CONSCIOUSNESS

IN

EVOLUTION:

BY

E. D. COPE.

EXTRACT FROM THE PENN MONTHLY FOR AUGUST, 1875.

PHILADELPHIA:

JULY 31st, 1875.

CONSCIOUSNESS IN EVOLUTION.[1]

I. PRELIMINARY.

THE evidence of what is termed "design" in the structure of beings exhibiting life, is often appealed to by one class of thinkers, as proving the intervention of a personal Deity in the creation of such; and the same feature exhibited in the movements of living creatures is regarded by metaphysicians of a similar class, as an indication of their possession of a power of choice, or "free agency," at least in the case of man. The opposing school, of whom Professor Bain may be selected as an example, believes that designed acts are without an element of freedom, but are simply performed in obedience to stimuli of various kinds, motion following stimulus as inevitably as effect succeeds cause in the non-living world. The evolutionists attempt to explain design in structure, through the operation of the Darwinian law of the "survival of the fittest," showing that only those beings whose organization displays that adaptation to use in relation to its surroundings, which is termed "design," could possibly continue to exist. It is justly urged against this reasoning, that it attempts no explanation of the *origin* of such structures. Another school of evolutionists have therefore maintained that such structures are due to the effect of effort, *i. e.*

[1] A lecture delivered before the Franklin Institute, Philadelphia, February, 1874.

stimulus or use, exerted by the living being on its own body, and that the design thus displayed, is an expression of the intelligence at some time possessed by itself.

So long as there is any probability of the last explanation proving valid, it will be important to examine into the questions of metaphysics which it necessarily involves. The investigation is indeed but the necessary projection of those which have resulted in satisfying the great majority of biologists of the reality of evolution, or of the fact of the descent of existing living beings, species by species, order by order, and class by class, from others which have preceded them in time. Clearly, then, we enter the question by considering the nature of movements of plants and animals in relation to the stimuli which are supposed to call them forth.

2. THE UNCONSCIOUS.

A true study of metaphysics necessarily has for its objects plants, animals, idiots and infants, as well as healthy men; nevertheless, necessity compels us, in discussing the question, to dwell on our own experiences as a *sine qua non*. Now experience, in a general sense, includes not only the memory of our conscious acts, but a knowledge of our unconscious ones, and to the latter especial attention must be directed, since they are most readily overlooked. The marvelous character of memory cannot be too much considered. Of the millions of impressions which the mind has received and registered, in the course of a lifetime, but one can be clearly present in consciousness at one time. The remaining millions are not lost; they are stored, each in its appropriate place, to be sprung into consciousness when the appropriate suggestion presents. How much more vast, from this point of view, is the unconscious mind than the conscious! But the phenomenon is not confined to memory. Who that has ever attempted the digestion of a subject which includes a mass of details, is not acquainted with the unconscious activity of the mind in classification? How frequently a question involving many parts, is, on the first reception of the constituent facts, all confusion; but in time displays its symmetry clearly to the con-

sciousness, every part in its proper place, and that with little or no further attention having been devoted to it. It is indeed probable that the every-day process of inductive reasoning is conducted in unconsciousness on the part of the subject. Induction consists in the generalization of some quality as common to a great number of objects of memory; a greater or smaller number of other qualities being neglected in the process. When this act is performed voluntarily, one or many qualities are successively passed in review before the mind, each one being in its turn impressed on the perceptive centres—so long as it is the object of inquiry, the others being excluded from consciousness for the time being. It is simply a process of classification, and when performed in consciousness, constitutes "experiment." But when no generality is anticipated and its existence is unknown, it often happens that such generalization becomes known or rises into consciousness, without the bestowal of effort in classification of the objects to which it refers. The impressions consciously received have been arranged out of consciousness, and when revived into consciousness display an order which was not previously known to exist. It is in the latter way that the "practical man" "finds out" the rules by which, as by an instinct, he regulates his intercourse with the world. He often cannot explain the reasons of their truth, nor does he know how he came by them, being generally content to call them the results of "experience." In some persons they are so feebly expressed in consciousness as to be called "feelings;" and many experiences or repititions are sometimes necessary to impress on us the importance of these mental products before we are willing to follow them in action. "Strength of mind" is an expression applied to a high degree of this unconscious reasoning; expressing the extent of ground the process covers continuously, as well as the exactitude of its results. The experimental investigator, on the other hand, performs this work deliberately, and is acquainted with the processes; he is, therefore, at first more confident of his results. And we observe here in passing, that a rule once discovered, is as readily retained in the cells of the unconscious, as is the memory of a simple object or event.

