CROONIAN LECTURES

ON

MATTER AND FORCE.

Delivered at the Royal College of Physicians.

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LECTURE I.

On the Three Stages of our Ideas regarding the Union of Matter and Force in the Abiological Sciences.

"But though the natural works of God can never by any possibility come in contradiction with the higher things which belong to our future existence, and must with everything concerning him ever glorify him, still I do not think it at all necessary to tie the study of the natural sciences and religion together."

FARADAY, MS.

MR. PRESIDENT,—I must begin this course of lectures by assuring you that I am fully sensible of my rashness in venturing to bring before you a subject which may be thought to be more metaphysical than physical, and to be too difficult to be of any practical utility; but I venture to take the great chance of failure, because I hold that the clearness and breadth or dimness and narrowness of our ideas regarding matter and force must constitute a good or a bad foundation of all the knowledge we possess, not only in medicine, but in every other science.

In the history of the development of scientific knowledge, whether in mankind, nations, or individuals, ideas of matter and force are found to become gradually more clear and more broad; and, as soon as clearer and more connected ideas are obtained, they immediately lead to fresh investigations; and on this account, if for no other cause, it is desirable that from time to time we should ask ourselves what is the degree of clearness and breadth to which we have attained in our ideas of matter and force. What are our present ideas? Whence have they come? Whither are they going? Ideas that have become too old give no new lines of research, and always cause the grossest misinterpretation of new facts; whilst new ideas, even though far from the perfect representation of the ultimate truth, yet can gradually be made to come nearer and nearer to that perfect knowledge which is based upon reason and demonstration, and not on external or internal authority.

In this lecture, I intend to bring before you the history of our ideas regarding the union of matter and force in those sciences into which the idea of life does not enter.

Three distinct stages of ideas or epochs of thought may be clearly recognised. The first may be considered as the authoritative stage, or that of complete separation between the ideas of matter and force. This stage may be summed up in two words, materialism, and immaterialism or spiritualism. It may be called primitive, because it implies a state of almost complete ignorance of the first principles of natural knowledge.

The second stage is founded partly on authority and partly on natural knowledge. It is marked by the incomplete separation between the ideas of matter and force. Force is held to be imponderable matter, or to be inseparably united with imponderable matter. This may be called the stage of imponderable materialism, and it may be marked as the transition or Newtonian stage.

The third stage rests solely on the advance of natural knowledge, and is characterised by the complete union or perfect inseparability between the ideas of matter and force. This may be called materialism, if, in the definition of matter, the definition of force is included; or it may be called spiritualism, if, in the definition of spirit, the definition of matter is contained. This stage, in which our ideas of matter and force are inseparably united, may be distinguished as the modern stage.

The first or primitive stage is that of complete separation between the ideas of matter and force. Before bringing to your notice some of the records of this stage which exist, it is desirable that you should for a moment consider what the earliest ideas of matter and force were likely to be when no knowledge of science existed.

The further we go back, the more we must expect ideas of force and matter to be formed on superficial likenesses and distinctions. Fundamental separations or relations must not be looked for. The different conditions of the same matter, as solid, liquid, or vapour, will strike the senses far more distinctively than the different elementary substances which are now known. So, also, variations of form and quantity will be far more noticeable than the action of the different forces which we now recognise in matter. Finally, we must expect no clear distinction between the highest and the lowest phenomena shown by animals and

vegetables. The immortal soul, the feelings, the reason, the instinct, the life as it exists in animals and in vegetables, are all likely to be utterly confused together; and it will be as vain to look for separate ideas of different kinds of matter and force as to look for separate ideas of the soul, the reason, the animal life, and the vegetable life, to which separation we are so well accustomed.

Probably by far the oldest recorded ideas which exist on the matter and force of inorganic nature are those of the Jews, contained in a few words in the Book of Genesis. It is said, "The earth was created, and it was without form, and void. Afterwards, God said, 'Let there be light, and there was light.' The firmament, the waters, and the earth, were made as light was made; that is, in its creation, light or force was regarded as perfectly separable from matter.

