

THE THEORIES OF LIFE BEFORE THE HIPPOCRATIC ERA.

By CHARLES GREENE CUMSTON, M.D.,

Honorary Member of the Surgical Society of Belgium, of the New Hampshire Medical Society and the Maine Academy of Medicine and Science; Fellow of the American Association of Obstetricians and Gynecologists; Member of the Mass. Medical Society; Corresponding Member of the Association of Genito-Urinary Surgeons of France, of the Obstetrical and Gynecological Society of Paris, of the Pathological Society of Brussels, etc.,

Boston, Mass.

That there was in Greece a medical art, both philosophical and practical, before Hippocrates, is amply demonstrated if one will read the works of this distinguished writer, the authenticity of which is now generally admitted since the researches of Littré. In his "Treatise on Ancient Medicine"* Hippocrates begins with this sentence: "*Ὅσοι ἐπεχείρησαν περὶ ἰατρικῆς λέγειν ἢ γράφειν.*" . . . "All those who have tried to discourse or to write on medicine" . . . As far back as one may go into Grecian antiquity, unless we arrive at the time of fables and semi-mythological recitals, where legends surround truth to such a point that it is often rendered unrecognizable, one will find two currents of thought, parallel but distinctly different, which sum up the entire history of medicine before Hippocrates, namely, the sacerdotal and the pre-Socratic philosophy. It is to both these sources that one should date back all knowledge pertaining to science and philosophy.

As to the medicine of the priests, which was entirely practical, as far as it is possible to judge from the very rare documents which have been handed down to us, or from what the older writers have said of them, we will pass over rapidly, because nothing has there been found relating to the subject of the present paper. The Asclepiades, for thus the disciples of Æsculapius were termed, exercised their profession more particularly in the temples, and a few cures have been attributed to them. It is also thought that they published a few notes on their art. For a long time they were the only sect in Greece who practiced the medical art, and it will be found that at the origin of the greater number of ancient races this intellectual culture was possessed exclusively by the priests. It may be that this privilege is the reason for the preponderant influence and power of various religions, and of

* Περὶ Ἀρχαίας Ἰατρικῆς, 1.

IN MEDICAL LIBRARY AND
HISTORICAL JOURNAL 1.3

3920 Pdx
GREENE, C.
1903
P. 185-196

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their ministers, in the history of people at their origin. Thus may be explained the jealous care with which the priests kept for themselves this intellectual superiority. But if in the medicine of the Asclepiades we find nothing relating to the problem of life, it is not the same in the second current of medical thought that we have already mentioned, and which is nothing else than the pre-Socratic philosophy.

The study of the first Greek philosophers is confounded with the history of medicine at the same epoch, and in order firmly to establish what we uphold, we will give some proofs based on the authority of certain medical historians. In the early times of Greek civilization, philosophers were men who gave themselves up, not exclusively to that part of science which to-day is termed "Philosophy" and which more especially comprises the study of the sciences of the mind and the fundamental causes, but to those researches, of a more general extension, which included all branches of knowledge. The study of the functions of the human body, the diseases to which it is subject and of life and death, were included in the domain of their philosophy, and if some of them took up the study of medicine more especially, these were none the less counted among the disciples of some one school of philosophy; thus their ideas on human physiology were the simple consequences deduced from their doctrines on nature in general. This is precisely what Hippocrates reproaches them for in his treatise already alluded to.

All writers who have traced the history of Greek medicine have included in their writings a study of these philosophers, who for the greater part were also physicians. Hippocrates speaks of them in his treatise, and later, in the first volume of Galen's works, the following passage is to be found: "*Τὰ γὰρ τῶν παλαιῶν ἅπαντα περὶ Φύσεως ἐπιγέγραπται, τὰ Μελίσσου, τὰ Παρμενείου, τὰ Ἐμπεδοκλέους Ἀλκμαίωνος τέ καὶ Γοργίου, καὶ τῶν ἄλλων ἀπάντων.*"

In the introduction to his work, *Notions d'Histoire de la Philosophie*, Monsieur Boirac says,* "In the period which precedes Socrates the nearly unique object of philosophy was nature. They endeavored to discover the substance and the origin of things, without any other method than by hypothesis." Galen said almost precisely the same thing in the passage that we have already quoted and Littré affirms the same thing in the following extract that we borrow from his work entitled *Commentaires des*

*Our translation.—C. G. C.

