without detection for so many years, and slew her victims by hundreds, according to her own final confession, was more dependent on the prevalent ignorance of the age than to any extraordinary power of the "Acquetta di Napoli," the chief poisonous agent in which, there is much reason to believe, was no other than common white arsenic.

Notwithstanding the existence of hundreds of poisonous bodies, each possessing greater activity than white arsenic, perhaps no one combines so many dangerous qualities. Colourless, tasteless, inodorous, it challenges the observation of no sense. Cheap and plentiful, it may be readily procured, if the prudence of the shopkeeper, and the safeguard of the law do not interpose. Devoid of immediate corrosive action on the mouth and throat,—although belonging to the division of acrids,—it may be swallowed, and the circumstance not discovered until the symptoms of poisoning come on. Nay, even then, so much are these symptoms like those of colic and cholera, that poisoning may not be suspected. These are very terrible qualities for a poison to have; and when to the above is added the fact that there exists no easily procurable and reliable antidote for white arsenic, the list of terrors is complete. Until the passing of the Act of Parliament, having for its object to restrict the sale of white arsenic, poisonings by this substance were a bane and a reproach to this country. Fortunately the chemical relations of arsenic are such, that the dangerous qualities of the poison are yet exceeded by the delicacy, and infallibility, of the tests for its discovery and reproduction. Had it not been for this circumstance, there is no predicting to what further extent the crime of arsenical poisoning might have gone. At present, since the incorporation into the statute book of the "Arsenic Act," cases of poisoning by this substance are rare.

The genius of secret poisoning has of late taken an extraordinary direction; in adopting strychnia, and a few other bodies belonging to the same category, namely, the vegetable alkaloids; and public apprehension, contemplating the enormous power which many of this class of bodies possess, and the consequently small dose necessary to a fatal issue, has been alarmed beyond the measure which a little calm retrospection on the point at issue would justify. If strychnia and other noxious alkaloids were cheap, easily accessible, tasteless, and not so immediately poisonous but that time, and opportunity, might be found for the poisoner to depart from the neighbourhood of his victim—there would be a great deal to fear; as it is, however, the chances of detection are so preponderating against the would-be murderer, that the probability of secret poisoning systematically carried on by this class of agents is but slight. Exceptional cases, doubtless, will continue to occur; and amongst the possible cases, the facilities possessed by medical men for becoming secret poisoners are too obvious for comment. Any substance, however nauseous, or coloured, may, of course, be administered under the pretence that it is a medicine. Let us hope it will be long ere a member of the honoured profession of physic is arraigned on a similar charge to that which has aroused of late popular apprehension to so high a degree.

The great Scotch writer on poisons, Christison, many years ago, in discussing the chances of any future instance of systematic secret poisoning, announced his belief that another Tofana or Brinvilliers could only arise from amongst the ranks of medical men. Taking all circumstances bearing upon the conditions of secret poisoning into consideration, he arrived at this satisfactory conclusion. The reader cannot do better than repose implicit confidence in so high an authority, and discard whatever fears he may have entertained concerning the probability of organised secret poisoning by any of the many terrible poisons which modern chemistry has revealed.

CHAPTER VI.

THE EYE AND ITS FUNCTIONS.

THERE is no part of the organisation of animals more beautiful than the special organ of vision, the eye—especially as it exists in man and the higher animals.

The eye being designed to take cognisance of luminous impressions, it will be desirable to its perfect comprehension that some preliminary notions be given of the nature and properties of light. There have been numerous theories relative to the intimate nature of light. Certain of the ancients believed it to consist of emanations evolved from the eyes of animals, a theory, which, if it were true, would invest much that we hear about "burning glances" with a reality to which the expression can lay no claim. Then followed the theory that light was an emanation evolved by bodies on fire, and no others; a notion which presupposes the belief that the luminous heavenly bodies are in a state of perpetual combustion. It was an impression of Huyghens that light consisted of wave-like vibrations in a certain something, the nature of which he could not explain. That theory was discarded mainly because of the objections brought against it by our illustrious countryman Newton, who argued that if light were really determined by waves, as advanced, it should be capable of turning a corner, whereas he said it clearly was not, as the existence of shadow proved. Strange to say, one of the strongest arguments in favour of the wave theory of light—the theory now generally received—is founded on the proof of its being able to turn a corner; as we shall hereafter discover.

The Corpuscular Theory of Light.—Newton, who urged such powerful objections against the wave theory of light, adopted another, to which the appellation corpuscular theory has been given, on the assumption that luminous emanations consisted of corpuscles, or little material bodies, continually darted away from luminous objects. No sooner had Newton demonstrated the compound nature of white light, by his memorable experiment of effecting its decomposition by means of a triangular prism, than the corpuscular theory assumed at his hands the following shape. He believed that white light was composed of seven primitive colours (we now know that the primitive colours in question are only three), each of which colours he assumed to be composed of particles of different sizes, the particles determining red light being largest, and those determining violet light smallest. He believed these particles to be darted away from luminous bodies in straight lines, and that by striking on the optic nerve of the eyes of animals, the impression of light was given. The theory accords perfectly well with all the phenomena of light known at the time when Newton lived; but it is totally incompetent to afford an explanation of many curious phenomena which have been discovered since that period, especially those which are concerned in the polarisation, and double refraction of light.

The Undulatory Theory.—I have already mentioned the great objection to the undulatory theory of light, in the time of Newton, to have been the fact, as was then assumed, of the inability of light to turn a corner, as we know that sound does. Now no better proof of the ability of light to turn a corner need be adduced than this: shadows are not equally dark throughout, but less dark at the edges than elsewhere. Every painter is conversant with this fact, and any person may convince himself of its truth by closely inspecting a shadow. That a portion of light thus can turn a corner is manifest, and sound does no more; a considerable portion of the latter being lost in the act of turning. Of this any one may convince himself by a little observation. Who has not failed to notice a carriage rattling along with deafening noise through a street in a direct line with the listener, but the sound becoming suddenly deadened if the carriage should abruptly turn down in a side street? This common occurrence satisfactorily proves that sound meets with some impediment in turning a corner. The same fact may be demonstrated by performing the following simple experiment. Having struck a tuning fork, and caused it to vibrate, hold it at some little distance from the ear, so that the sound it produces may be readily perceived. Then having interposed a card between the vibrating tuning-fork and the ear, notice the diminution of sound which ensues. No further proof after this experiment will be required of the effect of "turning a corner" on sound.

Many of the phenomena of light bear out this assumed analogy between light and sound in a very remarkable manner. Certain beautiful experiments, to detail which in this place would lead me too far from the subject of this volume, point to the belief that we might speak of octaves, and other harmonious intervals of light, with equal propriety to the employment of these terms in their usual acceptation by the musician. The analogies of the undulating theory of light are wider still, resembling in their functions those of waves, in whatever medium produced. For example, the act of throwing a stone upon a placid surface of water produces effects which closely resemble certain effects of light, and the rationale of which admits of every explanation if the wave theory of light be accepted. Let us assume a stone to be thrown upon a tranquil surface of water. Waves are then produced; each wave spreading outwards from the point where the stone fell as a centre. Farther and farther as these wave-like rays proceed, so do their crests become smaller, until either by long travelling, or by striking against some object in their course, they are ultimately lost: but these waves have imparted their motion to something, and the vibrations primarily created by the falling pebbles reverberate through the world,—to an imperceptibly small extent,—but motion we may say is never lost.

Amongst the speculative questions suggested by the corpuscular theory of light the following is one:—What becomes of light? Where do those little particles go thus assumed to be continuously darted off? Where is their final resting-place? The question presents difficulties of no common order, but they vanish if we give our assent to the undulatory luminous theory; the question—What becomes of light? then merges into the more general one, What becomes of motion?

But there are yet more important reflections than the pebble experiment is capable of awakening. Let us now, instead of dropping one pebble on the surface of the pond, drop two pebbles, not quite at the same instant, but consecutively. Let us assume, moreover, that they are both dropped at about the distance of two feet from each other, and trace what occurs to the waves produced. Two sets of waves will be developed, and they must necessarily strike each other at certain periods of their career. They may strike each other under two extreme conditions; two wave crests, each at its highest elevation, may coincide, or two wave troughs, each at its lowest grade of depression, may coincide. These are the extremes, and between them lie variations innumerable. Now, in the former case, the two waves will coalesce into one, and we shall obtain a compound wave, equal in size to the two separate waves; and, in the latter case, the result will be practically identical, because in both instances the waves will be said, in the language of science, to have coalesced in similar phases of vibration. But whenever the highest crest impinges on the lowest trough, then the waves mutually destroy each other, and both come to rest. If, therefore, the experimenter can manage by any device that two portions of light meeting each other shall produce darkness, important evidence will be adduced in favour of the theory that light is composed of waves. Now this can be done. Two portions of light, striking each other under peculiar conditions, can be made to produce darkness; and similar portions of light, striking each other under different circumstances, can be made to yield an increase of light. It would be impossible, without going into details too much at variance with the design of a physiological treatise, to explain the mechanical conditions for effecting this; but it can be done, and the experiment affords a very strong argument in favour of the undulatory theory of light. The corpuscular theory is totally incompetent to deal with the phenomenon in question. That two waves striking each other in different phases of their vibration should be able to produce darkness is intelligible enough: but that two luminous particles striking each other, except they be in direct opposition, which condition is not assumed, is totally incomprehensible.

Optical Properties of Light.—Whatever theory of light be adopted, the action of light, optically considered, is a matter of demonstration. Whether it be composed of particles or of waves, it acts in straight lines, to which, collectively, the term rays is applied; it is reflected, transmitted, and refracted, according to certain well known laws. It has been proved, by two distinct trains of reasoning, to occupy time in travelling. But so enormous is the velocity of its career—about a hundred and ninety-five thousand miles in a second of time—that we can scarcely bring the mind to appreciate it satisfactorily. Perhaps the easiest method of learning the beauty of adaptation of the eye to receive definite impressions of light will be to fix our attention on some kind of optical instrument resembling the eye in function, and afterwards to contemplate the extent to which the mechanism of the eye excels the former. Let us take the telescope as our starting point, or, rather, an opera-glass. This consists of a slide tube, and a pair of lenses; a large one termed the object-glass, and a small one to which the designation eye-glass is given. If the instrument be taken to pieces, a little metallic disc, painted black, will be perceived just inside the eye-glass. Through this disc is an aperture of one unvarying size in the same instrument; being drilled in a flat piece of metal, it is neither able to expand nor to contract.

The eye of man and the higher animals is composed not merely of two lenses like the opera-glass, but of many; and there is in it a representative of the black perforated screen, with this notable improvement: the aperture, instead of being of one unvarying size, is capable of expansion and contraction, allowing more or less light to be admitted according to circumstances.

Telescopes are of two varieties: refracting and reflecting telescopes. In the time of Newton, the refracting telescope was a very imperfect instrument, owing to its quality of imparting colour to bodies actually devoid of colour, and representing coloured bodies under false tints. Newton believed a refracting telescope, devoid of these imperfections (that is to say, an achromatic telescope), to be a perfectly hopeless desideratum. The problem has, nevertheless, been solved, by the application of certain principles; all previously applied by the Great Architect of our bodies in the construction of our eyes.

THE EYE.

The eyes of all mammals have almost the same characteristics; and those of man do not present any peculiar delicacy of organisation which brutes of the same organic class have not. On the contrary, many of these, and indeed many birds also, have a powerful acuteness of vision, far beyond the capacity of man. In one respect it may be, however, that the visual faculty of man is superior to that of every other animal; namely, in perceiving and appreciating the harmony of colours, that faculty on which so much of the painter's excellence depends.

Descending from mammalia into the lower divisions of animated nature, we find the eye to present numerous types, the simplest of which consists in the mere expansion of the optic nerve, upon which the light shines through a simple cornea. Of this kind are the eyes of the snail, and they serve all the purposes for which the presence of eyes in that animal is required, enabling it to distinguish between light and darkness, but perhaps no more.

Amongst the beautiful arrangements to be recognised in the eyes of the higher animals, the power of motion by the agency of a set of muscles packed in the bony socket is not the least remarkable. In many of the lower animals, however, that provision does not exist, and therefore equivalent, or rather compensating means of adaptation are devised. Thus spiders, for example, are little creatures which require to be tolerably wide awake, and to have their eyes in good seeing order. Good eyesight furnishes a spider's daily bread; and if he should by chance have the ill fortune to become blind, I really know not a creature in the whole living creation which would be more helpless.

That spiders are able to see perfectly well, and in every direction, every person who has watched them attacking their prey can testify; but this quickness of vision at all points is conferred on the spider by a totally different arrangement of visual organs to that which obtains in ourselves. The eyes of a spider are quite motionless: they are immovable, and always open. If our eyes were sufficiently sharp to see fully displayed a spider's eyes, the latter would be perceived always open, staring wide. But if a spider had only a pair of eyes like each of us, this perpetual staring would not avail him much. Each spider, however, possesses *many* eyes, and these being placed in various directions, the creature's field of vision is very large.

Very different is the visual apparatus of the fly. The spider is enabled to see in every direction by the presence of numerous simple eyes. The fly has only a pair of eyes, but each of these is compounded in a most wonderful manner. The cornea, a horny lens, instead of being a mere curved surface, is made up of numerous facets, and each facet looks in a different direction; so by this elaborate mechanism, the little animal, with its two eyes, can look backwards, forwards, and sideways with almost equal facility.

Were it consistent with the intentions of this work to expatiate upon the beauty of the eye, exemplifying the numerous resources which the Great Architect of all has thought fit to adopt in different grades of animated creation, a great deal more would have to be written. I must, however, finally leave this interesting subject; and proceed to offer a few remarks concerning the economy of the human eye, than which no organ is worse treated; and disease in no other is fraught with consequences so grave.

Amongst the earliest diseases to which the human eye is liable may be remarked a peculiar ulceration of the cornea, or transparent horny coat, which not unfrequently attacks young children. This disease is generally significant of bad nutrition; and is, therefore, seen most frequently amongst the poor. I do not advert to the malady here with the intention of offering any scheme of domestic treatment, it is far too grave for such method of dealing with it to be of avail; but for the purpose of indicating the cause of its existence, and the necessity of seeking medical advice at once. The amount of ulceration varies considerably, but its mere amount furnishes no index to the gravity of the disease. The real danger of ulcerated cornea depends on the exact locality of the ulcer. If over the pupil, or orifice through which the light enters to the sentient portion of the eye,—the sight is more or less compromised for life; if, however, no ulcer occurs on either side of the pupil, and the conditions which determined its existence be obviated, the mere existence of a speck would be of no consequence.

Myopia, or shortness of sight, is frequently a natural affection; but more frequently, perhaps, it occurs as the result of some mismanagement of the eyes. Individuals who are necessarily engaged in trades, or avocations, necessitating close inspection, frequently suffer from myopia determined by this cause. If the avocation be of a kind necessitating the continued use of one eye, the disease is usually confined to that, as we discover frequently amongst watchmakers. Children are very often caused to be near-sighted by bad habits acquired at school. The highly reprehensible custom of teaching children drawing, as it is called—like writing at a desk—has much to answer for in the matter of short-sightedness. The operation of blacklead-pencil drawing, as usually taught at schools, is peculiarly open to the objection stated; and the physiological consequences are no less grave than the objections to it in an artistic sense. If the process by which these so-termed pencil drawings are elaborated from a copy, be well studied, the result cannot be said to have been accomplished by the process of drawing at all. They are the result of a slavish copying of line by line, not the depictions of light and shade, or outline equivalents of light and shade, the result of true artistic feeling. If all children were taught to draw at an easel, standing, and from large objects—not only would a fruitful cause of myopia cease, but albums would in course of time be disembarrassed of the frightful things, miscalled drawings, which too often disfigure them. If, too, blacklead pencils were interdicted, and crayons used in their place, all the better. When myopia is confirmed, much can be accompished in the way of remedying it by judicious training of the eyes. They should be accustomed to regard objects at distances longer than feels agreeable, by which treatment, if commenced early, the focus of vision may be considerably lengthened.

If, however, the existence of myopia causes embarrassment to vision, glasses must be used, the choice of which will require much care. A patient when purchasing glasses should do so under the advice of a medical oculist, or an intelligent optician; the great point being, to make the employment of glasses an educational, no less than a palliative measure. A patient, if allowed to select glasses for myopia, according to the promptings of his own sensations, would, in the majority of instances, choose glasses he ought not to choose. He would select those which felt most comfortable at the time; imparting the clearest sense of vision at the usual distance of healthy eyes. This would be improper; recourse should at first be had to glasses the power of which is not quite equal to the fulfilment of perfect vision at ordinary distances. Perhaps the eyes may get accustomed to such under-power lenses, when a step will be gained.

It may be remarked here—and the remark applies to the use of glasses as well for presbyopia, or long-sightedness, as myopia—that, physiologically considered, spectacles are better than single eye-glasses; the reason for which is obvious. Habitual employment of one lens necessarily involves the unequal exercise of the eyes; which consequently soon cease to act in concert; the focal distance of perfect vision being different for each. Very few young ladies, however, like to be seen with spectacles; they would prefer suffering all the inconveniences of myopia. They should at least avail themselves of spectacles when at home; and care should be taken, when in places of public resort, and employing the eye-glass, to apply it not always to the same eye.

It remains now to state a few words about long-sightedness, or presbyopia. It cannot be regarded as a disease, but rather as one of the natural results of age. Individuals may expect to experience the length of their focal vision increase about the period of middle age; though in some cases individuals live out the full term of the normal age of man, and even longer, without ever having felt the necessity of spectacles. The remarks which applied to the choosing of glasses for myopia apply here too;—spectacles should never be chosen incautiously; still less defensible is it to employ a single eye-glass, inasmuch as the condition of presbyopia being almost always connected with advancing years, the repugnance which some young people have to the use of spectacles, and which, in the case of young ladies is, perhaps, justified—should have no place.

"Strabismus," or squinting, causes a peculiar aspect of the eye, which is too familiar to need description. It depends on some inequality of erection amongst the little muscles, by which the motion of the eyeball in its orbit is determined; and may be remedied by a surgical operation; neither difficult of execution, painful, nor dangerous. Still, however, this operation has of late years somewhat fallen into disrepute; the cures, in point of fact, which it effects are seldom absolutely perfect.

Such, then, are the most common affections of the eye which seem to demand notice in this place. As regards cataract, amaurosis, and a long list of painful and dangerous diseases to which the human eye is liable, they are too surgical or too medical to find place here.

CHAPTER VII.

HUMAN HABITATIONS, SANITARILY CONSIDERED.

"HABITATIONS," says a distinguished author on sanitary matters, "are to the family what climate is to the race, and comprehend an assemblage of various conditions by which health is preserved or illness determined."

In connection with the subject of human habitations sanitarily considered, the chief points for consideration are—the best method of securing that approximation to uniformity of temperature, which sanitary teachings prescribe; also the best means of protecting houses against the ravages of moisture from without, and the bad consequences of noxious emanations retained from within. The latter points lead us at once to the subjects of drainage and ventilation. These two latter subjects, indeed, are the ones to which the reader's attention will be principally directed, as being those which fall more especially under the cognisance of non-professional people.

Ventilation.—It seems to be an established law of nature that the function of life shall be a contaminating agent to living beings of the same division of nature. Vegetables can only live by withdrawing from the atmosphere carbonic acid—a gas necessary to their existence. Animals can only live so long as the atmosphere which they breathe continues to hold an amount of oxygen proportionate to their respiratory wants. Yet the vital functions of vegetables, and animals, are complementary of each other. That which one takes away the other gives.

It requires no little education and exercise of the reasoning faculty to enable mankind to appreciate the value of things unseen. This belongs to the higher aspirations of the human intellect, and its attainment is comparatively rare. If mankind were able to picture to their own minds the thousands of unseen deleterious emanations which hover about them, enter their lungs, are absorbed into the blood, and produce effects proportionate with their quality and their amount, no less surely than the most solid and tangible body we swallow, then would there be more hope that the necessity for ventilation and drainage should be more fully recognised, and not regarded as a mere national whim. A certain witty German traveller testified to the possession by us English of two especial crotchets: one of these being ventilation; the second, conversion of the Chinese. "Go where you will," he remarked, "you are sure to hear something about ventilation, as if an Englishman could not exist except in a blast of air."

It is true we do talk and write more about ventilation than the people of other nations, and we require to do this. Not only are our aggregates of population more dense than occur elsewhere, but the nature of our climate obliges us to stay a good deal in our habitations; add to this the circumstance of the chambers of an English house being for the most part smaller, lower, and therefore having less cubic capacity than the rooms of continental chambers, and our doors and windows habitually shut during a large portion of the year,—and we have a sufficient explanation of the necessity which exists for attending to the state of ventilation of our apartments, if we would avoid suffering from the ravages of disease.

The Spaniard, and Italian, play tricks with burning charcoal which would be fatal were an Englishman to adopt a similar course. Most people know that burning fuel causes the evolution of destructive gases, and other emanations; small quantities of which, if breathed, are sufficient to cause death. Of all the varieties of fuel commonly used, pit coal, perhaps, yields emanations which are the most deleterious; next in order comes wood; and, lastly, charcoal. Nevertheless, although charcoal is here mentioned third in the list, as being the substance exercising less injurious effects than the other kinds of fuel, it is the substance by which the greater number of accidents of this class are produced. We scarcely meet with a solitary example of suffocation by the emanations of coal or wood; suffocation by those of coke is rare, but suffocation by charcoal is, unfortunately, no uncommon event. The result is easily explicable; the products of the combustion of coal and wood, and coke to a lesser extent, are not only deadly if breathed in sufficient quantity, but they are intensely nauseous to the senses. Not so the emanations of charcoal; they are deadly too, but they are not repulsive to smell or taste, and they are, moreover, invisible. We in this country justly consider it a most dangerous practice to light charcoal in a brazier, place it in a room not having a chimney or flue, and remain in that room. Spaniards and Italians entertain no such fear; they habitually sit in rooms warmed by charcoal embers, and the evil consequences to health, if perceptible in any degree, are assuredly not marked. Why is this? The explanation is simple. In Spain and Italy the chambers are large; and having been constructed with reference to the extreme heat which prevails for the greater part of the year, their natural capabilities for ventilation are considerable. Noxious emanations are generated, as they needs must be wherever charcoal is burned; but they are heavy, and do not readily mingle with the air: they roll towards crevices and other ventilative crannies, and pass away.

The reader cannot be too strongly impressed with the fallacy of a common notion which exists, to the effect that the noxious qualities of charcoal are not necessarily inherent to the substance, but constitute an addition to it:—that they pass away with the first combustive efforts; leaving the remaining charcoal pure, so far as its capability of further contaminating the atmosphere is concerned. This is a most serious error. The case is directly the reverse; the fact being this:—charcoal, as usually procured, has been imperfectly charred; much of the nature of raw unburned wood yet remains in it, which renewed application of heat would dissipate in the form of smoke. Accordingly, when lighted, that smoke goes off; and so offensive is it that the human lungs cannot breathe it without suffering discomfort to such an extent, that the emanations, being offensive, carry with them their own protection.

It will have appeared from a consideration of the consequences of respiration already detailed, that emanations from the lungs of animals are similar in their nature to those of a charcoal fire; and the meaning of the proposition, that living beings, by the very condition of their life, deteriorate the atmosphere, so far as other living beings of the same organic kingdom are concerned, will be evident. Living animals, however, render the atmosphere which surrounds them unadapted to the healthy support of animal life, in another manner, besides the evolution of carbonic acid. The exhalations of the lungs, and skin, are not to be regarded as mere water, and an association of gases. They also contain various undetermined animal products; subject to absorption, putrefaction, and other changes. They enter into porous bodies wherewith they come in contact, and by the changes which they undergo therein, give rise to odours which by their presence is sufficiently indicated. Nor is disagreeable odour alone the only charge to which they are amenable. They beget, by their putrefactive changes, the elements of disease; and disperse far and wide the seeds of death. Against these animal emanations, even more than accumulations of carbonic acid, the results of combustion, respiration, fermentation, and other sources, it is the object of ventilation to oppose a safeguard.

Experiment has determined that a full grown human individual of average breathing capacity, consumes hourly an amount of oxygen gas corresponding with about 548 cubic inches of atmospheric air. In order, therefore, that the whole of a given quantity of air may not pass twice following through the lungs, and that the resulting carbonic acid may be kept below the limit of injury, a renovation of air to the extent of about one cubic foot per hour is necessary. In regarding the ventilation of buildings, two circumstances have to be taken cognisance of: one, the cubic volume of the building; the other, the volume of the current of air which passes through it. Looking at the full sanitary requirements of individuals in the matter of respiration, the space of an inhabited room should be so regulated that not less than two thousand cubic feet of breathing—or air—room, is allotted to each individual.

The effects of over-crowding are only too palpable. The medical practitioner, who is in the habit of visiting the abodes of the poor, notices the first indications of this state of things in the prevalence of a disagreeable odour, to which the denomination of "*poor's smell*" is expressively given. Fortunately, many classes of the poorer orders are necessitated by their avocations to be much in the open air. So much the better for them. This out-of-door life enables them to escape from the noxious influence of the deteriorated air of which the "poor's smell" is an indication. When the necessity arises for being continuously in an atmosphere of this kind, then the strongest constitutions are undermined. Fever, especially of the typhoid variety, springs up, and pursues its desolating course, often rendering abortive the physician's best efforts. Children grow thin and wan; every disease to which childhood is naturally liable is exacerbated; and a deteriorated progeny springs up, to their own discomfort and to the prejudice of the nation.

The means, and appliances, for insuring continuity of ventilation, are either direct, or collateral. For the most part direct contrivances are only applied in large public buildings; such as churches, prisons, edifices for legislative meetings, &c. All these constitute an exceptional case, which does not affect the question of social health, to the extent of private apartments. Let us examine then the conditions subservient to ventilation as they exist in private domiciles. For the purpose of thoroughly investigating the conditions of this subject, let us assume the following case :—There is no example in practice which fulfils the conditions to be indicated absolutely, but, more or less, there is an approximation to them; for which reason an extreme illustration, embodying the extremes of conditions which partially exist, is permissible.

I will assume—in furtherance of an illustration of the results which would take place, were every means of ventilation abolished—that an individual is enclosed, not in an apartment "close" in the ordinary acceptation of the word, but close absolutely. The walls, and floor, and roof, of the apartment may be assumed to be made of tin plate, or lead, and every piece accurately closed, or soldered. Under these circumstances the inclosed individual would continue to live for a period dependent upon the size of the chamber in which he was immured, modified by a few collateral circumstances; such, for example, as his natural breathing capacity, his power of endurance, his health, and perhaps a few others; but one unvarying list of consequences would inevitably follow :—Every expiration would contaminate the external air; the amount of carbonic acid in the latter would become greater and greater, and its amount of oxygen proportionately less. At length, when the quantity of carbonic acid had attained about the proportion of some twelve per cent., the air of the chamber would no longer be fit to minister to the respiratory function, and the person thus supposed to be incarcerated would die of suffocation, just as he would have died of breathing air contaminated with the emanations of a charcoal fire. Under the conditions of our proposed experiment, the breathing of an inordinate amount of carbonic acid would be the only clearly recognisable cause of death; for the animal emanations of the lungs and skin, although very prejudicial to health, as I have mentioned elsewhere, nevertheless do not kill so much by the effects of their immediate presence as by their setting up various forms of disease.

Having set out with this extreme case of an absolutely air-tight apartment, and traced the consequences attendant upon a complete stagnation of the included air, we may now with profit reflect upon the sanitary consequences (not so clearly evident, but which nevertheless exist) of living in apartments which approximate in their construction to the absolute impermeability to air, of the tin-plate box. Fortunately the defects of architectural materials and modes of construction are such, that they minister to our benefit in the end. If a room were absolutely air-tight, the act of entering it, shutting the door and going to sleep, would be no less surely followed by death than the act of going to sleep in a room containing lighted charcoal in a brazier. As houses are necessarily built, the floors and sides of apartments are full of air chinks. Even the ceiling, perfect though it may seem to the eye, is imperfect in respect to the quality of air-tightness. It would puzzle an architect to construct a chamber, having a door or window, so securely, and make it so air-tight, that absolute death should result to an individual closed within it, because of the want of atmospheric air. Unquestionably, however, a chamber closed to the extent of the builder's power, would be very injurious.

Where the climate is such that the doors and windows are habitually left open, or where the inhabitants live chiefly out of doors, the question of ventilation is diminished as to its practical importance; in other cases its consideration is scarcely inferior to that involved in the study of what we eat, and drink. No collateral agent could be devised better calculated to promote free aërial ventilation than our national British open fire-places. By virtue of the well-known law that gases expand, and become specifically lighter in proportion as they are heated, it follows that, a fire being lighted in an open fire-place, there must be a continuous upward rush of air through the chimney, and a proportionate rush of fresh air to supply the deficiency. Nor does the efficiency of an open chimney end here. Although a fire do not exist in it, there nevertheless is a current of air through it in one or the other direction. If the internal temperature fall lower than the temperature of the air externally, there will be a current of air from the termination of the chimney downwards. If, on the contrary, the opposite conditions prevail, a current will be established in the reverse direction. As ventilators, our open British fire-places do good service; ventilation is indeed to be considered as their major function. Regarded as sources of heat, they are less efficient than most others.

Although an adequate supply of pure air is desirable at all times, yet most especially is it desirable during sleep. There are few who have not, at some period of their lives, experienced the evidence of sleeping in an apartment, the air of which is foul, in the form of a fevered excitement or oppressive listlessness, attended with parched throat and coated tongue. Our sleeping apartments have much that is reprehensible in their structure, and adornments. They are too much crowded with furniture; the carpet is not in accordance with sanitary indications; and as for the feather-bed, and the drapery, were they both relinquished, the health of the sleeper would gain, though the ornamentation of the chamber would proportionately lose.

Although the presence of an open fire-place in a private room furnishes, generally speaking, a sufficient means of ventilation, certain special ventilating contrivances must not be passed over. Amongst the least efficient of these are the appendages to windows, occasionally seen in apartments. One of these, more common formerly than now, consists in substituting for a pane of glass, a sheet of tin-plate, with a circular aperture cut in its middle, affording space sufficient for the introduction of a rotating wheel, of the same material. The latter appendage, so far from being useful, is a positive disadvantage, tending, as it does, to impede the passage of a current of air. Judging from the industry wherewith the wheel rotates, an idea of efficient ventilation is suggested, though not in any way borne out by the result. In point of fact, the kind of ventilating apparatus here alluded to, merits no claim whatever to that denomination.

Scarcely more efficacious, as a means of ventilation, are the perforated glass plates, now much in vogue. They are more sightly than the rotating vane last mentioned, but their total area is far too insignificant to answer the purpose of satisfactory ventilation.

Perhaps the most efficient artificial ventilating contrivance adopted in private apartments is that proposed by Dr. Arnott, which consists of a square or rectangular orifice near the ceiling, and which, passing directly through the wall, terminates in the chimney. By means of an iron door communicating with a string or wire, and descending like a bell-pull, various degrees of occlusion may be given to the ventilating orifice; and, placed as the latter is, high up towards the ceiling of the apartment, the most favourable conditions are supplied for giving exit to the hot and contaminated air. Still, a ventilator of this kind is very disfiguring to an apartment, and except it can be veiled by a picture, or other appropriate ornament, the eye can scarcely tolerate it in a decent room. Moreover, except there be a chimney, the ventilator in question is inoperative; and granting the existence of a chimney, no specific contrivance for ventilation is required.

Drainage.—The object which ventilation accomplishes for gaseous and vaporous miasmata, is effected by drainage and sewerage, for the solid and liquid dejecta of animal life. These are matters almost beyond the direct control of private individuals. They, for the most part, concern the architect, and the designers of houses and of towns; but the sanitary disadvantages of bad drainage cannot be too strongly impressed on private individuals, who, in their capacity of members of parochial and municipal communities, may be enabled on some occasions to give to their representations a practical issue. When discussing the effects of contaminated air on the human organisation, the distinction was pointed out between the deleterious influence of known chemical constituents, and the deleterious effects of certain animalised emanations, the exact nature of which has never been determined, but which set up conditions of disease. A similar distinction may be drawn as regards the solid and fluid dejecta of animals, and the decomposing refuse of vegetables. Many consequences, injurious to health, are directly traceable to their chemical action, whilst other influences, more difficult to analyse, operate by indirect physiological influences. In point of fact, however, the distinction between the injurious results of solid and liquid dejecta on the one hand (matters, in other words, the removal of which from the sphere of human localities it is the professed object of drainage and sewerage to accomplish), and foul gaseous and vapourous emanations on the other, is more intimate than on a first glance might seem probable. If carbonic acid, as it exists in human habitations and other foci of animal life, be chiefly traceable to the function of respiration and to ordinary combustion—sulphuretted hydrogen, another extremely deleterious gas, chiefly results from the decomposition of animal matters generally, and certain classes of vegetable matters. To establish means of ventilation, therefore, whilst the scheme of drainage and sewerage remains uncared for, is almost trouble thrown away.

