

## LIFE.

By Surgeon S. BRERETON.

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

As would, *a priori*, appear probable, the consideration of such a momentous and intimate question as the cause of the phenomena designated life, has always engaged attention; and numerous theories and doctrines have been proposed and taught concerning it. These several opinions may be divided into two great classes, the metaphysical and the material; and, before discussing the state in which modern science has placed the subject, it will be advantageous to take a cursory review of the histories of those two classes of theories with their most important modifications.

From the remotest antiquity the phenomena which are displayed by living beings have been regarded as the emanations of a superior and immaterial principle acting on inert matter. Such is the opinion of Pythagoras, Plato, Aristotle and Hippocrates, accepted in later times by the scholastics and mystic savants of the middle ages.

Basil Valentine and his pupil Paracelsus were the originators of a further development of this theory; they taught that the several phenomena of the living body were presided over by immaterial intelligent principles, which they named *archei*. Van Helmont, the most celebrated representative of this doctrine, in whom an experimental genius is said to have been united with the wildest imagination, specified a number of these principles. In the first rank was the reasonable and immortal soul confounding itself with the Deity, then the sensitive and mortal soul, having for its agent a principal *archeus*, who in his turn commanded a crowd of subordinates. These specific agents, inherent in the living system, in his opinion, determined all the physiological actions in the body, and accounted for health and disease.

But the metaphysical theory attained its climax of favor and influence in the beginning of the 18th century, under the celebrated Stahl, Professor in the University of Halle. He referred the phenomena of life to a dominating principle which he designated *anima*, and was the most determined and dogmatic apostle of this idea perpetuated from the earliest ages, giving it a clearer expression and definition by the invention of animism, which is but the ultra development of the doctrine of the spirituality of life.

In opposition to the opinions, prevalent in the schools at that time, of the iatro-chemists and iatro-mechanics, which will be afterwards alluded to, he concentrated attention on vital actions produced by this hypothetical principle *anima*, and maintained that the operations of the living economy cannot be explained by the laws of mechanics and chemistry. Comprehending in another way the vital phenomena, and the relations of the soul and the body, he rejected all the explanations which are common to vital acts, and the chemical, mechanical or physical phenomena of inert matter. Being an able chemist himself, he opposed, with considerable power, the exaggerations of the iatro-chemists, maintaining that not only are the forces of chemistry different from those which rule over life, but also that they are in antagonism with them, and tend to destroy, instead of maintaining, the living body. There must be, in his opinion, a force which preserves the body against the attacks of the chemical forces which tend continually to invade and destroy it; from this reasoning he invented vitalism, but it was only the step towards animism. This forces he argued, work against the chemical forces, acts with premeditation and intelligent design for the preservation of the organism, and must be identical with the soul. Following Van Helmont with an interval of a century, he simplified all his conceptions of intelligent principles; he admitted only the immortal, intelligent, reasonable soul, which was also commissioned with the government of the body. The soul is for him the principle of life; life is one of its modes of operation—its vivific action; it governs directly and works the

corporeal matter, not only dictating our voluntary acts, but causing the heart to beat, the blood to circulate, the lungs to respire, and the glands to secrete. If the harmony of these phenomena is disturbed, or if sickness comes, it is either that the soul has not fulfilled its office, or that it is unable to resist the external causes of destruction.

There was something strange and contradictory in such a doctrine; for the action of a reasoning soul on the vital functions implies a conscient direction, while the most superficial observation shows, that all the functions of nutrition, circulation, secretion, excretion, &c., are performed involuntarily and unconsciously; as if nature, according to the expression of a philosophic physiologist, prudently wished to withdraw from the caprice of an ignorant will those important phenomena.

Stahl was the last representative of the doctrine of the spirituality of life. Modern intellect has not accepted a theory whose contradiction to science had become too evident; animism was characterised by an exaggeration which drove his successors, if not to reject it, at least to modify it considerably. Even Hoffman, his colleague at Halle, pointed out that the actions ascribed by Stahl to the *anima* were produced by the influence of the nervous system.