Oeuvres d'Hippocrate, and which we will translate literally because it goes to confirm several points relative to the subject of this paper: "Outside of the medical priesthood, most notable changes took place, and a science, created by other hands than theirs, surrounded it from all parts and extended beyond it. I refer to the first Greek philosophers and their works. This is, in point of fact, the second source of Greek medicine at the time of Hippocrates and after him. These ancient philosophers had taken nature for the object of their studies, and nearly all had written works under this title. Such are Melissus, Parmenides, Empedocles, Alcmeon, Gorgias and many others. These books have perished, and only short fragments are now to be found. Nevertheless, one may appreciate the questions that they treated of and the researches that they undertook. The philosophers of this century caused the organization of animals and the diseases which afflict the human species to enter into the circle of their speculation." As the philosophers introduced into their medicine and biology, those systems on the nature of things which they professed, and as they comprised the external world and the living being in a connected theory, it becomes necessary to follow in this paper the order that has been adopted in the history of philosophy, and to study the various schools which existed at this time. These schools of philosophy are four in number, namely, the Ionian, the Italic, the Eleatic and the school of Abdera. As Boyer says*: "All were desirous of immediately going back to the first principles, to their nature and their origin; nevertheless, they busied themselves more than has been thought, with man and the faculties by means of which he is able to gain his knowledge." Let us now endeavor to bring out the opinion of these philosophers on the problem of life in the triple point of view of metaphysics, biology and medicine.

The philosophers of the school of Ionia gave themselves up to the study of nature, of the sensible side of things; they were natural philosophers. The aim of their researches was matter, its combinations, movements, and the phenomena to which it may give rise. But their naturalism was more metaphysical than scientific, in the sense that they derived the entire order of phenomena from an unique principle, established *a priori*, consequently having no other value than that of a rather ingenious hypothesis. In the point of view of their theories of nature, and

*Histoire de la Médecine. In: *Dictionnaire Encyclopédique des Sciences Médicales.*, 2 sér., vi. p. 23.

consequently of life, two tendencies may be distinguished among the philosophers of the school of Ionia, namely, one which is rather dynamic in its nature, the other more especially mechanic. The former class admitted as a fundamental principle, as the base of everything, an element endowed with a proper force, a vital power which is the essence of everything. On the contrary, the latter class of philosophers upheld that it was the material particles and not an intimate force that they contained which explains the world by their combination, their arrangement, their various manners of reciprocal reaction. A rapid examination of the most noted philosophers of the school of Ionia will permit one to understand better the distinction of these philosophers into dynamical and mechanical.

Thales of Miletus considers that water, or the humid element, is the fundamental principle of all things. It is this material substance, essentially susceptible of taking on the most varied forms, that explains the entire living and inanimate world, by its successive manners of action. But in order that water shall transform, a communicated or a proper force is essential. Thales, who was a pantheistic philosopher, makes various forces, which are present, according to him, in all portions of the universe, enter into this action. It is precisely in this proper force with which matter is endowed, and the power possessed by the humid element for transforming and combining *ad infinitum*, that Thales considers the principle of life, and this principle is identified by him with the soul in the human body. He says all things possess an analogous soul.

Now in this theory, can one not detect a germ of hylozoic pantheism which might be called monodynamism, with a tendency rather towards materialism? In point of fact, Thales appears to admit a single principle in the living being, and by this principle he explains physical, biological and psychological facts. But he simply makes a material attribute of this intimate force, and he appears rather more to immortalize the soul than to spiritualize matter.

Anaximenes' doctrine also admits of a single and primordial element in the shape of air. Just as Thales considered water, so Anaximenes gives to this principle an intimate force which endows it with numerous transformations, such as condensation and dilatation, by which it can form all masses of inert and inanimated matter. Fire, water and earth do not in substance differ from air, and are simply the result of its successive transformations.

The soul commands all the manifestations of the body, and is identified with air.

Diogenes of Apollonia extends the hypothesis of Anaxemenes to its utmost limits and applies it more particularly to the human being. His doctrine may be found summed up in the writings of Aristotle who says that: "The soul is air; air moves and is cognizant. Air that we breathe gives us the soul, life and consciousness. Animals are possessed of the same sensations that we are; man alone is intelligent and thinks, because in him air has become drier, hotter, more subtle and acquires superior qualities."

