By N. S. Shaler

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THE INTERPRETATION OF NATURE

BY

NATHANIEL SOUTHGATE SHALER
PROFESSOR OF GEOLOGY IN HARVARD UNIVERSITY

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PREFACE.

THIS volume contains, with slight modification, the course of lectures on the Winkley foundation which I delivered before the students of Andover Theological Seminary in 1891. At the outset I addressed a few words to my audience with the purpose of putting myself *en rapport* with them, and with the same intention I address my readers in the same terms in this preliminary note.

It seems desirable to preface the book which I offer to you with some general account of its plan. When I was asked to undertake this task, I was conscious of the difficulties which I should encounter in the work, and was at first disposed to be daunted by them. You all know that

the relations between natural science and religion are somewhat strained. Naturalists generally have rather a bad name among theologians, and those students of the phenomenal world who have ventured to write about religious matters have rarely won laurels from their friends on either side. I was led to prevail over my fears by the considerations which I shall now briefly present as follows :—

My first contact with natural science in my youth and early manhood had the not uncommon effect of leading me far away from Christianity. Of late years a further insight into the truths of nature has gradually forced me once again towards the ground from which I had departed.

Although the individual man is apt to overestimate the importance of his mental history, I think I am not mistaken in believing that my own experience, in a way, represents the course which many other naturalists are more or less consciously

following. Beginning with the simpler and apparently mechanical facts with which they have to deal, inquirers into phenomena are, at first, almost necessarily led to conceive nature as a great engine, which can be explained as we account for a combination of wheels and levers. Gradually, as they are forced to more extended views of their subject-matter, they perceive that this simple explanation is unsatisfactory. Without conscious argument, moved merely by the weight of the truths which are insensibly driven in upon them, they find their conceptions enlarging; they are compelled to suppose a kind of control operating in their world which is not purely dynamic. When they attain this position, it seems to me time for them to examine the ground they occupy, with a view to finding what is its relation to that held by the older schools of interpretation, those which we call the theologic. The matter which I have to present to you is directed to this end.

After consideration, I determined not to try to undertake a connected argument concerning the relations of science and religion, but rather to take up certain leading questions which have at once a relation to natural history and to theology. In this presentation I approach the matter altogether from my own point of view, my aim being to show the state of mind to which the student of phenomena is brought by influences which are entirely independent of theological opinions.

Two of the topics which I treat, those concerning critical points in nature and sympathy, have already had some presentation in print, but the articles have been revised and rewritten for use in this series.

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THE INTERPRETATION OF NATURE.

CHAPTER I.

THE APPRECIATION OF NATURE.

THE most that men do in the routine of their daily life is so masked by habit that they fail to see how they are moved to their deeds. The veil of the commonplace is so thick that it admits no more light than just enough to show us where to place our feet. It reveals nothing of the way behind us or that which is far before. It therefore requires a good deal of careful thinking to secure an adequate notion of what we are really about in the ceaseless activities of our days. With a little pains a man may make a list of all his actions during a single day; it would,

however, puzzle the most introspective philosopher to accomplish the more important task of determining what were the mental processes which led him to the several activities. It is doubtful if such an analysis is within the limits of human ability. In such an effort we can at best discern enough to show us some general trends of our thought; something of those tendencies is indeed evident on a very little self-inquiry. One of these which is marked in every man's mind is to be the subject of our consideration.

If we examine the processes of our intellects, such at least as go on while we are completely conscious, we note that we are principally employed in trying to ascertain and rationalize what is going on in the world about us. For the larger part of our waking time we are attending to the sensations which come to us on the several lines by which we gain a knowledge of the matters beyond ourselves. Each distinct effect on the sensorium,

arising from light, from sound, from odors or other phenomena, as it is seized on by consciousness, is at once interpreted and classed, so that we feel that it falls into a fit place in our understanding. As long as this simple, every-day, or rather every-instant duty is easily accomplished, the work lies in the domain of the habitual, and does not more than momentarily, generally most imperfectly, affect our consciousness. We then deal with the impressions which are thrust upon us as a well-trained fencer does with the assaults of an antagonist. We instinctively meet them without a knowledge of our action. In an ordinary day we may reasonably estimate that a man with moderately quick wits devises many thousands of these simple explanations, which are secured by a quick classification of the impression, and its reference to an appropriate category. On his success in this unconscious endeavor his individual life depends, as that of his ancestors, human

and brute, for inconceivably many generations has absolutely depended.

This interpretation of the nature about his individual life which is so conspicuous in man began in his remote progenitors. It is first manifested in simple reactions which are termed "reflex" movements, by means of which, apparently without the exercise of any distinct intelligence, the lowly creature avoided dangers, sought its food, and recognized its mates. Gradually these actions, apparently so simple that some speculators have termed them automatic, rise in their grade. The advance is so gradual that between purely reflex action and consciously intelligent work no distinct line can be drawn. We can only say that by insensible gradations what was apparently an automaton becomes a conscious creature. When this stage of consciousness is attained, the reactions are complicated with distinct motives and influenced by more or less definite memories. Finally in man, the appreciation of

nature, with the advent of self-consciousness, rises to a higher plane, perhaps the loftiest to which intelligence is to attain upon this sphere. It is outside our purpose to consider the stages by which the merely reflex movements relative to the environment, such as may be exhibited by an amœba or by a decapitated frog, gradually become uplifted to the plane of conscious inquiry. The history of this development seems to me a matter which must for the present, and possibly forever, remain inscrutable. We need, however, to note that with the advent of conscious intelligence there comes that motive called curiosity, — the impulse which leads the creature to demand explanation of the world about it. It is clear that curiosity is a very intense motive in the life of a host of creatures below the level of man. It is indeed tolerably evident among all the vertebrates where the intellectual faculties are sufficiently developed to enable us to study their mental parts. If we are

observant we may, in any walk through the woods and fields, note this motive among animals, and observe how it contends against the more primal impulse of fear. The skilled hunter knows well that it is in certain creatures a stronger lure than hunger; that it will often tempt the most timid animal to its death.

In the groups of animals in which the mental powers are only moderately developed, as in the ordinary creatures of our flocks and herds, this element of curiosity appears to be related mainly to phenomena exhibited by other animals or by objects which they may presume to be of an animal nature. Thus the half-wild cattle of the plains will crowd about a footman, while they will not notice a man on horseback. They are unaccustomed to the spectacle of a man afoot, and it needs to be explained to their minds. A mounted man is to them a familiar object. They exhibit no strong desire to examine into the details of any other objects save those

which appear to be animated. It is otherwise with monkeys. These animals have the interrogative spirit developed in a surprisingly intense manner, and it extends to a very wide range of facts. Their well-known mischievous spirit mainly arises from the desire to attain to some understanding of the things with which they come in contact. The gratification of this impulse in the apes can hardly appear even to the exalted selectionist as the result of any advantage which the creatures' ancestors have won from the exercise of the habit. So far as the profit is concerned, it is clearly better for the animal to indulge in the impulse of fear and flee from any novel apparition, rather than to approach what may prove to be a serious danger. We must therefore regard the motive of curiosity which is evident in so many of the lower animals and becomes so exceedingly well developed in the higher groups of the infra-human mammals as something which is not to

be accounted for by the Darwinian hypothesis.

These considerations, when properly dealt with, serve to show us that we are not in any way distinguished from our immediate kindred among the lower animals as regards the fundamental habits which determine our intellectual relations to environment. Both man and the more intelligent beasts similarly receive this store of impressions from the outer world. They alike give them an interpretation from their previous experience; they alike have built upon this primitive habit the peculiar superstructure which we term curiosity, that is, the desire to seek even at the cost of labor and danger the explanation of phenomena which are not at once to be accounted for by the store of remembered experiences.