Another form of unconscious cerebration is seen in deductive reasoning, which employs rules already discovered in application to new cases. Calculating prodigies are a case in point. It is well known that those persons who have from time to time appeared, possessed of the power of calculating with enormous numbers with marvelous rapidity, have never been able to explain the process by which they reach their conclusion, nor are they conscious of going through the steps involved in the calculation they perform; and it has been said that great calculators have rarely been great mathematicians.

The explanation of these phenomena is not far to seek. In simpler forms it is presented to us every day. Thus it is an easy matter to read with but little consciousness of the process, and no recollection of the subject matter of what is read. Most manual operations can be performed while the consciousness is occupied with other objects.

If these be facts of human experience, how much more likely are they to be true of animals? If man be unconscious of the process during the performance of some of his most complex acts, how much more probable is it that animals are so while pursuing the narrower circle of their simpler ones? Yet animals are not devoid of consciousness; indeed, it is scarcely credible that any one should deny to them consciousness, after experience in their education.

But let these automatic acts be ever so simple or complex, it is claimed that they could not have *originated* out of consciousness. Whatever we call voluntary acts in ourselves, undoubtedly have to be *learned*. The acquisition of the primary act of walking is accomplished by a slow and painful education; while knitting and other manual exercises necessarily require preliminary training, some of shorter, others of longer, duration. This is true of such voluntary acts as we perform most readily automatically, and such as might be supposed to be most probably acquired by hereditary transmission, as for instance speaking. The case is the same with animals. All those services which are useful to us, or tricks which amuse us, are acquired at the expense of training, which involves a system of stimuli, consisting of rewards and punishments, as in our own species. Is there any reason to sup-

pose that those habits which we observe them to possess in a state of nature have had a different origin?

It is incontrovertible that a regular succession of muscular movements may be committed to memory as certainly as a color or a shape, and that a change of brain substance, such as causes the retention of the simple impression, is also involved in the retention of the complex. When this machinery is completed, through the repetition of conscious stimulus, it works thenceforth without necessary intervention of consciousness. The consciousnesss may then be engaged in fresh acquisitions, accomplishing new organizations, thus accumulating a store of powers. Once organized, these powers are at the disposal of their possessor, yet the organized machine will at some time undergo change, if not more or less frequently used. Without use it may indeed finally disappear, showing that the capacity for organization is identical with a facility of disorganization.

3. THE ORIGIN OF AUTOMATIC MOVEMENTS.

Is any habit originated in unconsciousness? Those who affirm this proposition, point to the movements of plants in the extension of their tendrils, and the closing of some sensitive leaves; the timely expansion of the down of the *Aesclepias* seed, and the insect-catching habits of *Drosera* and *Dionaea*. No one surely attributes consciousness to these. And there are many similar movements in animals which are as thoroughly unconsciously performed as are those of plants, from the first moment of the animal's birth; as for instance, the involuntary activities of the circulatory and digestive systems, etc. Did these originate in consciousness or unconsciousness? The answer to this question constitutes the key to the mysteries of evolution, and around it the battle of the evolutionists of the coming years will be fought.

