INTRODUCTORY LECTURE

ON

LIFE AND VITAL ENERGY CONSIDERED
IN RELATION TO PHYSIOLOGY
AND MEDICINE.*Delivered in the Middlesex Hospital Medical School, October 5th, 1870.*

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GENTLEMEN,—The various subjects comprised in the medical curriculum are all so important in their relation to each other, that the omission of any one of them would weaken, if not render impossible, the whole edifice of medical science. You will therefore understand why each lecturer claims for his own subject a special importance. "Where all are indispensable, it would be difficult to say which is pre-eminent." There are two subjects, however, or rather two divisions of the same subject, which, first in the order of time, if not of importance, form the basis of all your future acquirements: I refer to the subjects of Anatomy and Physiology.

All knowledge is relative; and, therefore, as your object is to acquire a scientific, as distinguished from a vulgar, knowledge of disease and its treatment, it is essential that you first become acquainted with the laws and conditions of the healthy structure and functions of the human body. And as your knowledge of disease must be continuous and progressive, so also must be your knowledge of anatomy and physiology. Hence the necessity of devoting yourselves earnestly to the study of these subjects, so that your acquaintance with them may be firm and enduring, and form, as it were, part of your mental furniture.

In addition to the immense importance of the science of physiology in its relation to medicine, the subject of which it treats, viz., life and its phenomena, has excited the interest and curiosity of thoughtful minds in all ages. Life and the nature of vital energy form the common ground on which metaphysicians and physiologists meet. And it is interesting to trace in the history of philosophy and of medicine the mutual influence which metaphysical speculation and physiological investigation have exerted on each other. In this light I propose to-day to give you a short sketch of some of the principal views which have been entertained at different periods on the nature of life, and to discuss the nature of vital energy in so far as it bears on the direction and methods of physiological research.

It was the custom, before science and philosophy had developed themselves, for men to transfer to the outer world the idea of cause or power which they felt within, and to attribute all natural phenomena to the direct action of gods or demons. In like manner they ascribed to similar agencies all the phenomena of their own bodies which did not come directly under the sphere of consciousness. Hence, says Lucretius, *diva religio* and superstitious enthrallment. When, however, philosophy arose, and with it the desire to shake off superstition, and the man was considered "happy who could discover the causes of things", many, like Thales and the early Greek philosophers, went to the opposite extreme; and, seeing nothing in the universe but fire, air, earth, or water, they considered the principle of life to be some *etherial sublimata* or *subtle essence* distilled from one or more of these elements.

Similar imperfect notions of matter and energy prevailed in the system of Leucippus and Democritus, who were the founders of the atomic or materialistic philosophy. They originated the doctrine of spontaneous generation, of which we now hear so much. Living beings, said they, came into existence by a fortuitous concourse of atoms of an indestructible nature. And they described the *anima* or vital principle as composed of atoms of a spherical, mobile, ærial, or igneous character—a sort of refined matter as it were.

The first great name in the history of medicine and physiology is that of Hippocrates, who has justly been called the father of medicine. Hippocrates was a man of wonderful industry and marvellous power of observation. He belonged to a family of priests who were connected with the shrines of Æsculapius, which were established in various cities and islands of Greece. To these shrines resorted all who were afflicted with bodily ailments and disease, in order to obtain a cure by worshipping at the altars of the god of healing. In gratitude to the god who cured them of their maladies, they hung up in his temples votive tablets, whereon were recorded the history of their disease and the benefits they

had derived. Hippocrates used these tablets as vital statistics, and with their aid and his own observations he arrived at a knowledge of the nature of the functions of the body and the phenomena of disease, which creates astonishment in the minds of those who read his works in all the light and science of the present day.

The nature of life and vital energy was explained by Hippocrates according to the principles of the philosophy which prevailed when he wrote. The Pythagoreans, the Platonists, and Stoics, all agreed in ascribing the activity of the universe to a *power* or *principle* which exercised a directing, regulating, and controlling influence over matter, and gave to it its laws. This principle was called the *soul of the world* (*anima mundi*). Hippocrates considered that life and vital activity depended ultimately on a sort of emanation from the soul of the world, which he called *Φύσις*, or Nature. The *Φύσις* exercised an intelligent control over vital phenomena, choosing what was beneficial, and rejecting what was injurious, to the organism.