Although there can be no doubt that the motive which leads men to interpret nature had its foundations laid in the grades of being much below the level of

humanity, it is clear that the impulse is vastly developed along the line of passage from the lower to the higher estate of being. The most imperfectly educated savage, as for instance the Andaman Islander or the Hottentot, doubtless gains a far higher grade of thought in his explanation of nature than the ablest ape or other inferior animal, and his curiosity is doubtless cast in a much more logical form than that of his lowly kinsman. The beast, when startled by an unusual sound or sight, probably at the moment uses a certain kind of logic in its mental processes; by its individual experience and the store which it has inherited from its ancestors, unexplained sounds and sights come to be associated with danger, and so the motives of fear and curiosity are aroused. My horse is startled by the appearance of a bit of paper stirred by the wind. The awakening of his fear is doubtless due to the fact that his mind associates movement on the part of any

object with possibly dangerous characteristics. His detailed memory and his power of associating ideas being weak, he cannot at once class the object with the things which he knows are not harmful. If I hold him in the face of the object until he can slowly gather its characteristics, he will be enabled to classify it as innocuous. When the impression has been frequently repeated, a general notion is formed; the creature, as we say, becomes accustomed to the thing.

Among men, even among the lowest savages, this process of generalizing the material afforded by the consciousness proceeds with vastly greater speed than in any of the lower creatures and attains to a far more advanced state; the curiosity likewise is more penetrative. It is not satisfied with the simple conclusions which the beast secures, but it demands a vastly greater measure of explanation as to the meaning of the phenomena. It inquires as to causes. The horse is content when

the bit of moving paper is classed with the things which are not likely to do him harm. In fact, so far as we can see from the actions of the creature, he is satisfied with the division of the surrounding world into the three simple categories of things to himself beneficial, harmful, and inert. The essentially human question which, so far as we can see, is never asked by the lower animals, is, "How did this action come about?" "What *caused* the event?" Indeed, this question is asked in the lower men only in those cases where the action is in some way forced on their attention; the idea of causation with reference to the great mass of events in nature which are neither friendly nor hurtful to them, but simply indifferent, appears to be limited to more advanced peoples.

Although we cannot see the origin of this motive which we term curiosity, it is easy to perceive that man inherits the impulse from prehuman stages of thought and action, and that the later time has

only served to elevate and extend the modes of its operation. In the first form the interest in the unknown was of a blind sort; seeking no further gratification than that which the simplest possible classification can afford, — a classification which has reference to the individual needs alone. In the primitive man and in children we see this shapeless and purposeless state of the motive, which seems to indicate its remote and animal origin. In the savage, even of the lowest sort, this spirit has led to some attempt at rationalizing the world. The first step toward this great human enterprise appears to have been independently taken by a great number of separate peoples, but it is always in one direction. The natural action demanding explanation is inevitably accounted for by the supposition that it is caused by the will of some being like those with whom the man has come in contact. In what may be its simplest form this explanation assumes that winds

are caused, say by the motion of the wings of a bird, experience having shown that the air can be moved in this manner, or the action may be accounted for on the supposition that it is due to the breath of some animal. Still further it may be assumed that the motion is brought about by a humanlike being in some one of the many ways in which man may stir the air. Very often, though at what seems to me to be a later stage in the process of thought, the phenomenon is accounted for on the supposition that it is controlled by the departed spirits of men.

Early in the organization of society the abler members of the tribe stand apart from their fellows by their strength of body or of mind. They are reverenced for their power. When they die it is natural for their kindred to suppose that they remain about their former dwelling-place and continue to show their ability by the control of events which affect their kindred.

We cannot here trace the wide extension of this belief which assigns the control of the world to the spirits of the departed; it was a natural and noble view. It did much to reconcile man to nature; it seems to me to have been the foundation of all our higher interpretation of the universe: the basis of both the theological and scientific explanations of the order of events. It is very difficult for us to hark back in imagination to the state of men before either religion or science had taken shape. Yet we should endeavor to conceive the primitive man with a dawning consciousness of the mystery about him; with a keen sense of the dangers of the present and of the hereafter; with experiences which led him to the belief that the world was a vast brutal enemy of his fondest hopes and desires. In the maze of phenomena he beheld a few traces of order. The days and seasons succeeded each other, animals and plants brought forth after their kind, the

streams flowed on forever. Even the evils which afflicted him were evidently in their nature ordered or successive. When these elements of obscure order were explained by the supposition that they were the result of the will of beings essentially like himself, a great step towards an intellectual and moral life was made. It is true that the great mass of phenomena which the world exhibited was still unaccounted for: the hypothesis was, indeed, inadequate, but a beginning was made, and with the advance in culture the conquest was rapidly extended.

Beginning with this animistic or polytheistic explanation of the orderly parts of the phenomenal world, the natural path of thought — a path trodden, it is true, by few peoples — inevitably leads to a more united and more monotheistic view of the universe. Where gained at all, the monotheistic idea is but slowly acquired, yet it logically follows with the advance in philosophic capacity. The subordinated

intelligences which regulated events were gradually represented as under superior control, something like a hierarchy of powers was conceived one above another, until the great conception was completed in the unique idea of a Supreme Being who used the lesser powers as the agents of his will. Gradually the grosser human attributes were removed from the conception of this omnipotence, and he stands apart from man in all save those qualities which men regard as Godlike. When this idea of nature is attained, even while the polytheistic stage alone exists, the motive of curiosity, partially allayed by the animistic conception, begins again to find itself unsatisfied. The fact is, the theologic explanation of nature gives scant room for the exercise of this motive. This explanation necessarily dwells on large matters which are to be accepted on the basis of faith alone; it cannot concern itself with the exploration of the very detailed happenings which meet the eye.

That it is the will of God that things are so does not satisfy the impulse which seeks to know the "how" and the immediate "why" of the matter. Thus the spirit of inquiry which led to the institution of the first explanation of the visible world finds in time that it has scant place in the theologic realm: it therefore returns to its natural quest and begins its inquiries anew.

Starting with the theologic conception which is apparently the necessary product of the first series of efforts to explain the order of the universe, the curious spirit necessarily enters on the new quest with its motives greatly affected by the primal beliefs. It is a very remarkable fact that while the theologic explanation of nature has been separately invented, or at least developed from a very primitive notion by many different peoples, the scientific motive is essentially peculiar to one body of folk, the Aryans, and has attained to any considerable development in only one

branch of that race, the Greeks and their intellectual descendants, the kindred Europeans. The essential shape of our modern science is Greek. We have inherited this part of our life from the Hellenes even more immediately than we have taken the basis of our spiritual motives from the Hebrew race. It seems quite probable that the Greeks in their early intellectual history derived the germs of their science from that part of the Aryan people which settled in India. There are indications of something like observational lore among these people of Hindustan in a very early day: but these notions as to the realm of nature were closely bound up with the body of religious opinion, and did not take the distinct form of science. Such as they were, these conceptions of phenomena were a part of the cosmogony of the Hindoo Aryans. From India they seem to have passed to the land of the Nile, and thence by the ancient ways of trade to the Grecian people. Although

the religious conceptions of the Greeks were diversified, they in general sought to account for the phenomena of nature by a complicated anthropomorphic polytheism. Although their conceptions are not distinctly formulated, it seems clear that every orderly occurrence in the world was usually conceived, at least in the ages before the fourth century B. C., as explicable on the theory that it was brought about through the will of a being who in essential characteristics was like man. These beings were supposed to be arrayed in a certain hierarchal subordination, the less powerful under the greater, and thus rank above rank until the supreme was attained. Certain more philosophical minds conceived the divine as a single personality from which the conception of human characteristics was, so far as possible, excluded. Thus Xenophanes spoke of the control as being in the hands of

"One god among all gods and mankind the greatest;
Neither in body like unto mortals, nor in his spirit."

Good as is this conception, it is not at all scientific, but purely theological, for even Anaximander appears to have believed that the order of nature was in the control of subordinated intelligences who were in some way dependent upon the supreme.

The peculiar task before the Greeks, one which they accomplished in a marvelously complete manner, was that of framing a conception as to the way in which phenomena were controlled, which would exclude the idea that occurrences were immediately influenced by personal divinities. The precise steps of the process are no longer traceable in detail, or at least it requires more scholarship to trace them than I have been able to bring to the undertaking. In general the course of thought of the philosophers who led the way to the scientific conception of nature appears to have been as follows: Reflecting on the hypothesis of polytheistic control, this ancient view became repugnant to them; the idea that the

majestic harmonies of the universe were brought about by the efforts of a throng of exceedingly human-like beings involved in endless discords, such as the mythologies pictured, was naturally offensive to thoughtful men. For a long time no way out of the difficulty was found. At length a hypothesis was invented which by a gradual series of transitions led to the conception of natural law. We find the first distinct marks of this invention in the writings of Plato. It is contained in his doctrine as to the existence of universals in the same sense as individuals exist; thus, for instance, he seems to have conceived that a particular species of tree existed as an abstraction from the eternal past, the actual plant itself being only the physical incarnation of the eternal form; the individual man was to be considered as only the animated expression of the equally real but ever enduring idea of humanity.