It may be asserted at the outset that those habits whose origin we have had the opportunity of observing in ourselves and in other animals, were certainly acquired in consciousness, and that we do not believe that they could have originated out of it. The stimuli to action are divided into the two general classes of pleasures and pains, and each stimulus is potent in proportion to the intensity with which it is consciously apprehended. If many and complex acts may be performed automatically, through the organization of special machinery in the gray matter of the brain,

it is altogether reasonable that similar powers should be found to be conferred on gray nervous tissues in parts of the body which are no longer seats of consciousness. It is well known that the spinal cord of the headless frog responds to stimuli in the vigorous muscular contractions of the limbs which follow the application of acid to the skin. So the ganglionic centres of organic-life respond to their appropriate excitants; the various glands of the digestive system discharging their contents into the ingesta at the proper moment, consciousness having no share in the proceeding. These phenomena are more readily explained on the theory of endowment, than on that of physical movements; since by means of the former the evident design in the movements is accounted for, while the latter gives us no clue to this characteristic feature of these and all other vital processes.

The lowest form of consciousness is common sensibility; and judging by the resemblance between our own experience and that of the higher animals, the lowest of animals also are not devoid of this quality. The structureless jelly of Rhizopods, such as Amoebas, Gromias, etc., evidently selects its food with regard to its nutritious qualities, in most instances preferring diatoms and desmids to sand and other innutritious substances. Its acquisitions in knowledge of articles of food can only be accounted for on the hypothesis of original, pleasurable or painful, consciousness of the effects of external and internal contact with these substances, and retention of the impression in unconsciousness. The impression reviving on the recurring of a similar contact, the substance is accepted or rejected as the former sensations were pleasurable or painful. And this is not incredible, if, as the researches indicate, the structure of the protoplasm of these creatures is of the same type as that of the bioplastic bodies of the gray tissue of the brain.

In accordance with this view, the automatic "involuntary" movements of the heart, intestines, reproductive systems, etc., were organized in successve states of consciousness, which conferred rhythmic movements, whose results varied with the machinery already existing and the material at hand for use. It is not inconceivable that circulation may have been established by the suffering produced by an overloaded stomach demanding distribution of its contents. The structure of the Cœlenterata offers

the structural conditions of such a process. A want of propulsive power in a stomach or body sac occupied with its own functions, would lead to a painful clogging of the flow of its products, and the "voluntary" contractility of the body or tube wall being thus stimulated, would at some point originate the pulsation necessary to relieve the tension. Thus might have originated the "contractile vesicle" of some protozoa, or contractile tube of some higher animals; its ultimate product being the mammalian heart. So with reproduction. Perhaps an excess of assimilation in well-fed individuals of the first animals, led to the discovery that self-division constituted a relief from the oppression of too great bulk. With the increasing specialization of form, this process would become necessarily localized in the body, and growth would repeat such resulting structure in descent, as readily as any of the other structural peculiarities. No function bears the mark of conscious origin more than this one, as consciousness is still one of the conditions of its performance. While less completely "voluntary" than muscular action, it is more dependent on stimulus for its initial movements, and does not in these display the unconscious automatism characteristic of the muscular acts of many other functions.

Bearing in mind the property of protoplasm to organize machinery which shall work automatically in the absence of consciousness, we can glance at the succession of vegetable forms. The active movements of the primary stages of the Algae are well-known. After swimming actively through the water, they settle down, take root, and assume the role of plants. The *Aethalium*, swimming with the movements of a Rhizopod, has been known to take food before establishing itself on the damp piles of the tan-bark, where it speedily becomes a low form of fungus. The approximation of the lower forms of plants to animals is notorious. The fungi, it is said, are the only terrestrial plants which live like animals on organic matter, appropriating the humus of their rich nidus in a state of solution. Now the paleontology of animals has absolutely established the fact, that the predecessors of all characteristic or specialized types have been unspecialized or generalized types, "neither one thing nor another." It may then be regarded as almost certain, that the ancestors of the present higher types of plants, were more animal-like than they; that the

forms displaying automatic movements were more numerous, and the difficulty of deciding on the vegetable or animal nature of a living organism, greater than it is now. Hence it may be concluded that "animal" consciousness has from time to time organized its machinery and then disappeared forever, leaving as result, the permanent form of life which we call vegetable. But it is not to be supposed that all changes of structure cease with the departure of consciousness. Given spontaneous movement (*i. e.* growth) and surrounding conditions, and the resultant product must be structures adapted to their surroundings, just as the plastic clay is fitted to its mould. And this is essentially the distinguishing character of vegetable teleology as compared with animal. In the average plant we see adaptation to the conditions of unconscious nutrition; in the animal, adaptation to conditions of conscious contact with the world under a great variety of conditions.