Borden, Barthez and Grimaud of the school of Montpellier were the followers of Stahl, but they only retained the first part of his doctrine—vitalism,—and rejected animism: contrary to him, they said that the principle of life was distinct from the soul; but with him they admitted a single ruling force or principle producing in harmony the vital manifestations, and acting independently of the laws of chemistry, mechanics or physics.

Meanwhile vitalism became gradually modified; the doctrine of vital properties marked an important era in the history of physiology; in place of a metaphysical we have here a physiological conception, which seeks to explain the vital manifestations by the very properties of the matter of the tissues and organs in which they occur. At the end of the 17th century Glisson had pronounced irritability as the cause of the movements of the living fibre. Borden and Barthez had a more or less vague idea of it: and Haller's name is also attached to the discovery of that motive power, by the publication of his famous experiments on the irritability and sensibility of different parts of the body. But it was reserved for the brilliant genius of Xavier Bichat to comprehend that the cause of the vital phenomena was not to be sought in a principle of a superior immaterial order, but in the properties of the matter in the midst of which the phenomena took place.

Certainly Bichat has only vaguely and obscurely defined the vital properties; his genius lies not in discovery, but in appreciation and comprehension of the meaning and value of discoveries. He is the author of the enlightened and fertile doctrine that in physiology, as in physics, phenomena are to be referred to properties as their cause. "The relation of properties to phenomena as effect and cause," he says in his "Anatomie Generale," "is a trite axiom now-a-days in physics and chemistry; if my book will establish an analogous axiom in physiology it will have fulfilled its aim." Further on he adds:—"There are in nature two classes of bodies, organic and inorganic, two classes of properties, vital and non-vital, and two classes of sciences, physiological and physical."

It might be thought that Bichat's ideas sided with the materialists, since like them he assigns the properties of matter as the cause of the phenomena exhibited, but on the contrary he differs from them completely; for in all ages the object of the materialists, iatro-mechanics, iatro-chemists, &c., has been to establish an identity between the phenomena of organic and inorganic bodies, while Bichat lays it down as a law that the vital properties are absolutely opposed to the physical, so that instead of being a materialist he is a vitalist,

like Stahl and the school of Montpellier. Like them he considers life a struggle between opposing forces, the vital properties preserving the organism by restraining the physical forces, whose tendency is to destroy it; and when death supervenes it is but the victory of the latter. He sums up his ideas completely by the definition he gives of life, *viz.*,—"Life is the sum of the forces which resist death, *i.e.*, life is the sum of the vital properties which resist the physical forces." This way of considering vital properties as a kind of undefined metaphysical entities in opposition to ordinary physical properties has doubtless the tendency to draw research into the same way of error as the other metaphysical theories. Nevertheless, the conception of Bichat is the foundation on which modern physiology is built. Before him philosophical doctrines, either animal or vitalist, soared too high above reality, to be initiatory to the science of life, only tending to render it torpid by the idle sophisms formerly prevalent in the schools. Bichat, on the contrary, by making life incarnate in the tissues, and attaching its manifestations to their properties, placed it under the dependence of a principle, still metaphysical, but less elevated in philosophic dignity, and more likely to prove a scientific base, accessible to a spirit of research and progress. In short, Bichat was deceived, like his predecessors, with regard to the theory of life, but not with regard to the physiological method: it is his glory to have been the founder of it by placing in the tissues and organs the immediate causes of life.

In opposition to the metaphysical theory hitherto discussed, with its various modifications, even before that physics and chemistry were constituted, and the phenomena of inert matter known, we find a philosophic tendency in advance of the times, trying to establish an identity between the phenomena of organic and inorganic bodies. This conception is the foundation of the atomism of Democritus and Epicurus: they did not recognize a motive influence, but said the world moved of itself. They allowed but a single kind of matter, whose elements, in consequence of their shape, had the property of forming, by uniting with each other, the most diverse combinations, and of forming not only inorganic lifeless bodies, but also organized beings which live and feel like animals, and which are reasoning, and free agents like men.

About the time that chemistry was beginning to advance to the dignity of a science, the iatro-chemical modification of the materialist theory arose under Sylvius LeBois of Leyden—which explained all the phenomena of life by chemical actions—fermentations, alkalinities, acidities, effervescences, &c., to the derangement of which processes disease was due. Willis, the eminent English physician, was of this school; he thought that there was a special fermentation for each organ.

