

53. DROWNING.—The records of 1870 yield 204, those of 1871, 222, and those of 1872, 314 cases of drowning, exclusive of cases of alleged drowning, where from the advanced state of putrefaction, no opinion could be given as to the cause of death. This small number of cases cannot represent the total deaths from this cause, and it is probable that only those cases where the cause of death is doubtful find their way to the civil surgeons. For this reason no trustworthy conclusions can be drawn as to the relative frequency of this mode of death in different provinces. 442 of the subjects were females and 284 males, and the excess of females occurs in every province. One hundred and one were accidental, 100 suicidal cases, while 21 were certainly and 32 more possibly homicidal. In the remainder this point is not alluded to, but the much greater number of females and the known greater propensity of women to suicide make it probable that many of the cases were suicidal.

The question whether a given case is accidental, suicidal or homicidal, is always difficult to answer, and is often quite beyond medico-legal solution. Murder by drowning, except in the case of children, is however so rare that the presumption is always in favour of accident or suicide. Marks of violence may point to murder, but, unless in situations where they could not be self-inflicted, to suicide also; or they may have been produced in the fall by shock against the water, or by blows against stones or other hard substances in the water, or after death by the body being carried against rocks or boulders by a swift current. Ligatures point to murder if they are of such a nature that they could not be self-tied, but the extraordinary complicated knots sometimes made by suicides make it difficult to say with certainty that knots found must have been fastened by a second person. All these points are repeatedly illustrated in the returns.

In a case at Jaunpur, where a contused wound was found on the occiput, an opinion was given that the subject, which showed well-marked signs of drowning, had been first stunned by a blow. As the case was dismissed, it is possible that the wound may have been received in the fall. A contusion of the nose with fracture of the nasal bones in a child, aged 9, at Bareilly, lead to a similar report; the result of this case is not given. A contused wound, 1½ inch in length, on the back of the head of a young woman who was drowned at Lucknow in September 1872, was attributed to a fall; case filed as one of accidental death. A similar wound was found on the crown of a frightfully decomposed body taken out of a pond at Lakimpore. The skull was not fractured, and the lungs were full of bloody watery fluid, apparently shewing that death had, in part at least, been due to drowning. The accused was sent to the sessions on a charge of murder. In all these circumstances other than the wound alone must have decided the nature of the case, but in the case of a boy at Lucknow, whose body presented twenty-five distinct *incised* wounds in addition to signs of drowning, the medical evidence would alone suffice to prove a murder, since such injuries must have been inflicted with intent, and could not have been caused after immersion. The following case, reported by Surgeon-Major C. E. Kilkelly in the Aligarh return for December 1870, was no doubt homicidal, although no opinion to that effect is given:—

Subject a Jat, aged 24. "Sand inside the groove of the nails; tongue grasped between the teeth, and loaded with mud and sand; dried blood inside the ear; 3 bruises, 1 on the right hip, 1 on back, and 1 on left side of face; 2 contused wounds on the vertex; a transverse fracture of the occipital bone implicating the right and left temporal bones; the last named bone depressed. Both hemispheres of the brain greatly contused; 2nd and 10th left ribs fractured; about half a pint of dark fluid blood in cavity of left chest; left lung ruptured in 4 places, right normal; some quantity of mud and water in the trachea and bronchial tubes. Heart ventricles quite empty; stomach, spleen, intestines, kidneys and bladder normal. Cause of death drowning." The result is not recorded.

The bruises, the contused brain, and the blood in the left pleural cavity make it to the last degree unlikely that the in-

juries were inflicted *post-mortem*, while their nature is such as to preclude the possibility of the man's committing suicide after being mortally injured by others, as the man with the spear in his belly noticed elsewhere probably did. He was probably believed to be dead; and his body thrown into water with a view to its concealment.

In a case at Seoni (C.P.) abrasions and contusions were found on the body of a woman found drowned. Her husband was accused of beating her to death. The injuries were slight; it was proved that she had committed suicide, and he was acquitted. A similar case of drowning after beating at Partabgarh was filed as suicide.