In other ancient nations, or in savage tribes, we may see how ideas of matter and force were distinctly separated, by observing how the different phenomena of nature were worshipped as separate personal deities, according to the distinctness of their action on the senses. Wherever we come to the dawn of ideas, we find man raising the forms or forces of matter which he perceives around him until he makes them into heroes or deities, to which he gives a body and qualities like those he finds in himself. Thus time, or night, or day, the heaven, the earth, the sea, or light, darkness, fire, or life, become incarnate gods, capable of doing good or evil. By reversing the process, we can descend from the deities to the ideas from which they came; and everywhere we shall find that, in the earliest ideas, force is regarded as self-existing, and altogether separable from the idea of matter.

The Vedas were perhaps compiled in the sixteenth or fourteenth century before Christ. The Hindu religion contained among its deities Indra, the god of the sky or light; Vritra, the demon of darkness or night; Agni, the god of fire; Savitri, the god of the sun; Ap, the god of waters; Prithvi, the god of earth. Creation, preservation, and destruction were worshipped as Brahma, Vishna, and Seva. Brahma formed fire, water, and earth.*

In the sacred books of the Chinese, the seven gods deemed worthy of peculiar homage are the sun, moon, and five planets. The animated material heaven and the earth were father and mother of all things. To them the emperor might sacrifice; whilst the mandarins might only worship the lower deities—wind, rain, lightning. Confucius, who lived perhaps in the sixth century before Christ, directs that the blue firmament should be worshipped, especially at the equinox, as the central point of influence whence the cause of all things acts.

The old Egyptians "lived in adoration of the world above, beneath, and around them". They divided their deities into paternal and maternal. Thus Phtah, the father of the sun, was the first Egyptian god; he was the original force of nature, the world-begetting fire. Neith, who was coeternal and coequal, was the great cow, the mother of the sun; she was primordial space or chaos, every where diffused as the material basis of created beings. Osiris was the male generative principle; Isis the female, represented and worshipped in the sun, the Nile, the bull, the ram, the cat, the crocodile, the serpent, the scarabæus.

In Persia, the nature-worship was like that of the Hindus. The sun, moon, fire, water, earth, and winds, etc., were divided into good and bad spirits. Zoroaster, the reformer, and writer of the Zendavesta or Word of Life of the Parsees, who lived before the sixth century before Christ, taught the worship of the sun and sacred fire as the best representative as the good eternal spirit, Ormazd or Ahuramazda. A corresponding evil spirit, Ahriman, was also worshipped.

The earliest Greek ideas of matter and force are given by Pherecides Syrius in the births and marriages of the gods. He says Zeus was first of all. The second principle was a plastic matter, or earth. Light was the third. Amongst the deities were Uranus, Neptune, Vulcan, and Venus—sky, water, fire, and attraction. Empedocles first taught the doctrine of the four elements. To him, the force of heat was quite distinct from the three forms of matter, earth, water, and air.

If, instead of turning to the records of ancient nations, we take the mythology of the natives of Africa, America, or Polynesia, we find

* "Wherever in the world around him the Hindu observed extraordinary manifestations of the brilliant or the beautiful, the barren or the prolific, the sombre or the terrible. Wherever the action of the elements was such as to produce extraordinary effects upon himself, his children, or his property, he betrayed the consciousness of his dependence by some special act of homage. He acknowledged in such powers the presence of divinity. He called the influence which affected him or his deva (*deus*). It was pregnant for a time with a divine or a diabolical efficacy, and therefore it became a fitting object of desire or dread, of adoration or of deprecation, according to the aspects it assumed in reference to the worshipper. Hence also every province of Creation was soon peopled by spiritual energies, all varying in their character with human hopes and fears, with human interests and passions. Nay, so far was the Hindu impelled in this direction, that he deified the sacrifice itself (the soma or milky juice of the moon-plant, *Asclepias auda*), from which he hoped to profit. He worshipped his own offerings. He worshipped the solemn form of words by which his offering was accompanied."—Hardwick, vol. i, p. 178.

everywhere that ideas of matter and force are distinctly separated or entirely confused, according to the action of the different phenomena of nature on the senses. In New Zealand, the Maori's held that night was the first god, because they thought night produced the day. Heaven was next; then earth; then their children, the gods of light, the sea, etc. They thought that everything was the organ of a special god, or father, or demon, who made it, and kept it what it was. Thus they deified meteors, rainbows, sharks, ants, rats, or any image, to which they gave their own shape and properties.