Aristotle abolished from his system the idea of an universally active soul of the world, and held that the very idea of matter or substance involved in it a power of acting, or *ἐνέργεια*. He attributed the *ἐνέργεια* of living beings, or vital energy, to a species of soul, which he distinguished from the rational soul, under the name of the *vegetative soul*, or vital principle, common both to plants and animals.

From the time of Aristotle to that of Galen in the second century of our era, the views entertained on the subject of life and vital energy were simply more or less modifications or corruptions of the doctrines taught by Hippocrates, Aristotle, and others. Physiology and medicine wandered from the path of observation and induction pointed out by Hippocrates, and degenerated into subtle disquisitions and dialectic. Galen endeavoured to recal them to the true path; and, by his brilliant researches and discoveries in all branches of medicine, he has earned for himself an immortal fame in the annals of our science. Galen, like Hippocrates and Aristotle, believed in the existence of a special principle, the *ἐννομήν* (*impetum faciens*) or *active force*, which was the ultimate cause of vital activity. The doctrines of Galen were for the time lost sight of in the absurdities of Oriental mysticism and magic which prevailed in the early centuries of our era; and, in the reign of barbarism which succeeded, all true philosophy and science were lost.

With the revival of letters in the fifteenth century, Galenism was again predominant, and men swore by Galen in all things—so much so, that they would sooner have disbelieved the evidence of their senses than question the utterances of their great master. In the sixteenth century, however, there arose in Germany a man of extraordinary energy and unbounded conceit, who, nothing daunted by furious opposition, proclaimed that the ancients and Galen knew no more about medicine than the latchet of his shoe. This was the famous Paracelsus. His real name, however, was Philippus Aureolus Theophrastus Bombast von Hohenheim. The doctrines taught by Paracelsus were a strange mixture of astrology, alchemy, and cabalistic mysticism. He thought that there existed in us a *spiritual* or *celestial principle* of the same nature as the spirits or demons who presided over the movements of the celestial bodies. To this principle he gave the name of the *spirit of life*, the *sideric principle of man*, or more generally the *archæus*. The archæus had its seat in the stomach, and presided over its functions. Subordinate to the archæus there was a number of other spirits, who had each his own place and his own function. When all worked harmoniously, it was health; but when any of the minor spirits rebelled, and had to be subdued by the archæus, it was disease.

The doctrines of Paracelsus read very like the old fable of the belly and the members. Notwithstanding their seeming absurdity they exercised an enormous influence, and were propagated widely by Van Helmont and the mysterious sect of the Rosicrucians. Van Helmont adopted the archæus of Paracelsus, but further explained vital phenomena by various kinds of fermentation. The views of Van Helmont in regard to fermentation were further explained on mathematical grounds by the metaphysician and physiologist Descartes. Descartes, however, did not derive vital activity from the elements and mathematical properties of matter; for he considered that matter, as such, was inert, and owed its activity to an immaterial cause. Hence, in explaining vital energy, he had recourse to the soul, which, he thought, resided in the pineal gland, and there acted on the vital spirits contained in the ventricles of the brain, and set them in motion.

The mathematics of Descartes, and the discovery of the circulation of the blood by the immortal Harvey, together with the brilliant researches and discoveries of Newton and Leibnitz, formed the basis of the doctrines of the chemists and physicists who attempted to explain life on principles of chemistry alone, or of mechanics. The imperfect state of these sciences, and the subtle and complicated hypotheses that had to be resorted to, failed satisfactorily to account for vital phenomena, and produced a reaction in the system of the celebrated Stahl, a

Professor in the University of Halle in the year 1694. Like Descartes, Stahl denied all energy to matter. He moreover abolished such agencies as vital spirits as the medium of action of the immaterial principle of life, and held that all vital phenomena were the *direct* action of the *anima* or rational soul. For this reason he banished such subjects as histology, chemistry, and physics, as misleading, and utterly unable to explain vital action, which, he said, was entirely independent of material concomitants.