The economy and disposal of organic dejecta, as they occur in large towns, is a matter of gravest import in a sanitary point of view. Isolated habitations present no difficulties in this respect. As regards them, cesspools amply fulfil the indications of sanitary teaching, and the periods of cleaning these receptacles being far distant, but little practical inconvenience results. In towns and cities it is otherwise; here cesspools, under the best regulations of which they are susceptible, are a nuisance; offensive to the senses, and, worse still—the foci of disease. There cannot be a question as to the propriety, when it can be accomplished, of removing these abominations from our presence altogether. Great care, however, should be taken, lest, in purifying our individual houses, we do not selfishly scatter broadcast the seeds of disease, suffering, and mortality. How frightful is it to contemplate, for example, the present relations of sewerage and water supply of this great city! The foul offscourings of our houses are washed into the sewer, and the sewer floods them into the Thames. There arrived, they are kept in a state of flux and reflux by the tide, liberating their miasms into the air above, only to come back to us in forms unseen; and by generating in our constitutions various forms of disease, they punish us for our individual selfishness and want of consideration. Nor is this all. Much of the water which supplies this metropolis and its vicinity, is drawn, as is well known, from the Thames. Much has been written and said concerning the impurities visible, by microscopic aid, in London potable water. They are only too visible and too repulsive; but even were they filtered away, as is frequently accomplished, there are sources of deeper evil than lie within the competence of microscopic examination to discover. The public, in their ignorance of the presence of things unseen, place a great deal more faith in the efficacy of water filtration than is justified by the result. Water may be filtered bright to the eye, and every visible agent of contamination may be removed—but there may exist in it thousands of unseen, invisible contaminations still—things nauseous to refined tastes, and bearing the very germs of pestilence, and disease. It is an opinion advocated by Dr. Snow, Dr. Budd, and many other members of the medical profession, that one method by which cholera is propagated consists in the passage into the human body of cholera poison in potable water; the poison being originally derived from the excretions of cholera patients. Our evidence in relation to this matter is not sufficiently explicit to warrant the assertion dogmatically made, that the theory in question is correct; but it is supported by a mass of testimony which has commended it to the appreciation of most of those who have directed their thoughts to the matter; and even though no further testimony bearing upon it should be hereafter adduced, it will be regarded as amongst the most credible of medical probabilities.

Disinfectants.—The consideration of the qualities of disinfectants may here be taken up with propriety. The belief in disinfectants is one of long standing, though it remained for chemistry to demonstrate all that we know concerning their reliable powers; a knowledge which is by no means so extensive or so certain, as the frequent adoption of this class of bodies would induce one to believe.

The philosophy of the belief in disinfectants is based rather on a probable supposition, than a principle actually demonstrated. It is believed that small-pox, the plague, and other diseases of acknowledged contagious character, are propagated by the absorption of an animal poison capable of destruction by various chemical agents. There exists the strongest probability that the theory in question is correct, though the belief can hardly be considered as demonstrated. Far less certain is the potency of disinfectants, so called, as to their agency on the causes, whatever the latter may be, of epidemic diseases, the contagious property of which is questionable; such, for example, as cholera: and also on certain endemic diseases, as those prevalent in many restricted localities, and presumed to be dependent on some local cause.

Admitting the validity of every doubt which reasonably attaches to the potency of disinfections, the chemical destructiveness of the best members of this class is so easily demonstrable, so undoubted, that no mere lack of absolute proof should be adduced, as a plea for the disuse of this class of bodies.

The agents which enjoy the popular character of being disinfectants are exceedingly numerous. Many of them, however, are so devoid of power, in any sense, that no reasonable confidence in their efficiency can be maintained. Rosemary and lavender, spices of various kinds, and certain odoriferous gums, have long enjoyed, in popular estimation, the credit of being disinfectants. To this end they are frequently employed in the sick-room, or in the chambers of the dead. The real efficiency of these agents does not consist in their disinfectant powers, if it be granted that infection is attributable to diseased emanations. They merely serve to cover ill odours by their own stronger perfume:—if, therefore, a disinfectant be indicated, an agent of acknowledged chemical potency should be selected. Amongst these agents chlorine, undoubtedly, takes the first place. Its destructive power on organic matter is so powerful, that all animalised products which may exist in the air, wherewith it may be brought in contact, must be almost certainly destroyed. Unfortunately, however, chlorine is a very injurious gas when breathed; not that it has any poisonous quality, in the ordinary acceptation of the term *poison*, but it is irritating to the throat, and air-passages; for which reason it sets up an alarming state of inflammation. Chlorine gas, therefore, which is the most potent condition of chlorine, cannot be liberated with safety in chambers which are inhabited. Recourse must be had to some form of chlorine-combination; of which, perhaps, all things considered, the preparation known as "chloride of lime" is the best. Although not quite devoid of the peculiar odour of chlorine, yet the odour is not strong enough to be injurious to the lungs, and sufficient chlorine is liberated to produce a marked effect on the ill odours which pervade the air.

Brought into contact with solid or fluid animal dejecta, the effect of chloride of lime as a disodorant is most surprising. It totally destroys sulphuretted hydrogen gas, the emanation so largely evolved in sewers, cess-pools, and other depositories of decomposing animal matter; and there is every reason to suppose that its effects are beneficial as regards an atmosphere holding the unknown germs of infectious diseases.

Powdered charcoal, more especially animal charcoal, and next in order, peat charcoal, is also a powerful deodorising material; and, by a parity of reasoning, there is a strong probability of its being a powerful disinfector also. This material does not act like chlorine, by destroying the volatile principles to which ill odours are due, but by absorbing them into the interstices between its particles, and thus rendering them fixed. This property of charcoal has been long known, but we are indebted to Dr. Stenhouse, professor of chemistry at St. Bartholomew's Hospital, for demonstrating the extent of the potency in this respect which charcoal possesses. By placing several boxes or parcels of charcoal in the dissecting room of St. Bartholomew's Hospital, the fœtid odours which under ordinary circumstances always pervade places of this kind, are almost totally removed. Following out the indications respecting the deodorising properties of charcoal which experiment made known, Dr. Stenhouse has ingeniously devised charcoal respirators; instruments which, by being attached to the mouth and nose, cause all the air inspired during the period of attachment to be strained through a certain thickness of charcoal powder on its way to the lungs. No more effective, and at the same time unobjectionable, method of obtaining air deprived of odorous matters could be devised than this; and very strong reasons exist, for believing that the disinfecting powers of the charcoal so used are proportionate with its powers of deodorisation.

Vinegar fumigations are sometimes had recourse to, under the impression that the vapours of this acid possess a real disinfectant agency. If our evidence, even as regards the powerful deodorisers just mentioned, be in great measure presumptive, and if positive demonstrations respecting their disinfectant qualities be still a desideratum, how much less worthy of confidence must an agent of such inconsiderable chemical potency as vinegar be. Even acetic acid, the active principle of vinegar, into the composition of which it enters only to the extent of some five or six per cent., is possessed of very inconsiderable destructive powers on organic substances; whence the strongest probability arises, that, the disinfectant, or even the deodorising pretensions of vinegar, must be classed in the same rank with those of rosemary, lavender, benzoin, camphor, &c.; that, in point of fact, it merely covers disagreeable odours by its own fresh and agreeable perfume; but that it in no way destroys them.

THE QUARANTINE.

Quarantines, or lazarets, are institutions ostensibly for the sequestration, during a specified period, of individuals and merchandise suspected of bearing the germs of contagious disease. The institution of lazarets dates from the period of the Crusades, when they were established by St. Lazarus, chiefly for protection against lepers. Subsequently, lazarets were employed as a sort of prison, for the detention of travellers coming from places sanitarily suspected; and of late their chief use has perhaps been to impose political restrictions, under the plea of sanitary care. The opinion of the majority of those who have made hygiene their especial study is, that the system of quarantine is worse than useless—that it is positively injurious. Even granting the existence of diseases propagated by contagion (as contradistinguished to aërial infection), much more fully than unprejudiced examination into the case would justify—granting to a proportionate extent the efficacy of a system of quarantine isolation, if such could be rigorously carried out to the extent required—still it is doubtful whether the most despotic government, armed with all its powers, and endowed with all its vigilance, could give practical effect to a system so complex and embarrassing as that involved in the maintenance of quarantines.

If the quarantine system were not subject to abuse for political ends, and if its professed laws were not contravened by subordinate officials, still there is reason to believe that the balance of sanitary advantages is against it; that more injury arises from the thronging, necessitated by quarantine, than would be attendant on the fullest possible intercourse. Perhaps the best test of the value of quarantine regulations is the one furnished by statistical inquiry into the prevalence of epidemics, both anterior and subsequent to the introduction of quarantine. The case stands thus. Lazarets or quarantine establishments were first instituted towards the end of the 15th century; about the middle of the 17th century civilisation first began to dawn; the beginning of the 18th century corresponds with the extinction of the plague in Europe, two centuries after the first establishment of quarantine establishments. On examining the three centuries which immediately preceded the establishment of lazarets, it is found that one hundred and five epidemics are recorded; but during the three centuries which immediately followed their inauguration, there occurred no less than one hundred and forty-three epidemics. M. Aubert Roche, an author who first drew attention to the above statistics, arrived at the conclusion that the real cause which terminated the existence of the plague in Europe is the progress of civilisation.

INFLUENCE OF LIGHT ON VITALITY.

Every gardener knows that the growth and peculiarities of vegetables are profoundly influenced by the conditions of light or darkness under which they may be produced. Potatoes will vegetate, throwing out roots and branches, in a damp dark cellar; but the vegetable offshoots are blanched and watery. Onions present a similar phenomenon, and many other parallel illustrations will be supplied by the reader's own experience. This condition of whiteness is denominated "*etiolation*," and it is practised designedly on certain kinds of vegetables, such as endive, celery, and seakale, for the purpose of imparting a succulent tenderness and a delicate white colour.

A knowledge of the properties and results of this vegetable etiolation concerns our present purpose in two senses. It concerns this purpose directly, inasmuch as we are led to consider the effects of etiolation in lowering or destroying the capacity of healthy vegetables to purify the air; and indirectly, by furnishing starting points of comparison for the results of etiolation on living animals.

The balance which subsists between various departments of nature is one of the most striking phenomena that can present itself to the physical inquirer. The aggregate of created material things displays one beautiful concatenation of mutual dependences. Carbonic acid—the gas so poisonous to animals—is a life-giving pabulum to vegetables. The former it kills, the latter it nourishes; and the process of vegetable nutrition determines the evolution of the gas which animals require. If, by any cause, the decomposing effect of vegetables on carbonic acid gas were suspended, animal life must after a short period cease from the world. Now vegetables are not able to effect this decomposition of carbonic acid gas, and liberation of oxygen, except they be subjected to the influence of light. For this reason it is that the presence of growing plants in sleeping apartments is injurious. During the absence of light their decomposing agency ceases, but they never cease to evolve odours, and perhaps other unhealthy emanations

The evidence as regards the influence of light on animals generally, and more especially on the human race, is not, for any individual case, of such striking character as the parallel evidence in the case of vegetables. Nearly all the reliable information we have concerning the functions of life and the agencies which modify them, are deduced from larger sources of statistical data. The physiologist can demonstrate the effect of absence of light on a single vegetable; but he cannot do this by the evidence of a single human being.

Looking at the human family in the aggregate, however, and, still more discursively, including in our survey animated nature generally, the inquirer will be at no loss for evidence in relation to the agency of light in modifying the functions of animated life, and impressing profound distinctions on different sections of the human race.

A curious experiment, performed by the physiologist Edwards, demonstrates the influence of light on a certain form of animal development. He procured two perforated boxes of equal size, one made of transparent materials, the other of perforated tin plate. Into each of these boxes he put an equal number of tadpoles, and this done he immersed the two boxes in the water of the Seine. The conditions to which the little things were exposed will be seen to be identical, except in the particular of light. One set of tadpoles enjoyed the rays of the sun, the other set remained in darkness. Now mark the curious result. All the tadpoles on which the sun shone passed in due time into that higher state of existence which ambitious tadpoles look forward to:—they became frogs. A less enviable fate awaited the benighted tadpoles; only two out of every dozen of the latter succeeded in passing into the existence of frogs.

The result of this experiment demonstrates how powerful is the influence of light on one form of animal development, and suggests further examination concerning the effects of light, and darkness, on the higher orders of animal life.

The circumstance is well known that inhabitants of densely populated towns, and cities, possess a whiter and more delicate complexion than those who are more exposed to the glare of daylight. Certain conventional ideas of beauty attach to this kind of etiolation when it occurs in women—

not that the beauty is a thing of itself, so much as it is the result of association of ideas between a certain complexion and a corresponding avocation, education, and social grade. The physician too well knows that the sort of beauty in question is only gained at the expense of health. When this etiolation is carried to excess, a long train of diseased symptoms arise, all characterised by a want of red colouring matter in the blood.

The brown colour resulting from exposure to direct rays of the sun, and to which the expression "sun-burn" is conventionally given, illustrates the immediate effect of the sun's rays upon the colour of the skin. The term "sun-burn" is suggestive of heat, but the result is assuredly not attributable to heat alone, if at all. Artisans engaged in several trades who are habitually subjected to more powerful degrees of heat than results from direct sunshine in any climate, do not get browned by following their avocation. Neither does a fatal condition, similar to "*coup de soleil*," or sunstroke, ever arise from exposure to heat without light; so that many observers have been led to believe the heat of the sun's rays is less operative in causing the disease than the associated light.

One curious deduction in reference to the effects of light in modifying the human structure is this:—persons who are most subjected to conditions of etiolation, are most prone to scrofula, osseous disease, and resulting deformity. Not only is the above illustration borne out by comparison of different social classes amongst any one section of the human family, but by the larger comparison of various races. Humboldt long since directed attention to the extreme rarity of physical malformation amongst races possessed of a skin either brown or black. Humboldt particularises certain dark-coloured races amongst whom he travelled, without ever, in the course of many years, discovering one case of physical deformity. According to a French writer on hygiene, of deservedly great reputation, M. Leon, a similar deduction may be arrived at by taking a field of observation no more extensive than France. Between the north, and the south, of France, there is a considerable climatic difference. In the former the sun shines with diminished brilliancy; whilst southern France is always glowing, and occasionally, the sun comes forth with almost African power. Now, according to the observer just quoted, there is a marked difference in the proneness to physical malformation as between the inhabitants of northern and southern France.

Speculations of still more extensive interest attach to the inquiry respecting the modifying properties of light. Some physiologists have seen in the variations of the intensity of light, a sufficient cause to account for the shades of dark, recognisable in different races of men. It is well known to anatomists that the darkness of coloured tribes is caused by the deposition under the skin of a dark pigment. If it exist to only a slight degree the skin is rendered brown, yellow, or copper coloured; if raised to a maximum, the ebony blackness of the negro is the consequence. To associate the amount of the dark-coloured pigment found in individuals of any race, with the degree of heat to which the race is exposed, is evidently an assumption not borne out by facts. True, the negro is black, and he lives under a powerful sun; but the Greenlander, and the Esquimaux, and the North American Indian tribes, if not actually black, are very highly coloured. Any explanation which associates the darkness with the mere temperature to which the races in question are subjected necessarily fails; but if, discarding the supposition of heat, as the presumed cause of the *pigmentum nigrum*, and adopting the hypothesis of light, a very curious uniformity of presumed cause and effect is disclosed. The Esquimaux, and the inhabitants of northern regions generally, though living under conditions of extreme cold, exist under a blaze of light scarcely less powerful, it may be, than that experienced by the negro. The latter receives only direct light, proportional with the force of the sun's rays, and the clearness of the atmosphere. In northern regions, on the contrary, the garb of snow in which the land is robed for months together, acts like a mirror in exalting the power of light, darted forth from a wan and pallid sun. How strong the reflected light is, may be seen from a contemplation of the diseases of vision to which people exposed to those conditions are liable—diseases which are so precisely analogous with the corresponding ones of certain hot climates, that the hypothesis which attributes them to the agency of one direct cause, is rendered extremely probable. In the island of Ceylon, the races who inhabit the open country have a copper-coloured skin; whereas, the races who inhabit the thickly wooded forests of that island have a skin which is almost white. The Europeans who settle down in hot climates assume, more or less, the tint peculiar to the region; and the darkness of the tint would seem to increase in succeeding generations. What an instructive illustration do the Jews furnish of the effects of region on the tint of their skins. Abyssinian Jews are scarcely less dark than the natives; a result which cannot be attributed to intermarriage, for such an event is unknown. Compare these with the Jews of Germany and of Poland. Exclusive in their alliances as Jews always are, the prevalent tint of skin visible in a German or Polish Jew is that of the people by which he is surrounded.

Before concluding this notice of the presumed effects of light on the growth and condition of organised bodies, it is necessary to add, that the word light has been employed in its largest and most ordinary sense, as including all solar emanations, save those resulting in heat. I need not inform the chemical and physical reader that the word heat, thus largely applied, comprehends agencies which are not in all respects identical. The experiments of Melloni, Nobili, Stokes, and, I may add, the experience of every photographer, point to the deduction that each solar ray is far more complex in its "organisation," if the expression may be allowed, than a mere compound of light and heat.

DISPOSAL OF THE DEAD.

Perhaps there is no subject of constant necessity which involves the lesion of such delicate sentiments, and is beset with such painful associations, as the disposal of the dead.

Not all the ratiocinations of philosophy, or the purer truths of Christian revelation, pointing to a spiritual existence of the living germ—can withdraw mankind from contemplating the material form as the entity around which the affections of humanity have clustered—the being to whom we have become endeared. These are circumstances which interfere with the cold teachings of unsentimental utilitarianism, and lead to infringements on the laws of social polity, in so far as relates to the question of the disposal of the dead.

Shorn of these collateral prepossessions, the subject of disposal of the dead is one the indications of which are few and simple. The animal form, once reduced to a lifeless mass of chemical combinations—the sooner the latter are decomposed into their natural elements the better; and the process which most rapidly accomplishes this the most economically, and with least prejudice to the living, is the best. Regarded on this basis, no method is comparable with incineration; it was adopted by some of the most civilised of ancient races, and indications of its revival have lately been suggested, rather than proposed, amongst ourselves. It would be absurd to hope that incineration can be adopted in this country, until the popular mind becomes more enlightened than the most ardent believer in human progress ever anticipated. Yet it seems not a little strange that the pagan Greeks, to whom the future was an inscrutable mystery, to whom that holy revelation which teaches of a spiritual immortality had not been vouchsafed—in the minds of whose priests, and philosophers there had not yet dawned one ray of that beautiful science which teaches the existence and perfection of the invisible world—should have adopted the practice which, of all others, involves the greatest departure from the belief in universal materialism; and which not all our faith in a spiritual existence, and the proofs which chemical science advances of the inevitable lot of matter to pass into other forms, can induce us to adopt.

Perhaps the system of interment is primarily referable amongst Christians to a sentiment encouraged by the early church, that some vague advantage resulted from burial in religious edifices, or places adjoining to them. At first this method of disposal was restricted to individuals who lived and died in holy sanctity, such as ecclesiastical dignitaries; then followed the corpses of temporal magnates; and, lastly, the honour and supposed advantages of this form of burial were craved, and obtained, by the relatives of all whose estate was rich enough to defray the outlay. This latter the clergy took care should be something great, of which, indeed, too frequent illustrations have been furnished in our own day. At present the system of intramural interment, in towns and cities, has been taken cognisance of by the legislature, and that baneful source of disease is gradually merging into the better system of extramural interment. It will be probably within the memory of the reader, however, that ecclesiastical personages, high in authority, have in our own day been the subjects of prejudice, in this matter, to such a degree, that some amongst them, not content with giving a general support to intramural interment, on religious or ecclesiastical grounds, boldly met the sanitarian chemist on his own field, and pronounced these localities unexceptionable, nay salubrious.

The civilised ancients, notwithstanding their ignorance of the reason of those physical causations, by which the influence of decaying mortality on the health of the living is determined, intuitively selected their places of burial external to their towns. This was the practice of the Jews, as we are informed by Holy Writ; it was also the practice of the ancient Greeks and Romans, though the rule was occasionally transgressed by the latter in favour of certain magnates; who, however, were not allowed the honours of intramural interment, except under the immediate sanction of a decree of the senate. By an edict, passed in the reign of Adrian, the ground of a tomb constructed within the walls of Rome was, *ipso facto*, confiscated. Even this partial permission of intramural burial was interdicted subsequently by Diocletian. Greece, ever intelligent, pursued much earlier the right sanitary path. We have already seen that incineration, followed by burial of the ashes, was the most honourable means of disposing of the Grecian dead. Sepulture, without incineration, was, however, adopted for the common people, who were, necessarily, the majority. From the very foundation of Athens, a law of Cecrops prescribed extramural interment, and an edict of Solon subsequently confirmed the law.

In mediæval and modern times, the abuse of indiscriminate burial in religious edifices has lain under the condemnation of many popes and councils of the Roman Catholic Church. Haguenot, in France, eloquently inveighed against the deleterious habit in 1754, having witnessed, at Montpellier, some of the bad consequences occasioned by it; he was, however, not much regarded. Twenty years later Maret, and shortly after him Piattoli, in 1774, then Navier, in 1775, made strong efforts in a similar direction. At length, in 1776, a royal decree was enacted, limiting the right of burial in churches to certain personages of the high clergy and of the civil order. The practice, however, was not finally abolished in France until the month Prairial of the year XII. (June 12, 1804), when the custom of burial in places of public worship, also within the boundaries of cities, towns, or villages, was interdicted by a special decree.

Taking a glance, now, at the methods of disposal of the dead had recourse to amongst different men and at different periods, they resolve themselves, so far as civilised people are concerned, to the three means of incineration, mummification, and inhumation. Burial was the process usually adopted by the Jews; who, nevertheless, burned dead bodies under certain circumstances. The place of incineration is referred to in Isaiah, chap. xxx., verse 33, under the name of Tophet. The Jewish cemeteries were always outside the town; and the hygienic consequences of being exposed to contact with the dead had reference seemingly to the condition of impurity; to guard against the effects of which, an individual, according to the Jewish law, is enjoined to submit himself to a purification—(Numbers, chap. xix.) A Hindoo law, moreover, contains a similar provision, doubtless with a sanitary object. Contact with a dead body, according to the laws of Menu, book v., is made a cause of impurity for ten successive days.

Burial and incineration were both adopted by the ancient Greeks; the latter, however, was most honourable. After burning, the resulting ashes were buried, and the spot of ground wherein this burial took place was ever afterward sacred. So in like manner was held sacred the ground where a dead slave lay; and the sentiment of consideration for the dead was so strongly developed amongst the Athenians, that by a special law of that republic, it was rendered imperative on every one passing near a grave to throw a handful of earth upon it. This sentiment was even sufficiently powerful to infuse itself into the ancient code of war. Though little of that feeling which we term chivalry was known, and though prisoners of war were treated with a harshness which seems marvellous, considering the intellectual progress of Greece and Rome, a sentiment which custom did not extend to the living, was readily accorded to the dead. Ancient international law recognised the right of granting armistices for burial or incineration; and a neglect of these rights was emblematised by the fictions of mythology, with consequences of privation and unhappiness, in the immortal future which classical philosophy dimly shadowed forth.

Mummification is, without doubt, the most extraordinary of all the known means of disposal of the dead. Ancient Egypt is peculiarly celebrated for this process. It was there determined by religious considerations. It was commenced at periods beyond the farthest verge of authentic history, and remained in vogue until the sixth century of the Christian era. Not only was the process of mummification applied in Egypt to man, but to animals, the varieties and the number of which thus preserved baffle all comprehension. The Grotto of Samoun contains a number of chambers which cannot be traversed in less time than five hours, yet they are so filled with mummified animals, that they may be not inaptly regarded as a museum of Egyptian natural history. At Thebes, again, the mummified bodies of apes, serpents, and crocodiles mingle, thousands upon thousands, with the mortal remains, similarly preserved, of Egyptian kings. At Touneh-el-Gebel, at the base of the Libyan range, there extends a subterranean town, the streets of which are cut out of the rock, and along which, on either side, niches are excavated full of apes. There are also lateral chambers, containing millions of the ibis and ibis-eggs, deposited in enormous earthen pots; the mouth of each sealed with plaster.

Although latent, and not expressed, the objects kept in view in selecting a burial site, are exactly those which the advocates of incineration would effectuate by a much quicker mode:—namely, the decomposition of corpses with the utmost rapidity, compatible with the agencies at work. To this end, a ground moderately dry and sandy is preferred, experience having demonstrated that when buried in such, a corpse more rapidly undergoes decomposition, and is resolved into its elements, than when the ground is either wet, or inordinately dry. The effects of dry earth or sand, or even dry air, on dead animal bodies subjected to the influence of either, is well illustrated by the existence of natural mummies. Certain burying grounds are known to have the peculiarity of preventing decomposition, or rather modifying it to a very different issue to that of ordinary decay. The burial cave in the chapel of Kreuzberg, near Bonn, furnishes a remarkable example of this. Ranged in coffins, all around a subterranean vault, in that chapel, may be seen the bodies of more than a dozen monks, withered and shrunk and blackened, but not decayed. This result is purely attributable to the dryness of the soil and air in the locality; though a deviation from the laws of ordinary decomposition to such an extent was too good an occurrence for the church to neglect: accordingly, the sacristan takes care to refer it to some miraculous agency. A similar phenomenon also occurs in whole regions where the soil is sandy, and the air habitually dry and arid. To the operation of these conditions is referable the natural mummies of Peru and certain parts of Mexico.

The effects of damp, or, more properly speaking, wet ground are still more curious. Exposed to this condition for a sufficient time, animal bodies are converted into a sort of soap, called adipocere; in which ammonia, generated from the nitrogenous elements of the body, takes the position of a base. There is no portion of animal bodies which, after being interred, will not suffer decomposition in time. The soft tissues are first resolved, then follow the bones proper, next the teeth, and lastly the hair and nails. Complete decomposition of the two latter is extremely slow, even under the most favourable circumstances; but the mean duration necessary to ensure decomposition of the soft tissues sufficiently for permitting a grave to be opened, and another corpse deposited, may be estimated at about five years.

Although the sites of cemeteries are chosen with reference to the facility with which they cause animal bodies to decompose, coffins, by a perversion of the same indications for which a pardonable human sentiment is responsible, are chosen with reference to their long duration. Elm, the undertaker's wood *par excellence*, better withstands the influence of subterranean damp than any other timber which is readily available. Nevertheless, if the sentiment of long-enduring coffins were carried out to a fuller extent, the economy of burial grounds would suffer; and its adoption to the fullest extent would be incompatible with the existence of burial localities for this purpose. Some years ago, an inventor alarmed the burial executive of England, by the attempted introduction of iron coffins. The professed object of their introduction was, in fact, cheapness, but it had especial reference to the prevention of those disgusting mutilations of which metropolitan churchyards furnished such numerous examples. The point had not, however, suggested itself for reflection in the mind of the ingenious coffin-maker, that his manufactured goods were too enduring. In vain he changed his tone of argument, and tried to make it appear that iron, when buried, crumbled into dust as speedily as wood; the churchwardens were incredulous of this, and the dispute having been carried before a superior court of law, the award was adverse to the inventor, and the fate of iron coffins was sealed.

The most unfavourable conditions to animal decay, with especial reference to the sanitary effects of the results of decomposition, are the alternations of extreme heat with extreme moisture. To the existence of these conditions in Egypt, the periodical recurrence of plague is on no mean authority attributed. M. Pariset, a French writer on hygiene, has drawn attention to the combined effects in Egypt on dead bodies by the succession of heavy dews, rain, drought, and, more than all, the periodical inundation of the Nile; and has furnished strong presumptive evidence between the operation of these causes and the periodical outbreak of plague. M. Hamont, formerly director of the Egyptian veterinary school, has supplied another link in the chain of evidence. He asserts, on the authority of many sheiks, that the chances of the outbreak of plague in Egyptian villages are in exact relation to the quantity of rain which fell on them during the wet season.

Many independent observers have arrived at a similar conclusion in attributing the origin of plague to the decomposition, under peculiar conditions of temperature and moisture. Mons. Ambrose Paré attributed the origin of the plague which in his time devastated the Agenois to the decomposition of numerous dead bodies which had been deposited in a well in the Chateau of La Père. Our own countryman Willis, treating of the plague which in 1643 raged in the army sent against the Earl of Essex, and particularly the foot-soldiers confined in barracks of circumscribed capacity, refers it to the accumulation of decomposing organic matter in the latter. Similar local conditions are said by Diemerbrock to have occasioned the outbreak of the plague in Amsterdam, Haarlem, and Dorfelt. Chiran affords similar testimony as regards the plague which broke out at Rochefort in 1694. It may be asked, wherefore it is, if the plague can be engendered by the causes specified, that it does not break ou in the West of Europe as an endemic, seeing that, notwithstanding all improvements in promoting cleanliness, too much by far of dirt and open decomposition exists. The reader will be startled to learn that perhaps the plague, mild and modified, *does* exist in Western Europe under another name. The celebrated French physician Degenettes, who witnessed the progress of the plague at Jaffa, affirmed that it reminded him of a form of disease which he had often seen in Lower Languedoc, Provence, and along the banks of the river Ponant de Gênes. The opinion of M. Louis Frank, in relation to the western existence of plague, is yet more strong. He believes the typhus of Western Europe to be nothing less than plague, modified by conditions similar to, but milder than those which give rise to the Oriental scourge. M. Prus recapitulates the following as the conditions which may generate the plague :—Dwelling on alluvial or diluvial localities, or in marshy situations near the Mediterranean; or near certain rivers, such as the Nile and the Danube; low-built, ill-ventilated houses; an atmosphere hot and humid; food deficient and unwholesome; lastly, mental depression, and bodily squalor.

PRODUCTS OF THE DECOMPOSITION OF ANIMAL BODIES.

The chemist is well aware of the fact, though the task may, perhaps, be not easy to awaken a full impression of it in the mind of one not conversant with chemistry, that the products of the decomposition of a body, more especially an organic body, are subject to differ according to the circumstances under which decomposition is effected. If a piece of soft animal tissue be decomposed, by subjecting it to the agency of fire, there results one set of products; if to the agency of water, another set; and so on for other means of decomposition. The ultimate elements of decomposition are of course the same; but these may be variously arranged amongst themselves, giving rise to secondary products. Every person must be aware of the highly offensive emanations which are evolved while soft animal tissues are undergoing the ordinary process of decay. These emanations are no less injurious than they are disagreeable; and though the human organism tolerates, without incurring perceptible damage, their existence when below certain minute proportions, yet, when exceeding these proportions, the insalubrious effects are productive of deviations from health to a variable extent, even to the issue of immediate death. Instances of the evil results of breathing an atmosphere evolved from burial grounds are, unfortunately, not unfrequent in this country; but, perhaps, it never reached to such a high perceptible extent as at Paris during the latter part of the last century. From the years 1774 to 1780, the ground in the Cemetery of the Innocents had become so charged with human bodies, that the gaseous results of their decomposition infiltrated into the cellars of neighbouring houses, and gave rise to grave calamities.

Animal tissues, when subjected to incineration, give rise to products very different to those furnished by them when interred, compounds far less noxious, far less disagreeable; but as this mode of dealing with our dead will not be adopted, the theoretical advantage of the system need not be further expatiated upon. Exposed to slow decomposition, under the combined influence of air and moisture, the sulphur and phosphorus contained in animal bodies are evolved in the condition of sulphuretted and phosphoretted hydrogen gases: nitrogen, chiefly in the form of ammonia; carbon, chiefly as carbonic acid; and the hydrogen not concerned in the formation of ammonia enters into several complex, and offensive smelling, organic compounds. Animal bodies, if burned with full access of atmospheric air, are almost totally resolved into fixed metallic oxides, and carbonates and phosphates of oxides, and gaseous matter; the latter being chiefly composed of carbonic acid and oxide, nitrogen, and sulphurous acid gas. It appears, then, that, leaving out of account the advantages of incineration as an eligible method of immediate disposal, the results of the decomposition of corpses by this process are far less injurious than those evolved by the ordinary form of disposal.

Not only are densely crammed burial grounds injurious to living humanity in their neighbourhood, because of the gaseous emanations which they evolve, but also by the liquid drainage which, infiltrating through the structure of the ground, passes away from them. Foreigners, when visiting London, notice the existence of pump wells close to the ground of contiguous churchyards; and are astounded, no less at the repulsive sentiment involved, than at the associated real sanitary evils. Many of the London wells have had their waters so contaminated by these churchyard percolations that at one time public access to them was denied. Not only was their taste rendered disgusting, but chemical analysis proved the existence in them of animal matter, putrid and poisonous.