Heraclitus makes another element come into play. For him fire is the fundamental principle of everything; it is the principle of life and of thought. His theory, which if we are to believe Aristotle, often obscure, is a materialistic pantheism. But what this philosopher has most admirably conceived is the universal mobility of phenomena under the permanence of the quantity of force. Fire is the representation of this continual destruction. The author of "*Περὶ Ψυχῆς*" gives us an opinion of Heraclitus, which is quite curious: the principle of thought, of life and of movement, which the expositor does not hesitate to assimilate with the soul, is a kind of exhalation of a fluid substance excreted by the bodies.

Anaxagoras is the author of the doctrine of homoeomerics, or analogous parts possessing their proper qualities, in virtue of which the entire world becomes organized. These give to all beings their faculties which depend on their material organization. For Anaxagoras everything in the animal and in man is in relation with the organization: the functions, life, and even intelligence. This theory is summed up in the first book of the poem of Lucretius, *De Rerum Natura*.

The doctrines of Empedocles mark a transition between the Ionian dynamism and the materialism of Archelaus and the school of Abdera. This philosopher, like many others living at the same time, built up his entire system on a hypothetical conception of the universe. He wrote a poem on Nature, a few fragments of which are left, and a work on medicine which has been lost. He also studied anatomy, and the discovery of the labyrinth of the ear has been attributed to him. It is, however, quite difficult to determine exactly the ideas of this writer on the problem of life, but nevertheless, it is probable that he had mechanical tendencies. He admitted the eternal existence of matter and its immobility, but in it he recognized two opposing forces which he called "amity

and inamity," and which produced the union or separation of the parts of the universe according to whether one or the other of these forces predominate. He also attributed elementary qualities to matter, whose variable combinations produced various modes of things. These qualities which he opposed two by two, he finally reduced to four, namely, *heat and cold*, which form the first opposition, and *dryness and humidity*, which formed the second opposition.

It is these four fundamental qualities which Empedocles defined as the four elements representing the irreducible forms of matter, namely, fire and air, earth and water. With these material elements, and the two forces of attraction, he constructed the universe, living creatures, man, the sensations and intelligence. Life is due only to the *presence* of heat, and sleep is simply a *decrease* of heat; death is an *extinction*. According to the logical consequences of the ideas of Empedocles, health is represented by a predominance of forces of union between the elementary qualities of the body, while disease occurs when the force of repulsion is greater.

Archelaus represents the mechanical and physical ideas of the school of Ionia, and explains everything by an infinity of material elements whose union, separation and varied combinations give rise to the various manifestations of life.

Anaximander of Miletus admits that the principle of all things is infinite matter, and it is from this that all living creatures are derived, and it is to this that they return after death. As Plutarch has said in his *De Placitis Philosophorum* this doctrine is faulty in two points; in the first place, Anaximander does not define just exactly what this infinite matter is, or more correctly, he does not give its characters, thus leaving the basis of his system in the realm of uncertainty. And furthermore, it cannot be understood how matter can become organized of itself without any intrinsic or extrinsic force, without efficient cause, according to the peripatetic expression (*οὐδὲ δύναται δὲ ἢ ὅλη εἶναι ἐν ενεργείᾳ, ἢ μὴ τὸ ποιοῦν ὑποκείμεναι*).

It would appear in the first place, from the rapid review here given, that there is a character in common in all the theories of the philosophers of the school of Ionia. Their entire system, and consequently their conception of life, is based on a purely gratuitous hypothesis, on a speculative consideration of the whole of the universe. Far from basing themselves on facts learned from observation, and without even endeavoring to verify their doc-

trines *a posteriori*, they distorted the phenomena, and interpreted the lessons gained from experience according to the necessities of their system *a priori*. In a word, they approached the vital manifestations with preconceived ideas, and it is for this reason that their theories could by chance only have a certain amount of objective value.