4. GROWTH FORCE.

The active processes of living beings are examples of conversion of physical forces, only differing from the conversions observed to take place in inorganic bodies, in the nature of the machinery which exhibits them. The construction of this machinery, as in its use when finished, involves a conversion of force, the resultant consisting of the attraction of nutritious material in definite new directions. This determinate attraction has been regarded as a distinct force, to which the name of bathmic, or growth force, has been applied. It differs from all the physical forces in this, that while they are only exerted inversely as the square of the distance, this one is in addition most excessive where pleasure has been experienced and weakest where pain has left its deepest traces. In other words, its movements express *design*, the essential condition of which is *consciousness*. It is thus evident that it differs utterly from all other forces, although a retrograde metamorphosis of matter is as necessary for its production, as for that of any of the other forces. Now, although the evidences that stimulated consciousness, or if you choose, mind, can modify structure, are, as matter of observation, not very satisfactory; yet, since the essential peculiarity of growth force is its instant attendance on the needs of consciousness, it is a permissible hypothesis that its activity is immediately due to consciousness. This activity is located in bioplasts which do not exhibit consciousness; whether it coëx-

ists with consciousness in brain bioplasts is unknown. The successive exhibitions of this force from the lowest to the highest of living beings, have ever been additions to the executive machinery of a more and more specialized consciousness. Thus it is that its results in structure have ever become more and more complex, that is, composed of an ever-increasing number of parts in some region of the organism. Hence another point of distinction from other forces exists, which has been pointed out in a previous paper. It is quite evident that the higher forms of life are the result of continued super-addition of one result of growth force on another, some examples of subtraction or simplification of parts being generally accompanied by a great preponderance of additions. This is evidence of the accumulation of the property of producing this kind of force, since each successive addition imposes on the growing animal a greater number of successive stages before the process reaches its termination, maturity. This involves the belief that the property of exhibiting frequent "repetitions" of growth activity exists in a higher degree in the reproductive bioplasm of the more complex animal, than in that of the lower ones. This is in accordance with the fact of the regular increase in relative complexity and bulk of the nervous system, which accompanies complexity of structure in other respects in the ascending scale of animals. Thus this force differs from all others, as remarked by Prof. Hartshorne, in that its expenditure ultimately increases the amount of its production, because it constructs machinery which feeds its especial organs more and more successfully. Although expended by becoming energetic, its energy produces the means of its own increase. Unlike the physical forces whose expenditure renders matter ever more inert, growth force when expended adds material which as a profitable addition, increases the power of the central machine from which the force emanates, by furnishing an increased supply of food.[2]

Thus it is evident that growth force is not concentric nor polar

[2] It is incorrect to say that growth force is "potential" in highly organized types, as it is undoubtedly expended in the movement of nutritive pabulum to a given locality. The maintenance of it in that locality is due to ordinary molecular cohesion, which can only be set free by greater molecular consolidation.

in its activity, as are the physical forces, and that its determinations are antagonistic to these. Its existence in the earth has been a succession of conquests over polar force, and if preceding assumptions be true, the gradual progress presented by animals in abandoning the symmetrical forms exhibited by the lower types, has doubtless been due to the constantly increasing amount of consciousness.