The amount of deleterious agency attributable to the cause in question depends, *cæteris paribus*, on the state of decomposition at which the inhumed bodies have arrived. In the earlier and middle stages of decay, the liquid products evolved are actively poisonous; at a later stage, though the idea of drinking a product of decomposition of human beings is repulsive to every delicate sentiment, nevertheless, the physical effect of a burial ground on water permeating its terrain, may be advantageous. It is a well established fact, that water naturally holding in solution portions of gypsum, and sulphate of lime, and which is therefore hard, becomes softened by the cause just indicated. The result is explicable on chemical principles. The decomposition of animal bodies, when arrived at a certain point, is attended by the generation of ammonia; the latter the porous earth absorbs, and yields it to the percolating water. The chemical effect of ammonia, added to water holding sulphate of lime, is to precipitate the lime; whence it follows that the water, deprived of the latter, is softened to a proportionate extent. However unexceptionable the chemistry of this operation may be, few persons will admire the source of ammonia.

CHAPTER VIII.

CLIMATE.

A CONSIDERATION of the laws of climate is of great importance in relation to hygiene; certainly of not less importance than a consideration of the laws and properties of ingesta.

At the present time we give to the expression climate a different significance to that given to it by the ancients, amongst whom it was understood in a purely mathematical or geographical sense, as may be learned from the origin of the term, from *climax*, a degree. According to the Greeks and Romans, therefore, similarity of climate meant similarity of geographical region, in relation to latitude. Twenty-four climates were recognised to exist between the equator and the polar circle, and six from the latter to either pole; thirty climates were therefore recognised in all.

But geographical position has in reality much less to do with climate than the ancients supposed. Purely local conditions, such as elevation, the presence of mountain ranges, the vicinity of water, and the prevalence of certain winds, are more potent in furnishing the peculiar characteristics of a climate, than any mere geographical locality. At the present time, we understand by the word climate, the external conditions which regulate and modify organic existence.

Far more true in principle than the mathematical distribution of climates, as adopted by the ancients, is the arrangement on the basis of lines of equal temperature—isothermal lines, as they are called—of Von Humboldt. Still, no conditions of mere equality of temperature can be regarded as constituting similarity of climate. Moisture, purity, and impurity, of the air, dependent on causes of local origin, and conditions of vegetable and animal existence, exert a deeply modifying influence; and perhaps more than all these, certain meteorologic conditions peculiar to the atmosphere in various regions.

Humboldt first called attention to the circumstance that the mean temperature of Europe is higher, for equal parallels of latitude, than the mean temperature of Central Asia or America. He demonstrated also that in the same hemisphere, and under the same latitude, the annual mean temperature diminished rapidly in the direction from west to east, as regards inland places; but that the diminution of coast line mean temperature followed a precisely opposite direction. Where this conflict of heating causes exists to the greatest extent, the effect is to give rise to violent contrasts of season; as, for example, we find in North America, where the winters are more cold, and the summers more hot than in any corresponding geographical regions of the old world.

Accepting the isothermal division of climate as an approximation to the truth, we have the following divisions established:—

1. Fervid climate of the torrid zone having a mean temperature varying from 80° F to 76° F.
2. Hot, showing a mean temperature varying from 76° F to 68° F.
3. Mild, from 68° F to 59° F.
4. Temperate, from 59° F to 50° F.
5. Cold, from 50° F to 41° F.
6. Very cold, from 41° F to 32° F.
7. Icy, below 32° F, or the freezing point.

Each of these climates, or isothermal bands, admits of subdivision into constant, variable, and extreme sub-climates; each of which is exemplified by the following places:—

Constant climate,—Funchal.
Variable climates,—St. Malo, Paris, and London.
Extreme climates,—New York and Pekin.

In how small a degree the question of mere similarity of temperature bears upon climate is demonstrated by the inability of certain plants to flourish under temperatures absolutely identical. The cocoa-nut palm furnishes a striking illustration of this circumstance. It confines itself exclusively to the sea coast, or regions not far inland: whence there are no cocoa-nut palms to be found in the interior of Africa. The distribution of various animal species also affords an illustration, though, for the most part, not so well marked, as is furnished by plants, if, perhaps, we exclude species of fish, which creatures, though no visible barrier be interposed to prevent their migration to any part of the aqueous world, they circumscribe themselves within invisible climatic bounds. Even no farther than the Mediterranean the species of the finny tribe are for the most part quite different to those found in the Atlantic, and so complete is the line of demarcation that neither Mediterranean nor Atlantic fish roam very far from their respective localities.

Of all living beings, man is endowed with the greatest powers of adaptability in relation to the endurance of extreme climates. Under the tropics, Europeans, born in a temperate clime—have dispossessed the natives, founded kingdoms, given laws, and implanted the civilisation of the west. Under the severest cold of two frigid zones, Europeans can still exist; and even in exceptional spots of great insalubrity, such as Sierra Leone and Vera Cruz, many, after acclimatisation, can flourish. All this wonderful adaptation is the result of the artificial aids which the human intellect can devise, for the preservation of the human body.

Still, even regarding the influences exerted on the human race as manifesting distinctions of climatology, there are phenomena which show how potent is the influence which climate exerts. The difficulty of preserving infant life in Hindostan is well known, and to a lesser degree a similar remark applies to the whole of the known continent of Australia. Indeed, even as regards the temperate regions of North America, the question has been frequently mooted by physiologists, whether the climatic condition there be so favourable to the European race as their native homes; and the problem, not less important physiologically than socially, has yet to be solved, whether, in the event of the stream of emigration failing to that vast continent, the physique of the race would continue equal to the European standard.

Looking at the national differences which exist between the natives of the United States and those of Europe, more especially the Anglo-Saxon division, it requires no physiologist to recognise the fact of the great national difference of physique which has become established. How great the difference between the broad-chested frame, rubicund visage, and muscular build of the Englishman, and the thin, wiry, narrow-chested, national representative of the United States. Between the women the difference is still more conspicuous. Look at an American book of beauty, and compare its delineations with those of our own fair ones. How great the contrast! Equal to our own female beauty of childhood and early womanhood, we look in vain for the ripe full-bosomed development of the mature female form. In nations where the humorous faculty receives no legislative check—where it is free to embody itself in printed description and mimic form, these expressions of the ridiculous in our natures may be generally accepted as the exaggerated exponents of truth. Who can doubt that the caricaturist's impersonation of the sturdy John Bull, and the lean Yankee, is a reflection, though exaggerated, of the corporeal peculiarities of each people?

Peculiarities of climate beget corresponding peculiarities of food, and social customs, which, in their turn, help to modify the characteristics of the human race. It becomes difficult, therefore, in many cases, to distinguish between the effects immediately due to climate, and to the conditions arising out of the latter. Still some important generalisations may be arrived at, and turned to advantage, in the treatment of various conditions of disease. Amongst the peculiarities of climate, which are best characterised by their influence on the human system, that combining the joint existence of heat with moisture is most conspicuous. No climatic condition exercises a more prejudicial influence on the human organism than this; against none is acclimatisation accomplished with greater difficulty.

The injurious conditions of heat, with moisture, are exemplified in all tropical countries during the rainy season, but two regions have attained a bad celebrity on account of the dangers attributable to this cause. The proverbial insalubrity of Sierra Leone has gained for it the characteristic name of the White Man's Grave; and, perhaps, even more dangerous are the Atlantic low lands of Mexico, especially in the neighbourhood of Vera Cruz. That the insalubrity of these regions depends on certain conditions of heat and moisture acting upon rank vegetable growths there can be no doubt, when we consider how circumscribed is the sphere of influence of the morbific conditions. The littoral inhabitant of Mexico has only to ride for a few hours inland, through a forest belt, and ascend the mountain range, which leads up to the table-land, to pass from a region of pestilential diseases to one of the most complete salubrity. Perhaps in the whole known world there is not a region so favourable to human life—so guarded against noxious influences—as the table-land of Mexico. Though the yellow fever rages at frequent periods on the Atlantic region of Mexico, so completely does it depend on local conditions that not a single case, I believe, has ever been met with on the Pacific coast.

Scarcely less marked is the connection between the morbific predisposition and the locality of its existence at Sierra Leone. The terrible coast fever is only to be dreaded there in the lowlands near the coast. It neither exists on the mountains, nor far inland, so that by taking refuge in any direction the European is safe from the scourge. Founded on a knowledge of the non-existence of the disease termed coast fever far inland, hopes have been framed of penetrating to the interior o Africa, by rapidly hurrying across the evered belt, up the arms of the large rivers; but unhappily the malarious influences have proved more rapid than our locomotive means of protection. The fate of the Niger expedition, protected as it was thought to be, shielded against the fevered malaria by all the preventives which science could suggest, must be fresh in the recollection of all. Long before the fevered belt was passed, the crew and general executive were almost annihilated by the ravages of disease. Nevertheless, so great are the adaptive powers of the human constitution, that it can accommodate itself even to the influences of African coast fever and the Mexican *vomito* by acclimatisation. There are many Europeans at Sierra Leone, who, having once recovered from an attack of fever, enjoy subsequent immunity from its ravages, and live through a long term of years as free from maladies as they probably would have done at home. This points to the employment of such acclimatised people if other expeditions should be undertaken for ascending the great rivers of Western Africa.

When the conditions of moisture and moderate warmth occur combined, then we have not indeed disease so terrible as African coast fever, or the Mexican vomito; the tendency is now towards ague or intermittent fever in one of its varieties. The proximate cause of intermittent fever has hitherto proved too difficult for chemistry, and physiology, to solve. We say it is caused by marsh miasmata, but we know not of what marsh miasmata consist. The remote causes, however, are beyond doubt. Whole regions which formerly were periodically ravaged by attacks of ague, have by draining been so completely freed from that disease that not a single case throughout a long range of seasons has been met with.

The influences which determine the existence of ague are even more localised and circumscribed than the corresponding influences on which African coast fever and the Mexican vomito depend. The elevation of a few feet above a given level will frequently suffice to remove an individual from a locality of certain ague to a locality of certain protection. This pronounced demarcation is well illustrated in certain parts of Mediterranean Spain, devoted to the cultivation of rice. Here the natives will point out with the greatest confidence the line of elevation beyond which upwards the malarious influence has never been known to extend.

The combined influences of moisture and cold give rise to a train of diseases peculiar to themselves. Under these conditions chest diseases are frequent, rheumatism is established, and circumstances are favourable to the outbreak of scurvy.

The mere condition of heat without the collateral influence of moisture, or injurious emanations, does not seem to be very prejudicial to the European adult, provided only due care be taken to adapt the ingesta (understanding by that term articles of food and drink) to the circumstances. Generally too little thought is given to this adaptation. Frequent meals of animal food are persisted in, as was customary at home; and should the appetite flag, by a wise provision of nature, it is solicited by spices, and other condiments, until the balance of excretion, and nutrition, is disordered, and some vital organs, usually the liver, succumb to disease. This result is still further aggravated by persistence in the use of strong alcoholic liquors, which though useful adjuncts to diet under conditions of greater cold and more violent exercise, are fatal now. The system which our Government has long adopted of giving large rations of spirituous drink to our soldiers and sailors on duty in hot climates, is a fruitful cause of the high mortality amongst those classes in hot climates.

Sanitary indications are well pointed out by extreme physiological cases, of which the following in relation to the combined effect of prolonged heat and a full diet is one in point. The celebrated *patés de foie gras,* for which Strasburgh is so renowned, are made, as is well known, of the livers of geese; not livers as they usually exist in healthy geese, but preternaturally enlarged by disease. This enlargement is produced artificially by nailing the birds by the webs of their feet to planks arranged in front of a strong fire, feeding them highly, and withholding water. The inevitable result of this treatment is to cause the livers to grow to an enormous size, thus artificially begetting the condition which proves so destructive in India and other hot climates.

Though the physician is seldom able to demonstrate physiologically, by the immediate correlation of cause and effect, the proximate origin of disease so satisfactorily as in the case just cited—nevertheless indications scarcely less satisfactory are often noticeable. The conditions under which the plague arises afford a striking example. This terrible disease never originates, nor can it with facility be propagated, in regions where the extremes of heat or of cold prevail. Its focus is Egypt and the Levant, where it seldom commences its ravages at the hottest season of the year. Now these regions are characterised by peculiar social conditions. Inhabited for the most part by a Mussulman population, thronged close together in ill-built towns; wood the chief building material; the streets narrow, drainage totally uncared for; animal and vegetable matters, and disjecta decomposing on every side: these are conditions to which the Levant is subject in an extreme degree. Given the proper temperature, and meteorologic conditions, the chemist is at no loss to figure to himself the abominable emanations of fermentive change which must necessarily arise. Now, extremes both of heat, and of cold, are unfavourable to the progress of putrefaction, a circumstance which, viewed in relation to the other conditions mentioned, affords strong presumptive evidence as to the origin of the plague.

Between climate, and locality, some distinction rather felt than explained, is generally made. If the word climate be accepted in the sense understood by the ancients, the distinction is obvious; not so, however, is the modern acceptation of the term. As I have adopted that acceptation, the influence of locality on disease may with propriety be included here, in cases where the influence of any peculiar locality is not due to artificial causes.

A few words, therefore, may be stated concerning that frightful enlargement of the throat to which the term *goître* has been given. In certain districts of the Alps and Pyrenees in Europe, also in certain parts of the Cordilleras and Andes—perhaps, too, in the Himalaya range, this disease occurs. Here, as in the instances of the plague, the immediate relation of cause and effect is not evident, yet a certain uniformity of conditions is suggestive of the origin of the disease. Some writers have surmised that it results from the drinking of snow water; but snow water collected in northern and level regions never begets goître. Others have surmised that it results from inadequate ventilation; many that the goître regions of mountains are usually deep valleys or clefts, overshaded by eminences on every side; but surely this explanation is palpably futile. No amount of impediment to the material circulation of air which mountain configuration is able to beget, can equal the deteriorated ventilation of our cities and large towns. Others, with more reason, have sought a probable explanation of the origin of goître, in the circumstance that the inhabitants of the valleys in which it prevails, being isolated from other parts of the world, intermarry amongst themselves, until the physique of the race deteriorates, and goître is the result. Nothing can be more certain than that the practice of intermarriage continued through many generations deteriorates the race, as may be witnessed in many parts of the world, where false notions of pride of family suggest this method of perpetuating a house; but so far from goître being a usual concomitant of such deterioration, it is altogether exceptional. Probably the habitual inhalation of highly rarefied air, such as exists on mountains, combined with coarse and sparing diet—for goître usually attacks the poor—are the proximate causes of the disease.

CHANGE OF CLIMATE AS A REMEDIAL AGENT.

This curative means is adopted far less generally than it merits; for the influence thus brought to bear upon certain states of disease, is energetic and profound. Not that mere change of climate, in the absolute or material sense of the expression, is the cause to which sanitary improvement is attributable; the agency is far more extensive than this. There is a mental as well as a corporeal change. The valetudinarian passes away from scenes which have been associated with the pains of illness, and the phantom terrors of delirium; new faces present themselves; beauties of nature are unfolded; consciousness of strength is suggested by the renewed ability of locomotion; and, in short, a whole series of mental influences begin to work beneficially on the corporeal frame. These things, far from being trivial, or extraneous to medicine, are integral portions of it, and will never be underrated by the physician who has himself been ill, and can remember how delicate is the impressionability of the mind under these circumstances; and who reflects on the intimate relation between the mind and the body.

Without underrating the collateral, or, as we may term them, the psychological advantages of change of climate, as the remarks just offered will testify, we are not called upon to expatiate further upon them here. Physical conditions of climate are those alone wherewith we have to deal in this place.

The diseases then to which change of climate in its physical sense is applicable, may be reduced to a narrow category. They must be necessarily chronic diseases, or if acute diseases, after their period of greatest exacerbation has passed, and convalescence has already begun.

By far the most important chronic diseases to which the remedial agency of climatic change is applicable, are phthisis, or consumption, and rheumatism. The former is popularly considered to be an especial scourge of these isles, but the opinion seems unfounded. Nowhere does the malady commit such ravages, perhaps, as amongst the negro population of America and the West Indies. Indeed there is reason to believe that the negro constitution is very prone to phthisis even in Africa.

The fact just noticed is opposed to the common impression that mere heat is a condition favourable to the non-existence of consumption; and other facts of similar import might be adduced. Neither is extreme cold to be regarded as peculiarly favourable to the production of this disease. Frequent mutations of temperature appear to be amongst the most frequent developing causes of phthisis; but the latent causes of the disease can be traced to a far deeper source—to an unhealthy condition of blood.

It may be that even the non-medical reader has met with the term "*humoral pathology,*" which was in vogue at one time, and according to which a diseased condition of blood was the cause of all maladies. However deficient of truth that doctrine might be, applied in all its universality, modern experience goes far to demonstrate that it may be implicitly accepted in relation to phthisis, or consumption; which is not primarily a disease of the respiratory organs, or indeed even a disease of the chest; although the chest symptoms are so generally the first to be noticed that they have been universally regarded until of late as indicative of the beginning of pulmonary tuberculous disease.

If a lung affected by consumption in what is generally called the first stage of the disorder be dissected, it will be seen to contain more or less of little, yellowish, granular, chalky, or, perhaps, horny substance, to which the appellation tubercle is applied. This tubercular substance is usually deposited in the upper edge of the right lung to begin with, where it may be discovered by the stethoscope and by percussion. Gradually it extends, softens, is expectorated, and a cavity remains in the lungs. Frequently spitting of blood accompanies the development of tubercles; there is a hectic blush; there are perspirations at night; and, generally, though not always, wasting of flesh; in consequence of which latter symptom the term consumption, or decline, is given to the disease. It is no part of my object, however, in this place to enumerate all the medical symptoms of phthisis; that to which I especially wish to direct the reader's attention is the discovery made in times quite recent that the true beginning of consumption is usually anterior to all the symptoms usually held to be consumptive, long before any disease of the chest has been noticed, or has set in. According to Dr. Pollock and other observers, who have minutely studied the pathology of this disease, the first symptom of consumption is usually the symptom from which the disease acquires its name; a wasting away without apparent cause. In a consumptive subject, when this condition of wasting has begun, the formation of tubercle from the blood is going on, and may, most probably does, exist in some part of the body, not necessarily the lungs. Indeed, tubercular matter may be deposited almost in any soft tissue of the animal body. Without going so far as to aver that consumption is never curable at stages farther advanced, thus much safely admits of being said,—that the chances in favour of successfully treating it are never so considerable as at this early grade. In some parts of Germany wonders are effected on consumptive patients by what is called the milk-cure; which simply means the condition of living on a diet almost exclusively of milk. If effective when the chest symptoms of consumption have fairly set in, how much more beneficial may it be expected to be at the still earlier stage? The fact is, there is strong reason to believe that thousands of cases really consumptive, and in which symptoms of chest disease would have ultimately set in, are amenable to the two powerful agents of diet and climate, at this turning point of their existence. Alas! they are not at the command of all. The poor have only limited range of choice as regards food; much less are they able to command the resources of climates properly selected. In choosing a climate for a consumptive patient who has the means of adopting the suggestion, the precise stage of the disease should be made out as well as possible, and the attendant symptoms maturely reflected upon. If the hectic be high and the night perspirations be strong, a hot climate, however equable, would be too enervating; but if those symptoms do not manifest themselves, mere heat, if it be not excessive, and attended with dust-bearing winds, heavy dews, moist emanations, &c., is not detrimental.

As regards marsh miasms—there are some physicians, and of high character and standing too, who believe in a sort of antagonism between marsh miasms and phthisis; or, to avoid theory, between the cause of ague and the cause of phthisis. According to these physicians the circumstance has been remarked that in the Pontine Marshes surrounding Rome, where ague always exists, cases of consumption are rare; and it has been furthermore asserted, that if consumptive persons chance to be attacked with ague, the original disease is suspended in its progress for the time. Hence Rome has been recommended as a fitting winter sojourn for phthisical persons. But the theory of those who believe in the antagonism between the causes of ague, and the causes of phthisis, is not quite consistent here. Rome is considered, I believe, on all hands as a bad summer residence for the consumptive, yet it is almost exclusively in summer that agues are rife in that locality.

The climate of Madeira has acquired a world-wide celebrity as a place of resort for consumptive people, and not without reason. Of late years, however, its fame has been rivalled by a charming city nearer home, and, I think, all things considered, preferable. I allude to Malaga, the climate of which is delicious, the necessaries and luxuries of life cheap, the people civil, and society good. Moreover, good medical advice (English and German practitioners) is available, an English clergyman, and, what is quite exceptional in Spain, a complete tolerance, the exercise of the Protestant religion; even to the extent of permitting the existence of a Protestant cemetery.

Our respected consul at Malaga, Mr. Mark, must have well ingratiated himself into the good opinion of the Spaniards to have been permitted to carry the point of having a Protestant burial ground. Its existence, however, must be a great comfort to the Spaniards themselves; for, beautiful as the climate of Malaga undoubtedly is, the English people living there must some day go the way of all flesh, and their dead bodies cannot be disposed of, as convention will hold to be proper, on the Atlantic coast. There it is the custom to bury all heretics deep in the sand below high-water mark, as being on the outermost practical limits of orthodox soil. In the Mediterranean, however, where there are no tides, and of course no high and low water mark, Spanish clerical ingenuity would have found it difficult to accommodate Protestant corpses, had some concession not been made to the shrine of heterodoxy. It is worthy of consideration by the Spanish ecclesiastics, whether much of the political and social trouble experienced by that unhappy race, may not be in some way connected with the sepulture of so many heretic corpses far inland, on the ground of the battle-fields of Wellington.

CHAPTER IX.

THE ATTIRE AS INFLUENCING HEALTH.

Farther than is immediately connected with their sanitary bearings, it is not my intention to discuss the fashions and mutations of human habiliments. Broad principles, therefore, will alone have to be discussed, and not those minute features of peculiarity which belong more to the *modiste* than the writer on hygiene.

Classification of materials of which articles of dress are made.—Scarcely any people have been discovered, however savage, who were found to dispense altogether with articles of apparel. Independently of any considerations of appearance or propriety, there does not exist a climate so congenial to the human organisation that some sort of dress is not required, and the deprivation of which would not be productive of suffering and ill-health; accordingly, even the most savage nations, who, before their communication with civilised men, had very few habiliments, soon learn to adopt more or less the usages of civilised life. No article of human clothing comes amiss to the sable potentates who hold dominions on the banks of the Niger; and still farther inland the cotton goods of Manchester have almost superseded the rougher manufacture of the natives.

The skins of animals, dressed or undressed, afford the most natural clothing to savage tribes living in cold or temperate regions. This material, however, is far too hot for natives of a warmer clime, who for the most part have discovered various methods of working animal or vegetable fibres into textile fabrics. The materials of these are but few. They are wool, flax, hemp, silk, and cotton for the most part; other fibrous materials might be indicated, such as the marine silk of the pinna, and the web of the spider, the fibre of the aloe, nettle, &c. All these, however, are exceptional, and require no further notice.

Perhaps of all these textile fibres, the most beautiful and most luxurious—though certainly not the most useful—silk, is that the manufacture of which was earliest begun. The silkworm is a native of China, that peculiar land where time and discoveries seem to have stood still—so impressed is everything there with the aspect of unchangeableness. In a region where the silkworm occurs and thrives no great suggestive ingenuity was necessary to turn the beautiful fibre to account. The Chinese appear to have done so from the highest periods of antiquity known to their chronicles, and the silken tissues thus manufactured, being carried westward, occasionally arrived at classic Greece and Rome, to astonish by their beauty all who gazed upon them—to be the envy of princes, and the puzzle of philosophers, until Aristotle, profiting by the discoveries made known by the progress of Alexander's Asiatic army, explained the true nature of silk—an explanation, however, which received very little credit at the time it was made.

Aristotle, it will be remembered, lived in the fourth century before Christ; he referred to the manufacture of silk fabric under the denomination of *bombykia,* and stated that the raw material originally came from the bombyx or silkworm. Other classical writers, before as well as contemporary with and subsequent to Alexander, entertained the most incorrect notions relative to silk; amongst other fictions, it was believed to grow on trees. Virgil has perpetuated this notion in the line,—

"Villeraque ut foliis depectant tenuia Seres."

Perhaps Virgil and the others who took this view of the nature of silk, were misled by the circumstance that cocoons of the silkworm depend from the branches of mulberry trees as if they really grew there.

Thus it seems that the beautiful tissue, which ladies use so profusely now-a-days, was at the period of Aristotle, and, indeed, long after, very rare amongst the people of the classic nations. Sappho and Phryne swathed their delicate limbs in woollen garments. I very much doubt whether either of these Grecian beauties had a robe of silk, even for best. When at this early period a portion of oriental silk tissue arrived from Asia, it was too precious to be used ordinarily in that condition. It was unravelled and spun into a lighter fabric, so that a given weight of silk might be extended over a large surface. The island of Kos has obtained a name in connection with this spurious silk manufacture, where a woman named *Pamphila* had discovered the process already, before the time of Aristotle.

About the age of Augustus tissues of silk had become somewhat more common at Rome than heretofore. Nevertheless, how scarce they were may be inferred from the circumstance that manufactured silk sold for its weight in gold. Subsequently, in the reign of Tiberius, sumptuary laws were enacted to regulate the wearing of silk. Ladies alone were allowed to wear the real oriental material, but the silken robes of men were restricted to the more flimsy fabric already adverted to as manufactured originally in the island of Kos. In the beginning of the third century it is recorded, as a proof of extreme effeminacy in the luxurious monster Heliogabalus, that he actually wore robes of true oriental silks. One can best appreciate the enormity of the crime by reflecting that, towards the end of the third century, the Empress of Aurelian, having entreated her husband to give her a robe of silk, he, emperor as he was, expressed his regrets, but said he could not afford it.

The estimation in which silk was held at Rome will be inferred from the fact, that in the second century the Emperor

Marcus Antoninus actually took the trouble to send an exploratory expedition to the country of the Seres—that region in the far East, unknown and undefined, from which the precious material, silk, was reputed to be brought. The country of the Seres, said to furnish *sericum*, or silk, was undoubtedly China, and the members of the Roman exploratory commission actually reached that empire, as is testified by the Chinese historian, Ven-hoen-tung. Nevertheless, the commission was fruitless as to result. Either they did not reach that part of China in which the silkworm flourished, or the Chinese managed to conceal the thing in mystery; for certain it is, that the source and nature of silk remained as unexplained as ever. It appeared agreed upon, however, on all hands, not to believe the statement of Aristotle, who correctly enough, as we have already seen, indicated the true nature of silk.

The imperialists of Byzantium were destined to be more fortunate than their predecessors of the west in their endeavours to discover the origin of silk, and to introduce into Europe the silkworm. This occurred during the reign of Justinian, and in the following way. Towards the beginning of this reign the supply of oriental sericum, or woven silk, had become so scarce, that there seemed a probability of its going out of use altogether. Under these circumstances Justinian enacted various sumptuary laws to regulate its distribution. Still the supply grew less and less. More than ever was it of importance to discover the nature of its source, whether animal or vegetable, and, if possible, to introduce it to Europe. Meantime Christianity, under the auspices of Justinian, was making progress. Monasteries were established in Persia, and the truths of the Christian gospel were preached in regions even so remote as China and Hindostan. These Persian monks, who had penetrated on a missionary enterprise to China, were fortunate enough to confirm the statement relative to the silkworm made by Aristotle long ago; and ingratiating themselves with the Chinese, they managed to glean some particulars concerning the processes of winding off the silk from the cocoons, and otherwise preparing it. Notwithstanding the confidence, however, which had sprung up between them and the Chinese, the missionaries appear to have been not a little watched. At all events they did not accomplish what they would have been willing enough to accomplish; they did not carry with them into Europe either silkworms or silkworm eggs. They, however, no sooner arrived at Byzantium, than they related to Justinian the particulars with which they had become acquainted in reference to the silkworm. The Emperor listened attentively, and urged them to proceed once more to the far distant land of the Seres,—not this time on a Christian mission, but for the express purpose of bringing either the silkworm or its eggs to Europe. They set out on the expedition, and in due course arrived in China. As to the fulfilment of their mission, the task was not easy. To procure silkworms and feed them during the long overland route was impossible, seeing that their only food was the leaves of mulberries. The only chance of success was to smuggle away some of the eggs, which also was difficult, because of the vigilance of the Chinese. Nevertheless, the astute missionaries triumphed in the end. Having procured some of the silkworm eggs, the latter were deposited in the hollow of a walking cane, and in this way passed into Byzantium. The eggs came to maturity in proper time, worms were hatched, and the climate of certain parts of the eastern empire, more especially some of the provinces of Greece, proving congenial, the silkworm flourished apace. Justinian now monopolised the production of silk, on which he realised an enormous profit. For more than six hundred years the Eastern Empire supplied silk to all Europe, and a great part of the west of Asia. Finally, however, Duke Roger, of Sicily, having invaded the Eastern Empire, carried back with him into Italy both silkworms and silk weavers. The mystery which formerly attached to silk was now at an end, and articles of apparel made of this beautiful material were slowly diffused over the west.

To show how slow the dignitaries of the west became familiarised with silk, the expressive fact may be here adverted to that Queen Elizabeth spent her youthful days without ever having indulged in the luxury of silk stockings, for no less sufficient reason than she could not get them. One of her courtiers, however, having presented the virgin queen with a pair of silk stockings he had procured from Spain, she became so enamoured of them, that never afterwards would she consent to wear stockings of any other material.

It would be superfluous to enlarge upon the uses of silk as a textile clothing fabric. Every lady has a sort of instinctive perception on this point, as papas and husbands and brothers can testify. If, however, the choice were placed before us of being deprived of one of the textile materials known to us, silk, notwithstanding the romance of its history, its extreme beauty, and its still comparative costliness, would be unquestionably the one society ought to give over to destruction. Silk is peculiarly the material of luxury, whilst linen, cotton, and wool are fibres out of which the textile fabrics of cleanliness are made. Silk cannot be washed; at least, it is so much the worse for the operation, that the latter is seldom attempted. For this reason silk never is and never can be used by any race of people characterised by their cleanliness, otherwise than for state purposes. The Chinese use silken tissues for table napkins, sheets, chemises, and bed coverings. The repulsive odours associated with these applications of silken fabrics are too obvious to be enlarged upon.

Wool.—Though less costly than silk, wool is far more valuable as a textile material. Generally the fabrics made of it are thick and coarse; but, even in respect of textile beauty, really good wool stands very high; and in relation to the power of imperfect heat conduction, or "warmth," as it is popularly termed, wool is far superior to any other textile material.

Wool resembles silk in the property of really taking dye stuff, a property in which linen is deficient, and which cotton possesses, only to a limited extent. It has a manifest advantage over silk in washableness, which operation if properly performed does no injury to the fabric. In our days woollen fabrics are restricted almost to the dresses of men, and the coarser habiliments of women; but anciently the uses of woollen fabrics were far more extended. Who has not admired, when looking at an ancient Roman or Grecian statue, male or female, to notice the beautiful folds of robing, hanging like festoons on the graceful form? It would be somewhat a violation of terms to denominate these dress festoons drapery, seeing that the material of which the dresses were composed was for the most part wool. Neither was the wool usually dyed, except for people of great rank. The Tyrian purple, concerning which so much has been said and written, was restricted exclusively to the Imperial service. The next most favoured colour was a sort of dull red, the produce of the kermes insect. The reader will do well to remember that no really beautiful dye stuff was known to the ancient Greeks and Romans, nor to the moderns either, until after the discovery of America, whence we obtain, not only the greater number of our dye woods, but the beautiful cochineal insect, so much superior to the kermes insect found in Southern Europe, and which formerly took its place, that the latter went out of use almost entirely so soon as cochineal could be procured in adequate quantity.

Cotton.—This excellent substance, termed by the ancient Greeks and also by our friends the Germans, tree wool, is the produce of several shrubs and trees belonging to the mallow family, or, to use a strictly botanical term, the malvaceæ. Writers are not agreed as to the number of species of cotton-bearing vegetables, but they admit of a practical division into herbs, shrubs, and trees. Cotton plants, in one or more of their several varieties, are indigenous to many hot countries. Africa produces not only shrub cotton but tree cotton, though the latter is not worth much. To Egypt the cotton shrub is indigenous; so also to China and Hindostan, in both of which places the art of spinning cotton into thread, and weaving it into tissues, has been known from time immemorial. We have the authority of Herodotus for saying that cotton tissues were almost exclusively worn by the natives of India at the time he wrote, about the year 445, B.C.; and Strabo, who died A.D., 25, quotes the authority of Nearchus, the admiral of Alexander the Great, to prove that the art of calico printing was known to the Hindoos, even so early as the time of Alexander. According to Strabo, the sort of printed stuff thus made by the Hindoos must have been a kind of chintz. I shall not quote the words of that writer, but shall merely remark concerning them, that they are very clearly expressed, and that his description undoubtedly refers to the refined process of calico printing.