Now in a point of view of metaphysics, to what system should we include the naturalism of the school of Ionia? In the first place should it be considered one of naturalism? We would reply in the affirmative, because although they were deprived of all resources for experiment, they gave themselves up in the first place to the study which had for its end the explanation of Nature, and of the external world as a sensible reality; this is the actual basis of their philosophy. If they took up man, the soul and the divine conception, it was only in a secondary manner, armed as they already were with the doctrines that they had formulated on Nature. Of the three great problems which compose metaphysics (the world, the soul and God), they more particularly gave themselves up to the study of the first. To explain everything by the laws of Nature is the essence of a naturalistic doctrine, even though these laws are established *a priori* beyond the sphere of observation.

An inevitable consequence of naturalism, when in presence of the problem of the absolutely Divine, is pantheism, and the members of the School of Ionia were pantheists in their way. We are here in possession of two facts of the philosophy of the School of Ionia namely, naturalism and pantheism. Now what could result from this general metaphysics in the particular case of the biological problem of this paper?

In order to determine this point we must base our reasoning on the very rare fragments of this philosophy which we possess, and which we have summed up in the beginning of this paper, and we must endeavor to indicate precisely their doctrine by carrying it back to the actual facts of the problem. We have already examined it, and it may be said that there was no scientific base to this system with the exception of those few anatomical studies which were undertaken by Empedocles.

Another character which we shall endeavor to point out now is the monodynamism of the School of Ionia, which has been called hylozoism. Not one of these philosophers has attributed two distinct substances to the living being—the thinking soul on one hand, and the vital principle on the other; this conception, which many

centuries later would be the duodynamism of Barthez, is absolutely contrary to the system of the School of Ionia. Furthermore, neither the ideas of Thales, of Anaximander, nor any other, can be attached to the monodynamic vitalism or animism of Stahl. They do not consider the soul as an immaterial substance on which the vital manifestations depend, considered as functions of the soul of a very low order. What appears more in conformity with their general doctrine, is to attribute every kind of physical, vital or psychical phenomenon to a single kind of force and a single type of substance. This force and this substance, according to them, are susceptible of undergoing an infinity of transformation, and an infinity of manifestations. But they nevertheless remained reducible to a unity throughout the diversity of phenomena which result from them, whether this substance was air with its force of dilatation and of condensation, as was upheld by Anaximander, or Diogenes, or whether it was water with its force of transformation, as Thales would have it; thus, it is none the less true that the theory of all these philosophers is one of absolute monodynamism.

The monodynamic vitalism, which is still called animism, admits two distinct substances, namely, matter or the body, and the soul, and to this latter it attributes all the phenomena of life. Now the followers of the School of Ionia include in the same order the physical, vital and psychical phenomena, life and thought and gross bodies; they admit but a single kind of substance endowed with an inseparable force, and they are, we repeat, absolute monodynamists. For them matter acts and lives, and it is for this reason that the term of hylozoism has been given to their doctrine.

Boyer in the article already alluded to, speaking of the Italic School, writes: "This school was struck with the intellectual form of objects, with their mathematical conditions, and their relation with the superior Being." The philosophy of the Italic School has been made a mathematical idealism, and the head of this school was Pythagoras.

It does not enter into the province of this paper to examine the theories of this philosophy, and we will simply indicate a few points which are related to our theme. Pythagoras admitted two eternal substances, namely, the mind and the matter, and from these he made everything spring. As Olivet* has said, his spiritualism is a dualistic spiritualism. But another character of the philosophy of Pythagoras, not less important, is the mathematical

**Vers Dorés de Pythagore.* Paris, 1813.

form of his conception of the universe which is most amply proven by his theory on numbers.

From this general doctrine what was to result in the domain of biology? Houdart* indicates it very well in the following words: "It was perfectly in conformity with the spirit of the Pythagorean doctrines to cause health to depend on the harmony of the constituting principles of the human body, and disease was caused by the want of this same harmony." The philosopher of Samos admits a vital principle, which when particularly applied to the organization of the body produces a harmony and an even mixture of the humors. Harmony and symmetry are synonymous in the language of Pythagoras.

Philoläus, one of the philosophers of the Italic School, admits four principal organs, namely, the brain, the heart, the umbilicus and the genital organs, to which correspond four functions, namely, thought, the sensible soul, the point of origin and germination, the emission of semen and generation. Littré says that "this opinion is most remarkable because it admits certain degrees in the life of living beings. In the first place, the common existence of all and which consists in procreation; the existence of plants; then that of animals, distinguished by a sensible soul; and lastly the life of man, which is characterized by reason. All these degrees of living existence are so ordained that the most elevated contain everything that goes to make up the lower degrees. It is quite easy to see in this fragment of Philoläus the germ of the grand idea of the modern anatomists who endeavor to demonstrate the uniformity of a plan in the animal kingdom."