Injuries received in the fall before the body reaches the water are almost confined to cases of drowning in wells, and will be noticed in the next section. Those from shock against the surface of the water are also chiefly found among well cases. A good example has already been quoted under Rupture of Kidneys, page 90.

A "contusion of the face, caused by striking the bottom of the tank," was found in a body at Purulia. Dr. Wilson was "satisfied that death was caused by drowning, but no details of the appearances are given. A little girl, aged 2, at Rajmahal, sustained a fracture between the right temporal and parietal bones by striking against a peg which projected from the bottom of the water into which she fell. All the signs of death by apnoea were present, and muddy water was found in the stomach, proving that she had died by drowning. Case filed.

Surgeon W. W. Galloway, M.B., found a fracture 2 inches in length extending downwards and forwards from the left temporo-parietal suture in the decomposed body of a child taken from the river Ul in June 1871. The right leg and thigh had been eaten away. Two silver ornaments were found on the body, a presumption against murder. Mr. Galloway was of opinion that the fracture might have been produced after death, and the case was filed as one of accidental drowning. It may have been caused by a blow against some hard substance in the river bed.

Several very interesting cases where bodies were found drowned bound hand and foot with ropes are recorded. Dr. Wise thus describes the ligatures in a suicidal case at Dacca:—

"One end of the rope was tied round the legs; the other was carried twice round the neck, then round the left wrist, and afterwards round the right. By extending the right arm the loops round the neck are tightened, and the individual is unable to move. A rope twisted in this manner can be easily self-applied."

(To be continued.)

LIFE.

By Surgeon S. BRERETON.

(After Mayer, Le Conte, C. Bernard, &c.)

(Continued from page 9.)

But, if the doctrine of the vitalists is untenable, the old problem remains still,—what is life? Or, what is death? for the two questions are intimately connected, and cannot be separated from each other. The living body is essentially characterised by nutrition. The organic edifice is the seat of a continual internal nutritive movement, which never ceases in any part: each individual draws its nourishment from the surrounding medium, and into it discharges its waste and effete products. This molecular renovation is unappreciable to direct view, but we see the beginning and the end, the entrance and the exit of the substances, and can conceive the intermediate phases, and imagine a current of matter which continually traverses the organism, pervading its substance, and maintaining its form. This movement, which has been called

the vital vortex, the material circuit between the organic and the inorganic world, exists in plants as well as in animals, is never interrupted, and is the condition as well as the immediate cause of all the vital manifestations. The universality of the phenomenon, the constancy which it presents, and its absolute necessity, constitute it the fundamental character of the living body, and the most general sign of life; so much so that some physiologists have taken it as the definition of life.

Nevertheless this phenomena is not simple; it requires to be analysed, and its mechanism minutely investigated, in order to render precise the idea which its superficial examination may give of life. The nutritive movement comprehends two distinct, but connected and inseparable, operations—one by which the inorganic matter is fixed, or incorporated in the living tissue, and becomes an integral part of it; the other by which it is separated and discharged. This double movement is really but a perpetual alternation of life and death, that is, of destruction and renovation of the constituent parts of the organism. The vitalists have not understood nutrition. Some, imbued with the idea that the essence of life is resistance to death, that is to the physico-chemical forces, must think that the living body, having arrived at its full development, has only to maintain itself in the steadiest equilibrium possible, by neutralising the destructive influence of the external agents; others, comprehending the phenomenon better, and appreciating the continual change of the organism, refuse to allow that this molecular renovation was produced by the general forces of nature, and attribute it to vital force. Neither have perceived that it is precisely the organic destruction effected under the influence of the physico-chemical forces which produces the incessant change and is the cause of the re-organization.