5. THE DOCTRINE OF THE UNSPECIALIZED.

It is, however, evident that the directing power of consciousness is limited by the nature of the matter with which it has to deal. There are certain fundamental necessities to which it must conform. No one supposes that any degree of power can make twice two equal to six, cause two solid substances to occupy the same space at the same time, or make an absolutely solid substance out of incompressible atoms of different forms. These involve the absurdity that something can be made out of nothing, or nothing out of something. From the present conduct of the inorganic world, it would appear to possess properties which render consciousness impossible to it. This is doubtless due to the relations existing between the atoms or molecules of which its various species consist. The movements it displays are polar. The colloid molecular state is, so far as this planet is concerned, the only one which we know to be capable of consciousness, and then only while in a state of active transformation. As we have seen, when protoplasm is once organized and working automatically, consciousness need not be present; and when this is absent, the rate of transformation, that is, the amount of food consumed is greatly lessened. The excess of expenditure during conscious activity over that necessary to unconscious activity, is well known. It is thus evident that organization renders consciousness unnecessary, so long as external conditions are unchanged, and most probably a degree of fixity may be attained which renders consciousness impossible. The history of the evolution of animal types is apparently an illustration of this truth. The relations of the divisions of the animal kingdom are those of the limbs, branches and trunk of a tree. Although the termini of the branches are successively nearer the root or starting point, as we proceed from the apex downwards or backwards, yet the connec-

tion is not from end to end of these. To find this we pass down the limb to its junction with the trunk, and trace the branches from the axis outwards. Thus with the branches of the animal kingdom. Although the divisions vertebrata, mollusca, echinodermata, etc., stand in an undoubted relation of succession to each other, there is no connection between the highest representative of one, and the lowest of another. It is the lower or less specialized forms of each which exhibit the relationship. Thus, among the articulates, the low group of the worms gives us connection with the mollusca above by *Brachiopoda*, and the echinoderms connect themselves with the *Vermes* by the less specialized *Holothurida*. It seems highly probable also that the point of contact of the *Vertebrata* with these is by one of the lowest divisions, formerly regarded as molluscan, viz: the *Ascidia*. The same principle holds good within the great divisions. The most specilized orders of mammalia are the *Artiodactyla*, higher *Perissodactyla*, the *Carnivora*, *Quadrumana*, and perhaps *Cetacea;* but the higher of these have not been derived from the lower. Modern investigations show that several of them have been derived from a common type of mammals of the Eocene period, which is intimately connected with their lower forms, while wanting in the features which give them their special characters. These two illustrations serve to explain the universal law of zoölogical affinity, and therefore of evolution.

The conclusion derived from a survey of this field is, that structure, like habit, when once established, is closely adhered to, and that the movement of growth force once determined or organized becomes automatic, *i. e.* independent of consciousness. Therefore a type which reproduces itself automatically becomes after a time so established as to be incapable of radical change in consequence of a molecular fixity which precludes it. Nevertheless susceptibility to influences of conscious stimuli may remain in some portions of the organism, and thus subordinate modifications of structure have their origin. When conditions of life change, as they often have done during geologic time, those changes of structure which are possible, take place under the stimulus of roused consciousness. But if the changes be radical, affecting the foundation processes of vital economy, the specialized forms must undoubtedly perish, and the life of the succeeding

time be derived from forms of less pronounced character. The adaptability of generalized types, as to habits, and the absence of mechanical peculiarities in their structure, explain fully the cause of their standing in ancestral relation to all the typical faunae of the earth.

Nowhere is this truth more remarkably illustrated than in the case of man, the predominant mammal of the present period. From the generalized mammalian fauna of the Eocene, the Carnivora developed a highly organized apparatus for the destruction of life and appropriation of living beings as food. The cloven-footed and odd-toed hoofed orders[3] are the result of constantly increasing growth of the mechanical appliances for rapid motion over the ground; the former superadding exceptional powers of assimilation of innutritious food. The proboscidians developed huge bulk and an extraordinary prehensile organ. The *Quadrumana* produced none of these things. In respect to speed of limb and powers of digestion, both in function and structure, they remain nearly in the generalized condition from which the other orders of mammals have risen. The limbs and teeth of man retain the characters of the primitive type. Yet but two species of proboscidians remain; the Perissodactyle multitudes are represented by but a few vanishing species. The day of the *Carnivora* has passed forever, and the remaining Artiodactyle herds exist but by the permission of their master, man. But past geologic time reveals no such abundance of true *Quadrumana* as the present period displays. These animals were evidently unable to compete with those of other types in seizing on the opportunities of living. They were excluded from the chase by the more sanguinary ancestors of the carnivora, and from the field by the multiplying herds of the swifter or more resistant hoofed animals. They possessed neither bulk, nor speed, nor cruelty to serve them in the struggle for existence. So they were doubtless compelled to assume an arboreal life, which required little or no modification of the limbs for its maintenance, although the ultimate production of the grasping thumb from their primitive squirrel-like feet, may be traced to this mode of life. The acquisition of a hand must be regarded as the first step in that marvelous accession of experiences which is the condition of mental development.