For that matter, Pythagoras' doctrine of harmony is to be found in the writings of Philoläus: "*Ἐπεὶ δὲ πε ἀρχαὶ ὑπὴρχων οὐκ ὁμοίαι οὐδ' ὁμόφυλοι ἐοῦσαι, ἥδε ἀδύνατον ἦν ἂν καὶ αὐταῖς κοσμηθῆμεν, εἰ μὴ ἁρμονία ἐπεγένετο, ὥτινι ἂν τρόπῳ ἐγένετο.*"

Among the followers of Pythagoras who particularly took up the question of medicine, may be mentioned Alcmeon of Crotona; Littré even considered that it is to his writings that the origin of the doctrine of Hippocrates on the proper mixture of qualities began. Alcmeon was probably the first who put forward the hypothesis that the vital forces, the "*δυνάμεις*" humidity, heat, dryness, cold, bitter, sweet, etc., aid by their equilibrium to the perfect functional action of the organism and constitute the condition known as health. Here again we find the predominating idea of the biology of Pythagoras, namely, harmony.

**Etude sur la Médecine Grecque avant Hippocrate.*

Timoeus of Locris, who was a partisan of the same doctrines of harmony of the vital forces, writes as follows: "The principal cause of diseases is the inclemency and a disturbance of the higher qualities, as for example, when heat, cold, humidity and dryness are present in too large quantities, or are wanting." Maximus of Tyre, also says: "Does not health consist in a correct harmony of contrary elements which enter into the composition of the animal economy such as fire and water, the earth and the air, etc."

The few quotations which are here given are quite sufficient for one to anticipate the nature of the conceptions of Pythagoras and his disciples on the question of life and animal organization. In the first place there is to be found an ample amount of speculation, for these philosophers knew little of the anatomy of the human body and the viscera contained therein; experiments and precise facts were lacking, and this defect which is certainly fundamental, they supplemented by imagination and pure reasoning. In the basis of the doctrines of Pythagoras and his followers there is a very marked tendency to reduce everything to a logical and even mathematical form.

They ignored the physiological mechanism and appeared only to suspect the various forces instead of determining the transformations of a single force through the various organs. They also considered the qualities of matter as entities to a *quasi* objective existence, instead of placing them in the rank of pure phenomena. Consequently, in order to explain the unity of the functions and the vital harmony, they invented a principle of harmony of which they made a proper and extrinsic force, so to speak, which presided over the bodies and became added to them in order to control and direct the happy functioning of the body ("εἰ μὴ ἁρμονία ἐπεγένετο," as Philolaus has said).

In this point of view they are certainly vitalists, but their vitalism is as far as possible removed from every organic conception of that vitalism in which the followers of Stahl would later detect the first rudiments of animism. The great weakness in their biology is their utter ignorance of anatomy, of the intimate structures of the organs, as well as the true laws presiding over their functions. Their vitalism is not organic, and it could not be so if we consider the condition of their knowledge regarding living creatures.

If we now consider the doctrine of harmony as the vital principle in the point of view of its philosophical value, it seems to us to partake of a very strong objection. The philosophical physicians of the School of Pythagoras indicate very clearly, according

to their ideas, the various elements which operate in the production of vital phenomena. But when they come to enter into the matter more deeply and to explain by what proper nature they establish the vital function they can find only one solution to this problem, namely, the harmony of these primordial qualities which sustain life. But where does this harmony originate? Is it the result of the properties of matter, or an action of the spiritual substance on the body? And consequently how can one explain this influence of an immaterial substance by definition on another material substance? Their harmony is never anything but a condition of phenomena, and is not the cause; it is a quality of the ensemble of the "*δυνάμεις*;" it is a relationship between the phenomena that we perceive, and this relationship is only conceived by our intellect which observes them, and is not an objective entity, nor an intrinsic property of the fundamental elements whose whole forms the organism. To say that harmony produces life by penetrating the vital forces, is to leave the problem unsolved. Whence comes this harmony, and what is the intimate nature of vital forces? Those are the questions that should have been worked out and these are what the disciples of the philosopher of Samos did not establish. Their theory only considers the aspect of these phenomena, and does not penetrate into the intimacy of the causes, and does not reach the idea of substance.