In a certain way the abstract or univer-

sal idea of the thing thus came to replace the earlier and grosser conception of the particular human-like God who shaped the phenomena. We may in a way term this universal a controlling or formative power from which the old conception of all baser qualities has been taken away. The Platonic universal immaterial being, which ever seeks to shape itself in matter, seems to me to be essentially the ancient god from which the philosopher has excluded all irrelevant qualities. The shaping power still remains a distinct creature, incessantly seeking expression in reality; it is in a sense the ghost of the old deity or demigod.

When the abstract conception involved in the Platonic theory of natural order had been formed, the next step toward what we term the scientific idea was quickly attained. We find it in the writings of Aristotle developed in nearly the same degree of elevation which it exhibits in our own day. The Stagyrite advances

the conception by still further withdrawing from the mental picture of the causes which lead to phenomena, all the qualities of personality. With him the category or framework takes the place of the universal. Things are by him conceived as shaped by some power acting behind the genus or species into which they fall, but he invented, or at least affirmed, the custom of leaving the mode of action of this causation quite without consideration, at least while he was dealing with the matter in a scientific way. With Aristotle, the category thus became a mere algebraic expression for control in nature; he used it as a mathematician uses the sign for infinity without pretense of explanation; with this recognition of the essential unknowableness of ultimate causes, science in its strict, we may say indeed in its Aryan, sense begins. We thus see, as far at least as the fragmentary condition of the records of Greek learning permits, that the manner of explaining nature

which is characteristic of science grew by rapid and tolerably clearly indicated passages of thought from the polytheistic method of accounting for the order of nature. Although there are many indications that the Greeks of times earlier than Aristotle were more or less affected by similar views as to the way in which the universe was controlled, it was in the century of the Stagyrite and his great master that the separation between cosmology, which seeks to account for all phenomena on the theistic hypothesis, and science, which professes and declares the ignorance which the observer finds to limit his inquiries, was accomplished. Although, as we shall have hereafter to note, science has made certain advances in the ways which were first clearly entered on by the Greeks, the essential direction of all its subsequent course was fixed by them.

The immense advantage which is afforded by the Aristotelian limitations to

inquiry is admirably shown in the vast results which the method attained in the hands of its inventor and first master. As long as men sought and seemed to find an account of all things in the imagined motives of human-like but undiscernible individuals who by their power controlled all happenings of the universe, it was impossible to set about the task of explaining phenomena in the physical, organic, or social world in a rational way. When, however, the conception of natural law began to form, a wide and tempting path was opened to a new kind of intellectual endeavor, in which men explained occurrences by the orderly features which facts presented on their face. It seems to me that the enormous work accomplished by Aristotle, which, taken as a whole and under the conditions in which it was done, must be esteemed as the greatest body of labor ever performed by a man, was due in part at least to the fact that he was the first clearly to see that the

thing should be interpreted by itself and its relation to other visible things. Or, in other words, to the newly awakened sense that phenomena afforded, if not all that was necessary for their explanation, at least all that could be utilized by human skill. Inspired by this view, which seems to our eyes so commonplace, but was in his day an inspiration, that brilliant and penetrating mind made haste to assemble the unorganized mass of Greek learning in clear and categoric form. His conception as to the meaning of natural order, and the limits which inquiry into it may put upon his work, enabled him to put the chaos of ancient acquisition into shape with a speed which has had no parallel in other ages. I am tempted to compare Darwin's work with that of Aristotle, but the British philosopher was limited to the narrow field of the biological sciences, while the great peripatetic marched as a conqueror through all the domain of the phenomenal world, and at his death in his

sixty-third year had founded science for all time.

The foundations laid by the school of Aristotle waited long before any considerable structure was built upon them. We can see some effect of his positivist view in the later states of Greek science. It is particularly manifested in the writings of Strabo. But many of the Greeks who sought to explain nature, even where they neglected the polytheistic notions, remained subject to the speculative humor characteristic of the Hellenes, and this led them, in the manner of Lucretius, who, though by birth a Roman, was in spirit and training a Greek, to invent purely speculative hypotheses to account for the facts of nature. They were unscientific in that they did not search the phenomena for the explanation they sought, but evolved it from their minds. The Romans, who so greedily appropriated, as far as their nature would permit, the culture of the Greeks, and who were successful

in acquiring a tincture of their literary and philosophical spirit, as well as their motives in the plastic art, utterly failed to gain any share of the Hellenic spirit in scientific inquiry. In the centuries of intellectual history after the fall of Greece, the Romans developed no inquirer fit to be compared with scores of men who belonged in the earlier civilization. Pliny the elder was exceedingly curious in all that related to the natural world, but his works show that he never had the faintest idea of science. He knew about as much of its spirit as does the moth when it meets its fate in the candle. Nature attracted him even to his death in the Vesuvian eruption, but it was mere primitive curiosity that impelled him to his tireless industry in gathering facts.

It is important for students of science to note this striking, indeed we may say amazing, contrast between the scientific spirit of the Greeks and that of the Romans; it serves to give us many impor-

tant lessons; it tells us how peculiar and exceptional is that organization of mind which permits the development of the scientific spirit. The Romans had a genius for many of the higher walks of thought and action. The difficult principles of jurisprudence first took clear and logical shape in their hands; they were of all the ancients the most skillful in mastering the conditions of nature and in turning them to the immediate uses of man. They had the historic sense as well developed as the Greeks, and in all matters of government, particularly in the work of administration, they were the superiors of the Hellenes. When, however, we come to science we find that they not only had no power to invent explanations after the manner of the Greeks, but they possessed so little intelligent curiosity that they could not make use of what came to them from that people. It would be interesting to note this contrast in more detail, but for the present we

are concerned with another aspect of the matter, namely, as to the effect of Roman dominancy on the history of the methods of explaining nature.

The singular contrast between the attitude of the Greek and Roman people in all which relates to the interpretation of nature, long ago led me to question the race kinship of those peoples. Until recently this doubt appeared futile, for the reason that historians and archæologists appeared to be substantially agreed in holding to the idea of their close affinity. It is interesting to note that at the present time students who are well informed seem inclined to believe that the Etruscans came to central Italy from northern Africa, and that they are possibly to be classed as people of Semitic affinities. If this view be correct, it may turn out that a large share of the Roman blood and of the inherited motives which go therewith is not of Aryan origin, and that many elements in the history of Europe

which are due to the influence of Rome may be accounted for by the supposition that the Latin impulses were founded on the character of a non-Aryan people.

It was a momentous event in the history of learning when Christianity passed to the people of western Europe through the gates of Rome, for it thereby came into the keeping of a people who were incapable of sympathy with the spirit of scientific inquiry. The result was that for a thousand years or more all trace of the broad catholic spirit which found its summit in Aristotle failed to find a place among the Latin and Gothic peoples. It is often assumed that the lack of the motive of inquiry in these centuries was due to the deliberate exercise of priestly authority in its repression. The truth is, that the spirit of the naturalist did not exist among the Romans any more than it did among the Hebrew people. In fact, the intellectual motives of the race who gave us Christianity and of the nation

which again propagated it in Europe are in many ways akin. This spirit in both peoples permits the nurture of a profoundly theistic explanation of the universe, but it has no room for the peculiar views of science. Hence while certain parts of Aristotle's works were almost adopted by the Church as sacred books, we find no evidence of effect arising from his inquiring motive until relatively modern times. All the parts of his writings which we may term naturalistic were essentially incomprehensible to those who had no tincture of the Greek spirit. We therefore do not have to look to the somewhat natural antagonism between the theistic and scientific explanations of the phenomenal world for the destruction or suppression of the Hellenic motive of inquiry. It is in the main sufficiently accounted for by the lack of all interest in or understanding of such matters among the people who had to support the structure of the Church.