[3]Represented by the ox and the horse.

And this latter growth has taken the place of all other means of conquering a position in the world of life, so that man has even retrograded in the efficiency of bodily powers. He has lost the prehensile quality of the hind feet, and the special usefulness of his canine teeth. But the competition among men continues to be such as to render it in the highest degree improbable that he will, as a species, lose the position gained, or suffer any prolonged diminution of the power of intelligence.

Now it is obvious that the more restricted the conditions of the life of a given animal type, the more sensitive it will be to changes. Hence it is that the risks to the existence of *Carnivora*, *Artiodactyla*, *Proboscidia*, etc., are much greater than to the omnivorous, all adaptive order of *Quadrumana*. The same is true of mind. The greater the proportion of unconscious automatism of habits, the less the power of adaptation; and this must be the condition of all animals, whose structure is so specialized as to place them beyond reach of competition, or to cut them off from a wide range of experiences. The greater the degree of consciousness of stimulus, the greater will be the degree of adaptability to new relations, and to such constant rousing the unspecialized mind is always open. If without strong natural weapons, vigilance is the price of existence; if not confined by organization to a peculiar kind of food, ceaseless investigation is stimulated. And these are the mental peculiarities which distinguish the monkeys among all the Mammalia.

The reverse of this picture may now be described, as has been done by Prof. Vogt. It is well known that the young of many parasitic animals are free and active, and discover during migration the localities to which they afterwards attach themselves for life. During the early stages they present the characteristic marks of their order and class, and in some instances the males, remaining free, continue to do so. Such are the *Entoconcha mirabilis*, the *Sacculinae* and the *Trematoda;* the first a mollusc, the second a cirrhiped crustacean, the third a worm. On their becoming attached to their host a successive obliteration of their distinctive characters takes place, so that they become so simplified as to be no longer referrible to their proper class, but susceptible, as Prof. Vogt remarks, of being united in a single division. A similar process is observed in the structural degeneration of the Lernean

parasites, which are at first free, but afterwards become parasitic on fishes. There is in this instance a coincidence between degeneracy of structure, and loss of compulsory activity: not only is every function of their sluggish lives automatically performed, but consciousness itself must experience little stimulus.

From what has preceded, it is evident that automatism is at once the product and the antagonist of evolution, and that it is represented in structure by specialization. It appears also that consciousness is the condition of the inauguration of new habits, and this is only possible to structures which are not already too far specialized. This is doubtless true, whether osseous and muscular tissue be concerned in evolution, or whether it be nervous and brain tissue. Hence in the highest form of development, that of brain mechanism, automatism is the enemy, and consciousness the condition of progress. As a product of development, automatism is the condition of stationary existence, and constitutes its effective machinery, but every additional step requires the presence of consciousness. This may be expressed in the every-day language of human affairs, by saying that routine and progress are the opposite poles of social economy.

6. THE ORIGIN OF CONSCIOUSNESS.

This question has not yet been touched upon, nor is it necessary to give it prolonged attention at present. Consciousness is in itself inscrutable to us, and the contrast which it presents to physical and vital forces is the great fact of life. It is obvious enough that certain molecular conditions are essential to its appearance; drugs intensify or obscure it; concussions and lesions destroy it. It will doubtless become possible to exhibit a parallel scale of relations between stimuli on the one hand, and the degrees of consciousness on the other. Yet for all this it will be impossible to express self-knowledge in terms of force. The question as to whether the product of the force conversion involved is the consciousness itself, or only a condition of consciousness, may receive light from the following consideration.