The acts of organic destruction and disorganization are immediately revealed to us; their signs are evident, being exposed externally, and repeated with each vital manifestation. The acts of assimilation and organization on the contrary remain internal, and have almost no phenomenal expression; they consist in an organic synthesis which collects together, in a silent and secret manner, the materials which will be expended later in the open manifestations of life. It is a remarkable fact, important to appreciate, how these two phases of the nutritive circuit are expressed so differently, the organisation remaining latent, and the disorganisation having as its sensible manifestations, all the phenomena of life. Here as usual, appearance is deceptive, and that which is called a phenomena of life is really one of organic death. The two factors of nutrition are assimilation and disassimilation, or organization and disorganization. But disassimilation is always accompanied by vital manifestation. When a man or animal moves, a part of the active substance of the muscle is destroyed and burned; when an act of sensation, or volition, occurs, the nerves are expended; and when thought is exercised, the brain is consumed. It can be said that the same matter never serves twice in life. When an act is accomplished the part of living matter which produced it is no more. If the act is repeated it is new matter by which it is performed.

The molecular expenditure is always in direct ratio to the vital manifestations, and the alteration of material is the more perfect and considerable in proportion to the activity of life. Disassimilation also rejects from the organism substances the more oxidised by the vital combustion, in proportion as the functions of the organs are the more energetic. This oxydation or combustion causes the animal heat, and produces carbonic acid exhaled by the lungs, and other different productions eliminated by the excretories of the economy. The body is expanded and experiences a consumption and loss of weight, which expresses and measures the intensity of its functions. Everywhere physico-chemical destruction is united with

functional activity; and it can be regarded as a physiological axiom, that any manifestation of a phenomenon, in the living being, is necessarily united with an organic destruction.

Such a law, which unites the production of phenomena with the destruction of matter, is not peculiar to the living world; physical nature obeys the same law. A living being with plenitude of its functional activity does not therefore present the greatest energy of a vital mysterious force, but simply the greatest activity of the chemical phenomena of combustion, or organic destruction. Stahl says with justice that the physico-chemical phenomena destroy the body, and produce death; but he was not aware of the fact, that the phenomena of vital destruction are the instigators, and precursors, of the renovation of material which is hidden to view in the secret depths of the tissues. At the same time that the phenomena of combustion are expressed with eclat by the outward vital manifestations, the formative process takes place in the silence of vegetative life, and has no other expression, but the organization and separation of the living edifice.

Life has been compared to a torch, which metaphor, thanks to Lavoisier, has become a reality. The being which lives is like the torch which burns; the body is expended, and the torch is consumed and burns with a vital, the other with a physical flame. But in order that the comparison should be exact, the torch should last by regenerating and renewing itself, like the living torch. Physical combustion is an isolated phenomenon, in a manner accidental, having no reciprocal relations in nature. Vital combustion, on the contrary, supposes a correlative regeneration, a phenomenon of the utmost importance, the principal characters of which we have now to trace.

Reparation or organic synthesis presents two principal modes of action; at one time the synthesis assimilates the surrounding substances, to form them into nutritive principles; at another to form them directly into the elements of the tissues; and thus we see, side by side, with the formation of the immediate products of the chemical synthesis, the phenomena of histological renovation, either continual or periodic. The phenomena of redintegration, regeneration, or reparation, which occur in the adult are of the same nature as those of generation and evolution, by which the embryo at its commencement constitutes its organs and anatomical elements. The living being is characterised, at the same time, by nutrition and regeneration, which two phenomena must be united, and instead of forming two distinct categories, are to be considered as a single act, whose essence and mechanism are alike. It is with this idea that it can be said, that nutrition is but a continued generation. Organic synthesis, generation, regeneration, redintegration, and even cicatrisation, are aspects of the same phenomenon—varied manifestations of the same agent—the germ.

The germ is the agent *par excellence* of organization and nutrition; it attracts around it cosmic matter, and organizes it, to constitute the new being. Enclosed at first in the cell of the ovum, it surrounds itself with nutritive elaborated materials, called the vitellus; but can only manifest its organizing power, secondary to combustions and organic destruction. The ovum thus constituted by the germ and the vitellus, by segmentation and division into an infinite number of cells, provided each with the germ of nutrition, develops the new organism. This cell germ, called the nucleus, attracts and elaborates special nutritive materials, destined for the functional combustions of the tissues and organs. When either natural or accidental acts of regeneration occur, when a divided nerve, for instance, is regenerated and restored in its functions, it is still their nuclei, which in virtue of the primordial germ, from which they are derived, divide and multiply, to constitute in the adult the new tissue, repeating identically the process of