Another phase of the materialist theory was the iatro-mechanical school, which endeavored to account for the various functions of the body on mechanical principles. The most celebrated supporters of this theory was Descartes, Boullé, Bellini, Hales, Piteairn, Boerhaave, and Des-Sauvages.

It is a remarkable fact that philosophers, who were most convinced of the spirituality of the soul, such as Descartes and Leibnitz adopted the materialist theory which attributed to the physical forces all the manifestations of vital activity; but the explanation of this apparent contradiction is found in the absolute separation which they established between the soul and the body. Descartes has given a metaphysical definition of the soul and a physical definition of life. The soul is the superior principle which is manifested by the thought; life is but the supreme efforts of the laws of mechanics; the human body is a machine formed of springs, levers, canals, filters, &c.; the soul contemplates as a simple spectator the working of the body, but interferes in nothing.

The ideas of Leibnitz, in a physiological point of view, have considerable analogy with those of Descartes. Like him he separates the soul from the body, and, though he admits a

concordance pre-established by God, he denies every kind of a reciprocal action. The body, he says, is mechanically developed, and mechanical laws are never violated in natural movements; every thing takes place with regard to the soul, as if there was no body, and with regard to the body, as if there was no soul.

The ideas of Stahl and Descartes produced a profound impression in science, and created two currents of opinion which have descended to our own times. The doctrine of Bichat effected as universal revolution in physiology and medicine, of which the anatomical school was the offspring, placing in the vital properties of the tissues, either physiological or pathological, the explanation of the phenomena of health and disease, thus pursuing but the progress of the methods of physical research, and the brilliant discoveries of modern chemistry, throwing new light on the vital properties, and increasingly contradicting the radical separation, and opposition that Bichat and the vitalists thought existed between the organic and inorganic phenomena of nature.

Descartes laid the foundation in applying the laws of mechanics to the working of the machine of the human body; his followers extended and rendered more definite the mechanical explanation of the vital phenomena. By its side iatro-chemistry progressed, and was definitely established in the accession of modern chemistry. Descartes and Leibnitz established the principles that everywhere the laws of mechanics are identical, and that there are not two systems of laws, one for organic, the other for inorganic bodies. At the end of the last century Lavoisier and Laplace demonstrated that there are not two chemistries, proving experimentally that respiration, and the production of heat take place in the bodies of animals by phenomena of combustion, identical with those produced by the calcination of metals. Bichat and Lavoisier are thus the representatives of the two great opposite philosophical tendencies, which have existed from the very birth of science; one trying to reduce the phenomena of life to the laws of mechanics, chemistry and physics; the other to separate and place them under the dependence of a particular principle of special power, whatever name—soul, archeus, vital force, or vital properties—may be given to it. This controversy, already so old, still continues; nor is it probable that it will terminate by one of the hypotheses triumphing over the other. The result of the progress of science is to weaken equally both those exclusive doctrines. As their stronghold was ignorance, in proportion as it disappears the controversy will cease, and opposing doctrines vanish, leaving scientific truth to reign without a rival.

Bichat, like most of the great promoters of science may be said to have formulated the floating ideas of his time: all the ideas of his contemporaries about life, all their attempts to define it, are in some measure but the echo or the paraphrase of his doctrines. Pelletan teaches that life is the resistance opposed by organized matter to the forces which tend continually to destroy it. Cuvier himself develops the same idea that life is a force which resists the laws which govern inorganic matter, death being but the return of living matter under these laws, and what distinguishes a corpse from a living body, is the presence or absence of this force.

These ideas of contrast and opposition between the vital and physio-chemical forces, which we find in the doctrine of vital properties, had already been expressed by Stahl, but in obscure and almost barbarous language. Explained by Bichat with luminous simplicity, and a great charm of style, they seduced and carried away every one. Not content with affirming the antagonism of the two kinds of properties, which divide nature between them, when characterising them he contrasts them in a striking manner. "The physical properties of bodies," he says, "are eternal. At the creation, their properties took possession of matter, which will always remain under their control. Vital properties, on the contrary, are essentially temporary; when inorganic matter enters into living bodies, vital

and physical properties are united, but this union is not durable, for it is the nature of vital properties to wear out. Time exhausts them. Vigorous in youth, stationary in adult life, they become weak and frail in old age. They say that Prometheus, having made images of clay, stole fire from heaven to animate them; this fire is the emblem of the vital properties; as long as it burns life is maintained, and becomes extinct as soon as it is quenched."