It should, however, be recognized that in its conception of harmony and universal rhythm, the theory of Pythagoras and his followers has certainly well seized a certain aspect of these phenomena, an essential character of their relationships. It might not be impossible to see in these doctrines a very distant rudiment of the conceptions of modern science. Fouillée, in the chapter on Pythagoras contained in his work entitled *Histoire de la Philosophie*, says: "The more science progresses the more it discovers rhythm in things; to-day, even, it is admitted that every movement is rhythmical, that is to say, submitted to regular alternatives which in turn cause the mobile to advance and retreat, like a pendulum which oscillates, or the wave which undulates." With the restrictions which we have made, the Italic theory contains some new and true points.

The Ionian and Italic Schools found common adversaries in the philosophers of the Eleatic School. The followers of the latter school opposed both the naturalism of the School of Ionia and the mathematical idealism of Pythagoras and his followers. The disciples of the Eleatic School were metaphysicians and dialecti-

cians above all things, and they occupied themselves very little and in an entirely secondary way with physiological and cosmological questions. For this reason we will be very brief in what we have to say of them because their doctrines appear to have little bearing on the subject of this paper. The three principal representatives of the Eleatic School are Xenophanes, Parmenides and Zeno. Xenophanes composed a poem on Nature in which he endeavored to demonstrate the existence of an absolute and infinite Being, of which the world is only a visible and gross likeness. Aristotle says that Xenophanes, having cast a look on the immensity of the heavens, believed that unity was God.

Parmenides, who was also the author of a poem on Nature, completed the doctrines of Xenophanes, and after having considered at length metaphysical questions in the first part of this work, composed for reason (*τὰ πρὸς ἀλήθειαν*), in which he demonstrated the presence of an absolute Being, and seems to make a concession to appearances to the vulgar opinion, in a second part of the book written for the senses (*τὰ πρὸς δόξαν*). Parmenides identifies Thought and Object, Thought and Being (*Τῶν τὸν ἐστὶ νοεῖν τε καὶ οὐνεκεν ἐστὶ νοήμα*). But in the physical part of his poem Parmenides was obliged to admit the plurality which he had in the first place rejected in his idealistic pantheism. Aristotle has well demonstrated this fact when he expresses himself as follows on the subject of physics as written on by Parmenides: "Obliged to place himself in accord with facts and in admitting unity by reason, by admitting also the plurality by the senses, Parmenides was reduced to exposing two principles and two causes: heat, which he attaches to the being, and cold, which he attaches to the non-being."

Zeno of Elea, by a very ingenious and subtle logic, vigorously attacked the partisans of Matter, and he opposed the absolute Being as the only possible and correct theory, to the old formula of Heraclitus which conforms so well to the conception of modern science, to this universal ultimate result that the thought of the philosopher had placed in the image of fire. Movement is only one appearance, and it cannot possess any objective reality. His famous argument of Achilles is well known, which somewhat resembles the paradox of the sophists and is based on the impossibility of the human mind to picture division to infinity. But this subtle logic, this abstract metaphysic, has nothing scientific nor physiological in its character. The Eleatic School, and Parmenides in particular, appear to identify life with thought, and they admit

that *vous* and *poûrs* signify the same thing. No matter what may be the metaphysical value of their general doctrine, it is very positive that physiology gained nothing by it. Their *a priori* animism in no way accords with psychological observation, nor with physiological experiments.

A younger school then arose against the Eleatic philosophers, namely, the Atomic. The metaphysics of these philosophers endeavors to find in matter the principle of everything which exists, and is opposed to the mathematical idealism of Pythagoras and his followers, as well as to the absolute idealism of Parmenides and Xenophanes. It may be said that this doctrine arose from the philosophy of the School of Ionia, but it gave a new form to naturalism by implanting certain changes in it which, as is pointed out by Boyer in the article already alluded to, "Presents it under a more precise and more scientific mode."