the formation of the embryo. All the various phenomena of regeneration and organic synthesis, have as a distinctive character, that they are invisible externally. The activity which prevails, and the importance of the phenomena which are accomplished, during the incubation of an egg, could never be suspected from the silence of the process, but it is the new creature emerging from it, which unveils by its manifestations of life the marvels of the slow and hidden work. It is the same with all our functions. Each has, so to speak an organizing incubation, and, when a vital action occurs, its conditions were for long collected by that silent and profound elaboration, which frames the causes of all phenomena.

These two phases of physiological action are not to be lost sight of; when we wish to modify the vital actions, it is their secret evolutions that must be attacked; when the phenomenon has occurred it is too late. Nothing happens by chance, and the most sudden event has its elementary latent causes, which it is the object of science to discover, in order to be able to modify, and thus to have under control the ulterior appearance of the phenomenon.

Finally, in the living body there are two great groups of phenomena, the functional or that of vital expenditure, and the organic, or that of vital concentration. Life is maintained by these two classes, opposite in their nature—the disassimilating combustion which consumes the living matter in the organs when in action, and the assimilating synthesis, which regenerates the organs in repose. The agents of the two are not less different. Vital combustion borrows the general external agent of combustion, oxygen, and in default of this, ferments, whose disassimilating action can occur in the depths of the tissues where no air can penetrate. Organic synthesis, on the contrary, possesses a special agent, the germ or the nuclei of the cells, which are the emanations of the primordial germ, situated in all the elementary parts of the living body. The conditions of functional disassimilation and organic assimilation are also different. The same agents of combustion, which expend the organic edifice during life, continue to destroy it after death, when the phenomena of organisation are extinct. Hence it is that all the functional phenomena accompanied by combustion, fermentation, or organic disassociation, can be accomplished, out of, as well as in the living body—thanks to which circumstances the physiologist can, by the aid of experiments, analyse the vital mechanism. In a mutilated organism he keeps up artificial respiration, circulation and digestion, and studies the properties of living tissues separated from the body; in these dismembered parts the muscle contracts, glands secrete, and nerves conduct stimuli as in life; but though tissues isolated from the organic conditions are expended, and perform their functions, they cannot be regenerated, on which account death is inevitable. The phenomena of organic renovation, on the contrary, cannot be manifested except in the living body, and each phenomenon in its special place. No artifice has hitherto been found to supply the essential conditions of the activity of the germ, or to take its place in the living edifice.

If, depending on the great difference that has just been indicated, a vital independent rôle in the economy was assigned to the combustion, also to the organic regeneration, it would be a grand mistake; for the two classes of phenomena are so reciprocal in the act of nutrition, that they can only be separated in conception; in nature they are inseparable. Every living thing, animal or vegetable, can only exercise its functions by the simultaneous action of vital combustion and organic synthesis.

Having considered, in its minutia, the characteristic phenomenon of life, nutrition, it remains to be considered, what conclusion can be come to with regard to the solution of the problem so often attempted—the definition of life. If it is wished to state that all the vital functions are the neces-

sary consequence of an organic combustion, it would be by the paradoxical expression,—“Life is death”—the destruction of the tissues; or with Buffon, “life is a minotaur which devours the organism.” If, on the other hand, we desire to lay stress on the second phase of nutrition, that life is only sustained on condition of the constant regeneration of the tissues, it would be “a creation executed by means of a plastic regenerative act in contrast with the vital functions” Finally, to comprehend both phases of the phenomena, organization and disorganization—we will come near the definition given by Blainville: “Life is an internal double movement of decomposition, general and continuous, at the same time;” or that more recently proposed by Herbert Spencer: “Life is the definite combination of nitrogenous changes, at the same time simultaneous and successive”—which expresses the idea of evolution and succession observed in the vital phenomena. Such definitions, however incomplete they may be, have at least the advantage of expressing an aspect of life—not merely verbal, as “life is the contrary to death;” or Beclard’s “Life is organization in action.” Kant, in his “Critique of Pure Reason,” has defined life: “An intimate principle of action” which recalls the idea of Hippocrates, and has been adopted by Tiedemann and other physiologists. In reality, there is no more an interior principle of action in animate than in inanimate bodies. The phenomena which take place in minerals are certainly under the influence of external atmospheric conditions, but it is the same with plants and cold blooded animals. If warm blooded animals appear free and independent in their vital manifestations it is because of the more perfect mechanism of the bodies, which produces heat in such quantities, as to be free and independent of the surrounding media.