We English have acquired great celebrity for our cotton manufactures, both twist, calico, and printed goods. This success is attributable to a fortunate union of many favourable conditions. Our coal is abundant, so is our iron. The mechanical genius of Englishmen is as proverbial as their industry is well attested. Hence then the excellence and magnitude of our cotton manufactures; nevertheless, in the production of a certain class of goods—very delicate muslins—not all our resources, natural and cultivated, bring our products up to the level of the materials fabricated in Hindostan from time immemorial. Of the celebrated Dacca muslins, it has been said they are so thin and transparent, that if laid flat upon the ground during night, so as to be gemmed with dew, it is impossible next morning to distinguish the muslin fabric from the adjacent dewy grass blades. This may be an exaggeration; nevertheless the circumstance admits of no doubt that the cotton twist produced by the native workmen of Hindostan, aided by machinery of the simplest kind, is superior to anything of the sort ever turned out of England. The reason has been thus explained:—The machinery of spinning jennies necessitates the formation of a very hard twist, whereas the hand-spun cotton threads of India not being so rigid, the fibre of the cotton remains more transparent. I may here remark that our word calico is a corruption of *Calicut*, a town in Hindostan, formerly celebrated for its cotton fabrics. The art of cotton printing, which now constitutes such an important part of British industry, is at present wholly exercised on white British calicos. The art of cotton printing, however, in Britain, preceded that of calico weaving. For many years we imported large quantities of Indian calico for the express purpose of being bleached and printed.

Some writers have advanced the opinion that the word fine linen, which so often occurs in Scripture, refers to cotton; but the hypothesis is hardly tenable. That cotton was known at early scriptural periods to Hindostan and China there can be little doubt; but between Palestine and eastern Asia the intercourse was slight, if at all, whereas between Egypt and the Asiatic lands of holy writ the union was intimate; hence the inference seems just that the fine linens of Egypt, of whatever material they might have been, were also the fine linens of Scripture. Now, many specimens of Egyptian mummy cloth are still extant, and diligent scrutiny, including microscopic examination, has been applied with the view of determining whether they were made of cotton or linen. Without exception they have been found to consist of the latter material. Moreover, Herodotus, who testifies to the existence at the period when he wrote of cotton fabrics in Hindostan, says not a word confirmatory of its existence elsewhere; on the contrary, as regards Babylon, he gives inferential testimony that it was not known, stating that the Babylonian priests were clad with garments of wool and linen, and that the dress of the Egyptians was wholly of linen, except that the priests wore a white shirt of woollen when not engaged in their ministrations.

Nevertheless, the Egyptians must have become acquainted with the use of cotton textures before the latter end of the first century, inasmuch as Pliny, writing at that epoch, states that in Upper Egypt, towards Arabia, there grows a plant, which some call "gossypium," others "xylon," from which are made the stuffs which we call "xylina." "There is nothing to be preferred to these stuffs," he says, "for whiteness or softness. Beautiful garments are made of it for the priests of Egypt."

The learned have puzzled themselves not a little to discover the derivation of the word cotton. The Arabic word for it is "kôton," very much like our own, and from "kôton" to "algodon," the Spanish equivalent, the similarity bespeaks the Arabian origin. Now, it has been thought, not without some probability, that the Arabs originally derived the word "kôton" from the Latin or Greek. The evidence in favour of this supposition is as follows:—

Pliny, when describing the island of Tylos, in the Persian Gulf, states, on the authority of Theophrastus, that amongst its remarkable products were certain trees, which had leaves exactly like those of the vine, but smaller. He proceeds to say that the trees in question bear fruit like a gourd, but of the size of a quince; that the fruit when ripe burst, and set free a ball of downy wool, from which costly garments are made, resembling linen. Now the Latin appellation of the quince is *Cydonium malum*, and the Greek equivalent κυδώνιον (*kudonion*), whence it has been surmised the word cotton is derived.

Cotton, though exceedingly useful, is inferior to flax as a material for textile fabrics. It is, therefore, too often used as an agent for adulteration. Being woven with articles of linen or silk, or wool, the compound fabric passes muster at first, but soon deteriorates. Not only is the mechanical quality of cotton inferior to either woollen, linen, or silk, but there are other disadvantages. Firstly, not being so strong as those, it more speedily wears out: then it so happens that certain dyes, which attach themselves perfectly well to silk and wool, do not attach themselves to cotton; for which reason articles of union fabric into which cotton enters, can never be efficiently dyed.

The best method of discovering the presence of cotton when it exists in a fabric, is an appeal to the miscroscope. The appearance or feel of the material is often sufficient, but not when the texture is new and highly glazed. Chemical examination may also be had recourse to in the following manner:—It so happens that corrosive acids act far more readily on cotton than on linen; if, therefore, a little weak sulphuric or muriatic acid be dropped on a union fabric of linen and cotton, and allowed to remain until the spot is dry, the cotton will be destroyed first. In this way may the presence of cotton be indicated; but to apply the process successfully requires a little chemical experience and manipulative dexterity.

Head Coverings.—All civilised, and the greater number of savage races, adopt some kind of protection for the head. In very hot and dry climates, perhaps, no amount of custom or acclimatisation could render the head independent of protection against the glare of a burning sun, but in the temperate climes of Europe a small amount of custom would, perhaps, reconcile the most delicate of both sexes to the abandonment in all but extreme cases of any kind of head-dress besides that of the hair. In England we find this acclimatisation of the head against the effects of heat, if the term may be permitted, to have been accomplished by the blue-coat boys; and amongst the peasant women of Germany, France, and Spain, the thickly plaited hair is a sufficient protection against all but the most extreme force of the sun's rays.

To what extent the habitual swathing of the head in wrappers or coverings is beneficial to the hair is indicated, if not shown to positive demonstration, by the peasantry of different races amongst whom head-dresses are discarded; and the higher female classes of Spain, amongst whom a mere thin gauze scarf—the graceful mantilla—is almost the only head-dress. None have such beautiful and luxuriant hair; amongst none is the hair so durable, so little prone to greyness or to decadence.

It would be a curious point to determine to what extent the acknowledged vigour, beauty, and duration of female hair exceeds these qualities in man, because of some peculiarity in the female head-dress. Bonnets, however much they may vary as to superficial dimensions, are never so close and oppressive as the European hat. Added to this when we consider that women are in the air much less than men, when consequently the time during which they wear a head-dress is of proportionately shorter duration, a sufficient *à priori* reason is established for making out a case in favour of free exposure as beneficial to the growth of hair. Nevertheless, the hair in women is naturally more luxuriant than that of men.

Whatever prolonged custom might be able to accomplish in the abstract, as to doing without covering for the head, certain it is that mankind, taking them as we find them, require some sort of head protection against the elements; it therefore remains for us to consider what are the most advantageous forms of head-dress, and to adopt them accordingly.

If we are to place credence in the testimony of Mr. Perkins, the Abyssinian traveller, the very best head protection against the elements, more especially heat and moisture, is abundance of grease. A thin inunction of pomatum would by no means suffice to fulfil the conditions set forth by Mr. Perkins. The use of grease, as he recommends, has to be more liberally adopted: a goodly inunction day by day, allowed to remain and become amalgamated with floating dust; until a compact matted texture results.

I have no doubt that a head-dress of this kind would be very effectual, but it is almost too much at variance with modern notions of propriety to be adopted. Nevertheless, people, during the fashion of powder and pomatum, emulated for other reasons the African coiffure; the operation of dressing of ladies' hair being so prolonged and so elaborate, that, being done, many a fair devotee has allowed the plastered tresses to remain day by day, rather than incur the trouble of the operation being repeated.

Looking at head-dresses from a purely sanitary point of view, and in their connection with all climates, their most important function is to protect the brain from extremes of solar heat. The protection of the brain against cold is a very secondary consideration, no part of the human organism being more tolerant of cold than the head, and no part more intolerant of extremes of heat. For cold climates, head-dresses cannot well be too thin: so that provision be made for protecting the head against rain, and the eyes against the reflection—so injurious to them—of snow, it is enough. Little or no special provision against cold is either necessary or agreeable.

The head coverings of people who have to move about under the mid-day sun of hot climates, are all based upon the principle of keeping the head cool. However much the shape or materials of head-dresses employed in hot countries vary, this one general result is aimed at by all. Accordingly, in order to maintain the head cool, or, in other words, to prevent its temperature being elevated over and above the temperature of the human body, the principle is adopted of constructing head-dresses that seem to the common observer only suggestive of warmth. The Spaniard who, in the midst of summer, wraps himself in the ample folds of his cloak or "capa," will tell one that what keeps out cold will keep out heat. The Arab and the Turk of the old school, when turbans were in vogue, and the fez had not been adopted, would make the same remark, and erroneous though the remark may seem, it is nevertheless based upon truth. The numerous folds of the turban are an effectual barrier against the transmission of heat. True the heat natural to the human body, and dependent upon it, cannot fall, but this is a matter of small importance provided the external heat due to the sun's power cannot penetrate. This latter occurrence the convolutions of the turban thoroughly prevent. For the same reason the native palanquin bearers of India load their heads with their scanty wearing apparel—any amount of covering being preferable to the consequences of submitting the head to the downward glare of the meridian sun. I need only indicate, with the view of removing any misconceptions in relation to the practice of protecting the head, and other parts of the body against the effects of heat by external clothing, that our notions of hotness and coolness, as regards apparel, have reference to no innate property of heat or cold, but merely to the conduction of temperature. If a person is obliged to handle a very hot substance, he can most conveniently touch it through the intervention of some material to which the epithet warm is ordinarily applied—such, for example, as silk, wool, or flannel. The explanation is simple. Silk and flannel are popularly termed warm, because they are worn under conditions in which the animal heat of our bodies has to be stored, and its escape prevented. In by far the greater number of days of our temperate clime, the animal heat within is higher than the atmospheric heat without: under these circumstances bad conductors are warm; but when the conditions are reversed, then they are cool.

Amongst the good qualities which head-dresses should have, that of permitting free egress to cutaneous transpiration, and allowing the air to freely change, is highly desirable. The thick folds of an oriental turban are even more conducive to this result, on account of the porosity of the material of which they are composed, than is the thinner material of the European hat, a species of head-covering which has, moreover, the grave defect of impeding, by the pressure it exercises, the circulation of blood through the vessels of the head. By this means headaches are caused, and other discomforts which necessary adherence to the conventionalities of fashion impose on the hat-wearing public.

Every good head-dress, as I have already remarked, should comprehend some protection for the eyes, against the glare of the sun; which is not only oppressive, but injurious to vision. Most of the oriental forms of head covering are deficient in this respect: the fez especially so. Such an obvious departure from the commonest indications would never have existed, had the cause determining it been less powerful than the one of religious prejudice. The religious culture of the Prophet requires that the devotee shall, on certain frequent occasions, touch the ground with his forehead; and inasmuch as this is done without the removal of the head-dress, of course anything like a peak would be inconsistent with strict adherence to the injunctions of Mohammedanism. The bad effects of not having a peak to the fez are illustrated by the severe ophthalmic diseases which oppress the Turks, and Egyptians. The evil is very much felt by the Turkish soldiery, and it is said the present Sultan tried to bring about a reformation in this particular; but although his reforming principle had apparently been applied to many things of greater moment than the fez, in no case did he meet with greater opposition. In point of fact he was obliged to relinquish the idea of giving to the Turkish soldiers peaked fezes. Certain orthodox functionaries were unbending in the matter; the Sultan therefore was obliged to succumb. His highness, the Sultan, appears to be somewhat of a wag, though his fun is of the sedate character which beseems the descendant of Othman, and a true follower of the Prophet. One day, when the sun was shining strongly, he summoned the orthodox gentlemen who had opposed so energetically the introduction of peaked caps, and requested them to accompany him in a morning ride. The honour was not to be slighted; the Sultan and his ministers were soon mounted and taking their ride. The Sultan adopted the unusual practice of riding full in the sun's eye. He might have gone in another direction, if a ride of pleasure was the sole object in view. Why, therefore, did he follow a course so perverse as riding towards the sun? The reason was soon manifest: his attendants soon found the sun's beams too powerful for their eyesight; each raising his right hand placed it above his eyes in the manner of a peak. His majesty remonstrated; peaks were immoral he said, and the hand thus used was a peak. The officers no doubt acknowledged the justice of the Sultan's remark; but, though made conscious of the use of peaks, their hearts were hardened against them; so, up to the present time, the Turkish army is devoid of this useful appendage.

Body Clothing.—The indication to be followed out in body clothing is to supply a sufficient quantity of non-conducting material for retaining a due amount of animal heat without impeding the movements necessary to health, or constraining the vital organs. All that concerns mere taste, and fashion, is foreign to our purpose here; whence our chief animadversions will have to be directed to that article of woman's apparel termed corsets, or stays; for, in relation to the mere dictates of hygiene, male apparel, however ugly it may be, is almost unexceptionable. When speaking of the anatomy of the human body, some casual remarks were made relative to the arbitrary change of fashions, as respects the height of the female waist. I then showed the anatomical impropriety of endeavouring to elevate the position of the waist above the region of the false ribs; and endeavoured to prove that sound sense would dictate the position of the waist to be below the latter. Unquestionably, by exercising a sufficient amount of constrictive force in early youth, even bone must give way, and the waist may be made to exist high up or low down, at the pleasure of the milliner; but this can only be effected at the expense of reason and in violation of every anatomical propriety. The usual plea advanced in favour of stays, is the support they give. When once the frame has become accustomed to this artificial support, there is truth in the argument; but that custom should never have become established. Young girls should never be allowed to wear stays; and grown-up women might always do without them, so far as the mere support of this article of female dress is concerned. The real cause of the retention of stays, is not the support they give, but the compact beauty they are susceptible of imparting to certain conditions of the female form. Women, however, who are not extremely developed, and whose busts are not preternaturally large, would always look better without stays, if they had only the good sense to believe so. Nevertheless I do not entertain the hope of being able to contravene the dictates of fashion in this matter; and shall only try to induce ladies to exercise moderate consideration, for the anatomical and physiological well being of their thoracic organs, by employing only such moderate lacing, and by using stays of such yielding materials, as may not be amenable to the charges so often and so justly brought against them. Nature, who does nothing in vain, does not give women the space of one-and-a-half cubic feet for the due play of the thoracic organs, when one cubic foot would be enough. If they will act in violation of the plain dictates of common sense in this matter, they must suffer; and the suffering in question not unfrequently ends in grave disease, and premature death.

Tight-lacing is altogether a modern invention. The ancient Greeks and Romans, both of whom perfectly knew what was beautiful, had the good sense, like anatomists and painters of modern times, not to be fascinated with extremely small female waists. Nevertheless, ancient Greek and Roman ladies had a sort of stays; not the corsets of whalebone and steel which are to be procured in our own milliners' shops, but a sort of light jacket, which sufficiently contributed to rotundity of form without injuriously constricting any vital organ. Greek ladies had their *séfodosne*, and Roman ladies wore the *castula*, both varieties of stays. But the whalebone-ribbed corset which has become the type of all modern stays, was, it is stated, an introduction of Catherine de Medicis. Doctors attacked the vile things from the first, Winslow and Sœmmering demonstrated on a physiological basis the injuries which these stays occasioned. Philosophers next swelled the torrent of attack, then followed the objurgations and edicts of priests and emperors. Joseph II. prohibited, by a severe edict, the use of stays altogether; yet stays, under the patronage of the wilful sex, were triumphant. How steel busks have partially superseded the original whalebone, need not be told, they being an invention of our own century. How unyielding wooden busks mercilessly take the place of both whalebone and steel in the stays of the female lower classes is known to medical practitioners. Stays, under every form of corset hardness, whether this be imparted by whalebone, steel, or wooden busk, are vile and reprehensible. They are at once repugnant to beauty and prejudicial to health. They contract the most important part of the human frame, and seriously compromise three vital functions,—respiration, circulation, and digestion. As consequences of their extreme and prolonged use, spitting of blood, hypertrophy of the heart, and irregularities of digestion are frequent; in addition to the organic dislocations and malformations already adverted to.

Notwithstanding that the practice of tight-lacing is still alarmingly followed, nevertheless it is but justice to own that the formation of stays is now ameliorated, owing to better notions of the requisitions of the human form being imported into their construction. To the French is due the practice of making stays without shoulder-straps; a plan which admits of greater freedom of action, and more unrestrained play of the thoracic organs than was possible under the old construction.

As regards the bearing of female dress on the preservation of animal heat, much, in a purely medical sense, might be written. Thousands have been thrown into consumption by the change of temperature consequent on leaving a ball-room after the flush and excitement of the dance, and subsequent exposure of the neck and chest to the colder atmosphere without. The fact cannot too generally be known that the first symptoms of phthisis, or consumption, usually manifest themselves, not low down, but in the upper part of the right lung, close under the clavicle, or collar-bone; a part always left exposed by the low evening dress.

Men, less trammelled by fashion than the other sex, do not so frequently err in the matter of scanty dress: nevertheless, some animadversions in this particular especially apply to Englishmen. Our climate is very perplexing in all that regards apportionment of dress to external temperature, with the exception of a brief period in the middle of summer. An Englishman cannot reasonably calculate on a settled temperature for any two days following, with even moderate probability. For this reason he never knows how to dress. One day in winter we may have little short of summer-heat, whilst the next may bring the sudden mutation of an almost Siberian winter. These sudden alternations of heat and cold are especially prejudicial to health; and there can be no doubt they tend to establish many of the pulmonary diseases—more especially consumption, for which our climate has acquired such a bad celebrity. As a rule, Englishmen are in the habit of going about under-clad. We altogether dispense with fur, and do not avail ourselves of flannel, to the extent that consideration for our health demands.

Of all the considerations, however, to which the subject of apparel, in relation to temperature, gives rise, none are so important as those affecting the clothing of children. In this respect we err egregiously. How often do we see, in mid-winter, some poor child dressed in Highland, or some other fancy costume, shivering with cold, blue, and miserable, because of the inadequate protection against cold which its scanty apparel furnishes! This is sometimes done from considerations of mere vanity: sometimes, however, the plea of making the child hardy is advanced; and it is vainly thought that by thus accustoming the little creature to the extreme of cold, its constitution will be rendered strong hereafter. The advocates of this case-hardening system fallaciously point to the treatment of the children of the lower orders, to whom scanty apparel is a necessity of their poverty. The illustration is most unsatisfactory. If in some districts the children of the lower orders are more robust and healthy than those of other classes, this is not because their constitutions have been strengthened, as because all the weaker children succumb. They die, leaving only the stronger ones behind to furnish an illustration. The animal heat of children is much greater than the corresponding animal heat of adults; their circulation and respiration are far more rapidly performed, and their susceptibility, under extremes of temperature, is greater. These circumstances point to the necessity of furnishing children with a thicker warm clothing than adults, and the indication should never be neglected.

Feet Covering.—All civilised nations have felt the necessity of protecting the feet, and the kind of protection has been mainly determined by the climate. The Egyptians, the ancient Greeks, and Romans, adopted many kinds of feet covering, some varieties being mere sandals, others more resembling our modern boots and shoes; but the idea of compressing the feet into a space smaller than themselves is one of the results of modern notions of elegance, to which the classic people of antiquity were strangers. Nevertheless the ancient Greeks and Romans were not altogether free from those minor pests, corns, as we learn from the medical writers of those times.

The requisites of an unexceptionable foot covering, an adequate protection against wet, protection against inequalities of the ground, the capability of allowing freedom of motion to the joints of the foot and ankle,—these may be called the mechanical requisitions of foot covering; in addition to which the material of boots and shoes should have a certain porosity, enough to permit the free egress of cutaneous moisture. Provided these indications be fulfilled, nothing more in a hygienic sense is required for ordinary boots and shoes. Occasionally, however, weakness of the ankles is treated surgically, and with success, by giving support by means of boots. Care should then be taken, lest in imparting strength to the joint the circulation of the blood be impeded.

Leather, though the ordinary material of boots and shoes for men, and for women also, to a limited extent; is not the best material for all occasions. If, for example, the feet be suffering from corns, the softest of leather even exercises an amount of pressure which is painful. Cloth boots may then be substituted advantageously. If the appearance of this material be objected to for men, the substance termed by its inventor *pannus corium* is an admirable substitute. Its advantages are as notable as the miserable specimen of shoemaker's Latinity embodied in the expression "*pannus corium,*" is abominable; which is indeed saying a great deal.

Of late, sheet india-rubber has been much adopted as a material for certain forms of foot covering. In this country only goloshes, or overshoes, are made of caoutchouc, but in Germany half boots for ladies' wear are not uncommon.

Notwithstanding the softness and total impermeability to moisture of india-rubber, its general adoption as a material for foot covering cannot be recommended. For persons who habitually wear their boots and shoes, who have suddenly to leave a warm apartment and walk through snow or wet to no great distance, india-rubber goloshes may be unobjectionable. But for pedestrians, in the proper sense of the term—people who walk for many hours consecutively—india-rubber goloshes are most reprehensible wear. The same impermeability to moisture, which enables them to repel wet from without, totally prevents the escape through their substance of all moisture from within. The acrid excretions of the feet are therefore retained; the feet being as completely wet as they would have been had external moisture found access to them, and far more prejudicially. Those who wear goloshes of this kind are recommended to cut them low down at the quarters, and sole them with gutta percha. Not only does the latter material help to keep the feet warm, but it obviates that disagreeable and dangerous tendency to slip, which is so great a mechanical objection to india-rubber, whenever it comes in contact with the wet ground.

That the objections to india-rubber goloshes just indicated are not mere theoretical ones, can be testified by those who have worn them continuously. Not only do the feet become tender, and otherwise damaged by the moisture retained, but the material of the boots and shoes worn underneath, speedily decays and works into holes.

If the objection to mere overshoes of india-rubber be so great, how much more objectionable must the practice be of wearing complete boots of this substance. I remember, some years since, meeting with a lady who bitterly complained of the person who manufactured her india-rubber boots. So far from being waterproof, she said they kept her feet perpetually wet. She could nevertheless discover no hole or rent, neither could the bootmaker discover any; but she appealed to the result in proof that the water actually came in. The fact is, no water entered through the material of her boots, but for the same reason that no water could enter—neither could any find exit. Boots of this material are so utterly reprehensible—so detrimental alike to comfort and to health, that they should never be worn.

And now a word about the sole of gutta percha, which I recommended as an addition to the soles of india-rubber galoshes. It is useless to give a shoemaker the order to attach this kind of sole; the task is altogether beyond the capabilities of his art. The wearer must do it himself, or see it done, in accordance with the following directions.

Having made a large poker red hot pass it rapidly several times in succession over the surface of the india-rubber sole, in such manner that the material may be superficially melted. Next take some gutta percha clippings; warm them, and add sufficient turpentine to form the whole into a stiff paste. The operation may be well conducted in an iron ladle, gently warmed over a fire. If the turpentine ignites, as it is very apt to do, the flame cannot be extinguished by blowing on it, on the contrary it will burn all the stronger. By placing a flat iron plate tight down upon the ladle, however, the flame is readily extinguished, and the paste will be none the worse for the accident.

The solution, or rather paste, of gutta percha having been prepared as directed, the next operation consists in spreading it evenly over the superficially melted surface of the india-rubber sole.

The best means of accomplishing this is pressure, rather strong, with a clean, hot, knife. The paste should not merely be brought into contact with the india-rubber surface, but should be well kneaded into it, and all air bubbles should as much as possible be destroyed.

When an even layer of paste has been laid on, the golosh should be allowed to stand for about an hour before a moderately strong fire, until the greater portion of turpentine has evaporated. This accomplished, a second layer of paste should be plastered on, and being allowed to consolidate as before, afterwards a third; the gutta percha sole is now to be attached, according to the directions which follow:—

Take a sheet of gutta percha, something larger than the dimensions of the sole. There is no advantage in procuring the sheet already fashioned into the shape of a sole, because trimming after it has been attached accomplishes all that can be desired in this respect. Warm the sheet before the fire, passing over the surface hereafter to come in contact with the india rubber, by lightly passing a finger over it wetted with turpentine. When the gutta percha has become quite soft by exposure to the fire, begin by attaching it at the toe of the galosh, gradually passing towards the heel, and taking great care that no air bubbles get imprisoned between it, and the india rubber. Lastly, strike the sole smartly two or three times on the floor, or any hard surface, to complete the adhesion. At this stage of the operation the gutta percha will be attached, but the sole will look the reverse of neat. It must now be trimmed close to the edge of the india rubber by a pair of scissors moistened with water, and any remaining inequality may be softened down or removed by reapplication of the hot poker.

Corns.—These troublesome things may be defined medically, as a hypertrophied condition of cuticle; that is to say, by pressure long applied, the cuticle, or scarf skin, becomes hard and callous, pressing upon the true skin underneath, and giving rise to suffering as would be equally the result of pressure from any foreign substance. Nor is this the only bad result. Not unfrequently the continued pressure sets up inflammation, and inflammation ends in the formation of matter, causing excruciating agony until an exit has been made for it.

Treatment.—The cure of corns is very simple, and would generally end in the result desired if the person afflicted could be induced to refrain from wearing tight boots or shoes, the original cause of the disease. If this be persisted in, the treatment of corns is merely palliative; they cannot be radically cured. The first thing to be done in the treatment of corns is to remove the hard callosity of preternaturally thickened cuticle. To this end the foot affected should be well soaked in warm water, by which means the horny texture of the cuticle yields, and its removal may be accomplished without difficulty. It may be peeled off by means of a knife or razor, but in this case great care should be taken to stop the cutting operation short of drawing blood, which instead of benefiting the foot would greatly aggravate the evil. The best plan is to cut away the surface of the corn, then to discard the knife altogether, and to rely for removal of the last traces of hardened cuticle on friction with pumice stone. This operation will always give relief, but it will be only temporary, except the pressure which gave rise to the corn be altogether removed from the diseased part. A good means of accomplishing this is as follows:—Take a piece of common diachylon plaister, cut a hole in it about the dimensions of the corn, leave an external margin of convenient breadth, and attach it to the toe affected, in such manner that only a healthy portion of skin may be covered, the corn itself corresponding to the central aperture. Over the first piece of sticking plaister lay several others successively of exactly similar dimensions. By following these directions a sort of protection wall will in the end be built up; removing pressure from the part affected.

Whilst on the subject of corns, perhaps I shall be expected to indicate what is meant by the root of a corn, about which certain empirics have so much to say. Corn roots have no existence save in the imagination of a too credulous public; certainly they have no existence in the imagination of the corn empirics. They know better; but in order to justify their self-laudatory accounts of surgical skill they are in the habit of concealing short pieces of hog's bristle, each of which is displayed to the admiring patient as being the root of a corn, and for each of these roots a distinct fee is charged!

How extensively the human feet suffer from the constrained treatment to which they are subjected by civilised aces is sufficiently known to artists. A living model, perfect in the foot, as nature made it, cannot be found after the age of childhood.

CHAPTER X.

COSMETICS.

THE term cosmetic, derived from κοσμέω, I beautify, may be understood as referring to every kind of personal adornment, with the exception of dress. It has, therefore, a rather wide signification, comprehending not only skin colours, such as pearl white, rouge, &c., but pomatums, depilatories, fancy soaps, and numerous other substances, which the memory of the reader will not fail to supply.

The practice of using cosmetics is of very ancient date, the use of bodies for personal adornment being, in point of fact, suggested by a leading sentiment of humanity. The use of cosmetics is mentioned in several parts of Holy Writ, and a notion of the prevalence of these substances amongst the classic people of antiquity, may be gleaned from the writings of Ovid, Martial, Suetonius, Juvenal, &c.

Closely allied with cosmetics, in the strict sense of the term, are perfumes; the professed objects of which generally have reference to some improvement of personal appearance, as well as the diffusion of an agreeable odour. Exquisite as are more modern perfumes, and large though the consumption of perfumery undoubtedly is at the present day, the luxurious Greeks of antiquity, and the Romans also, at a certain epoch of their history, surpassed the moderns in this respect. Inasmuch, however, as alcohol was a thing unknown to the ancient Greeks and Romans, their perfumes were, for the most part, confined to such as had an oily basis. The value of perfumes as curative agents was presumed to be greater by the Greeks and Romans than we moderns admit, or even imagine. An appropriate perfume was given to each particular organ. Palm-oil was considered good for the cheeks and breasts; balsam mint for the arms; marjoram for the eyebrows and hair; and wild thyme for the knees and neck. Amongst the materials of ancient perfumes, the *Nardus* and *Malobothrum*, both imported from Syria, were much esteemed. The odour of violets was held in great esteem amongst the Athenians. Myrrh was a great favourite both amongst the Greeks and Romans. Not only did it enter as a constituent into most of the perfumed ointments but it was burned in chambers, after the manner of a pastille.

The Greeks brought their subtle genius of distributive classification to bear even upon perfumes, which they divided into the two primary classes of χρίματα, or thick, waxy, perfumes, and αλείμματα, or those of a thinner nature, designed to be poured over the limbs. The thinner varieties of perfumes were more especially intended for the use of ladies, who greased their skins much more copiously than would accord with the notions of a modern belle.

Men occasionally perfumed themselves with the thin or ladies' perfumes, but it was considered effeminate to do so; the thick or waxy variety being considered more appropriate for the lords of creation. Solon interdicted the use of perfumery to men altogether; and he did not approve of the use of perfumes by woman. Socrates also objected to the use of perfumery, but the argument used by him is not a little peculiar. "There is the same smell," remarked he, "in a gentleman and a slave, when both are perfumed." Of course; and (negroes excepted) there must have been the same smell in a gentleman and a slave even when neither was perfumed, provided they both were equally clean. It was not a little unreasonable to imagine that Grecian ladies were to discontinue the use of perfumes, when even goddesses set the contrary example. Sophocles describes Venus as sprinkled with perfume, and regarding herself complacently in a mirror. Pallas, the goddess of wisdom, according to the same author, was a more inveterate user of perfumes and cosmetics still. He describes her as moist with scented olive-oil, and practising athletic exercises.

Division of Cosmetics.—Firstly, cosmetics may be divided into cosmetics proper, or such as merely beautify the person without contributing to odour—and scented cosmetics or perfumes. Again, the first class may be subdivided into those which impart beauty, by establishing a good condition of health, more especially of the skin, hair, teeth and nails, and those which, like pearl powder, rouge, &c., merely beautify the person as paint beautifies wood, by overlaying imperfections.

According to the dictum of many a rigid disciplinarian, the best cosmetics are soap and water. If it be meant by this that the use of complexion powders—scents and pomatums—are altogether offensive and abominable, except the condition of absolute cleanliness precede their employment, the dictum is granted universally; but to banish cosmetics altogether, is something more than can be expected of civilised ladies and gentlemen; something more, I may add, than can with propriety be recommended. For the stage at least flesh tints are indispensable; and there seems to be no valid reason wherefore they may not be used off the stage, with the sole provision that only such be employed as are innocuous.

The substances chiefly employed in cosmetics at the present time may be thus summarised:—*Acids.* Amongst these acetic acid (vinegar) in several varieties of combination, such as aromatic or scented vinegars, citric, and tartaric acid, are much used. They enter into numerous skin washes, and have the reputation of relieving the irritability of the cutaneous surface. That character, however, is unfounded. Their only effect on the skin is to produce a hardness or astriction of the part to which they are applied; and when used as a dentifrice or lotion for the teeth, they whiten the latter injuriously by the destruction of a portion of enamel. Certain concentrated acids, or acid mixtures, are sometimes used for the purpose of destroying warts. Of this kind are oil of vitriol (sulphuric acid), aquafortis (nitric acid), and spirit of salt (hydrochloric acid), also a mixture of strong acetic acid and nitrate of mercury. All these bodies are dangerous. If warts have to be removed, a far better method consists in tying them at the base, where their form admits of it, with a filament of silk, or if not, destroying them by lunar caustic, or caustic potash. *Colouring Matters.* Of these the chief are carmine, a preparation of cochineal and carthamus or safflower. *Essential Oils.* The number of which is very great, supplied by numerous orders of the vegetable kingdom, more particularly the family of labiatæ. The essential oils are rarely used unmixed, but constitute the odorous basis of pomades, essences, and perfumed powders. *Balms and Resins.* Amongst which benzoin, storax, balm of Peru, and myrrh are familiar examples. *Fatty Bodies.* These are obtained both from the vegetable and the animal kingdom. Palm, olive, and almond oil, lard, suet, and marrow, are the principal bodies of this class to which reference has to be made. By the ancients they were employed to lubricate the skin as well as the hair; but civilised moderns restrict the use of fixed oils as cosmetics, almost exclusively to their employment as hair pomades. The natives, however, of various warm climates, more especially the Abyssinians, and several tribes of negroes, smear their skin with grease; not only as a cosmetic, but with the object of protecting themselves from the power of the sun's rays, which the smearing effectually accomplishes. Nor is the employment of grease on the skin altogether confined to uncivilised people, even amongst us moderns. There exists a prejudice amongst certain French ladies, and English ones too, that the contact of soap and water is bad for the face. Amongst the substitutes for soap and water adopted by these ladies, certain soft animal fats, such as goose grease, and marrow pomade, have acquired some celebrity. Chicken, or veal broth, has a high cosmetic reputation in certain parts of Italy; and I have it on no mean authority, that a certain female member of the British peerage washes herself, or rather paints herself, with water gruel; all that portion which dries on the skin being removed by friction with a piece of soft linen. The use of oily and greasy bodies as hair pomades not only imparts an external appearance of beauty, but also diminishes that dryness of the skin to which the conditions of weakness of hair and baldness are attributable. *Vegetable Powders.* Amongst these, several varieties of starch are conspicuous, also orris root, which imparts the odour of violets.