Democritus is the principal representative of the School of Abdera. For him, the being is matter, and this matter is divisible into an infinity of particles, varying in form, analagous in substance and which represent atoms. These are endowed with an inseparable intrinsic property which is movement, and by this movement the atoms come together, or recede from each other, come in contact or separate, and by the various positions which they occupy in space they constitute the universe. The human body is itself composed of atoms, and what is called the soul is simply an aggregation of more subtle atoms. Thought has sensation as an only basis, which itself comes from the exhalation emanating from the bodies and penetrating our organs, and there depositing images within them. Fouillée says that "In this doctrine everything is explained by universal mechanism, under the law of necessity."

The other phenomena of life do not differ from sensation, and they are all explained by the reciprocal actions of the atoms. The laws of nature, following which the biological and cosmic phenomena are ordained, are not a thought beyond the world; they are intimately united to the universe and the organism; they are interior and not exterior. Such is the essence of the metaphysics, physics and biology of Democritus. For him these three sciences only make a single one, and their object is always matter with its varied forms and combinations. The atom is the ultimate term which explains everything, thought, nature and life.

Democritus has developed his ideas in several works. He has taken up various branches of natural science, and he has even

treated medical questions. The following books have been attributed to him, namely, "On the Nature of Man," "On Diatetics," "On Fever," "On the Prognostics," "On the Causes of Diseases," "On Cough," and "On the Pest." It is even thought that he was in communication with Hippocrates, and letters from Democritus to the physician of Cos exist, but their authenticity is very doubtful.

Before Democritus, Leucippus had professed the atomic doctrines which the former completed and made known. Among the upholders of the corpuscular doctrine we may also mention Nausiphanes of Teos, and Anaxorchus of Abdera. This latter philosopher was a contemporary and friend of Alexander the Great.

Now what conception of life can we extract from the biological doctrines of the School of Abdera? We will leave aside the metaphysical part of their system as well as its purely philosophical value relating to the explanation of the world, of the soul and the fundamental qualities, and we will consider only that part which is purely physiological in its nature which we will examine under its scientific aspect.

It would seem in the first place that the soul and life are but one, according to Democritus, but for all that, he cannot be considered an animist because the soul according to his way of thinking is only of material composition and does not have its explanation in itself and can consequently explain nothing. It is the atom which should be considered as the common explanation of both the soul and life. From this fact the system becomes one of absolute materialism, and in the particular case of the problem of life, it is a "mechanism" more complete than that of the School of Ionia. All the biological phenomena are the result of various combinations and movements of the atoms, and sensation is explained by a movement of particles detached from external objects which then act on the atoms composing the human body and the brain.

In this manner the philosophers of the School of Abdera establish *a priori* that everything in the organism, as in nature, is reduced to movement. Long before the discoveries in physics, chemistry and modern physiology, these philosophers had reduced everything to universal mechanics, but although we may admit that their doctrine was a most ingenious conception we must also recognize the fact that it was more than incomplete in several important points. It was as if they had a certain prevision of

mind, and this prevision has been partly confirmed by scientific discoveries in the domain of the sensible world, but they themselves had not founded it on sufficient observation or experiments, because they established it by the simple method of reasoning and deduction.

Now it is precisely in this domain, which is a methaphysical one, that atomism is insufficient, because both matter and movement are just those elements which are the most unaccountable ones of speculative philosophy. What is matter, and whence comes the movement? The idea of force is necessary in order to complete a system such as this. But it is not in this point of view that we wish to criticise the doctrines of the School of Abdera; we would more particularly examine the scientific side of the question, and in order to do this we will endeavor to explain in the first place the facts that Democritus and Leucippus possessed in order to build up their system of biological mechanics.

Physics already existed, and the philosophers had quite a number of ideas on the properties of matter, the laws of movement, certain transformations taking place in liquids and solids, etc., but they knew absolutely nothing on the intimate nature of light, heat and color. Experience had as yet taught them nothing on the reducibility of the phenomena of more or less rapid rythmical movements; speculation alone was ventured in this domain, and it certainly must be admitted that it served the philosophers of the School of Abdera well. But as we have already said, this was nothing more than a prevision, and this prevision was in no way confirmed by anything in the condition of the scientific knowledge possessed at this epoch. On the contrary, chemistry, whose results have been so very fruitful in their application to biological phenomena, was only in the most rudimentary state. Nothing was known as to the composition of the various bodies which are presented to us by nature; the elements were air, water and earth.