It is from this contrast, in the nature and duration of the vital and physical forces, that Bichat deduces the distinctive characters of organic and inorganic bodies, and of the sciences which make them their study. Physical properties being, in his opinion, eternal, inorganic bodies have neither a beginning nor an end necessarily—neither age, nor evolution, nor limits, except such as chance assigns them; vital properties being changeable, and of limited duration, organic bodies are variable, and perishable; they have birth, age, and death, in a word have a cycle to run. The vital properties being constantly antagonistic to the physical forces, and the body being the theatre of war, health and disease are but the vicissitudes of the fight, and death the consequence of the victory of the physical forces; whereas, if the vital properties gain the ascendancy, the organism recovers from disease, its wounds cicatrize and it enters again into the harmony of its functions. In inorganic bodies nothing like this occurs; they remain as unchangeable as death; hence a wide distinction between the sciences he calls vital and non-vital. Physico-chemical properties being fixed and constant, the laws of the sciences which treat of them are also fixed and invariable. Vital properties, having as their essential character instability, and all the vital functions being susceptible of an infinity of variation, nothing can be foreseen, or calculated, with regard to these phenomena. Hence it must be concluded that absolutely different laws preside over each class of phenomena.

Such is, in its main points and with its deductions, the doctrine of vital properties, which for a long time has held sway in the schools, notwithstanding the just criticisms to which it is liable.

Whether the division of phenomena into two great groups, such as the doctrine of which Bichat is the eloquent defender establishes, is well founded, or is rather a systematic conception than the expression of fact, demands examination. First, as to whether organic bodies are eternal and inorganic alone perishable, or whether there are simply differences of degree, delusive on account of their great disproportion, will be considered. The life of an elephant may appear eternity with regard to that of an ephemeris, and when we consider the life of man relative to the duration of the *kosmos* he inhabits, it must appear a moment in the infinity of time. The ancients contrasted the living world where all is subject to change and death with the stars, unchangeable and incorruptible. This doctrine of the immutability of the skies lasted till the invention of telescopes in the 17th century, which enabled the appearance of a new star, in the constellation of Serpentarius, to be established. This change, accomplished almost under the very eyes of the observers, began to shake the belief of the ancients that the skies were unalterable. Now-a-days the mind of astronomers is familiar with the idea of change, and continual revolution, in the celestial world. "Stars have not always existed," says Faye, "they have a period of formation, of decline, and of final extinction." The eternity of the heavenly bodies invoked by Bichat is therefore not real; they have an evolution like living bodies, slow compared with our hurried life—an evolution which embraces a duration out of all proportion with that we are accustomed to consider around us.

But if living bodies are not alone subject to the law of evolution, no more are the faculties of restoration and cicatrization peculiar to them, although in them their manifestations are more active. It is well-known that when a living organism is muti-

lated there is a tendency to restoration, according to the laws of its special morphology. In an animal or plant, a wound cicatrises, a loss of substance is made good, and the organism is restored in its form and unity. This phenomenon of renovation, or redintegration, has much struck naturalists, and they strongly insist on the tendency of life to individuality, which makes of the living organism one harmonious whole, a kind of little world in the great. When the harmony of the organic edifice is disturbed there is a tendency to reestablish it; but there is no necessity, in order to explain these phenomena, to invoke a vital contrast with the physical forces. Crystals have their particular form and plan like organised matter, and are subject to the disturbing actions of their surrounding medium. The physical force which arranges the crystalline particles, according to the laws of geometry, is analogous, in its results, with that which arranges organic matter in the form of animals and plants. Pasteur has described acts of cicatrization and redintegration in crystals which are worthy of attention. He mutilated certain crystals and saw reparation take place very rapidly and regularly. "When a crystal," he says, "is broken in any place, and put in its mother water, at the same time that it is seen to grow larger everywhere by a deposit of crystalline particles, a very active reparative process takes place at the broken part and in some hours the crystal is perfect, not alone with regard to its general regularity in other places, but also to that of the mutilated part." These remarkable facts of crystalline redintegration are quite analogous with those presented by organised structures, when injured. In the crystal, as in the animal, the damaged part cicatrises, and assumes its normal form; and in both cases, the work of tissue formation is much more active in that place, than under ordinary circumstances. The foregoing brief considerations which could be extended to infinity appear sufficient to prove that the line of demarcation, that has been tried to be established between organic and inorganic bodies, on account of their duration, evolution, and formative redintegration, is not well founded. With regard to the alleged strife between the vital and physical properties, it appears to be the expression of a grave error.