All the materials yet introduced in the present outline of the substances employed as cosmetics, belong to the organic kingdom—in other words, they are all either of vegetable or animal origin. The inorganic kingdom also contributes to the long list of cosmetics, and for the most part the substances it furnishes are noxious. Mercury, in several poisonous forms, has been adopted for cosmetic uses. So in like manner have preparations of arsenic, antimony, bismuth, and lead. The array of deadly poisons, indeed, which is disclosed by the list of cosmetics, is terrible, and the most serious consequences have originated in their use. Having premised these general remarks, let us now proceed to the consideration of the various classes of cosmetics.

COSMETICS FOR THE HAIR.

The hair, as supplied to people by nature, is not always of the description which people like. Fright or fever, not to say age, are all apt to turn it gray or white—a colour which, to ladies of a certain age, and of prospects yet unsettled, is objectionable. Certain blondes, too, are subject to a delicate embarrassment as regards the tint of their hair—especially that variety of blonde ladies to which our neighbours the French apply the designation of "*blondes ardentes.*" Occasionally the hair of ladies has been seen to have the tint of actual redness, though by polite convention the term "auburn" is constantly applied to it in books. Each of these aberrations of colour may suggest, if it do not actually justify, the use of hair dyes.

Nothing is more easy than to impart to hair of any colour the tint of deep black. This result, however, is not always one to be desired.

Hair, naturally black, accompanies skin and eyes to match. Nature has a fine eye for colour, and arranges her tints so harmoniously, that man has little power of meddling with them to advantage. Even people who possess hair decidedly red, have a skin and eyes so completely harmonising with it, that however objectionable the possession of red hair may be considered, it is, nevertheless—viewed relatively to the features and appearance, generally good colour in the eyes of an artist. There was a time when red hair bore the palm. At a certain period in the history of ancient Rome, great people covered their hair with red powder, and pomatum filled with particles of gold and brass. Then, see how fond painters are of red or golden hair. Rarely do we observe an ideal picture, where the figures of women are present, without it. I advise all ladies, therefore, of the blonde ardente genus to let well alone; but as I have not the slightest notion they will attend to that advice, some few words in relation to the philosophy and the practice of hair dyes may not be undesirable.

For red-haired people who are emulous, not of dyeing their hair brown or black, which would look ridiculous, but whose utmost ambition it is to coax the tint into one to which the term auburn or golden may be without impropriety applied, I believe the use of a leaden comb is superior to any known expedient. It should be employed daily, and although lead be a poisonous metal, no particular disadvantage will arise from this method of using it.

The resulting tint is not wholly due to the metallic stain which lead imparts by mere friction. A chemical agency also comes into play, which contributes not a little to the result. The hair evolves continuously, and more especially at night, sulphuretted hydrogen gas; and the latter, when it touches lead, or compound of lead, strikes a black colour. On this principle depends the use of a lead compound also employed as a hair dye, and which is far more objectionable in a sanitary point of view than a leaden comb. I allude to one of the most ordinary hair dyes sold, and which is a mixture of litharge (oxide of lead) and alkaline solution. If this mixture be applied to the hair, it penetrates the latter, and if the head be afterwards swathed in oilskin, or a cabbage leaf, and allowed to rest during the night, the sulphuretted hydrogen naturally evolved from the hair will react upon the lead compound, and turn the hair black.

In some cases it is considered desirable to effect the change of colour without delay, and this can be accomplished by supplying to the hair, already moistened with the lead solution, a portion of sulphuretted hydrogen from an extraneous source. Accordingly, hair dye, of which lead is the basis, is frequently sold in association with a second liquid which effects the immediate change of colour. The liquid in question is hydrosulphate of ammonia—a most disgusting, repulsive substance, the odour of which is almost identical with that evolved from putrefying eggs. People, however, are willing to suffer any amount of inconvenience, not to say actual pain, when addition to personal beauty is in question. It is necessary to remark that the lead solution just indicated is somewhat dangerous. When absorbed by the skin, and taken into the system, all the characteristics of lead poisoning may be, and sometimes have been, developed. Instead of litharge or oxide of lead, preparations of bismuth or copper, or of indeed any metal which has the property of striking a black colour with hydrosulphuric acid, may be substituted: none, however, are so effectual as lead. Any person who has applied lunar caustic to the skin, or marking ink to a piece of linen, and noticed the persistent blackness which results therefrom, may have imagined that a solution holding a certain portion of lunar caustic would serve the purpose of an efficient hair-dye. Indeed, a solution of this kind will dye the hair, and to this end it is not unfrequently used; but inasmuch as it blackens the skin as well as the hair, there is an obvious disadvantage in its employment. A similar remark applies to the expressed juice of the skin of walnuts.

All these hair-dyes ordinarily change the hair to black. The lead dyes are said to have the property of dyeing the hair brown, when applied in a peculiar manner—diluted with milk. The result is a very sorry attempt at brown, however; and indeed the resulting black, when the operation has been most successful, is anything but satisfactory. A certain metallic hue pervades the hair thus dyed, and is easily recognisable to an observant eye. I have seen ladies whose hair, when viewed under certain conditions of light, is candescent with the prismatic colours; beautiful tints in themselves, abstractedly considered, no doubt—but somewhat out of place in a fair lady's bands or ringlets. I have seen, too, a celebrated London physician, who, blessed with whiskers of luxuriant growth, yet of a rusty colour not pleasing to his refined tastes, walks about the streets, or peeps out of his brougham-window, resplendent with the play of colour that one sometimes observes on the neck of a pigeon, or the tail of a barndoor-cock; manifesting in his own person a sad proof of the weakness of chemistry as applied to hair-dyeing cosmetics.

Depilatories.—This is the term applied to designate various substances which are employed to accomplish the removal of superfluous hair. Many of this class of substances are very effectual, but all are open to the objection of danger. Most of them contain preparations of mercury or arsenic, and therefore are dangerously poisonous. I shall append the composition of three depilatories which are devoid of arsenic and mercury, which therefore are not poisonous, otherwise than by their causticity.

No. 1.—Quicklime, four ounces; orris powder, one and a half ounce.

Mix both these ingredients together, and when applied let a paste be made with a little water; paint the depilatory over the part whence the hair has to be removed, allow the paste to remain during four or five minutes, then wash away.

No. 2.—Quicklime, one pound; pearlash and sulphuret of potassium, each two ounces.

To be applied as the last.

No. 3.—Quicklime, one ounce; carbonate of potash, (pearlash), two ounces; charcoal powder, one drachm.

To be applied as the last.

Either of the depilatories above mentioned may be used without the fear of any ill result, otherwise than irritation of the skin; and against the occurrence of this, the skin may be to some extent protected, by smearing it with pomatum before the depilatory is applied. The precaution needs hardly to be mentioned, that after the application of the depilatory the skin should be well washed, until all traces of the substance are removed.

Remedies for Weak Hair, and Baldness.—The hair, which when viewed by the unassisted eye appears to consist of mere dead filaments, presents a different aspect under the field of the microscope. Each hair then seems to be composed of an elaborate tubular construction, springing from a root, containing a fluid and a colouring matter. From this revelation of the structure of hair, the deduction will be readily arrived at that the latter cannot be dealt with as a mere inorganic substance. It is subject to conditions of growth and diminution, health and disease, like other organic or living products. When the general health flags, the hair participates in the symptoms; its adhesion to the underlying skin becomes less firm, each hair becomes weak, splits at the termination, turns gray, or lastly falls off, giving rise, in the latter case, to the condition of baldness. If we are to believe in the self-laudatory comments of hairdressers and perfumers, remedies for the condition of baldness are common enough; but truth compels the physiologist to admit that the condition when confirmed—that is to say, when dependent on disease, or destruction of the hair roots, is incurable. Rational consideration of the physiology of hair, points rather to the prevention than to the remedy, of baldness, and in this respect much may be accomplished by judicious measures. Firstly, it is a matter of especial importance to preserve the health of the skin to which the hair is attached. Its surface is apt to get dry, hard, or even horny, the epidermis coming off in small scales, to which hair-dressers apply the term "dandriff." Whenever, from any cause, this condition of the skin is established, the hair begins to suffer. Pomatum, judiciously employed, goes far to prevent the occurrence of this condition of the skin, as to remedy it when once established. Pomatum, however, should never be used until the hair has undergone a preliminary cleansing. For men, who wear short hair, no cleansing process is so effectual as washing. Ladies, however, on account of the length of their hair, cannot avail themselves of water in this respect, otherwise than to a limited extent. They must have recourse to other measures, such as dusting the hair with finely powdered bran and brushing it out again; or moistening the hair with a mixture of the yolk of eggs and lemon-juice, allowing the application to dry, and then carefully brushing it away.

Whenever it is desired to wash the hair, soap need not be employed. A little hartshorn mixed with the water answers the purpose of cleansing the roots far better than soap, and the operation, always troublesome, of removing the last traces of soap, is avoided. When the hair grows weak, splits at the extremities, and falls off, the best thing to be done to remedy this evil, when it occurs in children and young girls, is to have the head shaved at once. The plan can hardly be recommended for adult ladies because of the disfigurement, leading to the adoption of artificial hair, the weight and heat of which counteract the good effects of free atmospheric contact with the roots of the hair.

There are certain applications in the form of washes and lotions, which have the repute, more I believe than they deserve, of remedying baldness, or modifying the diseased conditions of hair roots which are the prelude to that final result. Nitrate of mercury has a reputation of this kind, so has tincture of cantharides.

Both of these agents are beneficial when employed before the roots of the hair are entirely destroyed; but that result once accomplished, no benefit can be derived from any remedy. I shall here append two formulæ, for the employment of tincture of cantharides, and nitrate of mercury, respectively.

Cantharides Hair-Oil.—No. 1.—Tincture of cantharides, one fluid drachm; essence of bergamot, two fluid drachms; castor-oil, four fluid ounces; rum, fill up to six fluid ounces. A portion of the compound oil to be used every morning, or whenever the hair is dressed.

Nitrate of Mercury Pomatum.—No. 2.—Ointment of nitrate of mercury one drachm; any pomatum at pleasure one ounce. A portion of the result to be well rubbed into the hair every morning, or whenever the hair is dressed.

NON-MEDICATED HAIR-OILS AND POMATUMS.

Perhaps the best hair-oils are those which hold castor-oil as the basis. Castor-oil alone, however, is rather too glutinous, requiring to be diluted with oil of olives, or what is still better, spirit of wine, which latter has the property of uniting with castor-oil. As regards the perfume wherewith hair-oil is to be scented, this is a matter of taste, and the perfume which will be liked by one person will be disagreeable to another. Essence of bergamot furnishes an odorous matter, very commonly used for the scenting of pomatum, and which is, perhaps, more generally agreeable than any other of the class of perfumed pomatums; however, various other odoriferous agents will be mentioned. Occasionally hair-oils are tinted delicately red. There is no positive advantage in this, but those who wish to produce the tint may readily do so by heating or steeping the oil with alkanet root, the red colouring matter of which has the property of dissolving in fixed oily substances. Besides pomatums for the hair, there are compounds of almost similar composition for application to chaps, broken lips, &c.; to these the term "pomade" is more generally applied. I shall now subjoin a few approved recipes for the preparation of pomades and pomatums.

Pomade for Healing Chaps.—No. 1.—Spermaceti, two drachms; white wax, one and a half drachm; oil of almonds (sweet), half an ounce; oil of olives (Florence), half an ounce; oil of poppies, half an ounce; liquid balsam of Peru, four drops. All the ingredients, except the last, are to be heated together, over a water-bath, and the balsam of Peru well incorporated with the melted compound by beating with a wisp.

No. 2.—White wax, two drachms; spermaceti, four ounces; oil of sweet almonds, four ounces. Melt the three together over a water-bath, and add three fluid ounces of water, about six tablespoonsful. Rub all together in a marble or wedgewood mortar, adding a few drops of Mecca balsam and rose water, towards the end of the operation.

No. 3.—Rub together in a mortar equal parts of purified lard, fresh butter and honey, finally add half a portion of Mecca balsam, and a minute quantity of otto of roses.

The Skin.—The functions of the skin are of the highest importance in the animal economy, as I have already explained in a foregoing portion of this treatise. When diseased in any way its beauty is impaired, and a great element of attractiveness in the human face divine is lost. Certain skins, too, are defective in beauty without being positively diseased. Age may accomplish this result, or freckles; but a common cause of skin disfigurement is pimples, and these never occur when the patient is in good health. For the most part they depend on irregularities of the stomach, or the existence of previous disease, or the consequence of medical treatment for previous dissease; in either of these cases medical advice will be necessary, and little admits of being stated by way of advice concerning their treatment here.

The importance of frequent use of the bath, and of attending to the functions of the skin, have already been insisted upon; it remains, therefore, to enter upon the consideration of skin cosmetics, properly so designated. They admit of a conventional division into washes, powders, and pomades. The latter class has already come under our notice when treating of pomatums; it remains, therefore, to enter upon a consideration of the two former.

COSMETIC MILKS.

These liquids belong to the class of mixtures which chemists term emulsions. They do not contain milk in their composition, and their only plea to the designation of milks is based on their milky appearance.

Milk of Roses.—No. 1.—Pour into a mortar of marble or wedgewood ware one ounce of Florence olive oil, and two grains of purified pearl ash, add a quart of rose water gradually, and rub all the materials together until the milky appearance desired is fully produced.

No. 2.—Melt together in a vessel of earthenware over a water-bath, spermaceti, white wax and white soap, of each one ounce. Next rub up in a mortar of marble or wedgewood ware, two ounces of bitter, and one pound of sweet almonds. Remove three-fourths of the latter mixture, and upon the remaining fourth pour the first mixture. Rub briskly, and add, by degrees, the remaining three-fourths. Next prepare in a glass bottle the mixture as follows :—Distilled water, a quart; rose water, half a pint; and add, by small portions at a time, to the mixture already prepared.

No. 3.—Rose water, half a pint; tincture of benzoin, one tablespoonful; Mecca balsam, a tablespoonful; mix all together.

The reader will notice that in the preparation of the first of these cosmetic milks, an alkali is employed, whereas in the composition of the others, there is no such ingredient. The effect of the alkali is to impart to the cosmetic milk somewhat the property of a soap, preventing separation of the various constituents, but detracting from the value of the milk as a cosmetic.

COSMETIC POWDERS.

These are of various kinds. In one kind a red tint prevails; the powders of this class coming under the denomination of soaps. In another class, the colour is white, and the generic term pearl powder is applied. Cosmetic powders of a third class are used with the intention of curing pimples, blotches, and eruptions; their effect, however, is chiefly limited to the desiccation of humours, whence they cannot be regarded as curative agents in a medical point of view.

No. 1.—Astringent powder adapted for the treatment of pimples, blotches, and eruptions :—Alum, one pound; white sugar, one ounce; gum arabic, one ounce; carmine, one ounce. The white is to be mixed and reduced to an impalpable powder. When used, it is tied up loosely in a bag of gauze or muslin, and the latter rubbed over the skin.

No. 2.—Powder for imparting whiteness to the skin, and concealing unsightly pimples and blotches :—Paste of sweet almonds, ten ounces; rye meal, six ounces; potato starch, six ounces ; oil of jasmine, half an ounce ; oil of neroli, half an ounce ; otto of roses, two drops ; balsam of Peru, four drachms ; oil of cinnamon, two drops. Mix the essences and the oily matters respectively together, each in an earthenware vessel, then gradually add the powders ; rub the whole together, and pass the whole through a fine sieve. If it be desired to colour the powder red, this can be accomplished by cochineal.

No. 3.—Another powder possessing the same general properties as the preceding:—Sweet almonds peeled, two pounds; rice flour, four ounces; orris root, four ounces; benzoin, four ounces; spermaceti, three drachms; oils of rhodium, lavender, and cloves, each thirty drops. Mix the whole intimately in a mortar, and pass through a sieve.

WHITE COSMETIC PAINT POWDERS.

Unfortunately the most beautiful of these are compositions of lead or bismuth, which not only injure the skin when continuously applied, but induce general disease of the system. Zinc (white) has of late been substituted partially for lead and bismuth compositions; but though it cannot blacken by contact with the smoke of coal, or sulphuretted hydrogen, and therefore proves an advantage over preparations of lead and bismuth, in this respect the white of oxide of zinc is nevertheless deficient in the beauty which renders white lead and magistery of bismuth so attractive.

In addition to the white cosmetic powder just indicated there is another class having talc, or French chalk, for their basis, the members of which are perfectly harmless. Unfortunately, however, the colour is glazy and metallic, so different from the ordinary whiteness of the healthy human skin, that the members of the talc class of white cosmetic powder, though perfectly harmless, are imperfect substitutes for the various bodies they are intended to displace. Having thus pointed out the danger to be apprehended from the employment of lead, zinc, and white cosmetic powder, some readers will perhaps consider that I ought not hereafter to give the method of preparing them in detail. Believing, however, that, for stage purposes at least, these poisonous cosmetics cannot be dispensed with, I shall append the particulars, in order to their preparation; cautioning those who use the compounds in question, not to use a fraction more in applying them than what is absolutely necessary to produce the desired effect, and to wash away scrupulously every particle of the cosmetic as speedily as possible.

Though the colouring cosmetics have been spoken of as powders, nevertheless they are sometimes made to assume the condition of a paste. I shall treat of them together.

Alabaster White (poisonous).—Take finely powdered carbonate of lead, known as Krems white, rub it well in a mortar, with a little mutton suet to give it adhesion,—or still more mutton suet if the intention be to convert it into a decided paste. It may be perfumed at pleasure, and is, without doubt, the most handsome of all known white cosmetics.

Original Pearl White (less poisonous than the preceding).—This is nothing more than the subchloride, or the trisnitrate of bismuth: either preparation may be used, perfumed to suit the taste of those who employ it.

Thenard's White.—This is white oxide of tin, perfumed at pleasure. It is said to be harmless; and less injurious than the lead whites it is undoubtedly, but still far from harmless. However, there is little chance of its being generally used, seeing that the white which it is capable of imparting is very unattractive.

Talc, or French Chalk White.—These are all preparations of powdered French chalk, separated from all collateral impurities, and differently perfumed. The best method of purifying French chalk, already reduced to powder, consists in allowing it to stand in contact with vinegar, at a gentle heat, for about an hour, then washing until every trace of the acid is removed, finally drying and mixing intimately with sufficient gum tragacanth to impart the necessary adhesiveness.

Occasionally talc, before being applied to the use of a cosmetic, is burned, with the object of imparting additional whiteness. Although rendered more valuable as a cosmetic, in point of colour, it is less tenacious than raw talc, hence it cannot well be employed as a powder combined with other materials.

The chief use of talc white, whether raw or burned, is for mixing with rouges, to which it imparts body.

ROUGES,

Or red skin paints, consist of certain vegetable or animal matters, either alone or combined with talc white, for the purpose of imparting body, and applied to the skin either in a liquid, a powder, or a pomade.

Rouges were prepared of various tints, to suit different natural complexions. The rouge adapted for the skin of a blonde would by no means harmonise with the complexion of a brunette. Three different gradations of shade are usually prepared, the variation of tint being imparted by different amounts of talc white. Preparatory to a more explicit description of rouges it may be as well here to append the method of preparing carmine.

Carmine.—This beautiful and expensive pigment belongs to the class of bodies termed by the chemist "lakes," and the general nature of which may be explained as follows:—Alumina, the earthy constituent of alum, has the property of combining with certain animal and vegetable colouring matters, and when thrown down by adequate chemical treatment, carrying along with it in combination the colouring agents. To colouring materials, when in this state of aluminous combination, the general designation "lake" is applied.

There are also two lake colouring matters, in which oxide of tin is substituted for alumina.

Ordinary Carmine (preparation).—Take cochineal in powder, one pound; purified pearl ashes, three and a half drachms; alum in powder, one ounce; isinglass, three and a half drachms. First convert the isinglass into jelly by pouring over it hot water, and allowing the mixture to stand for about twelve hours, or until completely dissolved. Next boil the cochineal in four gallons of water, with which the pearl ash has been previously dissolved, not in iron, lest the alum of the fluid should be injured thereby, but in a vessel of tin, copper, or iron, lined with porcelain. At the expiration of about half-an-hour, during which the boiling has been continuous, remove the vessel from the fire, and place it on a table or other support at an inclination convenient for drawing off the liquor in a subsequent part of the process. Now add the alum, stir all together until the alum is dissolved, then allow the cochineal, exhausted of its colouring matter, to subside. The liquid which floats on the surface now becomes clear, and it is more highly coloured than previous to the addition of the alum. Pour off all the clear liquor into a vessel of convenient dimensions, add the isinglass liquid, and boil until a coloured pellicle floats on the surface; then remove from the fire, and allow to stand at rest. Presently the carmine will be deposited, leaving the fluid above it, not only clear but colourless. Collect, by straining through a cloth, and dry.

TIN CARMINE, OTHERWISE DENOMINATED CHINESE CARMINE.

Boil two ounces of cochineal, finely powdered, in a gallon of water; and add a drachm of alum. Continue the boiling for ten minutes, then drain it into another vessel, taking care that complete deposition of the exhausted cochineal has previously taken place. Next dissolve ten ounces and a half of common salt in a pound of aqua fortis, and to the mixture add four ounces of pure grain tin, by small portions at a time, taking care that one portion is completely dissolved before the next portion is added. Finally, heat the cochineal liquor already prepared, and add the tin solution to it drop by drop: a precipitation takes place of beautiful red colouring matter: it is the tin, or Chinese carmine, which must be separated by straining through a cloth, washed, and set aside.

Preparation of Carmine Rouge.—Intimately mix in a mortar two drachms of carmine with a little water. Then place in a dish or saucer four ounces of finely powdered talc, and mould the latter with the fingers in such a manner that a depression capable of retaining liquid may be formed in the middle. Into this depression pour the carmine liquor. Stir altogether with a glass rod, or ivory spatula, but by no means with a spoon or other metallic body. Continue the stirring till perfect mixture is effected. Then finally add six drops of almond oil, and a solution of gum tragacanth. The rouge thus prepared is still of a very deep colour: it may therefore be considered as presenting the first shade.

Second shade Rouge.—Vary the proportions of material just given as follows:—Take two drachms of carmine, four and a half ounces of talc, not quite so much oil, and gum as in the preceding case.

Third shade Rouge.—Take carmine two drachms, talc five ounces, olive or almond oil two drops, and fifteen drops of solution of gum tragacanth.

As many other shades of rouge may be prepared as the operator wishes, by adding proportionate amounts of talc; remembering to add additional quantities of gum, and oil, for each addition of talc.

Chinese Rouge.—This most beautiful of all the rouges is made by adding spirit of wine to carmine, and allowing the two to stand together until all the colouring matter of the carmine is exhausted. The alcoholic fluid is then mixed with a little solution of gum arabic, spread on paper or foil, and allowed to dry. In this manner a delicate crust or layer of colouring matter is obtained; a little of which can be removed by the finger, and used as a rouge. When the fluid just described is dried on porcelain saucers, the result is the well-known pink saucer, or rather it is what the genuine pink saucer ought to be.

Vegetable Carmines.—Cochineal being an animal production, the rouges already described are properly denominated animal rouges. There are also vegetable rouges: and according to the opinion of some persons, they are the most beautiful. The most beautiful of these vegetable rouges are those into which the red colouring matter of safflower or false saffron (carthamus tinctorius) enters. Safflower is very much like the marigold in general appearance; the flower which yields it belongs also to the same natural family as the latter, namely, the compositæ. Safflower petals are yellow, or orange-coloured. The last is a compound, not depending upon the presence of an orange coloured pigment, but of a beautiful red and bright yellow colouring matter, the combination of which constitutes orange. Of these the red colouring material is alone useful for dyeing purposes, and for the fabrication of rouge. It admits of being separated from the other by a process of treatment which I shall promptly describe.

Extraction of the colouring matter of Carthamus.—Having procured some carthamus petals, tie them in a linen bag, and immerse the latter in a current of spring water, kneading and beating the bag from time to time. During this process abundance of yellow colouring matter is washed away, and after a time no further colour is extracted. When this result is noticed the operation has been carried far enough. Only red colouring matter now remains in the carthamus petals. More water will not dissolve this, though it readily dissolves in solution of potash. Accordingly, it is to be mixed with the latter, and allowed to stand in contact with it until the extraction of colouring matter is complete. It is now to be thrown down by the addition of oxalic acid. Notwithstanding the care taken to effect the previous separation of yellow colouring matter by treatment with running water, traces of it will probably remain, and would very much damage the carthamus as a rouge. The final traces of yellow colouring matter may be separated thus:—Immerse a little finely carded cotton wool into the alkaline coloured solution. The cotton attaches itself to the red colouring matter exclusively, leaving the yellow colouring matter behind: accordingly, it only now remains to effect a separation of the red pigment from the cotton wool, which is effected by taking advantage of the superior affinity manifested by the pigment for alkali. The cotton wool having been previously washed with water, is next washed with solution of carbonate of soda, which dissolves the red pigment, leaving the cotton wool nearly colourless. The pigment may now be thrown down by the addition of citric acid as before, but if it be desired to prepare rouge some powdered talc should be suspended in the solution before the addition of the acid. The mixture of talc with the red matter of carthamus being collected, dried, and mixed with a suitable portion of oil of almonds and olives, constitutes a very beautiful rouge.

If the powder, instead of being allowed to fall in masses, be deposited in a thin layer on cards, it asssumes a sort of bronze colour in dyeing, and constitutes the rouge sometimes termed *Rouge vert d'Athènes.*

To all the rouges yet described, notwithstanding their beauty, and the resemblance of their colour to the tint of healthy skin, there is a somewhat grave objection. They all soil the handkerchief, thus not only marring the beauty of the rouged skin, but what is far worse tell tales. To obviate this inconvenience there have been devised certain preparations of carthamus, carmine, and other rouge matters, in combination with some adhesive material not soluble in water or the preparatory liquid. The rouge now to be described is very celebrated. It is said to have been invented by a French lady, Sophia Garbet, and so persistently does it attach itself to the skin, that not even friction with a handkerchief, in a theatre or warm ball-room, will remove it.

Spirit of wine, four ounces ; distilled water, two ounces ; carmine, twenty grains ; oxalic acid, six grains; alum, six grains; Mecca balsam, ten grains; smelling salts, ten grains.

The alcohol and water having been mixed together, the oxalic acid, alum, and balsam of Mecca are dissolved in the mixture. Solution is best effected in a stoppered bottle, which should be frequently shaken to promote incorporation of the materials. When complete solution has been effected, filter through paper. Next, incorporate the carmine and smelling salts together in a glass or wedgewood mortar; allow the mixture to settle for a time, then pour off the clear liquor and add it to the ingredients already mixed in the bottle. This rouge liquid cannot well be applied by the finger: a camel's hair brush is necessary for this purpose. I shall now conclude the subject of skin pigments, by describing the preparation of one for imitating the blue colour of veins. The colouring matter employed for this purpose is ultramine, either native or artificial, incorporated with powdered talc, and rendered adhesive by a convenient portion of gum arabic or tragacanth. Real ultramine is the more beautiful colouring material of the two, but it is very expensive.

THE TEETH—ANATOMY AND PHYSIOLOGY.

Amongst the train of evils induced by civilisation, are diseases of the teeth. How provoking is it to look upon the pearly grinders of a savage, one whose food consists perhaps of little birds, fish, and train oil, as among the Esquimaux, or as we see among the Brahmins and Hindoos—people to whom tooth brushes are unknown, and upon whose simple ears the very name of dentifrice or tooth powder has never fallen; and thinking of our own sad lot begin to make comparisons! Nay, even in our own country and amongst our own race, there is a manifest difference between the healthful organisation and well-being of teeth, as between the peasantry and the higher classes. All this points to the general conclusion that certain conditions of luxury are unfavourable to the duration of teeth. The result cannot with any justice be laid to the charge of any one particular article of food, or even special classes of food, seeing that diseased teeth are equally frequent amongst people whose code of dietetics is widely different. Sugar has the bad repute of causing the teeth to decay of those who frequently use it. That character, however, is unmerited. Its origin can probably be traced to the penuriousness of certain housekeepers, and the stigma can be disproved by abundant evidence. Probably the habitual use of hot drinks conduces more towards teeth disease than any other single cause; the habitual use too of hard tooth brushes exercises a most pernicious influence on the teeth. When the gums of a person who habitually uses tooth brushes of this kind are examined, they are found to be more or less destroyed towards the roots of the teeth, thus denuding the latter by drawing from them the supply of blood necessary to their vitality, and in this manner establishing preternatural decay. The habitual, or even occasional, employment of hard tooth brushes is a great mistake. No specimen of hogs' bristles can well be too soft for this use; and when employed in conjunction with a suitable dentifrice, will efficiently answer the purpose for which tooth brushes are intended. Even a soft-haired tooth brush may in many cases of irritable gums be advantageously dispensed with in favour of a sponge rubber, an instrument which may be easily prepared by tying a piece of sponge to the handle of a worn-out tooth brush.

In some localities early decay and destruction of the teeth are endemic. Berlin is particularly remarkable in this respect, a large proportionate number of individuals in that city being sadly disfigured by the destruction of their teeth. I am not aware of any well-accredited real cause to account for this; the inhabitants refer it to some peculiarity in the water.

REGULATION OF THE TEETH.

Sometimes the regular number of teeth is exceeded by the supplementary growth of others, as a second row. This is very disfiguring, and should be remedied in early youth. During infancy and childhood the attachment of teeth to their sockets is far less intimate than it becomes hereafter, whence it follows that teeth admit of extraction with greater facility, and with less suffering, in early life than at any subsequent period, when the extraction of teeth for any mere purpose of beauty is desirable, or likely to be recommended. To neglect the extraction of superfluous teeth, from any consideration of pain to the child, is an act of selfishness, and if the child be a girl, is one that she will not feel inclined to thank her parents for when she is a grown-up young lady.

We English are more particular in respect to the regulation of teeth in early youth, and the extraction of superfluous ones, than almost any other people. The Germans are very negligent in this respect, and one there sees girls who, notwithstanding great personal beauty in other respects, are ruined as to their appearance, owing to the irregularities of their teeth.

Caries or Decay.—He or she who does not know from personal experience some intimate particulars about this malady, and its attendant pain, may rejoice not a little. Few kinds of physical suffering are more severe, or more completely incapacitate the sufferer from any kind of exertion. Decay or caries originates from two sorts of causes—either from want of nutrition to the tooth, or as the result of contact with decomposing organic matter, lodged between two teeth, more especially if the enamel be abraded. For the most part the latter cause exercises but an inconsiderable influence in giving rise to carious teeth. The most probable cause of the malady is unquestionably the former—want of nutrition. Many circumstances may conduce to this result. Destruction of the gums, and a laying bare of the roots of the teeth, may cause it. So may constitutional disease, the abuse of mercury, and some other medicines, also the condition of pregnancy. A tooth for a baby is about as fair a compromise as any married lady can expect of the Fates, who preside over these matters; and fortunate may she consider herself if the requisitions of fate are rendered so mild.