Among the wild tribes of America, the Great Spirit is the highest member of a group, a personification of the mightiest of all natural energies; the sun, God. The living sun itself is not a symbol, but an actual god. The moon is the evil spirit, capricious and changeable. An animal or thing that is worshipped is not a symbol of this or that divine natural power, but becomes altogether a god, a fetish, or spell, or magical charm.

Even if we look to the origin of our own ideas, we shall find that the belief in the existence of four elements—earth, air, fire, water—which has lasted down to the infancy and perhaps beyond the maturity of some now alive, is quite sufficient to prove that we once had our ideas of force or fire entirely separable from our ideas of the three different conditions in which matter may occur. We have all gone through the primitive stage of ideas, in which matter is entirely separable from force.*

The second or transition stage of ideas consists in an incomplete separation between the ideas of matter and force. In this stage, force is considered as altogether separable from ponderable matter, but perfectly inseparable from an imponderable æther, gas, or fluid, which is capable of being attached for a time to the imponderable matter.

The first trace of the idea that force is imponderable matter seems to have started from Kepler; he used it to account for the motions of the planets. He thought that a current of fluid matter circulated round the sun, carrying the planets with it like a boat in a stream. He says the vehicle of that virtue which urges the planets, circulates through the spaces of the universe after the manner of a river or whirlpool (*vortex*), moving quicker than the planets. He asserted these vortices to be an "immaterial species," capable, however, of overcoming the inertia of bodies. Thence come the vortices of Descartes, by which he showed how the world must have been constructed, and thence the agitation of the æther of Leibnitz; and then follows Newton, who may rightly give his name to this stage of our ideas on matter and force; for Newtonian ideas on matter and force have continued in consequence of his authority down to the present time. Even with regard to gravity, Newton refused to entertain the third stage of ideas. In his second letter to Bentley, 1693, he says: "You sometimes speak of gravity as essential and adherent to matter. Pray do not ascribe that notion to me. The cause of gravity I do not pretend to know, and would take more time to consider of it." He seems to have been disposed to refer the tendency of bodies to a centre to the elasticity of an æther. It was, however, in his ideas of light that Newton held the imponderable materiality of force. Descartes said that light consisted of small particles emitted by the luminous body. He compares these particles to balls, and endeavours to explain, by means of this comparison, the laws of reflection and refraction. Hooke proposed the theory of undulations, and asserted that light consisted in a quick short vibratory motion propagated in a homogeneous medium. Huggins says Whewell would have established the undulatory theory, but Newton, though at first by no means averse to the assumption of an æther as the vehicle of luminiferous undulations, and even to the last considering the assumption of an æther as highly probable, and its vibrations as important parts of the phenomena of light, yet made the emission ideas the leading part of his optical doctrines. "His disciples found it more easy to conceive the motions of a particle than the propagation of a wave, and the general ascendancy of the Newtonian doctrines led to a belief in the materiality of light." Newton's ideas of the actual emission of some substance as the cause of light lasted until the time of Dr. Young and Fresnel. The materiality of light led directly to the assumption of the materiality of heat. Lambert, in 1755, published an essay on the force of heat, in which he likens the communication of heat to the flow of a fluid. To account for the phenomena of heat, a com-

bustible element, an igneous matter, capable of combining or separating itself from other substances, was assumed; this was phlogiston. It was considered, until the time of Black and Lavoisier, as just as much a chemical element as any ponderable element. It was assumed even to have a principle of lightness. The imponderable materialism of heat, however, survived in the idea of caloric; material heat was an actual flow and emission of material particles. Leslie, in 1804, says, "What is this calorific and frigorific fluid?" It is merely the ambient air. But afterwards he says, "It is the same subtle matter that, according to its different modes of existence, constitutes either heat or light." Even as late as 1832, in the *Bibliothèque Universelle de Genève*, vol. 49, and again in 1834, in the *Annales de Chimie*, vol. 58, M. Ampère published his views on heat and light considered as results of the vibratory motion of the imponderable æther.

