ATTRIBUTES OF THE HUMAN ORGANISM

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An eminent scientist has said that "science is verifiable, communicable, impersonal, unemotional knowledge". He further states that "the scientific mood is marked by (1) a passion for facts, (2) a cautious thoroughness in coming to a conclusion, (3) a quality of clearness, and (4) a less readily definable sense of the inter-relations of things".

While I freely admit that the paper which I present for your consideration at this time is not sufficiently impersonal and unemotional to be strictly scientific, yet I believe it embodies enough of the scientific mood to justify its presentation; for its essential purpose is the delineation of a striking uniformity which pervades the entire universe.

To say that science has made tremendous advances during the last half century is platitudinous. The important observation is that the artificial barriers erected by misconception are rapidly being torn down, and former "irreducibles" are undergoing reduction. The amalgamating process is reflected in the increasing use of such terms as "physico-chemical", "bio-physical", and "psycho-biological". The analytical process is illustrated by the successive revision of our conception of the character of matter from that of solid integrity to molecular discontinuity, atomic divisibility, and electronic componency. Science at present is very actively engaged in the unification of diversities and in the discovery of uniformities.

In the development of my thesis, I shall successively consider (1) the distinction between organic and inorganic matter, (2) the similarities of animal and vegetable life, (3) the relation of man to the animal world, (4) the connection of the human mind and brain, and (5) the metaphysical aspects of the human organism.

Obviously, the occasion permits but a cursory review of the theories and facts involved, and the evidence submitted must be fragmentary. As to originality in this work, I confess with Kipling—

"When 'Omer smote his bloomin' lyre,
'E'd 'eard men sing from sea to sea;
And what 'e thought 'e might require
'E went and took, the same as me."

ORGANIC AND INORGANIC MATTER

We have been accustomed to draw a sharp line of demarcation between the organic and the inorganic, the mineral and the biological kingdoms, the so-called living and the so-called dead. For centuries, we have attributed to the biological world a directive life process; a supreme, controlling "vital force" inherent in organisms but absent from the mineral kingdom.

The eminent Huxley (1825-1895) once said, "The present state of knowledge furnishes us no link between the living and the non-living". But when this statement was made Wohler (1800-1882), a German chemist, had already (in 1828) produced a typical organic substance (urea) from inorganic matter by simple laboratory methods, entirely without the directive influence of a "vital force".

And since that achievement, hundreds of carbon compounds long thought to be peculiar to organisms have been produced by chemical synthesis from inorganic substances. Emil Fischer, for instance, has artificially produced a very complicated compound, consisting of eighteen amino acids, fifteen molecules of glycin, and three of leucin, which in many respects resembles a natural peptone; and working along the same lines, it seems only a question of time until synthetic proteins can be made out of lifeless material in the laboratory. In fact, the fundamental laws of organic and inorganic chemistry are identical; and it is very probable that ultimately the artificial synthesis of every organic substance may be accomplished.

Contrary to Huxley's view, therefore, a link has been established between the living and the non-living; and the line of demarcation begins to fade.

Additional evidence of the uniformity of living and non-living matter is presented by our new conception of the essential character of the atom. This formerly

"indivisible" ultimate unit of matter has been dissected, and resolved into its component parts of "proton" and "electron", which in turn have been identified as positive and negative particles of electricity. It is also generally accepted that these particles constitute every atom of whatever kind; and it is therefore quite logical to infer that all matter, of whatever character, is but a manifestation of electricity.

This principle, then, pervades the whole physical creation: electrons combine to form atoms; atoms combine to form molecules; molecules are the bricks with which everything is built—the crystal, the flower, the animal, man, the stars, the entire universe. On this, our greatest scientists agree.

Another important consideration regarding the uniformity of matter is the fascinating theory of inorganic evolution. This theory is not new; but it has recently acquired a new significance as a result of very interesting observations made in connection with the spontaneous disintegration of radio-active substances and experiments on the x-ray spectra of the elements.