In a word, the spontaneity of living matter is but a false appearance; there are constantly external principles and stimuli, which provoke the manifestations of matter always inert by itself.

No single completely satisfactory definition of life can be given. Pascal remarks, that in reality true definitions are creations of the understanding; that is to say, definitions of names, or conventions used to abridge discourse: but he recognises primitive words, comprehended without definition. The word life is in this category. Every one knows what is meant by life and death, it is impossible to separate the two terms, the two correlative ideas, for what has lived will die, and what is dead has lived. The first thing is to understand the phenomena of life; definition can only be given subsequently as a resume of previous study; but this is, properly speaking, a view or conception, rather than a definition. We have now to consider, what conception we can form of the phenomena of life, in the present state of our physiological knowledge.

This conception must vary according to the progress of science. As late as the beginning of the century, Le Gallois published a volume of experiments “On the principle of life and the seat of that principle.” But now the seat of life is no longer sought for, it is known to reside everywhere in the particles of organised matter. The vital properties are the living cells, everything else is but mechanism and arrangement. The various manifestations of life are the combined and diversified expressions of the fixed and invariable organic elementary particles. It is of less consequence to know the immense variety of the vital manifestations, than to determine rigorously the properties of the tissues which produce them, on which account, now, all the efforts of science are directed towards the study of those infinitely minute bodies, which conceal the true secret of life.

As far as we yet go into the minutia of the phenomena proper to living things, it is the same question which always presents itself, which has existed from the beginning of science. “Is life due to a power, a particular force, or is it but a mo-

dality of the general laws of nature?" In other terms, "Is there in living beings a special force distinct from physical, chemical, or mechanical forces?" The vitalists have always argued from the impossibility of explaining physically, or mechanically, all the phenomena of life, and their adversaries have answered them by reducing a great number of vital manifestations to well established physico-chemical demonstrations. It must be admitted that the latter have constantly gained ground, and especially now are gaining daily more and more. Whether they will eventually succeed in reducing everything to their theory, or whether there will remain a *quid proprium sui generis* of life despite their efforts is the point to be examined. By carefully analysing the vital phenomena which can be explained by the physical or chemical forces, we will circumscribe and limit vitalism, and thereby render it more easy of determination.

Of the two orders of nutritive phenomena which essentially characterise life, and which are the origin of all its manifestations, one—destruction or organic disassimilation—comes now completely within chemical action; these decompositions in living beings present nothing more or less mysterious than those of organic bodies. As for the phenomena of organizing genesis, and nutritive regeneration, they appear at first sight of a vital and quite special nature, irreducible to general chemical actions; but this is only appearance, and for their proper comprehension, it is necessary to consider their phenomena under the double aspect which they present of ordinary chemical synthesis, and of organic evolution which takes place. In fact vital genesis comprises phenomena of chemical synthesis, arranged, and developed according to a peculiar order, which constitutes their evolution, but it is necessary to separate chemical phenomena in themselves from their evolution; for they are two quite distinct things, as far as synthetic action is concerned; their phenomena are but dependant on general chemical forces, examining them successively. This is clearly demonstrated. The calcareous matter met in the shells of molluscs, in the eggs of birds, and in the bones of mammiferæ are certainly formed in the evolution of the embryo, according to the laws of ordinary chemistry. Fatty and oily matters are in the same category and already chemistry has succeeded in producing artificially a great number of the immediate principles and essential oils, which are naturally the appanage of the animal or vegetable kingdom. In like manner amylaceous substances, which are developed in animals, and produced by the union of carbon and water, under solar influence, in the green leaves of plants, are well characterised chemical phenomena. If in the case of nitrogenised and albumenoid bodies the process of synthesis is more obscure, it is because organic chemistry is not sufficiently advanced; but it is certain, nevertheless, that these substances are formed by chemical processes in the organism.