It was seen, however, that the life of plants in many respects resembled that of animals; and as they could not, without an abuse of the term, be said to possess a rational soul, the *anima* of Stahl gradually became modified by his followers into a *vital force* common both to plants and animals.

The doctrine of Stahl was ridiculed by many; among whom was the great Hoffman, a colleague of Stahl in the University of Halle. Hoffman's theory, however, in many respects was liable to the same objection as that of Stahl, only he held that the vital principle acted according to laws strictly mechanical, and not rationally.

It was the great Haller, who, in the middle of the last century, first pointed out the proper method of physiological research. He inculcated the methods of observation and experiment in the study of vital phenomena, and showed the futility of attempting to explain the phenomena of life by metaphysical disquisitions on the existence and mode of action of a vital principle. Haller distinguished between the purely chemical and physical processes going on in the body, and the purely vital endowments. These latter he termed irritability or contractibility, and sensibility; and considered them as peculiar forces, independent of chemical or physical condition, and characteristic of vitality.

The progress of science, however, showed that many of the phenomena which were supposed characteristic of vitality were to be generalised under the terms "chemical" and "physical". With each succeeding advance in anatomy, chemistry, and physics, the domain of so-called *vital force* became more and more narrowed, so that to many physiologists the terms *vitality*, *vital force*, etc., became synonymous with *physical force*, as yet unexplained.

The views that prevailed regarding the nature of matter and force were revolutionised by the grand generalisation in recent times of the law of the conservation of energy. This law, which is of immense importance in its bearing on the subject of physiology, I shall have to explain to you more fully on a future occasion. For the present it may suffice to say that it is based on the axioms "nothing comes from nothing", and "nothing can be reduced to nothing". The amount of energy in the universe is like matter—constant; it cannot be created, and it cannot be destroyed.

Energy is said to be active or potential. Thus, in the winding up of a watch, the active energy of the muscle is converted into potential energy as the tension of the spring, which again expends itself during the day as the active energy or movement of the machinery. So the energy or heat of a fire is simply the setting free of the active energy of the sun, which was rendered potential in the formation of the oxidisable substance or fuel. Again, the various forms of energy, such as heat, light, electricity, and chemical affinity, are looked upon as convertible into each other and into motion. Thus the motion of a steam-engine is only the converted heat of its fuel. Motion, again, may become heat, as when heat is produced by rubbing two surfaces on each other. So in like manner electricity and chemical affinity are convertible; and all the forms of energy are also shown to be convertible with each other either potentially or actively.

Up to the time of the enunciation of this law, physiologists had looked upon the food which an organism requires, not as representing the amount of energy at its disposal, but rather as a means of somehow or other repairing the vital machinery, or oiling its wheels. They looked upon a living organism as an example of an automatic self-determining force-creating machine. When we look, however, at living beings, we find that they are as much dependent for their vital energy on the food they consume as a fire or a steam-engine on their fuel; and that just as a fire goes out when its fuel is exhausted, so as surely the fire and light of life go out when food is withheld. The question then comes to be asked, If life is so dependent on matter and its forces, is not vital energy merely a form of physical energy, and convertible with it? This is the view which is now maintained by almost all the advanced physiologists of the present day, and which was lately made the subject of a celebrated essay by Professor Huxley. The physical doctrines of the nature of life and vital energy have, however, been stoutly opposed by several metaphysicians and physiologists, prominent among whom stand Dr. Hutchison Stirling* and Dr. Beale.† They deny that vital

energy can be explained by chemistry or physics; and hold that vital energy, though associated with matter, is independent of it; that it is an immaterial force or power—a principle which, under the various names of *vital force*, *vital power*, *force of organisation*, *architectonic principle*, *constructive agency*, *vitality*, etc., has replaced the *Πνεῦμα*, the *ether*, the *Φύσις*, the *ἐνοπύων*, the *archæus*, the *anima*, the *materies vitæ*, etc., of the older physiologists and metaphysicians.