Sometimes the approach of caries or decay is ushered in by premonitory symptoms before any alteration of the tooth becomes visible. There is, perhaps, a dull aching pain in the gums and jaws, not referable to any one spot; there is a tenderness experienced on mastication, sometimes varied by sudden spasmodic pricks and starts. After the duration of these symptoms for a variable time, a small black spot will generally, on examination, be seen somewhere on the surface of the tooth. All that admits of being done in this stage of tooth-disease, is to guard against cold, to foment the face during the accession of pain with flannels dipped in hot decoction of poppies. The diseased tooth cannot in this stage of the disease be excavated and filled, on account of the extreme severity of pain which would be occasioned. After this condition of things has been some time in existence, the blackened exterior crust of enamel gives way, and the pain is much intensified. Palliative measures must now be had recourse to, for alleviating the pain, until the nerve is partially or wholly destroyed; and the pressure attendant upon the operation of filling can be borne. From the number of preparations in vogue for diminishing toothache, one might imagine that no malady was more amenable to medical treatment. Very few of these remedies are entitled to confidence. A mixture of nitric acid and camphor, taken up by cotton wool, and pressed into the cavity, if it can be borne, (for it exacerbates the pain at first,) soon destroys the nerve, when, of course, the pain ceases. Creosote, oil of cloves, or laudanum, absorbed by a pledget of cotton wool, and the latter inserted into the cavity, all sometimes effect diminution of pain, but more frequently fail in that object. The only certain agent for conquering toothache, that I ever met with, is extract of the tincture of aconite, applied according to the following directions:—Procure some tincture of aconite, immerse it in a little cotton wool, then heat gently, until the liquid of the tincture evaporates, and a thick extract, incorporated with the cotton wool, remains. Enough of the latter to fill the tooth should now be taken, and pressed into the cavity, previously made dry by the insertion of a pledget of cotton wool. I never met with a case of toothache, however violent, which could withstand this treatment. The tincture of aconite cannot be procured of every druggist, even in London ; and, being exceedingly poisonous, there may be some difficulty experienced in obtaining it. By employing it, however, as here described, no dangerous result can follow.

So soon as the pain of a carious tooth has been sufficiently alleviated to bear the pressure of stopping, recourse should be had to the dentist at once. For the most part, when caries has taken the course here described, gold stopping cannot be employed. The sufferer must be content to depend upon the use of one of the many varieties of soft stopping, known to dentists. I regard the amalgam of mercury and standard (not pure) silver, to be the most eligible material for the purpose, all things considered. When carefully impacted it will last many years, frequently to the end of life.

Such is the progress of tooth caries or decay, when it begins with pain from the first. More frequently, however, the first symptom of decay is an altered appearance of the tooth, first, a mere blackening, then an excavation, but still no pain. Incipient decay of this sort the dentist will be the first to discover, and no time should be lost in having recourse to the operation of plugging. Whenever freedom from pain and a suitable form of cavity admit of it, gold stopping should be used. It is far superior to all other kinds, lasts longer, and is, in the end, less unsightly; amalgam stopping becomes especially conspicuous after a time, inasmuch as it turns black.

False Teeth.—These are of various kinds; natural teeth, carved ivory, of a very hard description, furnished by the core of the molars of the hippopotamus, and lastly, mineral or enamel teeth. Preference will be given to one or the other according to various circumstances. Mineral teeth possess the admirable quality of never staining; these are totally unabsorbent, and, therefore, never discolour. These are great advantages; but, as a set-off, they are more brittle than either natural teeth or carved blocks of hippopotamus ivory; hence, although they answer admirably well for supplying the place of large, massive molars, they are unsatisfactory as substitutes for the thin incisors, or front teeth, or even shallow molars, such as are rendered necessary in cases where the underlying stump, instead of being extracted is cut off, and the false tooth attached to a shield or cap—is fixed outside. Natural teeth are, all things considered, the best for supplying the place of incisors; these, when single, are occasionally screwed upon the remaining stump, cut off level with the gum, a mode of attachment less conspicuous than any other, but which is deficient in strength as compared with the method of fixing them by a point to a gold or ivory palate. In some cases teeth, both molar and canine, and incisors, are carved, palate and all, out of a piece of hippopotamus ivory, and occasionally the palate is stained red, the better to imitate the colour of the natural gum. People who can afford to have duplicate sets of false teeth, and to replace them yearly, may adopt this invention; otherwise ivory teeth, and ivory palates, should be avoided: they both readily stain, and are then repulsive to more than one sense.

When teeth are screwed upon a stump, there, of course, they must remain,—being fixtures; but teeth attached to palates should be removed every night, placed in cold water, and merely cleansed with a brush before replacement.

Dentifrices.—Under this head are comprehended various substances, powders, liquids, and pastes, which are applied to the teeth and gums to effect their preservation, and collaterally to counteract the unpleasant consequences of caries. Some dentifrices possess a chemical agency, loosening and dissolving the concretions of solid matter, called "tartar," which sometimes collect around the roots of teeth, and help to cause their destruction. Others conduce to the same end mechanically, by the friction of their particles; and a third class, usually liquids, are used for the purpose of hardening the gums, and diminishing the soreness from which they occasionally suffer.

Of these, the first class, namely, dentifrices, which possess a chemical action, should be altogether banished from the toilette. All habitual use of them is strongly to be reprehended, though in the hands of a dentist or other careful person, and for rare and exceptional use, they may be had recourse to with advantage, for effecting the removal of foul incrustations at the base of teeth, and superficial black specks, which sometimes accompany teeth with rough surfaces. For this purpose I believe the very best of all chemical bodies, to be muriatic acid, or spirit of salt, strong as obtained from the druggist. The name of the liquid will sound frightful enough to a timid girl, but if employed in the way to be described no ill effects will follow. The method of using it is this:—Procure a clean butcher's skewer, hammer or batter out the sharp point of it into a very small brush, not larger than the tuft of one of the small sable brushes used in miniature painting. Dip this into muriatic acid, allowing all superfluous acid to drain off, and rub the part of the tooth to be purified. There are very few incrustations which will resist this treatment; but, as I have said, the operation must be regarded as quite exceptional, to be had recourse to with all the deliberation which attends the extraction or the filling of a tooth. Care should be taken that so soon as the operation is finished, all lingering traces of the acid be well removed from the teeth and gums, which can be best accomplished by washing the mouth with chalk and water, afterwards with water alone. For some time after the operation just described, has been performed, the teeth will feel rough, will "be set on edge," to use a common expression; a sufficient indication of the destruction which must result from habitual recourse to the process.

TOOTH POWDERS.

There are almost as many tooth powders as individuals employing them; and a great deal of evil ingenuity has been exercised in devising injurious, and sometimes disgusting substances for entering into their composition. The conditions which a good tooth powder should fulfil are these:—The presence of any substance capable of removing impurities by chemical agencies, is to be reprehended; when a chemical dentifrice is necessary, its use should be, as I have already described, exceptional. It should contain, as one of its ingredients, a powder of sufficient mechanical roughness to be capable of loosening and removing concretions, but at the same time not rough enough to destroy the enamel. Finally, the colour of the tooth powder should not be such that any particles of it remaining between the teeth, or at the root of the gums, shall be conspicuously visible, for this latter reason charcoal, though much employed as a tooth powder, yields to many other substances. Nothwithstanding the laudations bestowed on many tooth powders of a compound nature, I believe few, if any, are better than chalk. Not common chalk, however, for it is mixed with flinty and other hard particles, but that which can be procured at the druggist's, under the name of prepared chalk. If perfume be required, a little cinnamon powder, or powdered myrrh, may be incorporated with the chalk, and, if desired, a little carmine will impart an agreeable tint; but neither the colouring nor

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the odoriferous matter contributes to the efficacy of chalk as a tooth powder.

Notwithstanding the eulogium passed on chalk as a dentifrice, there are individuals who will not be content to use a tooth powder of this simple kind. For their sakes I shall therefore append a few more complex recipes:—

No. 1.—Take heavy calcined magnesia, twelve drachms; red cinchona bark (powdered), twelve drachms; rhatany powder, two and a half drachms; pyrethrum powder, forty grains. Incorporate all the ingredients well together in a wedgewood mortar.

No. 2.—Prepared charcoal, one ounce; red bark, one ounce; lump sugar, four drachms; oil of mint, four drops. Incorporate in a mortar.

No. 3.—Cream of tartar, one ounce; heavy calcined magnesia, quarter of an ounce; powdered cochineal, one drachm; oils of cinnamon, clover, and mint, of each two drops.

BATHING.

Perhaps there is no part of the human body more systematically violated than the skin. People are apt to consider the skin in the light of a mere mechanical covering to the flesh, a sort of dead envelope, which indeed should be cleansed for decency sake, but which might be allowed to remain dirty for aught of evil, in a sanitary point of view, the body would suffer thereby. There cannot be a mistake more false and pernicious than this. The skin is a real living organisation, made up of complex parts, easily affected by external influences, and when diseased, implicating internal organs which the non-medical reader would little dream of.

FUNCTIONS OF THE SKIN.

If a portion of human skin be examined microscopically, the elaborate organism of its construction, with reference to the functions to be performed, will be observable. Firstly we notice the epidermis or cuticle, usually a thin membrane, but which on some parts of the body is naturally thick, as for example, on the soles of the feet and palms of the hands. Pressure and friction cause it to be still thicker, as we observe on the hands of labourers, and too frequently in the instance of corns. There is a disease, the characteristic of which is the conversion of epidermis into scurvy or scaly matter; and in certain animals—the crocodiles and alligators for example—this scaly state of epidermis is a normal formation. When these animals are young, the epidermis is soft; and though marked according to the division of the scales hereafter to be generated, is so little indurated, that boots and shoes can be made of it, as is sometimes done in the United States.

The cuticle or epithelium is covered with little perforations, through which the liquid perspiratory matter and various gaseous emanations continuously exude. Close under the cuticle the terminations of the sentient nerves are placed; and the ramifications of veins and arteries are so numerous, that they form a reticulated expansion, the beauty of which can only be revealed by the microscope, or by anatomical preparations, designed for the purpose of illustrating them.

Strange though it may appear at a first glance, the skin in function very much resembles the lungs. That is to say, it performs a function appertaining to respiration; so that many animals in the lower grades of creation have no lungs, or other specific breathing organ, but breathe altogether by the skin. This peculiar functional alliance between the lungs and the skin affords an explanation of the fact, well known to medical men, that in certain skin diseases, for example scarlatina, measles, and small-pox, the lungs suffer. This alliance is also beautifully demonstrated in the case of severe burns, implicating large surfaces of the skin. Very seldom indeed is it that the skin is implicated as a consequence of burns, to any considerable extent, without the accompaniment of difficulty of breathing, cough, and drowsiness, all explicable by the circumstance of the retention of carbon in the system, and either the inflammation of the tissue of the lungs proper, or the bronchial tubes which ramify throughout their substances. It will be perceived then that the skin, far from being a mere dead envelope, only adapted to hold the flesh together, and to cover the bones, is really a very complex organisation, and has a great deal of work to do. If it be allowed to become foul and dirty for long periods together, its numerous functions cannot be adequately discharged, and suffering and disease ensue. Hence the necessity of frequent baths, the full advantage of which has only just dawned on the English public; though nations less ostentatious than ourselves in the matter of cleanliness might well set us an example in this particular. However slender their other claims to delicacy may have been, or may be, oriental nations surpass us greatly in that form of cleanliness which enjoins frequent use of the bath. It formed a part of the Mosaic code, and was inculcated subsequently by Mahomet. The devotees of Bramah too are inveterate bathers, regarding it as a religious duty which they durst not neglect.

All the civilised races of antiquity, indeed, were great bathers, and expended an amount of wealth in adding to the convenience and the luxury of baths, which would be hardly credited if the most positive records concerning these matters had not been handed down to us. The employment of baths, known from time immemorial, in the great cities of the East, passed thence into Greece and Italy. The water supply of ancient Rome was enormous; and considering that the methods of tubular conveyance and steam pressure were then unknown, we are led the more to appreciate the value the Romans entertained for water. Not only was there a profusion of water for drinking and baths, public and private, but rich persons indulged in the luxury of private fish ponds, the water of which was frequently kept lukewarm by furnace heat, the better to promote the propagation of fish. The thermæ, or warm baths, established by Augustus and Agrippa, were marvels of constructive skill. The pitiless Nero was such an admirer of salt-water bathing, that he caused sea water to be conveyed to Rome for that purpose. The thermæ of Caracalla, Titus, Trajan, and Diocletian are still further examples of the importance attached by the ancient Romans to the bath, and the profuse expenditure they incurred in building these structures, supplying them with water, and maintaining the latter at the desired temperature. From Rome the institution of the artificial baths was established amongst the races they conquered. The custom was readily adopted by the Gauls, and the remains of numerous baths of Roman construction at this time in France, is a sufficient proof of the universality of the adoption. The thermæ of Julian are now amongst the most ancient Roman monuments in Paris. The introduction and spread of Christianity did not check the adoption of the bath; on the contrary, bathing conveniences usually were attached to nunneries and monastic institutions. Occasionally these monkish baths were thrown open for the use of the laity, but the practice was not always complacently accorded to by the monks. Gregory, of Tours, left the fact on record for the edification of posterity, that the nuns of that town abandoned their convent because, amongst other reasons, the abbess had opened them to strangers of that place. When the Crusades were first established, a sort of Christian religious sanctity was thrown around the practice of the bath. It constituted an important part of the ceremony of knightly installation; whence the chivalric British Order of the Bath, which has come down to our own times. Subsequent to the twelfth century, the practice of vapour baths, doubtless acquired in the East, became established in Western Europe, and more especially in France. They were the representatives of the ancient thermæ, to which they presented many similarities. So prevalent did they become, that guests were as regularly supplied with them as now with food and drink. Hospitality was held to be incomplete without the proffer of the bath. For a time the preparation of vapour baths in France was restricted to no especial class; but at a later period, in the year 1655, that is to say, a community of bath-men was established. The custom of wearing perukes came in at the same time, and the functions of wig making, and bath preparing, were merged into the same people; hence the community designated themselves *des barbiers—perruquiers—baigneurs, estuvistes.* In 1761, the floating baths, now so common on the Seine, and on many other French rivers, were first established by a man named Poitevin. Unquestionably the practice of the bath was more common at former times than now, a fact which argues little for the cleanliness held to be so inseparable from civilisation. Some will be disposed to think that this greater prevalence of the bath formerly, must be attributable to the greater cheapness; an hypothesis, which is contrary to the deductions of the author, M. P. S. Gerard, who has devoted much attention to this subject. In his *Recherches sur les bains publics de Paris,* he makes it appear that the present price of enjoying the bath is only about half the price which obtained in the reign of Louis XI., basing the calculation on a comparative value of wheat at the two periods.

It is a curious fact, and one suggestive of the many sources from which prejudice may emanate, that where Christianity and Mohammedanism came into jarring contact in past ages, bathing was regarded by Christians in the sense of something heterodox. Herr Von Rochau, in his work entitled "Die Moriscoes in Spanien," relates how when the bulk of the Moorish race had been expelled from the peninsula, and only by comparison a small number remained, whom the Catholic hierarchy tried to Christianise by fair means or foul—use of the bath was altogether interdicted; and if some quasi Christian was unfortunate enough to be caught splashing in a tub of cold water, that act so innocent to society, and so beneficial to the individual, might have rendered the latter amenable to the censures of the Inquisition.

The ancient Greeks and Romans were great patrons of the bath, originally for the sake of health and cleanliness, but eventually as a luxurious and effeminate way of occupying time. They moreover combined with the use of the bath a treatment, the advantage of which to the skin is unquestionable; though it has gone out of practice amongst moderns, except the effeminate races of the East. I advert to the practice of inunction. The Greek and Roman bathers, after thoroughly washing themselves in cold or warm water—sometimes in both—were annointed with odoriferous pomades, and this being done, the skin was subjected to a sort of scraping operation with an instrument called "*strigil.*" It had the effect of removing the little scales of epidermis which nature designs to come away, just like the feathers of birds during the season of moulting. It must be remembered, however, that although we moderns reserve pomatums for our hair, and do not smear our bodies with it, we nevertheless have soap, which the ancient Greeks and Romans had not.

The bath is useful to persons of all ages and of every variety of constitution; but the same kind of bath is not adapted to the requirements of all. All healthy persons of whatever age, up to the period of senility, may, with advantage, use the cold bath, and they need not be afraid to enter it, however cold the weather may be. Persons not being in perfect health, in which category I include all those who have predisposition to fulness of blood or fits, ought not to employ the cold bath habitually, if indeed it be proper for them to have recourse to it in any degree.

The mere degree of coldness is only one circumstance determining the influence exerted by a bath on the human organism. The method of applying the cold water is an element which must enter into the consideration of the results. Thus we have the simple body bath, in which every part of the body can be immersed; the hip, or sitting bath; the shower bath, of which the douche or pump bath is only a particular and more severe modification. The douche bath is almost exclusively restricted, in England, at least, to the practice of hospitals and lunatic asylums; the shower bath, however, is of frequent employment in families; and when the patient is strong enough to bear it, there can be no more refreshing agent for rousing the body to corporeal exertion, and bracing the mental faculties. Especially useful is it to persons who, after a hard day's work, are obliged to write or think in the evening. To this end there is nothing which so completely answers the purpose as a shower bath. It is improper, however, for women, except they be stronger than women usually are, and for men of full habit prone to determinations of blood. Neither in any case does it stand much in aid of cleanliness; for which object there is nothing like the body bath.

The warm bath, perhaps, is that most generally eligible. It causes no shock to the most delicate organisation: it cleanses the skin, opening its pores, and by promoting the function of exhalation it is conducive to general health. But as a set off to these good effects, it is somewhat depressing; and does not accord well with the necessities of those whose occupation involves sedentary thought. When it is desired to secure these mental conditions in conjunction with the employment of the warm bath, the water should never be sufficiently warm to impart a decidedly agreeable sensation on first entering the bath. A temperature of 90° F. is quite enough.

Much virtue is supposed to attach to sea water baths; but I doubt whether, if we dissociate the mere act of bathing from the contingent pleasures of sea bathing,—such as its greater buoyancy rendering the act of swimming more easy, the purer air of the sea, and the usually delightful scenery,—sea bathing be more advantageous than fresh water bathing; and this granted, the schemes we sometimes hear of for bringing sea water through pipes, or aqueducts, far inland, be worth the trouble that labour would involve. Sea water may be regarded as furnishing the most simple instance of a medicated bath, of which various have been from time to time employed. Milk baths may be here mentioned, though not strictly medicated. Baths of this description have been sometimes recommended in cases of weakness, whether from consumption, or other causes; they have indeed been endowed by certain enthusiasts with almost miraculous powers, even the power of imparting to old people the vigour of youth. Doubtless, milk being a nutritive substance, would in some degree tend to impart nutrient particles; but whether these could ever become assimilated into flesh and blood, is a matter by no means so certain; and in any case requiring the nutritive qualities of milk to be applied, the stomach is a far better channel of ingestion than the skin. In certain cases of obstinate rheumatism, and as a remedy for skin diseases, water impregnated with iodine has been employed successfully as a bath: in other cases, water acidulated with nitric or muriatic acid, or both, have been similarly employed; but the use of baths of this description involves considerations so purely medical that I need not further advert to them in this place.

It would be improper to conclude the subjects of baths and bathing without adverting to the so-called cold water cure, or hydropathy. Nothing is more common than for the physician to be asked whether he believes in hydropathy; as if hydropathy were something universal in itself, and antagonistic to all other modes of medical treatment.

It is a part of the nature of all enthusiasm, real or affected, to be exclusive, and very markedly is this the case in medical enthusiasm. The thorough hydropath is not content to have the position granted that the medicinal use of water is advantageous in certain conditions of disease, but he arrogates to his treatment the exclusive privilege of being good for the cure of all diseases; and by applying this doctrine he is a liberal patron of the sexton and undertaker. Cold bathing, as I have stated, is advantageous to all who are in health and not yet advanced into the decrepitude of age; but persons out of health should beware of having recourse to an agent so powerful as cold water, except under the advice and by the sanction of an accredited physician. It may here be demanded whether the medical superintendents or principals of hydropathic establishments be not accredited physicians, and whether they may not be safely consulted. To this I reply, that though some accredited physicians may be amongst the hydropathists, yet by far the greater number are practising without any legal title. Some have German diplomas, which almost any one—the reader if he please—may purchase for a few pounds: others do not even enjoy that ambiguous qualification. There is something so repulsive and dishonest in the pretended belief that a curative agent, whatever it may be, is universally applicable, that no man of mark and standing and honesty, could lend himself to its employment. All that is good in the medical application of cold water can be, and is, taken advantage of by medical practitioners generally; but none, except knaves or fools, will pretend that hydropathy has so large an application as we find set forth by this class of irregular practitioners. Of late there has been a sort of alliance between the homœopathists and the hydropathists, exemplifying, I suppose, the "*similia similibus*" maxim of Hahnemann. But it is really somewhat hard to say what the homœopathic professors would be at. Many of them, with wonderful display of adaptive genius, put it to the sufferer at the first interview whether he or she prefers being treated homœpathically or allopathically; whether, that is to say, the patient will have large doses or small. If large, the usual practice is had recourse to; if small, a mode of exhibition is adopted, which may be not inaptly illustrated by the statement that the doctor does what is equivalent to letting fall a drop of physic into the Thames at Hammersmith, and desiring his patient to ladle up and swallow a drop of Thames water at London bridge.

CHAPTER XI.

MEDICAL CREEDS.

I WAS in the act of writing instead of medical creeds, "medical hallucinations." The latter term, however, would be objected to by believers in certain medical systems, which, in the believers' estimation, are true doctrine.

It is a tendency of enthusiasm to be exclusive. The eclectic endeavours of the rational, unbiassed physician to adopt any mode of treatment which is sustained by reason or experience, are too limited for the medical enthusiast. He must needs confine himself to some special agent, or special predilection; he calls himself by some special name, indicative of some leading peculiarity incidental to his system, publishes cases of marvellous cures after the manner of all medical enthusiasts—and, pursues his labour of death.

It would be curious to evolve the reason wherefore there exists, and there appears to have always existed, a tendency in the mind of the non-medical public to countenance what I would call "medical delusion," but which, if I denominate medical enthusiasm, will not be open to demur from any party. There is, and there has long been, a tendency in the public mind to consider medicine, as taught in the schools, rather a dogmatic creed, like the tenets of a religion, than a structure built up of deductions from various sources, and open to the accession of every substantiated fact which can tend to its advancement. Hence it happens that the epithet, "old school," is so frequently applied by those medical enthusiasts whom medical men, for convenience, call empirics, to all practitioners who are not of their own opinions, or, at any rate, who are not addicted to some empirical or exclusive, in contradistinction to a rational or eclectic system. The non-medical public are egregiously misled by this. To use the term "old school," in the sense in which it is used by the would-be new lights of physic, is simply absurd. As new discoveries are made and utilised in their application to medical science, the latter is perpetually undergoing a state of renovation, and assuming new phases. But the more it advances the more eclectic is it; the wider are the domains from which it culls its resources: whereas it is a tendency of empiricism to hem itself up within a circumscribed ring fence, and remain in a condition of torpor. In committing ourselves to an examination of medical delusions we shall find this primary broad line of distinction between them: some are founded on a principle true to the limit, but false when pressed beyond that limit. Others are false under all circumstances, based upon fallacy, depending for their progress on the credulity of mankind.

The celebrated Inunction system of St. John Long furnishes an example of a medical treatment true to the limit, but false when pressed beyond. Every physician knows that inunction of certain stimulating bodies, as for example tartar-emetic, is a powerful remedial agent in certain diseases. Thus in certain diseases of the chest and of the liver it is thus employed, but not in all diseases of these organs; much less is it eligible as remedial treatment against all other diseases. St. John Long, like all empirics, had greater faith in the universality of his remedy than rational practice warrants; he therefore failed.

The Cold Water-cure, or Hydropathy, may be referred to the same category. There is strong remedial power in cold water, externally applied, as any physician knows; and gladly does he avail himself of this power when suitable causes demand it: but to affirm that it is proper treatment for all, or the greater number of diseases, is simply absurd. This is the charge justly brought against hydropathy

Amongst the medical creeds now universally agreed to be founded in error, is the laughable one of "signatures," as it was called. The advocates of the doctrine of medical signature affected to believe that the medical property of each particular agent was made known by some external sign. These signs or signatures were always so vague that no small amount of the illumination of medical faith was necessary to their perception. If a substance were red it was considered, for example, to be good for stopping the flow of blood; if in the form of a heart, good for diseases of the heart, and so forth. One root is peculiarly celebrated in connection with this doctrine of signatures. The sparkling fancy of the adepts in the new faith represented it to their heated brains as being shaped like a woman; therefore, it must be good for the ladies to physic themselves with; but really I need not linger over the absurdities of the doctrine of signatures.

I do not know whether we are justified in treating of mesmerism as one of the medical creeds. Perhaps it is scarcely universal enough in its aims to warrant that designation, being rather considered a sort of adjunct to other medical treatment in a few special diseases, than an agent professed to be able to deal with the multifarious phases which disease assumes. Suffice it to say of mesmerism, therefore, that its originator, Mesmer, certainly had full opportunity afforded him to demonstrate the truth of the principle on which he founded his pretensions. He signally failed. All the collected instances in mesmeric influence and clairvoyance of which I have had personal testimony, have been, to my mind, pure charlatanry; the results easily explicable without invoking any supernatural power.

Of all the medical creeds which now exist, and perhaps which ever existed, that called "Homœopathy" is the most extraordinary. I am not warranted in classifying it under either of the two sections already mentioned, as embracing various medical creeds, seeing that it is not like the doctrine of signatures, a thing of the past, the amount of credence to be placed in it acceded to by all, but it is an enthusiasm still very much in vogue. Certain it is that homœopathy is not to be regarded amongst the medical systems discarded, even in England; it still exists amongst us, and maintains its hold on the convictions of society by the circumstance of its numbering amongst its votaries many advocates of high social rank. I believe, too, amongst the causes which have tended to support homœopathy in this and other countries, is the ridicule wherewith it has been treated, and to which indeed its principles, and professions, render it so amenable.

When a proposition bearing upon any subject is widely at variance with possibilities, and the whole array of inconsistencies is felt at once, the listener is apt to treat the matter with the same indifference as he would treat the babblings of an insane man, or the mental wanderings of a dream; or if the quality of the ridiculous be prominently brought forward, the listener may perhaps laugh. But to a certain class of minds indifference may be interpreted as inability to argue on the given topic, and ridicule as a blind wherewith to screen a baffled comprehension. Let no one speculate on innate or intuitive perceptions of the impossibility of things. Faith is a powerful element in the constitution of the human mind, and the very condition or being of faith may be defined as the capacity of believing that which is not comprehensible. Even in the constitution of the mind of philosophers, faith is wont to set itself in antagonism to induction—to blunt perception, dull the reasoning power, and warp the judgment. How much greater, therefore, must be the influence of faith, upon the minds of those to whom the practice of experiment is unknown; to whom the very terms of a subject like homœopathy are vague and ill-defined! The fact is, that when the most investigating, scrutinising, cause-seeking experimenter amongst us comes to examine many sources of belief, he will arrive at the conclusion that they are the children of faith. Does he believe that such a warrior as Alexander the Great ever lived? Of course. Then what is this but faith? Does he place credence in the testimony of palæontological geologists, in the existence, in times gone by, of gigantic monsters, of hideous forms, and wondrous dimensions? Comparatively few have seen the remains of these creatures, though few are there who disbelieve in the teachings of geologists. This is faith again; and so might we go on accumulating examples of matters accepted on faith, till at length we begin to see how the more startling propositions of homœopathy may, to a certain order of minds, be accredited.

Although it is a natural consequence of the short duration of human life, and the multifarious avocations which fill it up, that much of our belief is accepted on faith; yet so far as all matters belonging to the department of reasoning and science are concerned, the faith should be only provisional; for though a person may not be able to apply himself to any particular investigation with the object of gaining evidence to stand in the place of faith, he ought at least to be satisfied that the investigation is of the kind which the human mind may apply itself to; and beyond all things should he avoid giving evidence to the belief in the power of special illuminations, of individual minds, by any supernatural light. This is so directly at variance with the Baconian laws of induction, that no mind in which the tendency to hero-worship is very strong can belong to an honest experimenter.

Having thus endeavoured to lay bare some of the peculiarities of mental organisation, which have favoured the progress of homœopathy, and this without levity or ridicule, let us proceed to examine the principles on which the doctrine is founded; and by the truth of which it must stand or fall. One word, however, of serious advice to the reader on starting. If he be a strong believer in homœopathy, let such a one before following me in the examination of the principles of homœopathy seriously ask himself this question: "On what tenure do I hold my belief? Do I hold it on the tenure of faith—not provisional but absolute—a faith like that of my religion, too deep for experiment to disturb or testimony to shake? Do I look upon Hahnemann as upon one to whom a mystery was disclosed; and have I decided to believe all respecting homœopathy to which he has testified?" If so, we will save our time. *You* have perused homœopathy from beyond the regions of science into mystery, and there *I* cease to follow. Of this kind are the greater number of the homœopathic laity, and the belief in homœopathy will be generally found to accompany some other form of mysticism. If he, however, who having asked himself the question,—"On what tenure do I hold my belief in homœopathy?"—can answer himself and say,—"I hold it on the tenure of a provisional faith, as based upon the result of experiments performed; I acknowledge it to be a fit subject for experiment, and to be amenable, like other sciences based upon experiment, to the results of the latter. I claim for homœopathy no right of altering the ordinary laws of evidence on the sequences of logic. I invest Hahnemann with no idea of holiness or mysticism. I do not think it impious to criticise the records of his experiments and deductions, or to repeat both experiments and deductions for myself."—If the reader, I say, can meet me in the train of mind this answer presupposes, he may peruse the following with advantage:—

"Homœopathy"—I would begin addressing myself to a reader of this kind—"is the term applied to a medical system not professed to have been communicated by revelation, but deduced after much experiment, and profound reflection, by the founder of the system, Samuel Hahnemann." He,—the originator of homœopathy, does not say, "This medical system which I now make known to the world, is a thing concerning which you—the world—must not reason, and must not scrutinise by experiment." He proclaims it to embody the inevitable conclusions which a physician of equal pains-taking with himself, and equally unbiassed, must necessarily arrive at, if he follows the train of investigation originally followed. Hahnemann, I say, solicited investigation for homœopathy, assured that it would emerge triumphant from the ordeal. Such is the position assumed by Hahnemann :—it is fair—it is philosophic. He claimed for homœopathy the rank of an inductive science :—by the laws of induction, then, must it be judged.

Derivation of the Term.—The distinctive appellation homœopathy is derived from two Greek words, meaning "*similarity to the disease,*" an expression which embodies the leading principle of homœopathy. Every person knows that a striking peculiarity of this sort of practice is the administration of quasi-infinitesimal doses. This, however, homœopathic physicians hardly like to recognise as a fundamental tenet of homœopathy; and when a non-believer points to the miniature array of globules in a homœopathic chest, in proof of the system of infinitesimal doses being a tenet of their system, they are apt to refer him to the derivation of the word homœopathy, which has, it is true, no reference to infinitesimal doses. I cannot see that an advocate of homœopathy gains anything by this; for though the disciple of Hahnemann does not in so many words assert that quasi-infinitesimal doses are an integral part of his system, he habitually uses the infinitesimal doses, and appeals to experiment in favour of their efficiency. Whether, therefore, we choose to regard the administration of infinitesimal doses as an integral part of homœopathy, or as embodying a mere collateral discovery of Hahnemann, which he and his disciples make subservient to homœopathy—the general question of the trustworthiness of Hahnemann's medical deductions is not affected.

Hahnemann's Experimental Industry.—Nothing is more common amongst the disciples of homœopathy than the laudation of Hahnemann's excessive industry as an experimenter; the extreme care with which he conducted his experiments; and the trustworthiness which ought to attach to his deductions. Industrious he certainly was; after a fashion too he was careful:—but care without discrimination as often fosters error as it promotes truth. The experimental system on which Hahnemann proceeded is especially open to this animadversion: —He gave a medicine, and watched his patient; chronicling everything that happened to the latter for an indefinite time, after administering the medicine; as an effect. The merest neophyte in the ways of experimental investigation must feel that such a method of procedure is a mockery of induction—a satire on accuracy. No amount of labour, no multiplicity of experiment, can ever impart congruity to incongruous things; or establish sequences between things which have not the natural relation of cause, and effect. And here, in furnishing the reader with illustrations, I will rather select them from the "Organon" of Hahnemann—the book which contains an exposition of the force of medicines deduced from experiment, than imagine others. The reader may perhaps smile when the illustrations are set before him; but the fault will not be mine. Hahnemann, I have just said, is amenable to the charge of mistaking the "*post hoc*" for the "*propter hoc;*" of establishing relations of cause, and effect, where no such relations exist. Of this take an example. The founder of homœopathy gravely lays it down as a deduction from experiment, that cayenne pepper, given as a medicine, causes itching at the roots of the hair "after scratching,"—yes, indeed, thus it stands on the faith of the "*mighty master,*" as the disciples of Hahnemann call him—*after scratching!* We may not laugh, the disciples of the new creed tell us, it is not philosophy: we must accept facts as we find them, however seemingly ridiculous; we must ponder, reason, scrutinise, and so forth. Well, be it so: if then Hahnemann wished to proclaim the fact, as it seemed to him—that cayenne pepper, administered in any dose, caused itching at the roots of the hair,—why invoke scratching? Between the scratching, and the itching, there is that sort of relation, which may induce many persons to regard them in the sense of cause and effect.