Without doubt, the agents of organic synthesis, the germs and cells, can be said to constitute quite exceptional agents, and with regard to the phenomena of disorganisation, the ferments can be said to be also agents peculiar to living bodies. It is probable that it is a general law, that chemical phenomena are executed in the organism by special agents and processes; but this alters in no respect the purely chemical nature of the phenomena which take place, and of the products which are their consequence.

Having examined chemical synthesis, we come to organic evolution. The agents of the chemical phenomena not alone produce chemical synthesis of very varied matter, but they organise and appropriate them for the morphological edification of the new being. Among the agents of living chemistry, without doubt, the most powerful and remarkable is the ovum—the primordial cell, which contains the germ, the organising principle of the whole body. We have nothing to do with the creation of the ovum *ex nihilo*; it comes from parents, and the

origin of its evolutive power is hidden from us; but science daily advances towards the comprehension of this mystery. It is by the germ, and in virtue of the evolutive power which it possesses, that the perpetuity of species, and the discordance of being, is established; it is through it we comprehend the necessary relations which exist between the phenomena of nutrition and those of development. It explains the limited duration of the existence of the living being; for death must occur where nutrition ceases, not from want of aliment, but because the evolutive concatenation is come to its end, and the organising cellular impulse has exhausted its virtue.

The germ further presides over the organization of the being, forming from the surrounding substances the living matter, and impressing in it the character of chemical instability, which becomes the cause of the incessant vital movements which take place; the cells—secondary germs—presiding in the same way over the cellular nutritive organisation. It is very evident that these are purely chemical actions, but it is not less clear that these chemical actions, in virtue of which the organism grows and is built up, are connected with, and succeed, each other, with a view to this result—the organisation and growth of the animal or vegetable individual. There is as it were a vital design, which traces the plan of each being, and each organ. If considered separately, each phenomena of the organism is subject to the general forces of nature, but if taken together and in their succession, they appear to show a special connection—appear directed by some invisible condition in the route they follow and in the order which connects them. Thus the synthetical chemical actions of the organism and of nutrition are manifested, as if they were governed by an impulsive force, ruling over the matter and making a special chemistry, appropriate to the end in view. This power of evolution inherent in the ovule includes the phenomena of generation and nutrition, both of them having the evolutive character, which is their groundwork and essence.

It is alone this evolutive power, or property, which constitutes the *quid proprium* of life, for it is clear that the power of an ovum, which will produce a mammifer, a bird, or a fish, is neither chemical nor physical. This is the last refuge of the vitalists. By sheltering themselves by it, it is easy to see that vitalism is transformed into a metaphysical conception, and breaks the last tie which attached it to the physical world, or to physiological science. In saying that "life is the force of evolution of the being" we simply express the idea of unity in the succession of all the chemical and morphological changes, accomplished through the agency of the germ, from the beginning to the end of life. Our mind easily embraces that unity, as a conception which forces itself upon it, and explains it by a force, but the error would be to think that that metaphysical force acted after the manner of a physical force. The metaphysical force of evolution by which life can be characterised being outside the physical forces cannot influence them. The metaphysical world must be separated from the world of phenomena, which serves as a base for it, but has nothing to get from it. Finally, if life can be defined by a special metaphysical conception, it is none the less a fact, that the physical and chemical forces are the only agents of the living body, whose action the physiologist has to consider.

4th October 1875.

REPORT ON THE OUTBREAK OF CHOLERA AT NOWGONG, BUNDLECUND, IN JULY 1875.*

By Surgeon-Major J. J. CLARKE, 3rd Bengal Cavalry.

Nowgong is situated in the midst of independent states in the province of Bundelcund, in latitude 25° N and longitude 79° 28' E.

* This graphic and interesting report has been placed at our disposal by the Surgeon-General, Indian Medical Department.