The physical theory of vital energy is thus stated by Professor Huxley. All the phenomena characteristic of life—viz., nutrition, growth, and reproduction—are equally manifested by plants and by animals. The physical basis of these phenomena is a chemical substance of the nature of albumen, composed essentially of the elements—carbon, hydrogen, oxygen, and nitrogen—in certain definite proportions. This substance is termed *protoplasm*, or the physical basis of life. Protoplasm, he says, is of identical composition in the animal and vegetable worlds; this substance, variously modified, constitutes the organic clay of which all organisms are built; there is no chemical difference between living and dead protoplasm; the various forms of protoplasm, animal and vegetable, are convertible with each other; and, under the influence of pre-existing protoplasm, dead protoplasm may be converted into living protoplasm, and the protoplasm of one organism may become the protoplasm of another. Further, in such conversion there is no new entity as vitality added to it, any more than in the conversion of hydrogen and oxygen into water any such entity as *aquosity* is added to the elements; and, finally, all vital energy is the expression of molecular change in the physical basis of life.

Professor Huxley has been unfortunate in his use of the term *protoplasm*; and his incautious use of it has been the source of much misconception and misrepresentation of the theory of vital energy which he advocates. Had he clearly distinguished between the identity of protoplasm as such and the identity of its elements, and kept the term to its usual signification, the physical theory of life would have resisted much better the furious onslaughts that have been made against it.

It has been rightly argued by Dr. Stirling that we must regard protoplasm as possessing a definite organisation, and as existing as protoplasm only in that form of organisation which we call the *cell* or primary element of living beings. We may compare protoplasm to the familiarly known Prince Rupert's drop. If we attempt to take away a piece from it, it instantaneously falls to powder in our hands. The elements are still there, but the drop has disappeared; its molecular constitution has been altered; or, in Dr. Stirling's phrase, the idea has vanished. And in that consists the absolute difference between living protoplasm and dead protoplasm, between the elements simple and the elements in combination. Professor Huxley, therefore, would be in error if he claimed for dead protoplasm the same composition as living protoplasm, simply on the ground of the identity of the results furnished by chemical analysis. Mere chemical analysis of the elements of a substance teaches us nothing of its constitution.* We have numerous instances of substances which, on ultimate analysis, furnish the same elements and in the same proportion. But it cannot be said that the substances are the same, simply because their elements are the same, for with the same elements there may be infinite diversity of form and properties. I need only mention one instance. A piece of charcoal and a certain amount of water furnish us with all the elements of a lump of sugar, and in the same proportion. No one, however, would say that sugar is simply charcoal and water, or that the one may be substituted for the other. And we may safely predict that, to whatever straits the Parisians may be reduced, they will refuse to accept charcoal and water in lieu of their favourite *cau sucrée*.

We must therefore admit that, with the same elements, there may be a difference between dead and living protoplasm, and between the various kinds of protoplasm. It is essential to the stability of the physical theory of life that this difference should be recognised. Professor Huxley has done this, though somewhat vaguely, under the terms "subtle influences" and "influence of pre-existing protoplasm"—expressions which have been so much criticised. But whatever inconsistencies Professor Huxley may or may not be guilty of, an *argumentum ad hominem* does not affect the doctrine which he supports. And it is to be remarked that Dr. Stirling, in arguing against the universal identity of protoplasm, and in claiming for it differences in organisation and composition, has forged a most powerful weapon against himself. For if, with differences in vital phenomena, we have differences in constitution and chemical composition, the hypothesis of a vital force, independent of these differences, becomes the less necessary.

Dr. Beale has, consistently with his views as to vital force, endeavoured to establish, in *living or germinal matter* or bioplasm, a uniform appearance and composition. The microscope, however, is as incom-

* As regards Protoplasm, in Relation to Professor Huxley's Essay on the Physical Basis of Life. (Blackwood and Sons)

† Protoplasm; or Life, Matter and Mind. (Churchill and Sons.)

* This fact has been clearly brought out by Dr. Gamgee, in his able lecture on Force and Matter in Relation to Organisation. (MacLachlan & Stewart, Edinburgh.)

petent as chemical analysis to determine the constitution of substances; for we have endless instances where the same appearances coexist with entirely different composition and organisation. And therefore the argument of Dr. Beale, that because, with the aid of the highest powers of the microscope yet invented, he cannot discover any *molecular machinery* in living matter, and that therefore vital energy is independent of physical conditions, possesses little value. The theory that vital energy depends on molecular organisation does not stake its existence on the mere word "molecular". The essential fact which it seeks to establish is, that the phenomena are due to physical conditions. And if it can be shown that the hypothesis of a self-determining vital force, independent of matter, is untenable, we shall have the more reason for seeing in physical differences and physical conditions a sufficient explanation of the diversified phenomena and products of vital activity.