Between the administration of cayenne pepper, and the act of scratching, there is no apparent connection whatever; and any testimony, having for its object to establish such connection, should be carefully stripped of all accessories. Following the train of this argument, therefore, we are under the necessity of impaling the mighty master on one of the horns of a dilemma: either the scratching had no reference whatever to the itching, (in which case the circumstance ought not to have been mentioned;) or it had; in which case the testimony favouring the notion, that cayenne pepper and scratching stand to each other in the relation of cause, and effect, is invalidated.

Let the reader understand once for all, that the illustration just given *is not* a joke invented by me for casting ridicule upon homœopathy. The proposition is gravely set forth in Hahnemann's Organon, a book on which homœopathists look with a reverence only equal to the reverence shown for tenets of religion, or Holy Writ. Nor is the example the most ridiculous which might have been chosen. Still more wild —even as I may say to insanity—is the deduction gravely arrived at by Hahnemann—that charcoal, administered as a medicine, causes what? Loss of skin, *à posteriori* (after riding!) Yes, so is it gravely stated in the great Organon. Shade of Hippocrates, father of physic, what wild doctrine is this! Ghost of Francis Lord Bacon—you, transcendant spirit, who, working in the brain of that truly great man, taught him to abandon the dogmas of classic sages, and to interrogate nature by experiment; how must *you* frown, as looking downward from the spirit world to mother earth, you see what amount of folly can be wrought in the name of inductive philosophy!

Divesting oneself, if possible, of notions of the ridiculous in relation to charcoal, and its promised cutaneous effect, will the most fervent believer in homœopathy allow a doubter to ask—whether riding alone, without the charcoal, has not been known to produce the state of cutaneous denudation in the exact locality set forth by the mighty master? And yet homœopathists complain, with maudlin sentiment, that their adversaries do not argue, but treat them with ridicule!

The circumstance will not have escaped the reader, that the two illustrations just given, apart from the ridicule attached to them, and the wild departure from logic which they involve, have a disagreeable taint of indelicacy. The fact is, that the "mighty master" had a mind so repulsively indelicate, and the indelicacy finds place so often in his great book—that if he were not mad, he ought to have been expelled all decent society. Hahnemann is never so completely in his element, as when expatiating on a repulsive symptom. No swine could revel with more seeming pleasure amidst sewers and putridity, than Hahnemann in descriptions of certain physical infirmities of human nature, to which I may not further advert.

HOMŒOPATHIC TENETS.

The fundamental principle of homœopathy is, as I have remarked, involved in the proposition, that, medicinal agents causing symptoms like those of any particular disease—are the proper agents for treating the same disease medicinally. Thus, say the homœopathists, "belladonna produces an eruption like that of scarlet fever, and practice demonstrates that belladonna is a good curative agent for scarlet fever. Mercury gives rise to ulcerations of the throat, and practice demonstrates it to be a proper medicinal agent for the treatment of a certain class of diseases characterised by ulcerations of the throat." In this manner is a connection attempted to be established for all medicinal bodies, and all diseases. Now, there is a certain neatness in the proposition thus laid down, which is likely to commend itself to many classes of understanding. Medical science, dealing, as it does, with that most wonderful of machines, the human body—a machine not only subject to as many corporeal variations as there are human beings—but influenced, moreover, by all the varieties of mental influence, termed sympathies and motives—including a field so vast, and conditions of experiment so changing, may be not inaptly said to resemble the mass of English written law, as being a rich collection of uncodified materials. It is a tendency of all thoughtful minds to aim at the comprehension of general principles; and when these have been established on a firm foundation, we have progressed so far from the realms of uncertainty, into those of truth. Very fatal is it, however, to the interests of truth when general principles are attempted to be established on insufficient data; and when an unprejudiced inquirer comes to take a discursive glance over the realms of knowledge, he will, perhaps, be surprised to learn how small is the number of such general principles, which have borne the scrutiny of time. Perhaps, with the exception of mathematics, there does not exist a branch of learning in which general principles or laws absolutely irrefragable can be said to exist; still less does there exist a science which has been comprehended in all its length and breadth, within the limits imposed by one single law. Those best acquainted with the abstruseness of science, the difficulties of elevating and correlating its truths will be farthest from a belief of any simplicity of this kind. Without pronouncing such a result, as one in the nature of things impossible, the profoundest philosopher would assuredly hold the consummation to be amongst things the most improbable, and would not believe it until supported on the most irrefragable testimony. Thus the philosopher; but not all others. Many an individual will accept a neatly turned expression as an article of faith; wrongly interpreting the motives or the reasoning powers of its first originator.

Slight reflection will suffice to prove, that the dogma of "*similia similibus*" is by no means so firmly based, as to have any pretensions to the character of an undisputed fact of universal application to every substance which can act medicinally on the human constitution. This is strikingly evidenced by the fact that Hahnemann found himself under the necessity of admitting some exceptions. Amongst these, alcohol is a very notable one. To have retained alcohol amongst bodies amenable to the homœopathic law would have involved a very curious deduction. Perhaps not even the teaching of the mighty master could have sufficed to convince people that the proper remedy for an individual inebriated with brandy or gin, would consist in the administration of still more brandy and gin. Yet it must have come to this, had not the originator of homœopathy seen proper to recognise alcohol, in every form, as an exception.

The philosophy of Quasi-Infinitesimal Doses.—Everybody knows that whatever the etymological derivation of the word homœopathy may be, the practice of this system of medicine is intimately associated with the administration of doses of medicine so small that they may, without much impropriety, be called infinitesimal; but if we denominate them quasi-infinitesimal, the strictness of language cannot be well pushed further.

To assert that a quasi-infinitesimal dose of a substance, no matter how intrinsically powerful—say the millionth part of a grain of strychnia, for example—can have an appreciable effect on the animal organism, pre-supposes, to say the least of it, a no small amount of credulity on the part of the listener. Nor will the amount of faith in the mind of the listener be less requisite when, in place of a body naturally powerful, an agent like charcoal is in question; one devoid of any visible medicinal effect, even when largely administered. Still, we are not justified in opposing to direct testimony hypothetical objections based upon mere improbabilities. The question is, will experiment bear out the statement made? Now, on this point the boasted experimental industry and care of Hahnemann are open to severe animadversion. Had he been a mere dishonest charlatan, with no better object at heart than the deceit of credulous humanity, he could not have been more dishonest than we find him in reference to the doses of his medicines. Notwithstanding that in general terms he has advanced the most stealthy propositions relative to the effect of quasi-infinitesimal doses, yet throughout the Organon—the book professing to contain an exposition of homœopathic principles, as evidenced by the cure of diseases, he is content with saying that such and such medicines produce such and such effect; he does not mention the doses. From this it follows that the disciples of Hahnemann, are ever ready with the answer, that certain symptoms noticed by him may not be reproduced in the hands of succeeding experimenters, because the medicines may not have been given in the same doses as Hahnemann gave them. This is a mere subterfuge. The real question being, whether such and such medicines, given as homœopathic practitioners are accustomed to give them, produce the symptoms of the disease they are professed to cure?

But perhaps the most powerful illustration of the folly of homœopathy, its utter falsehood to the principles on which it professes to be founded, is this: Hahnemann affirmed that a medicine to have any homœopathic potency must be given unmixed with any other medicinal substance; and he furthermore stated, that the only substance absolutely devoid of medicinal qualities, as known to him, was sugar of milk; accordingly sugar of milk is, or is supposed to be, the basis of all homœopathic globules. Now it is easy to show that a pure medicine, in the sense of purity as understood by Hahnemann, does not, and cannot exist. The powers of infinitesimally small doses are assumed by homœopaths to be developed by prolonged trituration. This act of trituration, even if performed in the hardest mortars known, as those made of agate, will be attended with an abrasion of a portion of the mortar (silica), and silica, according to the homœopaths, is a powerful medicinal agent! In this way it is easy to demonstrate that no one medicine of the homœopathic materia medica can be pure; and, moreover, that the amount of impurity, small as it is, nevertheless exceeds the amount of the medicine.

Amongst other consequences which flow from accepting the postulate, that the shaking or rubbing of an exceedingly minute dose of an agent for a given number of times, develops its strength by some occult agency—not the least startling is the following :—It totally demolishes the basis, on which rests, the science of chemistry. Yes, it absolutely comes to this ;— if homœopathy be true—chemistry is false. The incompatibility of homœopathy with chemistry is strikingly borne out by contrasting it with the part of chemistry relating to poisons. Chemistry teaches us that poisons are poisonous in direct ratio to the ponderable quantities of them which act ; and in accordance with this teaching, the analyst, who has extracted a poison, and who exhibits it in a court of criminal law, is asked whether the quantity discovered is enough to destroy animal life. If homœopathy be a truth, the fatality of a given poison will not necessarily depend on the dose, but on the amount of rubbing or shaking to which the poison may have been subjected.

Think of this, ye country doctors ;—you who have frequently to send doses of physic many miles, by a messenger who rides a hard-trotting horse. If the homœopathic theory of percussion be a truth, a naturally harmless dose of calomel may become a terrible poison when arrived at its journey's end !

I shall not extend to any further length the arguments which militate against homœopathy. It has been assumed, for the sake of argument, that all the conditions laid down primarily by Hahnemann, as being necessary to the successful exercise of his system, have been scrupulously carried out: that the basis of the homœopathic globules (sugar of milk) has been procured pure as it can be procured ; that the medicines entering into the globules have been selected with equal care ; and that the manipulative part of the process, which is of such high importance under the system of Hahnemann, has at least been confided to men scrupulously exact so far as their means will admit. All this has been assumed for the sake of argument; yet, what is the fact? The globules, whose purity is of such essential importance, are actually made—by whom does the reader think? By the practitioner himself? No. By the druggist? No. By whom, then? Why, by the wholesale confectioner. Such are the careful hands to which these potent globules are delegated!

Then, what a set of men are those who practice homœopathy! Men who, having tried to earn a subsistence by the rational practice of physic, failed; and now take to homœopathy for the sheer inducement of gain; impressed with the fallacies of the system, and laughing at their dupes:—Men of weak intellects, who are deficient in the power of weighing evidence:—Men who take to quackery for spite, because of their antipathy to certain medical boards or corporations:—And, lastly, men who never belonged to the medical profession at all; but who, actuated by motives of mixed complexion, find at once their pleasure, and their profit, in that strange form of mental aberration—medical credulity. Non-medical believers in homœopathy there are, who hold that doctrine under full conviction of its truthfulness. Such men are not amenable to adverse criticism; but I am unable to conceive the possibility of a medical man, properly trained in the different sciences bearing upon his profession, and of average reasoning power, being a conscientious believer in homœopathy. I have met with several homœopathic practitioners trained to medicine; but never one who followed his profession otherwise than as a convenient policy.

Amongst the quasi-medical professors of homœopathy, I met with a veritable genius some time since. He was never, in sense, educated for the medical profession; but he followed in the train of a company of strolling actors; amongst whom he officiated in more than one sense, as the walking gentleman. He is now a self-dubbed Doctor So-and-so, practising homœopathy.* None more loud than he to laugh at the credulity of human nature, on which he thrives. He has no mock delicacy at all, and all the secrets of practice he expatiates upon with great unction when one draws him out. Whatever might have been my opinions respecting the morality of his style of practice, I could not deny that the success of Dr. N—— was something marvellous; something that bespoke no little amount of cleverness; proclaiming him to be a great, if not a mighty, master.

"How on earth did you manage to get up the ordinary routine of medical terms?" demanded I.

"Oh, God bless you! the terms I learnt, I learnt from a cyclopædia; but I invented more than I learnt, and people thought me all the cleverer."

"I should like somewhat to be an undertaker in your patronage," was my remark.

Dr. N—— shook his head. "You wouldn't thrive," said he. "Bless your soul, my patients never die. In the first place I never have patients, as a rule, who have anything the matter with them. When I *do* get a severe case, then——" (My informant winked one eye, and pointed over his left shoulder). "Well, what then?" said I. "Call in somebody in consultation," he replied.

"But will practitioners meet you?"

"Not those of the old school, but those of my own."

"And what do you gain by that?"

"Why, do you see, I leave my patient in another Doctor's hands. Not having passed any medical examination myself—taking to it by the illumination of my own genius, as I may say; getting it naturally, as one might the small-pox or the measles—it would, perhaps, go hard with me if a patient died in *my* hands, and inquiries were made."

I felt I was in the presence of a master.

"My patients never die—no, never. Consultation's the

* In the North of England.

word. In comes Dr. So-and-so. He is gratified; my anxiety is gone; patient gets worse; picking of bed clothes; raving; hiccup; facies hippocratica—(I know a thing or two, you see) —off and away's the word, sir. Your humble servant goes home. It is day, and the patient sends. I am not to be seen. Important business. Twenty miles away—very sorry. Patient dies. Return in time for crape and hatbands. Patient buried, you see, but *not Dr. N——'s patient*. Had *I been* at home matters might have otherwise eventuated. But the joke is," continued my informant, "I was called in consultation long before I called in anybody else. A fellow who first tried to snub me, finding I was not to be snubbed, thought he had better be civil, so he called me in."

"And how did you get on?" I inquired.

"Jolly, sir—like two bricks."

"But did you talk over the case?"

"Devil a bit! The man who called me in felt the pulse and shook his head. *I* turned up the whites of my eyes. *He* chewed the end of his cane. *He* wrote a prescription, and *I* said 'good.' Nothing could be more comfortable."

"You will find yourself in a scrape some of these days, sir," remarked I. "How do you get your fees?"

"I flatter myself I know what a man can pay as well as anybody," replied Dr. N——. "I say to him, *your* disease is so-and-so, *my* fee is so-and-so; my terms are in advance."

"'What *are* your terms?' the patient is sure to say. And now," continued Dr. N——, placing his hand on my shoulder, "I'll tell you a dodge. Patient asks me my terms. Before replying, says I, let's revolve your case.

"'Shut your eyes, sir.'

"He shuts them, and I press my thumbs upon them to keep them shut. Meantime, I view him over and over. Has he a watch? What kind of watch? A chain? What kind of chain? Coat, new, and fluffy—old and worn. Waistcoat, what trim? Trousers, what sort? Pockets, fat or lean?

full or empty ? Take in this way, a flying inventory, sir. Can judge to a T what he'll stand.

"'Open your eyes, sir! I see all about your case. Twenty pounds fee, sir.'

"That's what I call the blinding dodge," said Dr. N——, finishing his description.

And this, reader, is a professor of homœopathy!

I beg now to intimate that the foregoing description is actually true. It refers to a real individual, and a real conversation which I had with him; not with him *tête-à-tête* alone, but in the presence of two others.

CHAPTER XII.

THE NATURE, OBJECTS, AND TENDENCIES OF LIFE ASSURANCE.

In comparing ancient and modern civilisation, with reference to the agencies wherewith advances into the regions of the unknown are accomplished—with reference, that is to say, to the progress of knowledge and the utilisation of truths made evident—it will be seen that the most prominent distinction between the two, consists in the spirit of association, which characterises modern periods, and more especially our own.

In all that related to clearness of individual perceptions and subtle ratiocination on speculative things, the ancient Greeks were far superior to any modern race. Hence, the secret of their excellence in those departments of culture which are but little dependent on rules and canons, or on the experience of those who had gone before; departments such as music, poetry, and the fine arts. But the ancient Greeks did little to forward the advancement of physical science; not so much that the object was held to be mean and unworthy, as the labours in this direction of Aristotle and Theophrastus testify; but because any considerable success was then, as now, impossible, without the aids of mutual association.

To whatever branch of physical science we direct a glance, understanding the term physical science in its largest acceptation, as standing for every investigation of natural phenomena, the wonderful consequences of utilising the principle of association are in none so manifest as in the application of statistical facts to the establishment and efficient working of life-assurance companies.

The duration of human life is adopted as the favourite type of things uncertain, and death is chosen as the most fitting illustration of those which are sure to come to pass. Looking at the chances of death, to which every living mortal is daily and hourly subjected, chances which seem to merit that designation in every sense of the word—apparently subjected to no law; capricious, amenable to no rational calculation—looking at the casual effects of pestilence, famine, war, and many other conditions of human existence which no mere perceptive acumen, or clearness of judgment, could predict—it does seem extraordinary that the mean duration of human life can be ascertained with a sufficient certainty to admit of pecuniary guarantees being purchaseable, to take effect at death; constituting life assurance.

Nevertheless, all that seems extraordinary at a first glance vanishes when scrutinised narrowly. In this, as in many other branches of investigation, that which seems to be capricious incertitude, only assumes that guise, because the field of investigation, as circumscribed by the restricted limits of one human existence, is too small for displaying fixed principles, or natural laws. Though the highest degree of incertitude exists for any one human life—nevertheless, when the human species is contemplated as a whole, or even isolated families of the human species—the aggregate duration of life is found to be subjected to laws. Compared with the researches of physical astronomy, our estimates of the mean duration of human life must be pronounced imperfect: not, however, we may be assured, because laws are wanting, but because the investigations of philosophers have made them inadequately acquainted with these laws. It may be accepted as an axiom, that nature ignores the existence of laws *nearly* correct. Investigations in every department of knowledge go to prove that nature's laws are *absolutely* correct; and in proportion as discoverers master the complex circumstances and relations—the forces, it may be said, of which nature's laws are but the resultant—so is the faith of the philosopher in their absolute truth justified by the event.

Guided by this analogy, it seems not too much to predict that extraordinary as the knowledge is which actuaries have even now acquired relative to the mean duration of human life, the amount of that knowledge is destined to be increased until predications relating to vital statistics acquire all the certainty of predications of an eclipse. To this end, a large field of observations, with deductions therefrom resulting, are alone required; thus proving that incongruous, and dissimilar, as the two subjects may at first sight appear, the science of vital statistics, and the science of astronomy, are endowed with the same elements of abstract truth; are amenable to laws of nature equally exact; and are advanced by parallel methods towards perfection.

The practice of life assurance is such a prominent feature of the age; it is so important to the individual, and so powerful in moulding the characteristics of the family or race, that all who believe in the possibility of human moral and material advancement, are called upon to set forth the principles on which it is based. When the practice of life assurance was first established, religious objections were urged against it. The argument was used that the bargaining, during life, for a sum of money, payable at death, partook of irreligion, if not of immorality; that it was impious to attach a pecuniary value to so portentous an event in the existence of man, as death. That feeling, happily, has long since given way to a more rational faith; and the practice of life assurance is now advocated by members of every Christian religious denomination. There is another popular objection urged against life assurance, and which tends to limit its adoption. The objection in question is founded on a belief, that the data on which insurance companies are based, do not embrace the conditions of truth, and certainty, necessary to confer permanence on the institutions, and safety on the insured. No mistake can be greater than this. Undoubtedly life assurance is founded upon a consideration of chances, or probabilities. But these words convey a very inadequate meaning to such as have not reflected on the matter. Chances, when investigated, over a sufficiently large extent and through the necessary ramifications, are found to be subjected to the operation of laws, no less certain and immutable than the laws of gravitation, or electricity; and if, owing to the incompleteness of records, the ultimate precision of which these laws are susceptible be not attained—danger and inconvenience from this source can be practically obviated, by leaving a small working margin for contingencies.

Vindicated then from the objections which have been unjustly urged against the practice of life assurance, it comes commended to civilised humanity as a rational means of obviating many of the troubles, and inconveniences—not to say actual privations, which are attendant on civilised social communities. It not only facilitates the accomplishment of that which we all desire—the pecuniary benefit of surviving friends, for whom it is a duty that provision should be made—but, by encouraging habits of thought and foresight in early youth, it tends to impart stability of character to those who would have otherwise felt the want of this quality. The small periodical outlay which is involved in keeping a life policy in force, may be not inaptly compared to the effect of the fly-wheel or the governor of a steam engine; contrivances which, though involving the expenditure of a proportionate amount of motive power, so far from wasting force, contribute to it; by equalising that power, controlling it, and rendering it applicable.

Every year of the existence of life-assurance companies adds to the mass of statistical information; guiding their management and rendering them more universally applicable to every class, and condition, of humanity. Whatever may be the precise scheme adopted in the administration of these associations, the great advantages to be worked out are sufficiently clear; and in all respectable insurance companies are invariably arrived at. The first great end for achievement, and one to the accomplishment of which the endeavours of all concerned in the management of insurance offices should be directed, is to dissociate the laudable solicitude of provision against the pecuniary losses attendant upon death, from the nefarious element of gambling. To a very great extent this has been done; indeed so great are the difficulties opposed to the practice of gambling through the machinery of life assurance, that it can scarcely be practised with any probable anticipation of a successful issue, except in association with murder—murder, too, under circumstances altogether exceptional. The world has been so recently horrified by an example of this kind, furnished by the case of Palmer, that popular attention has been naturally directed to the attendant circumstances. The facilities presented by these circumstances were such that the most ingenious villain who ever contemplated the robbery of an assurance society through the agency of murder, could not select more favourable ones. Nevertheless, the issue was not of the kind to encourage further attempts in this direction. It is well, however, to look at the facts with the object of eliminating such practical conclusions as may be available for the future. The scrutiny discloses an important fact in what may be called the *philosophy of fraudulent murder*. It demonstrates what might have been arrived at by inferential reasoning—that by comparison with the laity, the medical practitioner has enormous facilities afforded him for effecting, without detection, murders by the use of secret poisons. A writer who, although belonging to the medical profession himself, should expatiate on the high moral characteristics of its members, would be absolved, I believe, by a reflecting public, from all charge of unjust bias. Practitioners of medicine, in whatever capacity, are usually, and very justly, regarded as men, in the aggregate, of sound principle, great humanity, and scrupulous conscientiousness. Such is the tendency of both their education and their labours. Having said thus much of medical practitioners in the aggregate, it may be asserted, without injustice to the class, or wounding of the honour of the medical commonwealth, that tendencies are in operation amongst individual practitioners to which the laity are not exposed; and under the influence of which, isolated members may succumb. It would be futile to endeavour to conceal the fact, that the depraved medical man has within him a power of evil-doing, which facilitates the schemes of fraudulent dealing with insurance offices to an alarming extent; not only lessening the resources of these institutions, but, what is far worse, striking a dissonant chord of social sentiment, and tending to diminish the confidence which ought to be reposed in the philosophy, and practice, of life assurance.

Acting on the general principle that individual hardships, and even wrongs, may be committed in certain cases for public advantage — it seems an open question, whether medical men should be permitted to hold a collateral interest in the death of any person whatever, or under any circumstances. This proposition may appear extreme, and two principal objections may be urged against it. Firstly, it may be said, that a rule of action of this kind conveys an insult and a reproach to the whole medical profession. Secondly, that if carried out it would be at best a temporising measure; manifesting a weakness in the general scheme of checks and counterchecks, which ought to be contemplated, when framing an original code of life-assurance laws. To the first objection this answer may be made. Viewing the medical profession as a whole, no aspersion is made, and the aggregate of its influences is beneficial; but the benefits which redound to society in the aggregate are, perhaps, mingled with cases of individual wrong. If individual considerations did not prevail amongst those whose lives are insured, and benefit to society in the aggregate were alone contemplated, no exceptional treatment need be devised; but inasmuch as the opposite condition prevails—inasmuch as each member of society who insures his life, or whose life is insured, expects to derive an individual advantage from it, and to remain individually secure from any bad consequences which are possible to arise—therefore in the absence of a check or moral restraint to evil-disposed members of the medical profession, the case of medical men holding collateral assurance interests should, perhaps, be treated exceptionally. In reply to the second argument against the restriction, it must be conceded—that the scheme of restraint is merely palliative; yet in the imperfect state of human affairs, palliative measures must often be resorted to as mere scaffoldings wherewith to build a sounder and more permanent structure. The evil tendencies suggestive of the perpetration of murder for gain would be eventually, there can be little doubt, checked, and counterbalanced by an ulterior stage of moral development in the social leaven. *How* this may be accomplished we know not; but that such result will eventuate, is forced on the conviction by a comprehensive series of analogies. Every new material advance, in the application of life-assurance principles, presupposes a new channel of knowledge, and therefore of power. Power is, however, both for good and for evil. That the struggle between the good, and the evil, will terminate in the domination of the former, there can be no doubt: thus justifying the benevolence of the Deity in giving man the faculty of acquiring knowledge, and not living in the condition of brute beasts with mere instinct as a guide; but whilst the conflict between good and evil tendencies is going on, exceptional measures will be required for the comfort, and safety, of individuals.

Another point of vital consideration for the managers of life-assurance companies is, so to regulate their conditions, that the man of uncertain income may avail himself of the advantages of the system to a larger extent than he has hitherto been enabled to effect. Several insurance companies are, and have long been, devoting a large portion of their capital to further the end in question; and have, doubtless, been rewarded by an increase of business, proportionate with the extension of the scheme. It was a great, and seemingly irremediable objection to the life-assurance principle, as first brought into operation, that whilst it furnished a means of alleviating the pecuniary effects attendant upon the death of an individual, who had a small but certain means of subsistence, it did not afford proportionate advantages to the man of uncertain income. Of course, the circumstance need not be indicated that every income is uncertain, within imaginable limits. By the words uncertain income, as here employed, is meant an income, the degree of the uncertainty of which is beyond the limits compatible with the ability, of keeping up the punctual payment of instalments, necessary to insure the validity of a life policy. All individuals whose income depends on the exercise of mental power are especially typical of this class; and men who make literature a profession are more than any other the exponents of the type. Individuals whose career is science exemplify it strongly, but to a minor degree; inasmuch as their productive services are more vicarious, and may be often delegated, for a period, to a friend. An astronomer, or a chemist, afflicted with sudden blindness, or bereft of reason, may have his functions delegated to a colleague. Many persons are equally capable of observing the altitude of a star, of calculating the advent of an eclipse, or of performing an analysis; but the higher walks of literature, which consist in the production of original thoughts, is totally unbending and unvicarious. A sudden fit of illness may end in the loss of a fortune; destroying all hopes founded on prospective advantages, to be derived from the adoption of life assurance. To deal with this case successfully involves the solution of what may turn out to be, the most difficult problem which actuaries have to encounter; nevertheless, the solution of the problem does not seem to be beyond the possibilities of the case. Considerations of the laws of chance, extended over a wider field, may lead to the desiderated end: indeed, though the bulk of the labour in question has yet to be encountered, many insurance societies have already gone far in this direction; and have extended the advantages of the admirable system to a class of men who were previously almost beyond its pale. How the desiderated end may be more fully accomplished, remains to be seen. Some will indicate, by the infusion into the management of insurance societies a larger amount of philanthropy, and the disregarding of many considerations of profit and loss, on which the existence of these societies depends. No moral element, however, requires so much judgment in dealing with it, when introduced to commercial associations, as philanthropy; none is more liable to end in financial wreck, and the attendant deceit, and fraud, and trickery, when mixed up with associations founded on mere commercial principles—which assurance companies undoubtedly are, and ought to be. Without going to the extent of asserting, that however philanthropic the tendency of life assurance may be—and it is undoubtedly great—the consideration of philanthropy should be altogether excluded as a primary element—still the point must, I fear, be conceded that the crude infusion of this motive principle requires a master mind; and the working of it must be regulated by a master system of compensations; to render it practically advantageous to those for whom that infusion is designed.

CHAPTER XIII.

STATE-MEDICINE.

It is almost an occurrence of to-day that an English word has been found of a kind to give effect to the well-known French expression *hygiène.* The word "*state-medicine,*" to a considerable extent, but not completely, answers that purpose.

Confessedly, Great Britain is behind all civilised countries in respect of codes, and regulations, directed to the prevention of morbific influences, and to the exercise of all those prophylactic measures, which have for their object the preservation of public health; securing the maximum of salubrity to which each class, or section, of the population might, humanly speaking, attain—under a comprehensive scheme of medical police. It is a hard, and a somewhat repulsive, task for an Englishman to bring himself to the conviction, that any amount of public detriment, in any form, or through any channel, can accrue from the peculiar genius of his cherished representative government—a system, the very genius of which consists in setting up a conflict of divergent interests, each wielding its own local power, modifying the rule of imperial will as by act of Parliament laid down, and antagonisting that spirit of centralisation to which so much of continental tyranny may be traced; but to which, unquestionably, an impartial observer will attribute much of the superiority in the regulation of matters domestic, and social, which characterise the laws of a benevolently disposed despotic power.

It is no place here to enter upon the comparison of the relative *political* advantages of constitutional, and of despotic governments. Were it the place, and were I the agent of the comparison, I should perhaps feel myself impelled, like most true Englishmen, to say that—given the choice of a perfect system of state-medicine under despotism, associated with loss of political freedom, or the maintenance of political freedom as the price of a devastating epidemic at shortly-recurring periods,—I should elect the latter alternative; and, having made this demonstration of political sentiment, I must summon courage to express my belief that any system of medical police, at all equal in excellence to a system which may be devised, and carried into execution, by a government bound by decrees emanating from one dominant, and central power—is, if not for ever hopeless, altogether incompatible with the present motives and sentiments of mankind. The proposition, I imagine, can be amply demonstrated, that,—looking at mankind individually,—the desire, to each member, of personal and immediate advantage is stronger than the desire of conferring on the community the maximum amount of public good. This granted, it follows that—the conditions of personal advantage varying for different individuals, the thing prejudicial to one being advantageous to another—the resultant of all these individual, and conflicting tendencies, will be one, incompatible with the unity of action, and relation, necessary to the efficient working out of many social problems, having reference to the welfare of whole communities. To the foregoing deduction a rejoinder may be made. The position may be taken, that the conditions intrinsically and absolutely best for the individual, are intrinsically and absolutely best for society; whence it would seem to follow, that the maximum amount of social well-being would result from the doing by each individual of that which by its essence, or nature, is absolutely and intrinsically best. Viewed abstractedly, this postulate may be granted; but being granted, the counter-argument is not a whit advanced—seeing that a knowledge of what is best to each individual, presupposes the existence of a higher grade of intelligence than falls to the lot of mankind; and the giving effect to that knowledge if possessed, necessitates abnegations of immediate satisfaction, which the testimony of both past and present demonstrates to be foreign to humanity.

Of late years, and more especially during the last two Parliamentary sessions, considerable advances have been made towards establishing a system of hygiene, accordant with the claims of society, and the resources of science; but hygienic reformers have been checked in their career, and parliamentary vigour has been shackled by a senseless outcry against municipal privileges imperilled by the enactment of comprehensive schemes. The watchword of alarm is "centralisation." Under the influence, corporate dignitaries have grown frantic, and vestrymen have launched burning philippics against despotism in all shapes. The power now happily brought into operation for checking the prevalence of intramural burial was not made effective until it ran a whole gauntlet of corporate attacks. That clause of the Metropolitan Local Management Act which enjoined the election and installation of medical health officers, was far from cordially received; and a spirit of corporate opposition was, in too many cases, organised to render the duties, and ministrations, of these gentlemen needlessly troublesome, and lamentably ineffective. Still greater opposition will be shown to the imperial measures which must inevitably result, or at least be attempted, in deference to the wants made known by the late committee on food, and medicine, adulterations. Nor is this self-willed spirit of jealousy and exclusiveness at all less rampant in *medical* corporations. Each of the three kingdoms has its own examining and licensing bodies; conferring mere local privileges, and local rights; each has its own pharmacopœia, comprising medicines of similar names, but dissimilar composition, and different powers. The medical graduate of Oxford, or Cambridge, has no legal right to practise in London; though he has the right to practise in England elsewhere. He may not, however, practise in Ireland or in Scotland; in return for which, forgetful of the Christian rule of doing good for evil, the English on their part make it illegal for a medical graduate of an Irish, or a Scotch university to practise here. To crown the absurdity, a medical degree of the University of London—notwithstanding the rigour of the examination there pursued, is greater than that of any other medical examining body in the world—confers no legal right to practise anywhere. In the kindred profession of pharmacy, the jarring elements of corporate discordance are not less evident. The apothecaries have creditably risen superior to their ancient status, and from the position of mere dispensers of the physician's recipes, they have assumed the grade, warranted by their education, of the physician himself. The London College of Physicians has the power to exercise a supervision over the metropolitan apothecaries' stock, lest prescriptions should be compounded of improper drugs; but over the druggists, the principal compounders of prescriptions, the College exercises no control whatever. We enclose the summit of the Monument, and the Duke of York's column, each with a hideous iron cage, lest desponding hypochondriacs and love-sick juveniles should dash their brains out against the pavement beneath, but against the obtaining of poisons almost *ad libitum*, the law interposes no bar.