Moseley (a brilliant young Englishman who was killed in the recent war) is responsible for an entirely new conception of the mutual relations of the elements. On the basis of his work with certain x-ray spectra, it has been conclusively demonstrated that the characteristic number of electrons in the atoms of the several elements increases with definite mathematical regularity from the lightest and simplest, hydrogen (number 1 in the series), to the heaviest and most complex, uranium (number 92 in the series). An arrangement of the elements on the basis of Moseley's "atomic number" has now been accepted as more fundamental than Mendeleeff's periodic system based upon atomic weight; although the two systems are practically coincidental. This orderly progress of the elements from simple to complex structure is very suggestive of an evolutionary series in the mineral kingdom.

The behavior of radio-active substances indicates that the more complex elements are built up of the simpler elements. When, for example, the complex atom of

uranium spontaneously disintegrates, one of the cleavage products is the simple atom of helium.

The transmutation of elements has been artificially accomplished. Sir Ernest Rutherford has bombarded the nitrogen atom with alpha particles and split it into hydrogen and, probably, helium. According to a very recent report, he has likewise succeeded in disintegrating the atoms of aluminum, sodium, potassium, boron, phosphorous, fluorine, magnesium, silicon, sulphur, chlorine, and argon. The evidence very strongly suggests that all elements, and therefore all matter, may eventually be found to consist of various combinations of the comparatively simple atoms of hydrogen and helium.

The question of the evolution of the elements has been considered from another angle. Lockyer, the English astronomer, has suggested that the elements composing the stars are in a state of inorganic evolution. In the hottest stars, hydrogen and helium predominate; and in the cooler stars, the heavier elements appear. On this basis, it is inferred that the light elements combine to form the heavier elements as the temperature decreases. Rutherford states in this connection, "There can be little doubt that conditions have existed in the past in which electrons have combined to form the atoms of the elements, and it may be quite possible under the very intense electrical disturbances which may exist in hot stars that the process of combination and dissociation of atoms still continues."

While it is quite true that we have seen the spontaneous disintegration of complex atoms into simpler ones, and have artificially accomplished this result, we have still to behold the contrary process of combining simple atoms to produce the heavier, complex ones. Moreover, it is very probable that the electrodynamic forces involved in such a combination are of so great an intensity as to postpone this experimental achievement to a distant future.

If we accept the theory of inorganic evolution (and I think that no rational mind which has examined the evidence can avoid the conclusion), it is quite logical to believe that at some point in the development of the structural complexity of inorganic matter the conditions

of primordial life were fulfilled. In this manner, spontaneous generation may be said to have occurred.

Personally, I can see no objection to this hypothesis of the first origin of life. As Hertwig puts it, "Whoever, in agreement with the teachings of astronomy, adopts the view that our earth was at one time in a molten condition and has gradually cooled, must assume that life on the earth has not existed from eternity, but at some time has had its beginning. If he wish to base his explanation, not upon a supernatural act of creation, nor upon hypotheses like that of the transference of living germs from other worlds through the agency of meteors, there is left only the hypothesis that, according to the generally prevailing and still to be observed laws of chemical affinity, compounds of carbon, oxygen, hydrogen, nitrogen, and sulphur have been brought together to produce living substance."

While we have as yet no definite knowledge of the origin of life, everything points towards the conclusion that, in the evolutionary development of the inorganic realm, simple atoms combined to form complex atoms, simple molecules combined to form complex molecules, complex molecules combined to form aggregations of matter which had the power to reproduce themselves. Thus life began; not as the result of the violent interjection of a special "vital force", but as the summation of extremely complicated chemico-physical processes. And from these primitive vital substances, by a slow and continuous process of evolution, the present animal and vegetable forms have emerged.

ANIMAL AND VEGETABLE LIFE

For the sake of completeness, let us now briefly consider, somewhat parenthetically, the similarities of animal and vegetable life.

Thomson (J. Arthur) suggests that the genealogical tree of living creatures may be likened to a letter V. On the one side are animals; on the other side are plants; at the base there are simple forms of life which have not taken any decisive step in either direction.