But, before proceeding further in the argument, it is absolutely essential to distinguish between two questions widely separated from each other, and, as far as we are at present concerned, having no relation to each other—I mean the question of the *primary origin of life*, and that of the *nature of vital energy*. The two questions differ from each other *toto calo*, yet they have been constantly confounded with each other; and the arguments of the vitalists, however powerful they may be against the spontaneous origin of living beings, are, as regards the physical theory of vital energy, glaring instances of the fallacies of irrelevancy and *non sequitur*. Thus it is argued that, because the elements of protoplasm cannot spontaneously or by artifice be made to combine so as to form a living protoplasm, therefore vital energy does not depend on the chemical and physical constitution of protoplasm. In the same manner it might be argued that because iron, coals, and water, cannot of themselves give a steam-engine action, therefore the action of a steam-engine is not explicable on chemical or physical grounds; or, to render it still more absurd, that it is impossible to understand the action of a watch unless we know the maker's name!

Again, the argument that, because vital energy has peculiarities which distinguish it from every other form of energy with which we are acquainted, therefore it cannot be a form of physical energy, is a manifest begging the question. We know so little of the ultimate nature of energy that it would be presumptuous to dogmatise on the subject: and yet the vitalists constantly charge their opponents with dogmatism when all they do is to generalise vital energy under the term energy, in so far as it is understood by us; namely, as connected with matter—physical energy.

Having considered the arguments of the vitalists against the physical theory of vital energy, let us turn to the position which they take up, and examine the nature of the *vital principle* or *immaterial force* on which, they say, vital activity depends. Dr. Stirling speaks of a *force of organisation*, an *architectonic principle*, an *entelechy* or active idea, as the cause of vital action. Now, granting for the time, the idea, the architectonic principle, according to which the organism was formed, to elevate this idea into an immaterial constantly operative force is a form of the Platonic doctrine of ideas, which, if logically carried out, would virtually annihilate the distinction which Dr. Stirling seeks to establish between material forms of organisation and living organisms. For, in like manner we should have to ascribe the action of a steam-engine, not to chemistry and physics, but to a *steam-engine principle*. And what better foundation is there for the existence of an architectonic operative principle, or force of organisation, than a steam-engine principle, apart from the material properties of the thing organised?

The vital force advocated by Dr. Beale is more difficult to understand. Vital force, he says, is a peculiar power, which influences matter for a short time, and which may be transmitted through the infinite multiplication of living matter without increase or diminution. This is equivalent to saying that it is a power or force which may be infinitely multiplied or divided and yet remain the same. Such a power would fully deserve its title "peculiar" if it really existed.

If we look at the germ or first rudiment of a living organism to which we may suppose this power has been transmitted, one or other of two suppositions may be entertained regarding it. It may be supposed, in the first place, that the germ contains potentially all the vital energy of the fully developed organism, that the vital principle exists in it in a state of extreme tension, and that with the growth of the organism it expands, so to speak, in a series of dissolving life-views. This idea, however, is disclaimed by Dr. Beale. The other supposition is, that the vital force exists in the germ exactly in the same amount as in the fully developed organism, and that in the multiplicity of vital phenomena there is really no increase or diminution of vital energy. This might or might not be true of a vital power, if it were of the immaterial nature which is claimed for it. It cannot, however, be immaterial, for the immaterial is an unity, and indivisible. But the vital power of the germ is capable of infinite division; and the reason for the specific life

of an individual part does not lie in the whole organism, for a part may be separated from the body and yet live.