The preceding are a few examples of the damage to the cause of public hygiene which results from the full development of the corporate, and municipal system, in this empire. However cherished by old associations these systems may be, however they may conduce to the political welfare of England, and beget that spirit of self-reliance, and individual energy which characterises our race—these individual corporate privileges, exercised with more than nominal independence, by functionaries impatient of even parliamentary control, are inimical to the exercise of concentrated will, and determined energy, which the best interests of a nation—in a hygienic sense—require.

The clause of the Metropolitan Local Management Act which ruled the appointment of medical officers of health, was a great advance on everything which had previously been accomplished in the way of state-medicine in these realms; but it is impressed with the defect of a too local application, and of too great deference to the will of municipal powers. In order to avoid the appearance of meddling with the independence of local action, the salary of the medical officer of health is defrayed out of local rates, hence in most cases the amount of salary paid is smaller than the arduous, and varied functions of the office demand. To compensate for this paucity of remuneration, the medical officer of health is allowed to cultivate private practice—the impolicy of which license, regarded in the abstract, it is not difficult to perceive. A medical man practising his profession must necessarily be regarded by his brother practitioners as an intruder: one who by virtue of his position, as head of the local sanitary police, may be assumed to have, and indeed cannot fail practically to have, advantages in the way of introduction, and influence, which other practitioners, holding no connection with the medical police, necessarily have not. This feeling inevitably springs from the nature of human sentiments, and the correlation of things; its existence betokens the perpetration of no wrong on either side, but it follows from the operation of forces brought into play. Much of the efficiency of a sanitary officer will depend on the information tendered to him, by non-official practitioners. Between him, and them, the most cordial union should exist; but it is too much to expect that in the interest of public health, any non-official practitioner will jeopardise his position, by improving the personal relations of one who from the first must be considered a rival in the abstract; and who, as his connection increases, must necessarily become a rival in effect.

Still further objections may be urged against the appointment of gentlemen engaged in private practice. The major qualification for a medical man who would advance himself in practice, is the possession of a kind demeanour and conciliatory deportment. Medical men who have risen highest in the world's favour, as estimated by the numbers and the amount of their fees,—will testify to the fact that mere professional knowledge, without easy manners and diplomatic finesse, is of little financial avail ; and the records of professional history also bear witness to the fact, that men of the highest scientific celebrity are rarely, or never, those on whom the golden favours of the British Plutus wait. The major function of a sanitary officer is not to advance his interests by palliating abuses or slurring them over; not to effect a compromise between his duty and his private interests, as he must inevitably do if he occupy the position of one in practice; but to glance comprehensively over the whole range of things properly subject to his scrutiny; to eliminate the evil influences at work ; and to denounce them sternly without favour, passion, or affection. He ought to be protected against the imputation, even, of subserving his private interests, by the removal out of his path of any private interest capable of being subserved. He ought to be placed as far beyond the reach of deteriorating influences as an English judge; and the integrity of his position promoted, and guaranteed, by a rigorous code of medical ethics ; no less strict and severe, no less rigorously enforced, than we find it in the highest walks of English law.

The objections here urged to the practical application of the sanitary clause of the Metropolitan Local Management Act did not pass unnoticed by the framers of the measure. Sir Benjamin Hall, it is only just to state, did all in his power, directly and indirectly, to establish in the position of sanitary officers—men who were placed under the minimum constraint which medical practice involves ; he could do no more in the present state of British social feeling. To have paid the new functionaries of medical police at a rate adequate to recompensing them for a total abnegation of practice would have involved their adoption into the civil service; and this would have evoked so loud a cry against what is called "centralisation," that the bill could not have passed into law.

There seems to be an indication that the objections just pointed out are in the way of being partially removed. England has at length begun to see that justice, no less than policy, requires that she should give effect to the energies of those persons who are called by the name—loose and too indefinite as it is—of "scientific men." If I call them men of "mediate energy" the adoption of the term will keep the argument clear of the vicious and fallacy-breeding antithetic words "theoretical" and "practical" men; than which coupled pair of words it would be difficult to find a third; more pregnant with falsehood under the semblance of truth, and therefore more prejudicial. Those to whom the world applies, in a somewhat opprobrious sense, the term theoretical men, admit of two rational subdivisions; the members of both agree in the respect that they foresee, by inductive reasoning, the effects of combined things, from a consideration of premises; but they differ in this: the results foreseen by theorists of the first class never come to pass, nor are possible, the deductions being false; whereas the results of the latter are fulfilled, or capable of fulfilment. In thinking out complex problems, by the intellect alone, it is but natural that the deductions arrived at should be sometimes incorrect; wherefore, it happens that theorists of the first subdivision will be numerous. The most exalted intellects will have to number themselves in each subdivision, on different occasions, and at different times; but notwithstanding all that has ever been said about the errors imparted through the channel of theories unfulfilled—a theory census, I am disposed to believe, would show a balance in favour of theories, which are ultimately inscribed on the records of truth. Our own immortal Newton erred in disbelieving the possibility of making telescope glasses achromatic; but he also by the light of his radiant genius discovered the path which led him to a deduction that the diamond would hereafter be found to be combustible. Impartial justice has never yet been dealt out to those whom the world calls "theoretical men;" they have all been complacently inscribed in the division of those whose anticipations never have—and never can be, fulfilled: and the large per-contra of wasted energy and abortive attempts, of men, whose progress towards truth was made through an avenue of tentative failures, has never been taken into account.

I would designate individuals who foresee the result of certain consequences from a combination of things, possible and compatible, and whose speculations are either capable of being proved by existing tests, or likely to be proved when the condition for testing them arise,—"*men of mediate energy;*" and I would designate the individuals now commonly known as practical men by the appellation, "*men of immediate energy.*" In the year 1819 the Danish philosopher Œrsted, of Copenhagen, happened to discover the fact, that by an electric current, passing in the vicinity of a freely suspended magnetic needle, the latter was deflected; and he furthermore ascertained, that the deflection took place according to certain laws. Subsequently, Faraday and Ampère made known the relations subsisting between electricity and magnetism: how magnetism could beget electricity, and electricity magnetism; and how from these agencies attractive forces could arise. Here, then, are examples of two discoveries starting from which neither Œrsted, nor Ampère, nor Faraday, as it would seem—thought of making any immediate application. The minds of these great men were moulded in another type: they were employed in the development of electrical and magnetic laws: they saw a truth and had faith in the ultimate issue of truth. As the mariner on the ocean throws a flask into the water, heedless where that flask may stray, but conscious that its progress will mark the flow of an ocean current in the direction of its course—so the philosopher of mediate energy little heeds the immediate ap-application of the laws he may have deduced. Œrsted knew that the progress of electricity was amazingly swift: he also had discovered the laws of divergence of a magnetic needle, suspended near an electric current. Here were principles of the telegraph of Cooke and Wheatstone, of which Œrsted may be said to be the mediate, or theoretical discoverer. Again, the fact of the instantaneous transit of electricity through conductors, was known to both Ampière and Faraday—a fact which taken conjointly with the knowledge of electro-magnetic attraction which they had made out, warrants their being considered the mediate or theoretical inventors of the other varieties of the electro-magnetic telegraph. These illustrations will explain the distinction I venture to draw between individuals of "mediate and immediate" energy. England has never yet done justice to the claims, or protected the rights, of the man of mediate energy. There are nations whose rulers, in their admiration of scientific learning, have opened the career of reward, pecuniary and social, to philosophers, for the sake of philosophy; little heeding whether the views advanced were likely to be demonstrated or not. This is taking an extreme course, which I would not advocate; but surely on the broad basis of justice—if not of policy—the plea may be urged of recognising the original perception by which the man of mediate energy eliminated a law: which law being subsequently tested, demonstrated all which theory predicted. The English government is far from recognising the value of mediate knowledge. It applies too recklessly the term "abstract" to theory, the application of which is postponed for a season; and though a wise legislature should legislate progressively for all time, lending aid to those of the community whose peculiar genius lies in advancing the achievements of the future, this,—no less a policy than an obligation, is not perceived—the men of mediate energy have no reward,—no recognition beyond the fruitless honour of their own scientific circles; whilst the immediate agent of giving practical aim to the original idea obtains substantial recompense.

I repeat, there are some indications of a coming state of things more just to the men of mediate energy. Notice was given during the past session that a proposition would be mooted, for giving a better position than heretofore to the class denominated scientific men. The Council of the Royal Society are endeavouring to suggest a basis of action on which the government may co-operate in this matter, and there is reason to hope that the legislature will endeavour to act in accordance with the suggestions proffered. The task will be no easy one; inasmuch as a belief in the prospective benefit of mediate knowledge belongs exclusively to minds indoctrinated with the genius of science, and versed in the history of its development into practical forms. Two difficulties will have to be encountered in giving effect to the desire of finding a *locus standi* for scientific men. Firstly, it would be in the highest degree undesirable, that they should be invested with functions little else than nominal, places of mere sinecure trust; again, it would be impolitic to make their remuneration, and their tenure of office, dependent on the caprice of local or municipal corporations.

The Metropolitan Local Management Act, though of recent date, has been long enough in existence to demonstrate its utility; and the well-wisher to the cause of state-medicine, may be permitted, to entertain the hope that the time is not far distant, for it to be more extensively applied: not to large cities merely; but to the whole of the three kingdoms.

If present indications be followed out to their issue, the government will perceive the necessity of speedily devising some means to secure to the community a supply of medicines and food; pure, up to the requisitions of determinate standards: thus removing the possibility of those shameful sophistications which have long been perpetrated unchecked. The methods by which this is to be accomplished have yet to be devised. Whether reliance shall be placed in a Central Metropolitan Board of scientific men, or whether the supervision shall be more diffused—each district having its own competent officer, is yet undetermined. Of the two, the latter alternative seems to promise the best results. Not only would the business fall too heavily on any central board, but there would be objections of another kind. Notwithstanding the present facilities of travel, furnished by our railroad communications, it would be inconvenient for witnesses to be accompanying to London each sample of a suspected article. Moreover, a considerable amount, if not all, of that collateral evidence which a person in authority on the spot might obtain, would be wanting to the central board.

Assuming, for the sake of argument, the provincial system of agency to be determined on, the question next arises, What kind of men ought we to choose? Upon what department of the home executive should the responsibility fall? It has been proposed by some, that the scrutiny should devolve on the department of inland revenue, or excise; being undertaken by men specially educated to the purpose. Grave exceptions may be taken to the latter scheme. Not only must an officer of excise necessarily be obnoxious to imputations of favour and vindictiveness—imputations to which the very nature of his professional calling lays him open; but a still wider objection flows from a consideration of the nature and genius of the scientific mind. Individuals having this complexion of mind are rarely made by previous education—understanding by the term a directive tendency imparted with the object of imparting qualifications previously held in view. The best known scientific men in all countries are those who have taken to science impelled by the love of it, in opposition to their temporary interests, and with no prospect of gain. Surely, in England, at least, there does not exist a stronger inducement to the cultivation of science than is furnished by the love of it. The experience, I think, of all scientific teachers will prove, that no men are more unsuccessful than those who try to adapt themselves specially to some particular walk of any one science. Pupils of this bent of mind rarely, if ever, benefit by the kind of knowledge thus acquired. The *nexus* of philosophy is far more intricate than they dream of; and they ultimately find to their cost, that in pursuing the restricted kind of study indicated, their time has been thrown away.

Correlation of vital and intellectual forces.—The education which aims at rendering man a creature of high intellectual culture, without simultaneously having regard to his physical developement, and corporeal force, must always remain, for every grade or position in life—imperfect. For two reasons must it be imperfect:—Not only are moral and intellectual perfections shorn of their power, in respect to practical application, if bodily force be wanting to give them effect; but the correlation between matter and mind—between corporeal force and intellectual energy, is such, that, taking our observations in a statistical field, sufficiently large, it will be found that just in proportion as one languishes, the other flags. So far as our own land is concerned, much exception cannot be taken to the education of the well-to-do, easily-circumstanced, community of the middle, and higher, classes. Whatever complaints admit of being urged against the *kind* of intellectual labours the children of these classes are obliged to undergo in schools, and colleges,—such objections are urged on grounds altogether foreign to the argument in question. For present purposes we have not to examine these intellectual exercises as to their *kind*, but as to their *degree;* ascertaining whether they are, in the main, incorporated with corporeal exercises sufficiently to the maintenance of a due educational balance between the requisitions of body and mind. I think it will appear that the tendency of Englishmen, and English boys, to field sports and gymnastic games, is sufficient for all practical ends; and that the English gentleman will not be found to come off second in any comparative examination, as to the *physique* of manhood, when viewed in correlation with any one of his own class abroad; or with an artisan following the most healthy calling at home. It is not the well-to-do classes which call for any state hygienic interference; but with artisans, and others following special bodily occupations it is otherwise; and the act of educating, or literally bringing them up—involves some of the deepest considerations of hygiene.

Of all diseases to which the human family is liable, phthisis, or consumption, is perhaps the one which we all most dread, of which the deteriorating influence to communities is the greatest, and to the statistics of which, in relation to callings, the inquirer should first direct his glance. M. Lombard, of Geneva, has turned special attention to the statistics of consumption in relation to occupation in life, and the following are his deductions. For every thousand deaths by phthisis, he gives the following relative proportions:—

Professions involving the breathing of animal and mineral emanations	176
Those involving the inhalation of various powders	145
Sedentary occupations	140
Factory life	138
Breathing a dry and hot atmosphere	127
Sitting in a bent position	122
Operations calling into action the muscles of the upper extremities	116
Muscular exercise and active life	89
Exercise of the voice	75
Animal emanations	60
Aqueous vapours	53

Perhaps the above statistics may disclose figures which the general reader would scarcely have anticipated. The fact may appear strange, for example, that habitual exposure to aqueous vapours should be the least pernicious, considered in relation to phthisis, of any occupation in the recorded list. Nevertheless, there is every reason to believe that the deductions are correct. I have already mentioned the opinion, prevalent amongst some medical men, that the causes of ague and of consumption are mutually antagonistic; in like manner, rheumatism and phthisis are considered to be antagonistic of each other. Both intermittent fever and rheumatism, it is well known, are generally determined by, or at least co-existent with, the condition of a moist atmosphere.

The occupations of mining and factory life are the most conducive to disease, more especially phthisis and scrofula, which proved, we see the influences exercised by these callings on two of the greatest sources of physical or sanitary degradation which can affect a community. The seeds of these complaints exert the greatest potency in childhood, and hence legislative measures designed for the protection of children occupied in these labours are amongst the most imperative which fall to the lot of a government to enact. In England, the abuse of infantile labour in factories devoted to the manufacture of woollen, linen, flax, and silk, had progressed to an extent so fearful, consequent on the large development of machinery towards the end of the last, and the beginning of the present, century, that, dating from 1802, a series of acts have been passed to limit the duration of child labour,—define the age at which labour in these departments might legally commence,—and establish collaterally a rude system of mental education.

The Factory Act, passed in 1833, established the following regulations:—Nine years was fixed as the minimum age of juvenile labour in these establishments: from which age to thirteen, the hours devoted to factory labour were to be no more than forty-eight per week; nor more than nine hours for any day of the week: moreover, it was rendered incumbent on the parents of such children to send them for two hours, at least, per week, to school. From thirteen to eighteen years of age, the duration of weekly labour was fixed at a maximum of sixty-nine hours, and twelve hours daily. The law of Austria, in relation to child labour, fixes the minimum age at twelve, except under the especial condition that if the child be admitted younger than this to the ranks of labour, its religious and moral education be simultaneously cared for: the minimum age of the children exceptionally situated, being fixed at nine. For children between the ages of nine and twelve, the maximum number of working hours, per diem, is twelve, with several intervals. For children of ages between twelve and sixteen, the number of work hours is also twelve per diem, with a single interval of one hour. Persons younger than sixteen are not allowed to be occupied in night labour: night being defined as the interval between 9 P.M. and 3 A.M. In Prussia, a law almost identical with the last is in force; but, strange to record, (having regard to the paternal care which the Prussian Government exercises over every class of its subjects,) the law was not enacted until 1840. It interdicts juvenile labour to children under nine years old; between which age and sixteen the number of working hours per diem is limited to ten: but it is not permitted by the Prussian law, for *any* children to occupy themselves in industrial labour until they have learned to read German with fluency, and write moderately well. No law of a similar kind existed in France until the one passed March 22, 1841. It fixes the minimum age of juvenile labour at eight years, with an exceptional proviso, enabling the government, on special representation being made, and due cause assigned, to interdict juvenile labour until the age of sixteen. According to the provisions of the same law, the hours of actual work are limited to eight per diem, divided by an interval of rest. Between the ages of twelve and sixteen, the hours of effective labour are restricted to twelve per diem, divided by an interval of repose, and comprised between 5 A.M, and 8 P.M. Occupations demanding night-labour, are interdicted to children who are not at least twelve years old; and they are permitted for not more than eight hours, until the age of twenty-four. Subsidiary laws, emanating from the department of public administration, provide for the regulation of morals in the different operative establishments; and also specify the amount and kind of education, to be imparted; according to schemes laid down. It will be seen, from a consideration of the above, that the legislature of France has thought fit to adopt a standard of minimum age lower than ourselves, or Prussia, or Austria. Undoubtedly the age of eight is too young. As a French writer on hygiene,* himself remarks, at that age the organic change of the second dentition is hardly past, nor has the osseous system attained sufficient hardness and development to guard against the malformations which many industrial arts tend to produce.

In legislating for masses, it is a necessity, that certain broad facts must be adopted as the foundations of law, though these facts are far from meeting the case of individual conditions. If it be imperative to regulate the terms of juvenile factory labour by an appreciation of circumstances in the aggregate, no better line of discrimination than that of age is perhaps open to adoption; but the French author just quoted argues, with great plausibility, that it is at least equally unreasonable, and unjust, to regulate the condition of factory labour by reference to mere age, as it would be to regulate the admission of soldiers in a parallel way. Operatives concerned in labour have claims to the considerations of a government equal to the claims of those whose profession is arms; and in respect of whom the qualification of mere age is allowed to be, on all hands and by every nation, insufficient.

It is a pleasing reflection for those who desire to see at-

* M. Levy.

tained the highest combination of moral, and intellectual, and productive forces,—that the progress of England in all which relates to wealth resulting from factory labour, has amazingly increased since the various acts giving effect to the limitations of factory labour have been in operation. It was easy for well-wishers of the system to have predicted this result, but proofs were required to convince the opponents to the system; and not even the stoutest proofs have yet sufficed to convince some of them.

At the present time, there is a laudable attempt being made in some parts of England to extend the provisions of the factory acts to other branches of manufacture. The clergy of the West Riding of Yorkshire have of late displayed a praiseworthy activity in their endeavours to ameliorate the condition of children employed in coal mines and potteries. The movement is of a mixed character. Acting under the plea adduced, and with all truthfulness, that the two occupations mentioned are highly detrimental to physical development and health, the cause of popular education is sought to be advanced under cover of legislative measures directed to the promotion of hygiene. Some movement is also taking place in agricultural quarters, to fix the minimum, and limit the duration, of child labour. In the latter sense the movement is purely educational; for it would be idle to affirm that the conditions of field labour, such as children can perform, are in the aggregate detrimental to the health of a community. It seems the fate of our country, that every educational advance with us, secured for the benefit of the lower classes, must be carried out under the protecting ægis of some collateral plea. Between the advocates of education, prosecuted in accordance with the dogmatic teaching of religious creeds, and of an education altogether secular, there is a contention so dire and rancorous, that not even the most clear-sighted scrutiniser of the shadows cast from coming things, can offer a plausible guess as to what the issue may be. On one point, however, the coryphœi on both sides seem to be agreed; namely, that it is preferable for children to have no education whatever, than to have an education which does not embody the extreme opinions of the two ruling factions. If people of extreme opinion were merely to reflect, that all the dogmas of Christian theology are, after all, no more than so many edifices built upon one general foundation—and to act accordingly, an advance might be made in the cause of national education.

Wherever the extension of factory acts, or their equivalents to children employed in other gregarious manual avocations, shall take effect, every well-wisher to the cause of education will desire to see it prosecuted, not on one unvarying system, but according to the necessities of the professions in which each class of children seem likely hereafter to find employment. Selecting the children of coal-mine operatives for example; how desirable would it be that instead of the mere rudiments of reading, writing, and arithmetic, to which the term education is applied in a much too comprehensive sense, the children should be made acquainted with the physical conditions, on the observance of which their future health and safety must so largely depend.

GERMAN AND FRENCH SANITARY POLICE.

It may here be desirable to indicate the outlines of the system of medical police adopted in Germany and France. Notwithstanding the various governments which exist in the former, and the conflicting political interests involved, yet in the matter of sanitary police there is not much variation. In the capital of each state there exists a supreme Medical and Sanitary Council, the regulations of which are subject to the minister of the interior, and presided over, therefore, by the minister of public instruction. In the provinces there are secondary boards of medical police, similar in all respects to the centre one, and placed in immediate subordination to it. Prussia being the state which presents the type of superior organisation, its regulations may here be set forth as indicative of all the rest. The head of its medical police is the supreme Medical Council of Berlin; its members are appointed for three years, but being eligible for reappointment their tenure of office sometimes only ceases with death. The greater number, but not all the members, of this council, are medical men, and at the present time we find the most celebrated medical names in Prussia in this category.

The head of the medical police in each city, town, or district, is usually the medical governor of the same. Subordinate to him, are two physicians, one surgeon, one accoucheur, one apothecary, and one veterinary-surgeon. The provincial council is called upon to place itself in relation with the central or metropolitan council, in forwarding to the latter the reports of all cases which may arise; and power is given to it of demanding and receiving co-operation from police bureaux, and all local agents, which may be necessary, to make its provisions, and mandates, respected.

Nor does Prussia commit the guardianship of her public health to the metropolitan sanitary council and its subordinate colleges; for in every city, the population of which is more than five thousand inhabitants, there is a special sanitary commission, which may be compared in its nature and workings to our local boards of health.

Though the nominal head of these sanitary boards is seldom a medical man, yet the real working party, from whom all power emanates, and who gives life and spirit to the whole, is the medical officer of health, as we may call him, —the *Physicus*, called *Stadt*-physicus if he has the supervision of a town—*Kreis*-physicus if he has the cure of a rural district. To him are delegated the execution of all the provisions, which, from time to time, emanate from the supreme medical council. He has the precedence of all other medical men in his district; he is expected to keep himself *au courant* with all new facts and discoveries which bear upon hygiene; he should, therefore, be known amongst the most highly educated of his class, and, to do the Prussian government justice, the Physicus is never appointed in deference to low or impure considerations. Before appointment to office he undergoes a severe examination by the members of the supreme medical council; not only in the practice of medicine, but in his acquaintance with the laws of public health; and, in addition to this, he is expected further to justify his appointment by the writing of a thesis on some medico-legal subject. If he be competent his appointment follows, provided he belong to a Christian denomination; the office of Physicus never being allowed to devolve upon a Jew.

This *Physicus* may be regarded as the counterpart of our own metropolitan officer of health; but his functions are more numerous, and his responsibilities greater. He cannot absent himself from his town or district without permission of the resident authorities, nor even then, except he provide an efficient substitute. He is exempted from serving on juries, and he is required to wear a distinctive uniform. He is expected to superintend the general doings of all other physicians, surgeons, cuppers, and veterinarians, resident in his district; and to see that none transgress the limits assigned to them by law. If any unqualified person commence medical or surgical practice, the Physicus is expected to become public informer; communicating the particulars of the case to the supreme medical council. He is, *ex-officio*, responsible for the purity of drugs, and the existence of standard quality in medicines; and in order that the last provision may not become a dead letter, special times are enjoined for him to go round and make inspections. The Physicus takes cognisance too of fluctuations in the price of drugs, and reports on the same to his chiefs; and, lastly, he sees that neither physician, apothecary, barber-surgeon, accoucheur, nor veterinarian, encroaches on the rank of the other.

The Physicus, in addition to the above numerous functions appertaining to his office, fills a corresponding post to that occupied by our own coroner. He has to take cognisance of all cases of violent death, to be present at the *post-mortem* examination, to register all the appearances which he may find. Probably, the reader will think, by means of the Physicus above described, the care of the public health, in Prussia, is sufficiently complete; that all which human ingenuity and human care are able to accomplish in the way of banishing the malice of Pandora—is accomplished. The social advisers of his majesty of Prussia consider otherwise. Though the Physici, appertaining directly or indirectly to the central college, have, in a large degree, the functions of a medical police—there is, in addition, a regular staff of police medical officers. Under the superintendence of the latter, are unions, gaols, lunatic asylums. It is incumbent on the functions of the police physicus to check to the utmost of his power all ravaging diseases, the discrimination of which has been sufficiently made out to demonstrate the means of controlling them. The ravages of small-pox he neutralises, or controls, by seeing that vaccination is regularly performed; compulsorily if need be. He is called upon to make himself acquainted with the statistics of syphilis in his immediate district; and to take measures, by isolation and medical treatment, to limit or diminish the insidious workings of that plague of modern society. One function of the restless medical police may distort the countenance of good John Bull with an angry, muscular twitch; and redden his face with the crimson tint of rage. So little do the police physicians of his majesty, Frederick William, respect the right of persons afflicted with strong taints of hereditary disease—to fall in love and get married,—that, hard to say, the hymeneal priest is not allowed to kindle the matrimonial torch in behalf of such. They cannot, in other words, get married. Equally obstinate in this matter is the police physicus as concerns people of, as may seem to him, immature years. The general tendency of public opinion in Germany is, indeed, at variance with the notion of early marriages. There is no edict against young people falling in love with each other. Accordingly, the delicate sentiment finds place in Prussia, and other parts of Germany, no less than elsewhere; but nothing like the impulsive fervour of boys and girls, which must needs glow and kindle until it lights up the torch of Hymen at once, is congenial to the race. Boys, and girls, are satisfied with exchanging rings, seeing each other in the presence of mamma, and advertising their engagement in a local newspaper. Thus they wait with monumental patience for years together; alleviating what to English young ladies, and gentlemen, would be a tedium great beyond endurance, by *studying each other's characters,* as the phrase goes; and perhaps, on the part of the lady, by taking lessons in cookery at some restaurant's, the better to fit her for the duties of a German wife. So far, then, extends the power of the police physicus in the imposition of shackles upon the hymeneal god; nevertheless, many well-wishers to the beneficent scheme of crushing hereditary taint, doubt on the whole, the policy of the Prussian system of rigorous restrictions on marriage. Cupid is not the biggest of the gods, nor the most strong-minded; but he is, perhaps, the most daring, heedless, and unscrupulous.

In Denmark, some of the police regulations in respect of taking measures to guard against the propagation of disease, are more stringent than in Prussia, or indeed any part of Germany; lovers not being allowed to get married until they are able to adduce proof of either previous vaccination, or having had the small-pox. A somewhat amusing illustration of the working of this law was afforded a few years ago, and I believe may be afforded still by certain brothers-in-law and deceased wife's sisters, who, debarred by the harsher canon of our ecclesiastical laws, flee to Denmark to attain the consummation of their wishes. Denmark, like all Protestant countries, except Great Britain, legalizes this class of marriages; and if marriage be once solemnized in a country which holds it to be valid, it is henceforth held to be valid at home. In Denmark, then, the only bar to matrimony between brothers-in-law and deceased wife's sisters, comes not from the ecclesiastical courts of Scandinavia—if there be any ecclesiastical courts there—but from the department of police. Have the bride and bridegroom elect brought with them, each a certificate of *vaccination?* If they have, the course of true love runs smooth, and they are married; if not, they must previously be vaccinated:—and thus, not unfrequently, the interesting ceremony at the altar has to be literally preceded by the shedding of blood—the bride and bridegroom, not in this case a boy and a girl, but a gentleman and a lady of mature years—must first submit to vaccination!

Notwithstanding the harshness of the code of Prussian police regulations, medical and otherwise, I am compelled to testify, after considerable experience of it, to its general excellence. It is harsh only on paper, not in action; and whenever the police have to take cognisance of social matters, they do it with a mild demeanour of suavity and politeness, which ought not to be offensive to any well-ordered mind. Taken as they are meant,—an Englishman, who is expected more than other people to have a notion of humour or fun in him, may derive a good deal of amusement, from witnessing the pedantic minutiæ thrust upon the executive of the Prussian police.

Amongst other matters of small dignity, the soldier-clad *polizei* of his majesty Frederick William, have to see to the sweeping of your chimneys at certain intervals, duly set forth. Yes, the Prussian police are chimney-sweeps in the same sense that British high-sheriffs are hangmen, and the Prussian *sooterkin* goes to work with the proud consciousness that he is on the civil service lists of his *Vaterland.* This strict Prussian regime of periodical chimney-sweeping has afforded me great amusement in times gone by.

A little stumpy, florid, pretentious fellow-countryman of mine took it into his head, once upon a time, and that time not long ago, to live under the sanction of licence of domicile in a Prussian town. One day I had gone to his house as a guest invited to dinner. Promise of an excellent dinner, there seemed to be. Little *mädchen* were hurrying about with nice things. The kitchen stove sent forth such an assemblage of odour, of roast, fried, and boiled, as only the multum-in-parvo capabilities of a German cooking-stove can do. My host was stalking about his little domain, with his two hands stuck in his nether garment pockets, whistling, *sotto voce,* airs from Bellini, as when pleased from any cause he was wont to do. Baskets of wine-bottles were being carried about; their delicate necks and silvery corks looking so pretty, that were one only half a teetotaller, he would have placed them on the chimney-piece (if Prussian chambers had chimney-pieces) for an ornament.

Some epicures were already licking their lips, and enjoying, by anticipation, the feast which our portentous little friend had initiated—prepared, I cannot say, for reasons which will by-and-by appear.

Outside—the birds were singing; and festoons of purple grapes were hanging from the doorway porch; for it must be here understood, that I speak not of that miserable, sandy waste, of toothless philosophers, and muddy water, called Prussia Proper, but of that most bright, and verdant strip of the kingdom spread like a ribbon over the map of Europe, which is nestled by the Siebengebirge and watered by the Rhine. My friend's place was a little Eden, without forbidden fruit. No pleasure, however, in this world is without alloy. Into this Paradise of bliss which my friend had created, there came a serpent in the shape of a police chimney-sweeper, with brush and scraper, bag and ladder. In he came, without so much as saying "By your leave."

Summoning the best German he could muster (truth obliges me to confess he was not strong in this line) my little host swelled himself up as big as he could, and said, "Who are you?"

Sooterkin touched his queer-looking cap, and very politely said he was the "Kaminfeger" (chimney-sweeper).

Without more ado, Kaminfeger pulls out a little book, ruled into all sorts of columns, and filled with hieroglyphics; and in very good German, though coming from a sweep, he says, pointing to a certain column, and a certain line, "Your time is come!"

Heavens! What words from a thing in black, carrying a bag too, big enough to engulph my little friend, head and shoulders. "*Your time is come!*"

The ladies were struck dumb with astonishment, save one, who was a German, and understanding the nature of things began to laugh aloud. The British resident parson directed first an inquiring glance at my little friend, then at the feet of the apparition, on hearing the latter exclaim, "Your time is come." Why he did this I cannot say.

Not to enlarge needlessly, let it at once be told—that the time had come *for my friend's chimney to be swept,* and swept it was, regardless of all the dining preparations.

The stove was relentlessly torn from its pipes, and the pipes cleansed from soot by various clever sorts of Prussian state chimney-sweeping machinery. Sooterkin then bundled up his traps, demanded his fee—took it, and departed.

Another Englishman I knew who thought proper to hang his sitting-room with a certain description of green-coloured paper, into the pigmentary composition of which Scheele's green (an arsenical compound) entered. The operation of hanging the walls was nearly completed, when the police Physicus of the district got scent of the matter, and sent people to strip all the paper off, much to the Briton's annoyance.

Another case illustrative of the strictness of the medical regulations of Prussian police is the following:—

An English lady had a school in a Prussian town, and a servant having misconducted herself was sent away. She thereupon, actuated by revenge, went to the police office, and represented that the pupils in the establishment were afflicted with cutaneous disease. The polizei Physicus must needs satisfy himself on this matter. He did it with many an apology for the intrusion, and with much politeness. If space permitted I would here present a fuller sketch than has hitherto been accomplished of the workings of the French sanitary police. It differs, however, so little in effect from the hygienic part of the Prussian police, that one being described, the other may be considered as identical.

FINIS.

Printed by Petter and Galpin, La Belle Sauvage Yard, Ludgate Hill.