It should, moreover, be noted that the death of Greek science was as complete, though it came about in a less rapid manner among the descendants of the Hellenes in eastern Europe than in the western world. In the Byzantine empire the spirit of interpretation was buried beneath trashy word-spinnings, and was lost in all save the imperfect manuscript records. The fact is apparent that Hellenic science was a frail and temporary flower of that marvelous culture which blossomed in Athens in the fourth century B. C. We may well doubt whether it would have given fruitful seed and come to possess the earth, even if Greece had remained unsubjugated, and the Christian religion had not, by giving new life to the theistic explanation of this world, turned men's minds from this inquiry.

The revival of scientific explanation in the latter part of the Middle Ages affords a much more puzzling series of facts than does its origin in the Hellenic time. The

original invention of the method we can trace back to a particular age and place when a small body of cultivated people contrived the way of thinking. The revival took place almost simultaneously in several widely separated countries. The renaissance of learning occurred separately and at about the same time in Italy, in Germany, and in Britain. It is difficult to say in what degree it is to be attributed to the influence of the Greek learning in general, which was widely disseminated after the fall of Constantinople, and how far it was due to the better understanding of Aristotle. Rarely is the student able to tell us whence he derived his motives. Yet more rarely does he take pains to analyze the history of his intellectual motives and record them for history's sake. It is, however, clear that whether it was the study of Greek science which aroused our western learning to life or no, the shape it took was determined by the Hellenic writings, mainly by those of Aris-

totle. He was the one man of science whose works were patronized by the Church. His works were more widely disseminated than those of any other philosopher, and have provided a foundation for thought in all the more important branches of science.

The portion of Aristotle's writings which the Church most favored was, it is true, not that which treats of natural science. This part of his contributions long remained inaccessible in the original language, while the more purely philosophical treatises became common property in the Latin translations. Nevertheless, there were Greek scholars enough for the need, and the principles of the Aristotelian system which penetrated all his works imbued the minds of men with the scientific spirit. Even a cursory glance at the influence of Aristotle on mediæval learning will convince the student that this philosopher's position was such that no scholar who understood him could

escape from his control. His influence was then more pervading in all branches of learning than that of Darwin now is in the particular field of biology. For my part I am convinced that while the tendency towards inquiry which led to modern science was indigenous and marks a stage of intellectual development, as it did in Greece, the organization of that motive is due to Hellenic science quite as much as that of our religion is attributable to the motives which arose in certain Asiatic peoples.

Although modern science has in its essential features departed but little from the main lines indicated by Aristotle, and this because his position was in its nature final, there have been noteworthy changes in certain practical and theoretical features which have very gradually effected the conduct and success of this method of inquiry. We have learned a simple lesson which the Greeks never knew, which is in effect that it is necessary to verify opin-

ions so far as is possible by experiment, and where that cannot be effected, by repeatedly comparing the occurrences with the hypothesis by which we seek to explain them. For lack of this system of verification, the Greeks, even Aristotle himself, were often beguiled by mere speculations, where the tyro in modern inquiry would have found his way to the substantial truth. It required many generations of modern science to make this need of criticism and revision clear, and to this day it remains the weakest side of most scientific work.

The modern conception as to the mode of action of energy has perhaps also served in a measure to change the state of mind of naturalists with reference to the true position of phenomena in the universe. We probably see the curious succession of events in their lines of dependence and interdependence in a clearer manner than the abler Greeks of the peripatetic school, but these are differences of so minor a

kind that the naturalists or physicists of to-day, apart from the language, would find hardly more difficulty in exchanging ideas with Aristotle than they would encounter with educated men of their own time and country.

One of the most essential peculiarities of modern science, as compared with the Hellenic system, is the range of the motive in this age. In the days of Aristotle this branch of inquiry commanded the sympathies of only a small part of the societies in which it was nurtured. It remained the possession of the limited class of intellectual people; it did not sensibly affect the conduct of life, either in practical affairs or in the field of morals; it never became, as in modern times, the agent by which the faculty of mechanical invention has been quickened. Its only conquests were in the minds of men. It did not extend beyond the limits of the Hellenic civilization until some centuries after that civilization fell to pieces. Then in the

seventh century of our era some of the seed which fell upon what would have seemed at first sight hopelessly stony ground, among the Arabian Moslems, quickened into a brief but vigorous life. I cannot here trace the unique excursion of the scientific motive beyond the limits of the Aryan folk. It is in many ways, however, the most singular and interesting incident in the history of learning. For our purpose we need only to note the fact that the Saracens eagerly sought for the scientific works of the Greeks. They made effective use of all of their more practical parts; for two centuries they cultivated the sciences of mathematics, chemistry, and astronomy, and, perhaps, advanced them somewhat beyond the stage in which they were left by the Hellenes, and then, in an inexplicable way, abandoned the field.

Except for the above-mentioned brief culture of natural science by the Arabians, we have no evidence that its mo-

tives have ever been appreciated by any other people than the Aryans. Even among the Saracens, although some of its votaries appear to have been of a naturalistic turn of mind, this branch of learning seems to have been used as a toy or a convenient tool, and was not to any extent sought as a means of exploring the world of phenomena. This exceptional extension of science seems rather to accent than to invalidate the general truth that the scientific interpretation of nature is a task for which as yet only the Aryan people are truly and instinctively fitted, and even in this race there are folk such as the Romans who have no innate tendencies towards this form of thought. Similar limitations in the intellectual powers of diverse peoples are shown in other fields than that of science. The Aryan folk, notwithstanding their singular capacities, have to thank another race for their religion. A pure monotheism based upon an exalted conception of the duty

owed by the individual to the Supreme Being did not, so far as the history of our race goes, seem to lie in the trend of their thought. While individual men attained to it they were unable to give it the intensity necessary for dominance. The genius of our western nations appears to lead its people towards the consideration of the phenomenal world. It secures ever eminent success in the task of dealing with the immediate and tangible realm. It is doubtful if the sense of the unseen which leads to moral and religious conceptions was as strong in our ancestors as it clearly was among certain other peoples, particularly the Hebrews.

It would be an interesting matter to consider what shape the interpretation of nature would have taken among the Aryans of modern Europe, if they had lacked the inspiration which came from the revival of Greek learning. There are not wanting indications that the motives which lead to this interpretation would

have created a new something like the methods of inquiry which were invented by the Greeks, and that modern Europe, even if it had lacked Hellenic traditions, would, though doubtless more slowly, have found its way to the existing methods of interpretation.

In summing up these considerations, we may say that the appreciation of phenomena among all men seems to begin with the assumption that their order is determined by the action of beings essentially like men or animals. A polytheism commonly anthropomorphic appears to be the universal and apparently inevitable first step in this process of accounting for events. With the enlargement of these primitive conceptions they become more rationalized; the order of nature is gradually conceived as due to the influence of more and more powerful unseen agents, until finally the monotheistic conception is more or less perfectly attained. This final majestic picture of universal control appears to

have originated in several different places. It seems to be a natural outgrowth from polytheism. It is true that these monotheistic views do not exclude, in fact they may be said always to include, the existence of subordinate divinities who are more or less completely conceived as the servants of the supreme power. Nor in an imperfect way is this idea of a central and supreme power made to account for the phenomenal side of the world. It is rather directed towards the moral relations of man.

With the further development of culture there arises an intenser curiosity concerning the processes of nature. In the highest state of Grecian culture, when men by a very perfect training in the fine arts had their minds quickened to the utmost, they eagerly demanded some explanation as to the prevailing order of the organic and the physical world. They were not satisfied with the account which was presented by the religious system of

their age, and so they gradually found their way to the conception of natural law. Again, in the Renaissance, once more quickened by the sense of natural harmony through the arts of painting, sculpture, and poetry, men instinctively sought a rational account of the world which their religious traditions did not offer them. In this time they had the good help which came from the remnants of Hellenic science, and so were hastened on the way which they would probably have achieved, though with greater difficulty, if they had been left altogether to their own resources. For a while and most naturally the Church contended against the new method of interpreting nature. It would have been indeed false to its duty if it had not opposed the ways of science. It was morally bound to uphold the conviction that the old method of accounting for the course of events by the supernatural hypothesis was true and sufficient. Omar's conclusion that the books which

contained the truths of the Koran were superfluous, and all which gainsaid them mischievous, is the logical outcome of reason as exercised by the thorough-going supernaturalist.