What, then, is the nature of this principle, which, though associated with matter, is not of it, but independent of it? We find that under certain conditions this power may be added to and vitality increased: and it will not do to argue that there is no increase of vitality, but merely increased physical or chemical change; for increased nutrition and growth, being increased vital work, must mean increased vital force. Whence, then, the increase? If not from conversion of physical energy, then the vital principle must possess the power of adapting itself spontaneously to the infinite diversity of material conditions, and be capable of creating itself out of nothing. It must be a miraculous force—a force which can be increased, multiplied, and divided, and yet remain the same. There is only one thing that may be added to, subtracted from, multiplied and divided, and yet remain the same, and that thing is nothing. If the vital force exist, therefore, and be of the nature claimed for it, we should seem to have arrived at the positive existence of "nothing", and at reading *ex nihilo nil* in a new light. But if, on the other hand, it be said that vital energy depends for its existence on material conditions and physical energy, but yet is a peculiar power inconvertible with physical energy, then we have a source of the dissipation of energy which physicists have not yet taken into account; nor, I may add, are they likely to.

I have thus endeavoured to show that the arguments of those who support the doctrine of an immaterial principle, or force, operating in and through matter, and distinct from its chemical and physical organisation, are based on two fundamental fallacies, and on an unnecessary and unfounded hypothesis.

Regarding vital energy, then, as a mode of motion, so to speak, yet, inasmuch as it manifests itself in modes peculiar to itself, and different from any of the other modes of energy with which we are acquainted, we may yet use the terms vital energy, vitality, vital force, to signify this special mode of manifestation, so long as we do not use the term in the sense in which it is used by the vitalists. Vitality, therefore, is only looked upon as a fiction when it is used to signify a special force added to matter and independent of physical organisation. If used in this sense, it has just as much reason for existence as a hypothetical *aquosity* on which the properties of water depend, or a *steam-engine principle* to which the action of a steam-engine is due. When we turn to the other side of the question; viz., the *origin of life*, we must confess that it is to us now as much as ever shrouded in mystery.

Some biologists, however, who hold the doctrine of spontaneous generation, argue very plausibly that, if vital phenomena are dependent on certain combinations and molecular organisation of simple elements, it is quite conceivable that spontaneously, or by artifice, these elements may be so combined and organised as to form a substance which shall manifest life. But conceivability is not fact; and we yet want proof that spontaneous generation takes place, or that the elixir of life or philosopher's stone has been discovered by which lifeless is transformed into living matter.

The physical theory of vital energy has been absurdly styled materialistic, and regarded as tending to overthrow established and sacred beliefs. There never was a greater mistake. These beliefs are really more endangered by these who claim to be their only friends and supporters. For the vitalists, by identifying their arguments for the existence of a vital force in living organisms, with those for the existence of the immaterial soul, have fallen into the error of Stahl. In their haste to avoid Scylla they have fallen into Charybdis, and are themselves the most dangerous enemies of the doctrine which they think they are upholding. It is, moreover, only by recognising the physical nature of vital energy that we can ever hope to establish therapeutics on a firm and sound basis; and this is the only view consistently with which we can continue to pursue our investigations, with the hope of further elucidating the more recondite and complex laws and phenomena of vital action.

Physiology must be regarded, therefore, as an experimental science. This has not, however, been sufficiently recognised in this country. It has been too much the custom to look upon physiology as of very inferior importance as compared with anatomy, and to consider it as merely a record of interesting and curious opinions and speculations, or as a part of the very pretty but scientifically worthless doctrine of final cause. In addition to this, physiology has had to contend in this country against the absurd prejudices of those—and, unfortunately, their name is legion—who imagine that they are advocating the cause of humanity by opposing those methods of physiological experiment on living animals which are essential to the advance of scientific medicine, and with it of the promotion of the welfare of the human race.

Until such ideas are cleared away, and physiology is studied practically as much as anatomy or chemistry, and laboratories are esta-

blished for physiological research, we cannot hope to do much in the way of advancing the scientific basis of medicine. When we consider what is done by Germany, and see her now *facile princeps* in war, as also in all that relates to the advancement of science, we must bestir ourselves if we are to maintain the position among the nations which we persuade ourselves we hold. A step in the right direction has been taken by the Council of the College of Surgeons. They now require of all those who present themselves for examination satisfactory proof that they have made themselves acquainted with the principles and methods of experimental research.