Nowhere does "the doctrine of the unspecialized" receive greater warrant than in the constitution of protoplasm. Modern chemistry refers compound substances to four classes, each of which is characterized by a special formula of combina-

tion. These are called the hydrochloric acid type, the water gas type, the ammonia type, and the marsh gas type. These series are defined by the volumetric relations of their component simple substances: thus in the first, a single volume unites with an equal volume of hydrogen; in the second, two volumes of hydrogen unite with a single volume of another element; in the third, three, and in the fourth, four volumes of hydrogen unite with the single volume of other elements. Hence the composition of these compounds is expressed by the following formulas—chlorine, oxygen, nitrogen and carbon being selected as typical of their respective classes: HCl, H_2O, H_3N and H_4C. Now it is an interesting fact that protoplasm is composed of definite proportions of four simple substances, each one representing one of the classes above named, or in other words, the capacity for proportional molecular combination which characterizes them. The formula $C_{24}N_8O\ H_{17}$ expresses the constitution of this remarkable substance. Now although the significance of these combining numbers is unknown, there is a conceivable connection between the characteristic peculiarities of protoplasm and the nature of the substances which compose it. It is probable that these, when in combination with each other, exert a mutually antagonistic control over each other's especial and powerful tendencies to form stable, and hence dead, compounds. It is therefore reasonable that the terms "unspecialized" or "undecided" should be applicable to the molecular condition of protoplasm, and in so far it is a suitable nidus for higher molecular organization, and a capacity for higher forms of force conversion than any other known substance. If also in inorganic types, as in the organic, the generalized have preceded the specialized in the order of evolution, we are directed to a primitive condition of matter which presented the essentially unspecialized condition of protoplasm, without some of its physical features. We are not necessarily bound to the hypothesis that protoplasm is the only substance capable of supporting consciousness, but to the opposite view, that the probabilities are in favor of other and unspecialized, but unknown forms of matter possessing this capacity.

Consciousness constitutes then the only apparently initial point of motion with which we are acquainted. If so, we are at liberty to

search for the origin of the physical forces in consciousness, as well as the vital; their present unconscious condition being possibly due, as in the case of the vital, to automatism; the automatism being the expression of the automatic type of the substance exhibiting it. And, doubtless, the simple quantitative relations of the lowest types of forces are related to correspondingly simple geometrical conditions of matter, both representing the simplest grade of automatic action and machinery. We may also suppose that all of these primary conditions were necessary to the production of protoplasm, the only form of matter known to us in which consciousness can persist.

In conclusion, it is obvious that the metastatic condition of protoplasm necessary to the *persistence of consciousness* could not be supported without a constant source of supply by assimilation. Hence it would appear that the preliminary creation of dead and unconscious substances and organisms were a necessary antecedent to the accomplishment of this end; at least under circumstances of temperature under which living brings or protoplasm exist on this planet. Without the unconscious inorganic and organic products of nature, consciousness could not exist on the earth for a day. No animal can maintain consciousness without food; and that food must be, in the main, protoplasm. Protoplasm is manufactured from inorganic matter by the (supposed) unconscious protoplasm of the plant. What form of matter originally gave origin to protoplasm is yet unknown, but it is obvious that the ordinary physical forces must have existed as conditions of its creation, since now they are absolutely necessary to its persistence. Hence we may view the succession of automatic activities, somewhat in the light of the fagots used by the elephant to lift itself from the well into which it had fallen. One placed upon another finally raised the footing to an elevation which enabled the animal to obtain its freedom.

Consciousness is the essential, and at the same time, the only condition of personality; so that in this view of the case we are led to a primitive personality, although not to what we call life. And the reason why this personality is to us so obscure a conception, is probably to be found in the fact that it as well as ourselves is conditioned in its relations to matter, by necessary laws of "mathematical" truth.

E. D. Cope.