The clearest outcome of the debate between the extreme supernaturalists and the naturalists is that science still lives and has won a curiously strong place among men. There is, however, a less evident, but, to the thoughtful student, larger view of this interaction. This, as it appears to me, I shall now endeavor briefly to set forth.

As long as natural science dealt with the immediate aspects of simple phenomena, the measure of explanation which was demanded was small. It was necessary only to suppose the existence of actions of causation as simple as those with which our own voluntary deeds make us familiar. That necessary kind of sequence of phenomena which we term "cause and effect" appears at first sight very simple,

because it is so like in results to our individual actions, and thus the first stage of natural inquiry led men of science to the curious and undeclared assumption that the visible was the essential part of the universe. As inquiries have gone deeper into the realm of causation, especially as the conditions of organic life have been made the subject of more penetrating study, the sense of the profundity of natural law has been continually enhanced. In the study of the successions exhibited by animals and plants it has been perceived that the march of events from the primitive simplicity towards greater and greater complication, culminating in man, requires us to assume the existence of something like permanent guiding influences operating in the world of matter. As the conception of these and of other laws or principles operating in nature becomes more complicated, naturalists are being driven step by step to hypothecate the presence in the universe of conditions

which are best explained by the supposition that the direction of affairs is in the control of something like our own intelligence. As yet this thought is vague, but whoever will inform himself as to the trend of modern science will see that even where the votaries of the new learning are most indisposed to recognize the increasing measure of their theistic motives, the increase is nevertheless discernible. I am myself convinced that in the next century there will be a state of science in which the unknown will be conceived as peopled with powers whose existence is justly and necessarily inferred from the knowledge which has been obtained from their manifestations. In other words, it seems to me that the naturalist is most likely to approach the position of the philosophical theologian by paths which at first seemed to lie far apart from his domain.

On the other hand, the theological conceptions, though in their nature rigid, are

yielding much to the influence of scientific or phenomenal truth. They have already been greatly affected by the conceptions of physical law operating in material things. Theologians have in good part abandoned the old contention that the course of events was controlled by an arbitrary and variable divine will. They are now generally content to abandon the interpretation of the phenomenal world to the naturalists, confining their thought within their true and unassailable stronghold, the moral kingdom.

The issue of this great discussion is as yet not clearly foretellable, but enough of it can be determined to lead us to the conviction that the two methods of interpreting nature which were originally united, then long separated, are again to be conjoined. The primary condition of this union will be the abandonment of the existing conception that there are two distinct realms accessible to man, the natural and the supernatural, and the replace-

ment of this view by the idea that the universe is one great field through which the spirit of man is to range with ever-increasing freedom.

CHAPTER II.

CRITICAL POINTS IN THE CONTINUITY OF NATURAL PHENOMENA.

THE greatest contribution of modern science to human thought is doubtless to be found in the idea of the continuity of causation which it has brought home to the minds of all educated people. The ancients, it is true, speculated on this possible orderly succession of events; but it has been the peculiar fortune of our own century to trace step by step the links of the great chains of order until the universal bond which unites all actions has been made clear. Our present conception of nature is perhaps no more imbued with the idea of continuity than that set forth by Lucretius, or by the earlier Greek philosophers from whom he derived his ideas; but, unlike these ancient specula-

tions, our modern opinion is founded on knowledge and is affirmed by experiment. The doctrine of the conservation of energy was obscurely set forth by the Pythagoreans in the sixth century before Christ, but until within a hundred years it was a mere speculation. It now rests upon as firm ground as the theory of gravitation. By the experiments which affirm it our conceptions of the physical universe are unified as they never were in the earlier history of natural science. Seen through the light which this far-reaching law throws upon the physical world, we conceive all the material universe to be moving onward from stage to stage of being, its primal store of force unchanged; its matter passing from one form to another, but the quantities of the force and matter remaining as they were in the remotest age of which the imagination can form a picture. Thus the modern philosophical conception of the world excludes the possibility of accidents. The

orderly succession of events apparently demands the belief that the transitions from one stage of action to another shall not be sudden. It appears to exclude revolution and to give the continuity of a stream to the movement of causation on its way from the infinite past to the infinite future.

My object in this essay is in a brief way to examine the validity of our present conception which assumes the entire continuity of the universe; to see how far our observations may serve to qualify a certain assumption which has entered into our thought, and which leads us almost insensibly to conclude that because every condition of the physical world is absolutely the product of actions which have gone before, we can therefore assume no room for sudden changes in the course of events.

Accepting, as we must, the idea that every cause is the source of effect, and every effect the result of causation, we

shall try to see what room this leaves for the occurrence of the unexpected in the phenomenal realm. I cannot too strongly affirm that my intention is not in any way to contend against the doctrine of continuity of action in nature. I shall seek only to modify this conception, and to show that there is an element of unexpectedness in the operation of natural causes. In this effort I shall first consider certain phenomena of the physical world, and then a group of actions which we find displayed in the organic realm.

We readily note the primal fact that the visible universe as far as regards its component elements, those apparently ultimate individualities in the structure of matter, is extremely discontinuous and, so to speak, fragmentary. There are some scores of these elements, each apparently endowed with primal characteristics differing from one another in an absolute way. Though it is possible and, indeed, probable that some of them may be decom-

posed at high temperatures such as prevail in the sun, there is no reason to believe that as a whole there exists, or ever has existed, an elemental uniformity in the universe. The visible realm of nature as we know it is composed of a battalion of individualities, the separate forms of matter. Each of these primal forms exists separately and has its individual characteristics; it acts in a certain limited coöperation with the other elements. When apart from these combinations it appears to have an absolutely independent life.

When these separate elements enter into combination, the result of their association has an unpredictable quality. Given a knowledge of the properties belonging to two or more separate elements, it is impossible to say in the present state of our knowledge what will be the result of their association in this or that of the many numerical relations which they may assume. Each of these almost infinitely varying phenomena of association appar-

ently institutes a new condition in the world of matter. Whenever two elements or molecules enter a combination not before attained, novel and often startling influences are introduced into the physical world. It is true that the primal force and matter are not changed in quantity; but the mode of action, the effect of these original entities, may be very greatly altered. If we conceive an intelligent being looking upon a mass of nebulous matter having only those forms of association which are possible in gases, we must believe that such a being would have been entirely unable, if his intelligence were less than infinite, to form any conception of the result which would arise when that matter came to take the present shape of this earth. Thus at the outset we see that we cannot properly extend the conception of uniformity, which we gain from our limited knowledge of the permanence of matter and the persistence of force, very far. The original elemental diver-

sity of the universe directly provides for the most unexpected results in the course of the successive combinations of its atomic units.

Turning now from these general considerations based upon the complexity of matter, let us consider the element of the unexpected which arises from the variations in the application of energy to the elemental combinations, variations which are independent of the materials associated in these combined substances. It is my purpose to call attention to the well known but much disregarded fact that, with variations in the amount of energy to which it is subjected, the behavior of matter may alter in a manner calculated to bring about most unforeseeable and divergent consequences. I desire also to show that these variations may occur with extreme suddenness, indeed with revolutionary rapidity, and that through this action there may come about in the visible world very great modifications in con-

dition, made, so to speak, in the twinkling of an eye. The circumstances under which these revolutions occur I shall term critical points. By a critical point I mean a station or period in the series of changing conditions at which a new mode of action is suddenly introduced.

I can perhaps best explain my meaning of the term "critical point" by a simple illustration. Let us imagine a sphere revolving in space about a central sun. Let us conceive that in the simplest condition the planet pursues an orbit which is affected only by the gravitative energy of the two bodies, and which is therefore a perfect circle. Now let us imagine that the revolving sphere is subjected to a gradually increasing attraction which leads it away from the controlling sun in some definite direction. Under these conditions the body will have its orbit gradually changed into an ellipse of greater and greater elongation. Then the increasing attraction will at a certain point

change its path to the parabolic form. Up to a certain position in this series of changes, the sphere will continue to obey the attraction of the sun which originally altogether controlled its motion; but beyond that point it will suddenly change its orbit to a hyperbolic form. It may then no longer return about the parent sun, but depart from it altogether. By this illustration we see how in the course of successive gradual changes, each of infinitely small amount, we may in the end attain a critical point, leading to consequences which are indefinitely great. The place in the series where the orbit ceases to lead back to the parent sun is clearly of revolutionary importance. The foregoing is perhaps the simplest illustration of the nature of a critical point, for in it we can see a variation in but one condition, that of the gravitating impulse alone.