The next thing that requires to be done is the establishment of laboratories for that purpose. This is now being effected. In this way we hope soon to see a new era inaugurated in the prospects of scientific medicine in this country: for when all our students have it in their power to learn the methods of physiological investigation, and their practical application to therapeutics, we shall be the better able to sift fact from tradition and hypothesis, to clear up what is doubtful, and sweep away the fallacies on which quacks flourish and by which medicine is disgraced.

CASE OF IDIOPATHIC MYELITIS.

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THOS. McDERMOT, aged 11, a strong healthy-looking boy, was admitted to the Infirmary on February 24th, 1870. He stated that, about one week before admission, pains commenced in the small of his back, and gradually extended round his body on both sides, as high in front as the umbilicus. The pains were very much worse at night, preventing him from sleeping. Micturition was frequent, giving him temporary relief. Walking caused severe pain. He had received no injury, and was in perfect health previously to the attack.

On admission, his condition was as follows. The pulse was 120; the tongue coated; the skin hot. His countenance was expressive of great pain. The body was inclined slightly forward. He was unable to assume the erect posture. He could not walk without causing great increase of pain. The pain over the lower dorsal vertebrae was very severe; it extended round the abdomen and down the lower extremities, and was greatly increased by pressure over the spinous processes. Micturition was very frequent. The bowels were costive. Sensibility was nowhere impaired. The skin was red over the lower dorsal vertebra.

February 26th. Pulse 116; temperature 103.2. He seemed much worse, and had profuse perspirations. The pain was constant in the legs, and there was slight hyperæsthesia. Constant pain, increased by pressure, continued in the back. He jumped up frequently in the night and cried out with pain. Incontinence of urine, constipation, and priapism, now existed.

March 3rd. There was complete paralysis of the lower extremities; anaesthesia extended upwards as far as the seventh intercostal space in front and the fifth dorsal vertebra behind, above which slight hyperæsthesia existed. The feces and urine were passed involuntarily. The priapism continued. He had a burning pain in the back, increased by pressure. The temperature in the groin was 102.1; in the axilla 100.4. Bedsores were forming over the sacrum and the trochanters of the thigh-bones. All the symptoms continued unchanged till April, when the bed-sores were rapidly extending, completely exposing the sacrum posteriorly, and the trochanters and head of the femur on each side. He died on April 18th.

Post Mortem Examination.—Inflammatory lymph extended over the lower dorsal portion of the spinal cord. The membranes here were very much injected, and partially adherent to bone, particularly posteriorly. On laying open the membranes, nothing abnormal was observed. A longitudinal incision of the cord showed white softening to the extent of half an inch opposite the fifth dorsal vertebra; and whitish fluid exuded here. The vertebrae were perfectly healthy. On removing the calvaria, the dura mater was not so vascular as is usual. There was slight subarachnoid effusion, general over the upper surface. At several points along the longitudinal fissure, clusters of minute white nodules resembling tubercle were situated on the arachnoid. The substance of the brain, on section, seemed very anæmic. At the base, slight adhesions and a few minute white nodules were observed. The bladder was found firmly contracted. In its walls, at the apex, was an abscess of the size of a hazel-nut. The interior of the bladder was ulcerated. The ureters were greatly dilated. The pelvis of the kidney was much enlarged and ulcerated. Points and patches of a brown colour with gritty particles, were scattered here and there through the substance of the kidneys. The renal structure was very pale; and numerous abscesses were present on the surface of both kidneys.

ON THE SHOULDER-TIP PAIN, AND OTHER SYMPATHETIC PAINS, IN DISEASES OF THE LIVER.*

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OF the group of symptoms ordinarily representing a disease of some internal organ, there are usually a few primary, central, and distinctive members, forming, as it were, the nucleus, and which are directly referable to the organ itself; to these are frequently added others more outlying or peripheral and less characteristic, indicating the influence exerted by the diseased organ upon parts, more or less distant it may be, but more or less importantly connected with it. Parts thus secondarily affected have been said to sympathise with the primarily diseased organ.

The study of the sympathies, morbid or healthy, of the different organs or parts of the body, obscure, intricate, and difficult, has from the earliest ages riveted the attention of Physicians, who in their earnest strivings after truth, have been led astray into the wildest conjectures and vainest hypotheses.