The imponderable materialism of the electric and magnetic force commenced with the same stage of ideas regarding heat. In 1733, Dufay proposed the idea of two electric fluids, each repelling its own parts or attracting those of the other. Franklin assumed only one fluid, repelling itself and attracting all other matter. In 1803, Dr. Thomas Young, in the *Journal of the Royal Institution*, vol. i, p. 103, gives his ideas regarding the imponderable material substance which, when present in different bodies, gives rise to electricity. "Perhaps," he says, "some antiphlogistian will soon give us a chemical analysis of the electric fluid. Might I be permitted such a doctrine, it should be that it consists of oxygen and hydrogen combined with caloric only." And in the *Annals of Philosophy*, new series, vol. ii, p. 196, Sept., 1821, Mr. Faraday says, "There are many arguments in favour of the materiality of electricity, and but few against it; but still it is only a supposition, and it will be as well to remember, while pursuing the subject of electro-magnetism, that we have no proof of the materiality of electricity, or of the existence of any current through the wire."

With regard to the imponderable materiality of the magnetic force. Descartes considered magnetic curves to be the traces of currents of ætherial matter, which are thus rendered sensible even to the eye. According to Æpinus, the phenomena of the opposite poles arose from an excess or defect of a magnetic fluid. Coulomb assumed an austral and a boreal fluid instead of a single fluid; Whewell says the hypothesis of magnetic fluids, as physical realities, was never so widely or strongly embraced as that of two electric fluids. There was no spark, shock, discharge, or mechanical effects. He continues, "if we doubt regarding electric fluids, we cannot help pronouncing upon the magnetic fluids as having still more insecure claims to a material existence. They must be regarded as different effects of one common cause. No philosopher would dream of assuming electric fluids and magnetic fluids as two distinct material agents. Thus, then, in the second stage of ideas of matter and force, force is made quite inseparable from imponderable matter, although this is considered to be perfectly separable from ponderable matter. In other words, there is an incomplete separation between the ideas of matter and force.

(To be concluded.)

CASE OF VACCINO-SYPHILITIC INOCULATION.

By CHARLES DRYSDALE, M.D.,
Physician to the Farringdon General Dispensary.

ROSA B., 14 weeks old, was seen June 4th, 1866. The child had a dry scaly eruption on the buttocks, and had some mucous tubercles at the anus; also a *café au lait* colour of the chin and the skin around the mouth. There were cracks at the corners of the mouth. Two of the posterior cervical and one of the occipital glands were enlarged. She was moderately thin, not emaciated. There was obstruction to the breathing, or "snuffles." The child, it appeared, was born quite healthy, and remained so until some time after it was vaccinated, which event took place when it was nine weeks old. The eruption appeared four weeks after the vaccination, or a week before the child was first seen. On inspection by myself and Mr. R. W. Dunn of the scars left by the vaccination, they were seen to be copper-coloured, and a distinct induration was remarked at the spot. The mother was 34 years of age, and had been married five years: she had always been well, and had healthy children. One born since that time is now (March 1868) in perfect health. One girl, three years old, was at that date quite well. Her husband, employed in the post-office, came at my request, and presented not the slightest trace or history of syphilis. The child became much better for a time on chlorate of potash; and afterwards, during my absence from town, was reported to have died in August.

* "In the origin of some of the latest religions, the separability of matter and force is distinctly seen. In 1792, Johann Schönherr felt that he had got the results of nature in his grasp. Light is the male vivifier; water the female, the nurse. These two arch-beings, the supreme male and supreme female, bound in eternal and necessary wedlock, explain everything; for in this great wedlock of principles lies the only chance of the seed of things being brought to life. Schönherr felt that this sudden gift of insight was no accident of time and place. It must be more: a revelation from on high; a working of celestial love in his soul; a pouring of the divine will into his spirit. One day he went to Emanuel Kant, to whom he wished to make known his grand secret, that all living things consist of light and water. 'Very well,' said the expounder of pure reason, 'have you tried to live on them?'"—Dixon.