Next we may note a few of the striking instances which may be observed in the

field where materials are affected by temperature. Perhaps the most familiar of these actions are found in the cases in which matter passes from the state of a gas, first into the liquid and then into the solid form. In this series of changes the molecules or atoms are held apart and maintained in the gaseous state by the action of heat. By progressive cooling, due to the escape of the energy, the mass assumes the fluid form. A yet further loss reduces it to the solid condition. Each of these transitions, though brought about by a progressive and undiscriminative series of changes, is usually accomplished in a sudden manner. The passages from the gaseous to the fluid or from the fluid to the solid state are, speaking generally, immediate, though the changes of temperature which lead to them are absolutely continuous. A very striking instance of this action is seen in the case of water when that substance is affected by variations in heat. Within

the limit of temperatures which may be readily observed on the surface of the earth, water or its components exist in several diverse conditions. With a certain high temperature, the elements which compose water are disassociated and exist as two very diverse gases, neither of which has any trace of the physical properties of the fluid which is formed by their union. With a lower temperature, together with certain influences which may serve to bring about a chemical union of the elements, the oxygen and hydrogen enter into relations with each other, producing water. Given a sufficiently high temperature, the conjoined elements may continue in the state of vapor. At a certain lower temperature we perceive that the vapor is suddenly converted into a liquid. Each of these changes occurs suddenly and is revolutionary in its effects.

Within the limits of heat in which water is liquid we find a number of crit-

ical points dependent upon the temperature. The most noteworthy of these is where at about 39° Fahr. the material which has hitherto been contracting in the process of cooling suddenly begins to expand. This increase in volume it maintains until at the freezing point it at once becomes solid, and in so doing acquires a totally different set of physical properties from those it had before.

We should now attend to the fact that the properties of water in these three conditions have entirely different relations to the numerous other substances with which that material comes in contact. In its vaporous form, water is capable of taking almost all other chemical compounds and a great number of the elements into solution, but on the whole its dissolving power differs widely from that which it has in the liquid state. In the form of vapor it is entirely incapable of establishing any relations, such as those which are acquired in the formation of organic

bodies. In the liquid state we also find that water has certain very peculiar functions, differing in an essential way from those possessed by its diffused form.

It is only in its liquid state that water can enter into those combinations with various substances which afford the foundation for the greater part of the chemic and organic life of the earth. In its gaseous state water plays a very active dynamic rôle; in the liquid, the dynamic work is limited, while the range of chemical activities is vastly extended. In its gaseous condition water stores up energy derived from heat; passing to the liquid state it applies in the descending rain the husbanded force to the earth's surface.

Downward in the scale of temperature we attain another critical point in the conditions of water which depends, not upon the physical property of the fluid alone, but also upon the relation of its qualities to other substances. At about 150° Fahr. we pass into a part of the tem-

perature scale where the combinations of water with other substances begin which make organic life possible. From this part of the scale down to the freezing point of water we find a realm of action in which occurs the whole evolution of organic life. At the freezing point an instantaneous revolution takes place as the substance passes from the liquid to the solid state; from a condition in which it is the type of instability and the vehicle of the earth's activities, it changes to a rigid form in which it appears to be capable of no movement except that derived from the gravitative impulse. In the body of an animal water is the agent of inconceivably numerous and varied actions which continue as long as it remains in the mobile state. Converted into a solid, it may act as an arrester of all change; it may preserve the tissues of a dead creature from decay, even for a geologic age, as in the case of the Siberian mammoths.

Above the freezing temperature the

physical conditions of water in relation to the other elements vary with every alteration in the measure of heat which it contains. Below that point down to the level of the greatest cold which we are able to observe, it remains substantially unchanged in all its relations to other substances. Thus, at the freezing point, in an instantaneous manner, this substance absolutely reverses nearly all its relations to the surrounding world.

The important relations of water to the physical universe make its critical points more evident to us than those of any other substance. Yet, on examination, we perceive that not only the chemical compounds which are known to us, but the elements also, those substances which we suppose to be simple in their composition, exhibit substantially the same feature of critical points in the scale of temperature. Experiments show that oxygen, hydrogen, and other fundamental substances which at ordinary temperatures remain in the

gaseous form, with sufficient cooling pass first into the liquid, and then into the solid state, accomplishing these changes of condition with critical rapidity. As before noted, each of these substances and the critical points of each are more or less related to all the others. The critical points of carbon in the state where it unites with oxygen, the critical points of all substances which enter into relation with water, affect one another in all the combinations which take place in the ordinary processes of nature. Thus the operation of this visible machinery of the world depends in an inconceivable measure on the interaction of these critical points derived from the relation of substances to heat.

It is not difficult to see that a very large part of the phenomena of this sphere is brought about by the relations of these critical points of the various substances to one another. Thus, for example, let us take the relations of the critical points of

water to those of the various materials which enter into the organic body and are necessary for its construction. It happens that the critical points of carbonic acid, or the places in the temperature scale where it becomes gaseous, liquid, or solid, are so fixed with reference to temperature that its solidifying and vaporizing are below the zero of our temperature scale. Were it otherwise, were the solidifying point of this substance, we will say, at the temperature of boiling water, organic life would be impossible, and the activities of the world would be limited to purely physical changes.

To extend our conception of this interaction of critical points, let us consider in the first place that organic life, as manifested on the earth's surface, depends upon a coincidence in the qualities of a score or more substances within a certain range of temperature, and also on the occurrence on the earth's surface of a certain limited range of heat which must

be maintained in order to make it possible for these substances, at their particular critical points, to coöperate in the production of life. The maintenance of a certain temperature on the earth's surface depends in turn upon the coincidence of a variety of physical conditions, the actions of which, in order that life be possible, must be balanced with extreme nicety. The delicacy of this adjustment may be judged when we consider the vast range in heat which exists within the limits of our solar system. The temperature of the sun is probably to be measured by the hundred thousand degrees; that of the space intervening between the solar centre and the earth is certainly hundreds of degrees below zero; that of the earth's interior is probably more than ten thousand degrees. In this great scale of heat organic life can only occupy the narrow span of about one hundred degrees, or from about 32 to near 135, or, perhaps, the one thousandth part of the temperature

variation which the solar system affords. Thus, the possibility of organic life depends upon the occurrence at the earth's surface of a temperature not exceeding a range of about one hundred degrees, while the actual temperature range of the solar system exceeds one hundred thousand degrees of variation.

To secure a clearer conception of these conditions, let us convert the data from terms of abstract number to terms of length. In a line one hundred thousand inches in length, an extension of about one mile and a half, let the space of each inch represent one degree of Fahrenheit. On that scale mark off a space of eight feet near one end, and this trifling part of the length of the whole line may give us a diagrammatic representation of the ratios between the temperatures of the solar system and those in which organic life can be maintained. If at any time the temperature of the earth's surface should in general fall below or rise much above

the narrow limits which have been indicated, the result would, in a brief time, be the destruction of organic life. Now, we know with certainty that for a hundred million years or more such a departure from the prevailing temperature has never taken place on the earth's surface, and this by the fact that the series of organic forms have continued unbroken and in continuous development, both on the land and in the sea, for something like this vast period of time. From age to age changes have occurred on the earth's surface which clearly show that in high latitudes great alterations in the measure of heat occur and continue for periods of considerable duration. Glacial sheets now and then extend toward the tropics, and again the tropical climate moves far toward the poles, but very soon some check on these extravagances comes into operation; after a brief period of instability the régime of the earth's climate returns to its normal state, and the adjustment of temperature is restored.