Within the past century, however, an increasing light has been dawning upon this part of our science. Thus we can, to a certain extent, account for the pain in the knee in hip-joint disease, through the connection of the knee and hip-joints by means of branches of the anterior crural and obturator nerves, and so on for other examples.

It must, however, be allowed that these explanations, such as they are, are neither full nor satisfactory; they only show that these pains do occur in certain cases, and that the parts concerned have certain more or less direct nervous interconnections, but they fail to inform us of the nature or essence of the sympathy existing, of the mode in which it is evoked, and of the good, if there be any, that comes of it; and the mystery of sympathy remains as great as before. And yet there can be little doubt that all the sympathetic pains we meet with are susceptible of satisfactory explanation, could we only examine them with sufficient care, and by reference to trustworthy anatomy.

The shoulder-tip pain in liver-disease belongs confessedly to the same category of sympathetic affections as that just named, but I have not been able to find any sufficiently satisfactory explanation of it, even to the extent to which explanation has been carried in the other instances.

The object proposed in this paper is to attempt an explanation which shall be plain and satisfactory, and shall dispel the ancient mystery which hangs around and obscures the morbid sympathy of organs.

As a preliminary, however, it may be interesting to glance at what has been written on the subject, for this pain has received a good share of attention from the time of the father of medicine, and probably long before, down to the present day.

For convenience, several quotations have been placed in foot-notes.

1. *Ancient Authors.*—Hippocrates,† Celsus,‡ Galen, Aretæus,§ Cœlius Aurelianus, ||Paulus Ægineta, ¶ Haly Abbas, and Rhazes, all mention the existence of pain in liver-disease in the shoulder, clavicle, or throat of the right side. Prosper Alpinus** notices it as occurring in the right side of the throat and the right scapula.

* Read in the Medical Section at the Annual Meeting of the British Medical Association in Newcastle-upon-Tyne, August 1870.

† "Pains in the shoulder, which, passing down the arms, occasion torpor and pains, do not usually terminate in deposits, but the patients get better by vomiting black bile. But when the pains remain in the shoulder, or extend to the back, the patients are relieved by vomiting pus or black bile. But if they have more difficulty of breathing, or if there be any unusual colour on the countenance, whether reddish or black, it is to be expected that they will rather spit blood."—(The Genuine Works of Hippocrates, by F. Adams, LL.D., Append. to Prognosis, vol. i, p. 268. Sydenham Society, 1848.)

‡ In Acute Hepatitis.—"Dextrâ parte sub præcordiis vehemens dolor est; idemque ad latus dextrum et ad jugulum humerumque partis ejusdem pervenit; nonnunquam manus quoque dextra torquetur."—(A. Corn. Celsi Med., libri octo, by Milligan, lib. iv, viii.)

§ "The diaphragm and succingens (pleura) are dragged downwards, for from them the liver is suspended as a weight. For this reason, a strong pain extends to the clavicle of the same side."—(Extant Works of Aretæus the Cappadocian, by F. Adams, LL.D. Acute Diseases, book ii, cap. vii, p. 277. Syd. Soc., 1856.)

¶ "The symptoms of scirrhus of the liver are a round circumscribed tumour, felt below the ribs, the colour jaundiced, the urine muddy, pain extending to the throat of the affected side, etc."—"The Seven Books of P. Ægineta, by F. Adams, book iii, p. 566. Syd. Soc., 1848; or, Cœlius Aurelianus de Morbis Acut. et Chron., lib. iii, cap. iv.—De Jecoris. Amstelodami, C1712CCIX.)

¶ "When the liver is inflamed, there is, in all cases, pain in the right hypochondrium, extending upwards as far as the clavicle."—(The Seven Books of P. Ægineta, by F. Adams, LL.D., book iii, sect. xlv, p. 560. Syd. Soc., 1848.—On Affections of the Liver.) See also pp. 567 and 568.

** "Hæc deprehenditur a dolore in dextro hypochondrio tensivo juxta costas spurias (cum quadam illiusce partis gravidine) aliquando ad jugulum, et ad scapulam pro-