The doctrine of vital properties teaches that, in inorganic bodies there are only physical properties, while in organic bodies, there are both physical and vital, constantly in antagonism and trying to predominate the one over the other. "During life," says Bichat, "the physical properties evinced by the vital tissues are continually restrained in their tendencies." Hence it results logically, that the more power the vital properties have the less the physico-chemical will have, and *vice versa*. It is directly the contrary proposition which expresses the truth; as has been abundantly demonstrated by Lavoisier and his successors.

Life is the image of a combustion, and combustion is a series of chemical phenomena, to which are directly attached calorific, luminous and vital manifestations. Let oxygen, the agent of combustion, be abstracted from the atmosphere, immediately flame becomes extinct and life ceases. If the quantity of combustible gas is increased, or diminished, vital phenomena, as well as the chemical phenomena of combustion are increased, or lessened, in like proportion. It is not an antagonism that is to be seen between chemical phenomena and vital manifestations; but on the contrary a perfect and necessary harmony and union. In all the series of organised beings the intensity of vital manifestations is in direct ratio with chemical activity: of this everywhere proofs are found. When the living being is attacked with cold, first the chemical phenomena of combustion grow feeble, then the movements become slow, and sensibility and intelligence grow dull and disappear. On awakening from this lethargy the vital functions reassume their power, but always *pari passu* with the appearance of the chemical phenomena. When life is suspended in a dried in fusion, and restored by a few drops of water, it is not that life, or the vital properties, were affected by the desiccation, but that water, necessary for

the realization of the physical and chemical phenomena, was wanting. When Spallazani resuscitated rotifers dried for 30 years, by moistening them he simply restored their physico-chemical phenomena. An antagonism between the properties of animate and inanimate bodies is absurd as the composing elements of both are the same. Buffon was logical in his attempts to explain the difference between organic and inorganic bodies, by imagining a special elementary organic substance in the first, of which the others were deprived. But chemistry has completely upset this hypothesis, by demonstrating that living bodies are exclusively formed from inorganic elements. The body of man, the most complex of all, is materially composed of 14 elements; it is easily comprehensible, that these elements, by uniting and combining with each other, may form infinite combinations, endowed with various properties; but that these properties should be of another kind and order from the combinations of which they are the attributes, is incomprehensible.