It would be possible to extend these evidences of the balanced relation of critical points in reference to organic life much further than we have done. We may note the organization of the atmosphere, for instance, and show how the ratio of its several ingredients to each other, notwithstanding the fact that the circumstances seem to lead to a profound instability in their relations, has been preserved through all the geological time which is recorded in our fossil-bearing strata. We may observe the proportion of carbonic dioxide or carbonic acid gas which is present in the atmosphere. It is absolutely essential to the preservation of organic life that this material shall exist in the air, for the reason that the plants depend upon it for sustenance; but the proportion of it to the bulk of the atmospheric envelope must never exceed a very small portion of its weight. To serve its purpose it is probably essential that it should exist in the proportion of not less

than one tenth of one per cent. and not more than one hundredth of the atmospheric mass. If the quantity of this gas should become much less than it now is, vegetable life would cease; if it should ever be present in excess, animal life, at least in its higher forms, would disappear. We should now observe that the quantity of this gaseous carbon which is taken from the atmosphere and built into the rocks in any geological epoch, say in a period of one million years, is certainly greater than all which at any one time can be present in the atmosphere which sustains life. Few geologists will doubt the statement that at least one hundred times as much carbon has passed through the air on its way into the strata as has at any one time since organic life began been contained in the aerial envelope. It is evident that there are some phenomena of compensation or adjustment in the complicated actions which serve to bring gaseous carbon into the atmosphere or to

remove it therefrom, and that this arrangement preserves the necessary balance in a singularly accurate manner. It is as yet undetermined how the required supply of carbonic acid gas is thus constantly and uniformly fed into the atmosphere. The students of the problem are now inclined to believe that it enters the realm mainly from the celestial spaces, possibly in small carbonaceous meteorites which burn in the upper parts of the air.

A little consideration will show us that these critical points, and especially their adjustment one to the other, exercise a profound influence on the course and aspect of the material world. The revolution which occurs in each of these substances as it passes its critical point, the change in its mode of action and in its physical properties, and the interaction of these changes of one substance with those of another, introduce an element of variation which must qualify the conception of

uniformity in the universe which we derive from the ideas of continuity of causation and of the indestructibility of force and matter. We see that at each of these revolutionary stages the change in the conditions of any substance may result in causing a total alteration as to the effects of the energy which operates in and through it. Thus, in place of imagining the physical world as the seat of absolutely continuous work, we are, by such considerations, compelled to conceive it as a field in which, though the energy and the matter on which energy operates are both constant, the direction in which this force may work, and all the consequences of its action, may be subjected to the most sudden revolutions. It is evident that in each elemental substance we have a certain latent directing power which entirely escapes ordinary apprehension. Until the proper moment arrives, this hidden and inconceivable determinant exists only in a potential state; but at the appointed

time it may so change the operations of the force which acts upon the matter that the profoundest revolution can be accomplished. We have only to consider the effects of the passage of water across that slight, indeed, we may say infinitely small, increment or decrement of temperature which separates the solid and liquid conditions, in order to conceive the importance of the principle which we are endeavoring to understand. These critical revolutions in matter, it is true, modify only the results of force; they do not affect the total energy which the universe contains.

We may now in a measure perceive the way in which we have to limit the idea of causation. We note that, although this idea of continuity as applied to matter and energy is a vast and most informing conception, it does not of itself alone enable us to explain the occurrences which take place in the universe, or even give us an idea of their mode of happening. At first

sight this conception of continuity suggests to the mind a sense of identity in the direction of the action of the given cause and of the succession of events which it brings about. We unjustifiably conceive the processions of phenomena in the physical world as going forward, as it were, on straight lines; but the foregoing considerations, though only a small part of those which could be adduced, indicate to us that we have in the mechanism a provision for the most sudden departures from the direction which events may have hitherto followed. In this revised picture of the mode of action in the field of nature to which we come from a study of critical points in particular elements, and the larger similar points which arise from the interaction of the first in various compounded substances, we see that our ideas as to the mode of action have to be greatly modified. This world is thus to be conceived as a place of surprises which take place under natural

law, but are quite as revolutionary as if they were the products of chance, or a result arising from the immediate intervention of the Supreme Power. It is evident, moreover, that the existence of critical points makes the interpretation of the world much more difficult than it would be if such accidents did not occur.

It does not seem likely that we shall ever be able to predict the nature of these critical latencies of matter in states of which we have had no experience. Certainly, at present we have no means of conceiving the conditions of substances at temperatures of which we cannot make acquaintance by observation or experiment. In the present state of our knowledge, we know, for instance, the critical point at which oxygen passes to the solid state at a temperature far below zero; but we know nothing of the properties which that substance may possess at possible other critical points beyond the degree of heat to which we have seen it subjected. At

temperatures other than those in which we observe, the substances in nature may suddenly develop properties which revolutionize the condition of the field in which the particular association of matter and of temperature occurs.

Turning from the domain of inorganic matter, let us now consider the other realm, in which substances take on the shape which we term organic. In that field we have not only to deal with the elements in their uncombined state or in the various forms of association which prevail in the inorganic world, but we find certain of them entering upon extremely complex forms of association. With each of these almost infinitely numerous varieties of associated matter which exist in animals and plants we have not only the determining influence of the original critical point proper to the materials, but we have in each of the associations particular crises which apparently are not to be predicted from any known condition

of the several elements which compose them. Thus organic structures, from the very great number of the interacting materials of which they are composed, represent a far more complicated equation of physical influences than any inorganic association of substances. Besides the physical combinations of elements which constitute organisms and which may depend upon their material relations, we find in these living forms a host of other motives and impulses which are not evidently due to the mere physical state of their body. These motives we may term the inheritances of the organism, impulses which are derived from the previous life of the individual in its own body or in that of its ancestors.

The leading or more important inheritances are impulses derived from the ancestral experience of the organic form. We have to imagine them as essentially separate motives handed down from generation to generation, sometimes remain-

ing latent for great periods, to become suddenly manifested under conditions the nature of which is not yet discernible, and which bids fair to remain permanently unknown. Except by their manifestations these inheritances elude perception. Even the imagination of our most fertile naturalists has not yet suggested a conceivable way by which they may be transmitted. In many cases these motives which are handed down to us from our ancestors may be utterly unprofitable; indeed, their existence is only here and there revealed to us by some exceptional accident which is quite out of the order of usual events.

I venture to describe one of these exceptional facts, which, though quite well known to naturalists, is unfamiliar to the general reader; choosing it for the reason that it is a peculiarly striking instance, and one well suited to show us how hereditary tendencies may for an indefinite period remain latent, and then become

most plainly manifested. In all the vertebrated animals above the level of the fishes, — that is, in all amphibians, reptiles, birds, and mammals, — the number of the digits or of fingers and toes is normally five on each extremity. The exceptions to this general rule are so definitely limited and so explicable that they may be neglected, except to state that, whenever these exceptions occur, they are almost always in the nature of a reduction in the number of these digits. Where the number is increased, the augmentation is to be explained on the principle of reversion to the characteristics of a lower ancestral species.

When, in following the ascending series of vertebrate forms, we come to the group of animals which have a close physical kinship with our kind, we find a number of the digits almost invariable. In all forms which can be regarded as in or near the stem of man's genealogical tree, the number of fingers and toes, except for the

accidents we are about to describe, is invariably five. It is, in a word, evident that this pentadactylic character of the vertebrate extremity was instituted almost immediately after the development of the series above the level of the fishes, and that inheritance has fixed it in the gnomons of species which led to the human form in a very firm manner. Yet now and then among these five-fingered forms we find an additional digit occurring. These chance duplications of fingers and toes are more common in the lower mammals, especially in the carnivora, than in man; but they not infrequently occur in human beings. The rate of their happening probably differs considerably among various peoples; but in general it is likely that one such case exists in somewhere between one hundred thousand and one million births. Although there is considerable variety in the conditions of these supernumerary digits, they commonly appear on the side of the hand or foot, next

to the little finger or the little toe. They are usually provided with a system of bones and muscles, in the manner of the normal digits.