To the ordinary observer, there seems to be a very marked distinction between plants and animals: plants

are made of wood, animals of flesh; plants take in carbon dioxide and give off oxygen, animals reverse this metabolic process; plants are stationary, animals move about; animals have brains, plants do not.

To the scientific observer, however, this distinction is not so clear. For instance, the tunicates, which are very highly organized animals, have an abundance of cellulose in their bodies. Examining closely the metabolism of plants, we find that in the performance of its vital functions the vegetable protoplasm, like the animal, consumes oxygen and produces carbon dioxide. As far as movement is concerned, some of the bacteria, which are definitely vegetable, have very marked powers of locomotion; while such highly organized animals as the barnacles live completely sedentary lives. As to the absence of brain in plants, it is very interesting to note that none of the protozoan animals have the slightest evidence of organized nerve tissue; and not until the flatworms are reached in the ascending scale of animal complexity is there any semblance of a brain. On the other hand, how can we explain the marvelous ingenuity of plants in certain modes of behavior, and on what basis can we deny them intelligence?

The fundamental uniformity of animal and vegetable organisms is manifested by (1) their common origin from primitive vital substance, (2) their incorporation of similar chemical constituents, and (3) their joint possession of the peculiar functions of life, namely, metabolism, growth, reproduction, and internal powers of adaptation to environment.

MAN AND ANIMAL

It would be ridiculous, in this age of intelligence, to raise the question of man's relation to the rest of the animal kingdom were it not for the fact that stupid legislators and bigoted "fundamentalists" are still broadcasting their denial of the theory of evolution.

Lamarck (1744-1829), the French zoologist, was one of the early proponents of the theory of evolution. He taught that the first simple organisms of the earth arose in a natural way through spontaneous generation from

non-living matter; that the present species of plants and animals have developed from these simplest living creatures by gradual changes, in the course of an immeasurably vast space of time, and without any break in the continuity of life upon our globe; that man is the terminal point of this series; and that all the other animals are the descendants of those forms from which man has developed.

Later, Darwin (1809-1882) modified Lamarck's theory by the important addition of his doctrine of the causes of evolution, as set forth in his "Origin of Species". And more recently, Mendel's (1822-1884) work has revolutionized our conception of the laws of heredity. Like every sound doctrine, the theory of evolution is in process of evolution; but the fundamental fact that man is an animal is beyond controversy.

It is obviously impossible, within the limi s of this paper, to present anything more than a mere suggestion of the mass of evidence supporting the theory of evolution: the uniformity of chemical constituents and cellular composition; the increasing complexity of organic structure and function; the paleontological evidences of progression; the transitional forms between the great divisions of animals; the phylogenetic recapitulation by the individual animal in its embryological development.

That man is an animal physiologically, the everyday functions of the human body amply demonstrate. Comparative anatomical evidence is equally convincing. Embryologically, he recapitulates the entire series of lower animal forms. Psychically, he duplicates many of the faculties of the brute. When all these lines of evidence are considered, they are seen to converge in the conclusion that man is identical with the rest of the animal world, built of the same stuff, functioning in the same way, although on a higher plane.

As Darwin says: "We must acknowledge, as it seems to me, that man with all his noble qualities, with sympathy which feels for the most debased, with benevolence which extends not only to other men but to the humblest living creature, with his God-like intellect, which has penetrated into the movements and constitution of the

solar system—with all these exalted powers—man still bears in his bodily frame the indelible stamp of his lowly origin."

MIND AND BRAIN

In considering the connection of the human mind and brain, it might be interesting to note, in the first place, that the brain has not always been recognized as the exclusive "seat" of consciousness. This is illustrated by the phrase, "bowels of compassion". As Shakespeare said, "Thou thing of no bowels." And still another (Fuller), "That corpulent tyrant, full of guts, and empty of bowels". Did not the Psalmist exclaim, "O Lord, strengthen me in my reins", that is, "in my kidneys"? Someone has also said, "As a man thinketh in his heart, so is he." And we still refer many of our mental states to this organ.