This doctrine is not only built, on false hypothesis and erroneous ideas, but it is also by its nature contrary to scientific spirit. Wishing to create two classes of sciences, one for the animate the other for the inanimate bodies, it came simply to deny science itself. Bichat, as we have seen, established the principle that the laws of the physical sciences are absolutely opposed to those of the vital. In the first everything is fixed, and invariable; in the second variable and inconstant, which must ever leave them strangers, and incapable of assisting each other. He says: "As the physical and chemical sciences have been perfected before physiology, they thought to explain the latter by associating it with the former; but they have made it more obscure. This is inevitable, for to apply the physical sciences to physiology, is to explain by the laws of inanimate bodies the phenomena of living beings which is a false principle." With regard to the peculiar characteristics of the science of animate bodies, he says: "It is a science, where laws, like the vital functions themselves, are susceptible of a crowd of varieties, which escape all kinds of calculation, in which nothing can be foreseen, or predicted, in which we have only approximations of the uncertain." These are scientific heresies of an almost incomprehensible enormity, but they are the logical deductions of the system. To allow that the vital phenomena cannot be submitted to any precise law, or any fixed or definite condition, and admit that these phenomena, thus defined, constitute a science, is a prostitution of the word science. It seems that there is no answer for such arguments, as they are but the negation and absence of all scientific spirit. Descartes, Leibnitz, Lavoisier proved that matter, and its laws differ in no respect in organic or inorganic bodies, that there is only one science of mechanics, one of natural philosophy and one of chemistry common to all nature. Every science, worthy of the name, knows the precise laws of the phenomena of which it treats, predicts them with certainty, and masters those within its reach. All that does not come under this character is empiricism, or ignorance: there cannot be conjectural or demi-sciences. It is a profound error, to suppose that in living bodies we have to occupy ourselves with the essence, or principle of life. We cannot arrive at the principle of anything and physiologists have no more to do with the principle of life, than chemists with the principle of the affinity of bodies. First causes are unknown, we can only attain to the knowledge of the immediate causes of the phenomena. But these immediate causes, which are but the conditions of the manifestations of the phenomena, are capable of as rigorous a determination in the sciences of animate, as of inanimate, bodies. There is no scientific difference in all the phenomena of nature, except it is that the complexity, or delicacy, of the conditions of their manifestations, renders them more or less difficult to distinguish, or explain. Hence it may be concluded that the duality attempted to be established between the sciences of organic or inorganic bodies is contrary to science itself, and

that both of them have for their cause the same principles and for the means of study the same methods of investigation.

(To be continued.)

ON THE PHYTODERMATA OR PARASITIC DISEASES OF THE SKIN (TINEÆ) OF VEGETABLE ORIGIN.

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(Continued from volume X., page 325.)

*Tinea Circinata*—(continued.)

Mahomedan male, aged 55; duration ten years. His constitution is broken down by malarious fever and consequent rheumatism. He passes large quantities of lithates from time to time.

The disease commenced simultaneously on the two thighs near the groins, and spread thence to the penis, scrotum, and perinæum. It was vesicular at first and spread by a red raised margin, leaving a raw weeping eczematous centre. The itching was most intense. It is never quite well at any time, but it is always much worse during the rainy season, disappearing in great part, however, during the cold and hot seasons.

During the last 12 months it has not altered much.

At present on the upper and inner surface of both thighs, on the penis and scrotum, on the lower  $\frac{2}{3}$  of the abdomen, and on the back as high as the neck, there are patches of dark melanic skin, with defined irregularly gyrate margins. In some parts there is considerable thickening of the skin. The newest patches are circular on outline, with red, raised, slightly vesicular margin; and raw weeping eczematous surfaces.

*Hindoo male, aged 23; duration 3 years.* It first appeared 3 years ago in the fork as small circular spots, which gradually spread by their margins, which were raised, dark red, and somewhat papular, and at first presented a few vesicles. The centre was less normal, and they now occupy the clefts of the thighs with patches the size of the palm of the hand.

On the chest is an old gyrate patch made up of the remains of numerous small circular patches. On both thighs there are distinct patches. The patient is a cultivator. It is bad only in the rains.

Mahomedan male, aged 40; duration 10 years. It commenced in both groins, as a small patch, and spread from thence to the thighs and waist, on which parts it has not been seen to any great extent for some 3 or 4 years.

Three years ago he first noticed it on his arms. The scalp has been affected for some years.

At present there is a scaly eruption on the dorsum of both hands, the arms, shoulders, chest, and thighs. There is none on the fingers, but the nails on three fingers in each hand are diseased.

In a few patches the skin in the centre is normal, but in most the centre is covered with whitish scales. On some there are hard inflamed sweat follicles with white apices. In others the hair follicles are affected, the orifices being surrounded with scales.

In conclusion, I must mention that I have never seen the ulcers mentioned by Mr. Nicholson. In his opinion also it is not contagious. Though not eminently so, the affection must however be admitted to be contagious. I have seen marked cases in which it has been transmitted from husband to wife, and also in which many members of the same family have had the disease together.

I have devoted considerable space to the subject of *tinea marginata*, as it is not only the most common but the most important form of *tinea circinata* met with in the native. Before concluding a few words must be added on the other localities in which *tinea circinata* is found on the body.