It was not consequently a knowledge of this order which could furnish the basis for their system to the philosophers of the School of Abdera, but nevertheless, the germ of our modern theories on atoms can certainly be recognized in their doctrines. Although not scientific, their hypothesis is, however, in accord with the most recent writings, at least in its more salient features, and by appealing to their imagination they supplemented their insufficient experience. Physiology was the science which had more particularly preoccupied them, and we have already seen that Democritus had devoted a certain part of his writings to it. But like the phil-

osophers of the School of Ionia, it was from speculative physics and metaphysics that the followers of the School of Abdera borrowed their hypotheses that they afterwards applied to biology. The complication of phenomena troubled them somewhat, and their reasoning, desirous of simplifying everything and to find a unity under the diversity of vital manifestations, made an appeal to matter reduced to its most simple expression, divided up to indivisibility. It was to the atom, the fundamental element of the world, and to movement, which was inseparable from the atom, that their reasoning reduced the entire living world. Life consequently is no longer an unaccountable entity, and is a result and not a cause of separated existence. In the scientific point of view we touch upon the true conception, which goes from the lower to the upper order in its explanations. Metaphysics could always demonstrate that by suppressing an entity (life or the soul) the atomists created another, namely, movement. But science must admit that if everything is not explained by such a system, there was at least a great advance made on the road which it continues to follow at the present day more fully armed by the experience and the reasoning of the many past centuries.

If one wishes to recognize that the hypothesis, the general idea, is useful to the progress of scientific knowledge, we should then render justice to the atomists who were the pioneers, speculative without doubt, but no less useful, and none the less admirable for all that. That their system was a metaphysical one before becoming a physical and biological one, is what we have felt obliged to conclude from the condition of their scientific knowledge, and it is this reproach that perhaps might be made to their method; but this defect should be most indulgently excused if we thoroughly appreciate its cause. It would seem to us most unjust to make them responsible for their experimental insufficiency, and certainly they could not abstain from making hypotheses, and we should give them due credit for having conjectured what they could not prove. Instead of ridiculing their metaphysics on account of its insufficiencies, it is far better to extricate that which completed and perfected, is to-day to be found in the great theories of the English and German evolutionist school. Far from reproaching them for their incomplete scientific conceptions we should pardon their errors of method, and bear in mind all the results which they arrived at which are found taken up again and confirmed by the theories actually in vogue.

We may conclude that as far as scientific hypotheses which are

applicable to the sensible appearance and to phenomena go, and if one does not search for metaphysical substances, atomism is a fruitful doctrine, although as yet insufficient. To sum up, it may be said that the works of the first Greek philosophers show that they constructed the entire world according to a metaphysical idea, and then going into the domain of sciences and the real, they applied their data just as they were, thus forcing, or better still, neglecting experience. According to Taine this proceeding well responds to the speculative mind of the Greeks; thus, of the naturalism of the School of Ionia which becomes a monodynamism in the problem of life, of the idealism of the Italic School which engenders animism and the hypothesis of harmony and rhythm, of the materialism of the philosophers of the School of Abdera which produced the fruitful conception of a universal mechanic, of all these first systems of Greek philosophy and science we only retain some of their results in recognizing the error of the method, at least in a biological point of view.

THE TYPEWRITER IN CATALOGING AND SHELF-LISTING.*

By CHARLES PERRY FISHER,

Librarian of the College of Physicians of Philadelphia.

The following remarks are made as a plea in favor of the general use of the type-writing machine in cataloging. As one of the pioneers in the work (five years) I give with pleasure the results of my labors which will enable you to avoid some of the difficulties and annoyances that I was forced to overcome.

The illustrations which I present for your inspection are not cards especially prepared for the purpose, but cards selected from the cataloging now in progress at the Library of the College of Physicians of Philadelphia, and give a fair example of the varied use of accents, brackets, the insertion of words in the Greek character, etc. They also show the result of several years' labor in obtaining a machine that will write cards in nearly a perfect manner with the minimum of attention. For the sake of comparison, I have one card, in duplicate, written in the style of penmanship taught in library schools.

*Read before the sixth annual meeting of the Association of Medical Librarians, Brooklyn and New York, May 16, 1903.