"That the phenomena of our conscious life are connected with the actions of the brain is suggested by the fact that mental excitement, strain, or fatigue is apt to induce sensations which we commonly localize in the head. It is still more distinctly suggested by the common observation that an injury to the brain produces unconsciousness. When to such common observations science added the fact that the brain is the great central station or meeting point of the nervous system, the inference that it has a special significance as an organ of mind became inevitable." (Sully, Outlines of Psychology.)

Furthermore, physiologists "believe that every state of consciousness is correlated with some definite molecular change in the substance of the nervous system, in such a way that a being possessed of sufficient intelligence could infer the character of the state of consciousness from the knowledge of the molecular change, or infer the molecular change from the knowledge of the state of consciousness". (Rice, W. N.) Molecular changes in fatigued brain and nerve cells of certain animals have been already microscopically demonstrated by several investigators.

The interdependence of mind and brain, and a definite correlation of nervous and psychical processes, is gener-

ally accepted by physiologists and psychologists; but the precise nature of this relationship has been a subject of argument for centuries, with no satisfactory conclusions thus far.

The mechanistic, or materialistic, theory holds that mind is a direct product of the brain: as the liver secretes bile, so the brain secretes thoughts. The contrary theory presumes that mind is the reality, and the body has only a phenomenal existence. Animism attributes to each living body a soul, which is the directing force of all its mental and physical processes.

Monism assumes that both the mental and material are real, or self existent, but are not independent realities. Consciousness, the fundamental property of mind, and extension, the fundamental property of matter, are conjoint attributes of one and the same substance. Thus the ultimate reality or fundamental substance is neither spiritual alone, nor material alone, but both.

Wundt (1832-), the German psychologist, says: "The ego is not compounded of body and soul, but is a determinate stage of evolution of being, which, contemplated from different standpoints, divides itself into bodily and spiritual being."

The monistic, or two-aspect, theory, which postulates a psycho-physical being, functioning at once as mind-body or body-mind, is perhaps more acceptable to the scientists of today because it does justice to the extraordinary interactions of mind and brain, and is not inconsistent with the theory of psychic evolution.

That the mind is a product of psychic evolution, just as the body is a product of organic evolution, certainly is a plausible theory. Herbert Spencer (1820-1903) has said, "If the doctrine of evolution is true, the inevitable implication is that mind can be understood only by observing how mind is evolved."

Psychologists of today do not place intelligence in sharp contrast to instinct, as was formerly taught, but rather regard it as an evolutionary product of instinctive behavior. And, in turn, as Whitman suggests, "The primary roots of instinct reach back to the constitutional properties of protoplasm, and their evolution runs, in general, parallel with organogenesis."

To carry this hypothesis to a logical conclusion, we must also assume that something akin to consciousness exists in connection with inorganic substances; and thus we may attribute to every form of matter a quasi-mental aspect.

RECAPITULATION AND CONCLUSION

In closing this paper, may I briefly recapitulate, and draw a few conclusions.

All matter is apparently a manifestation of electricity. The theory of inorganic evolution has acquired a new significance. The first origin of life has probably occured as a summation of complicated physico-chemical processes in the mineral kingdom. The artificial production of complex organic substances has rendered less distinct the line of demarcation between living and non-living matter. Man is a product of organic evolution, and is identical with the rest of the animal world. Organic evolution is a direct continuation of inorganic evolution, with hydrogen at the beginning and man at the end of the evolutionary series. Mind is coexistent with matter. Psychic evolution parallels inorganic and organic evolution. The metaphysical attributes of the human organism may be sublime functions of matter. As time is the fourth dimension of a cube, so may immortality be a fourth dimension of the human organism. A profound uniformity of constitution and behavior pervades the entire universe.

None of these postulates is inconsistent with a rational interpretation of prevailing religious and theological tenets. The more closely we analyze the constitution of the human organism and the more carefully we scrutinize its behavior, the greater, and certainly the more intelligent, reverence we gain for the profound facts of human existence. Man loses none of his divinity and God loses naught of his majesty in the process.