If these rare variations in the number of digits were limited to a single excessive part, we might be tempted to account for them by the question-begging supposition that they are mere redundant growths, or we might make the more convenient and perhaps equally rational explanation that they are matter of chance; but we are startled to find that when these supernumerary digits are removed by the surgeon's knife, they have the extraordinary power of growing again. It is a matter of familiar experience that the normal fingers and toes do not have this capacity of renewing themselves after they have been destroyed. These facts, from their exceptional nature, demand a careful explanation. Fortunately they at the same time give us a hint as to the cause of their occurrence.

There can be little doubt that the explanation which we have to apply to these abnormal growths is as follows: when the fishes began to pass upward into the groups where limbs and their extremities attained a more definite and elaborated organization than we find in the fin, the first steps towards this higher state of the extremities probably took place in a series of creatures which have disappeared from the earth, and whose history is now lost in our paleontological record, where the digits were more numerous and less well defined than they now are in the elevated vertebrates. In this lower and conjectural realm, the habit of having fingers and toes to a greater number than five was firmly impressed on the organism, and thus became the subject of somewhat obstinate inheritance. When in the course of advance, by natural selection or other processes, the number of digits was reduced to five, there remained in the body to be handed on from generation to

generation a latent and, so far as we can conceive, utterly unprofitable tendency towards the production of the old lost fingers and toes. From one species to another onwards through millions or hundreds of millions of generations this ancestral impulse has survived, — never strong enough so to prevail over the forces which lead to the five-fingered body that it could give rise to six-fingered species, but ever trying to assert its power, and here and there marking the obdurate continuity of the effort in occasional temporary successes.

It is not to be believed that the impulse which leads to supernumerary digits is the only one of these inherited impulses which remain latent amid the vast array of motives, the effective inheritances, which exist in the higher organism. We must conceive a great number of these inheritances to continue latent in the organism without even the remote chance of claiming the right to presentation

which is granted to the impulse to polydactylism. It is perfectly clear that the human body has passed through thousands of forms, specifically different the one from the other; each having definite peculiarities, each sending on in the procession of life a shadow of itself which has been transmitted from species to species to the existing state of man or the other higher animals. We may thus imagine each organic species to embody not only the impulses which are effective in the development of its shape, and which serve to determine the functions of the body, but also a vastly greater number of unsatisfied motives, remaining dormant, yet abiding as potentialities which may from time to time prove influential in the history of the creature.

We probably perceive the influence of these latent inheritances when, in the battle of existence, species undergo retrograde changes, or, as naturalists phrase it, revert to a lower state of being. In this

process of reversion, the inheritances which lead toward the higher modifications diminish in energy; the old long-unsatisfied tendencies, being left unopposed, obtain their chance of action; the result is that the form degrades in structure, passing through, though in reverse order, the steps which led it upward, and undergoing the modifications of decline with greater rapidity than they were accomplished during the period of ascent. In the moral as well as in the physical world, we may see these hidden seeds of ancestral impulse, when no longer overshadowed by the newer and therefore stronger motives, spring into activity, and win the creature back to a lower estate.

It is hardly necessary to say that we cannot fairly compare the interaction of associated organic impulses with that which takes place in organic matter. It must be confessed that the relation is, so far as we can perceive, mainly analogical. Nevertheless, the analogy has its value to

us; for, as we may readily imagine, each of these impulses derived from inheritance is combined with the other conditions existing in the organic body much in the same manner as the interacting impulses in the physical world. We may make a comparison between the organic and the inorganic world more effective if we limit ourselves in our choice of physical examples to those correspondences which we may obtain from the motions of matter, rather than from the static part of material phenomena. Let us take the motions of waves, such as those which produce light, or the other class of vibrations which give rise to sound. It is a well-known fact that diverse vibrations of either of these two classes may coexist in the same medium, provided their waves do not interfere with one another. With a given amplitude of wave and a given rate of transmission, these impulses may move on without collision with one another; but at certain points, which we may for

convenience also term critical, the undulations may serve, by combining their force, to increase the action. Again, they may be so combined as to destroy one another. I am forced to conceive in the organic body, at least where that body has a high state of development, a conflict unseen, but of momentous importance, among the vast array of extremely diverse impulses derived from individual and ancestral experience. The result of this conflict may be such, from time to time, as to bring about an accumulation of energy which serves so to intensify some one or more of these inherited motives that the form is affected by it, and the effect may be transmitted to the offspring. In other conditions, the interferences may lead to the more or less permanent subjugation of certain of these inherited tendencies in such a manner as to bring about a change in the shape of the body.

It seems to me tolerably evident that we cannot account for the conditions

which serve to determine the form of any highly organized animal or plant without assuming the inheritance of what we may safely call an inconceivably great number and variety of impulses; nor can we assume that these impulses, or any considerable part of them, are manifested in the actual form of the organism or in the interaction of its several parts. Beside the indefinite number of impulses which express themselves in the animal as it actually appears to our observation, there must exist in the organism a vast number of unmanifested or faintly indicated tendencies which, on account of their weakness or other circumstances, have been unable to bring about distinct observable effects. That there is a contention between these tendencies, leading to sudden destruction of the prevailing equilibrium which exists among them, is evident from such cases as that which we have just reviewed. It must be conceived that this combat goes on from generation to gen-

eration. With each successive stage, or even in the lifetime of the individual, new motives are gained through experience, and the old become less vigorous from the lack of manifestation. Thus the equation of the impulses which control the organic body must be constantly varying; the direction of development, dependent as it is upon this equation of impulses, must also vary.

It appears to me that this view affords us a possible means of explaining the variations which take place in organic forms, and that we may perhaps find in it a source of change in animals and plants which has been substantially overlooked. It has already been recognized that inheritance affords us a clew to the continuities exhibited in the series of the organic world. It now appears likely that the conflict of inheritances may also lead through other lines of action to the reverse of continuity, in fact to the institution of variety. We may conceive the

organic species gaining from experience and transmitting to the successive generations a body of diverse impulses, of tendencies to variety of form and action which are ever on the watch for a chance to manifest themselves. If these acted singly, each for itself, the tendency would be to produce mere reversions to ancestral shapes and states. But if they operated interactively, if they combined their motives in any way, as they assuredly do, it may well come about that the changes in structure or function which they cause would be considerable, and some of them might well be in the line of advancement.

The hypothesis last set forth may be made the clearer by means of an illustration. Let us suppose the tendency to supernumerary fingers to have been originally of no profit to the animal which inherited it, for the reason that its habits and its relations to its environment in general made more than five fingers disadvantageous. In course of time, we may

well imagine that this polydactylic tendency might become combined with other tendencies, so that, when the extra finger or toe offered itself for trial in the competition of life, it would not be just what that finger was in the ancestral form whence the constructive impulse was derived, but would be profoundly modified through the commingling of other influences.

This interaction of one influence with another is not altogether hypothetical, for we perceive in the supernumerary human digit that it does not appear in the shape of a batrachian or other prehuman structure, but in the general form proper to a human body; that is, it represents the result of commingled impulses which are in part inherited from a very remote period, and in part derived from the more recent experiences of series of organisms in which the creature belongs.

The reader probably now sees, as clearly as the circumstances permit, the analogy

which I have been endeavoring to suggest as possibly existing between the interaction of the inorganic elements, one with another, and the similar combination between the separate but more or less related motives which guide the development and control the functions of the organic body. As in the elemental world the combination of two substances commonly gives rise to a third, differing in qualities from either of the original ingredients, so, when the motives or impulses of inheritance combine in the organic body, the result may exhibit a very great complexity, and give rise to sudden and most important changes.

This conception as to the influence of the unseen impulses which may for a time remain latent in the organic body appears to me to have a justifiable extension to the moral realm, and to throw much light on the historical development of peoples and on the conduct of the individual. The spectacle which is presented

by the development of any civilized state affords us many instances in which motives slowly and insensibly accumulate in the minds of men, until a great body of folk may at once be aroused to revolutionary action. Cases of this sort may be perceived in those great migrations which from time to time have led the tribes of northern Europe and of western Asia suddenly to abandon their sedentary conditions, and to move forth over land and sea for great distances, under an impulse which appears to have affected in a simultaneous manner a great host of men. It is unreasonable to suppose that these movements were due to a suddenly acquired motive. We can best explain them by the supposition that for generations the equation of impulses which determined the conduct of the folk was undergoing a gradual change, which in the end disturbed the ancient equilibrium, and thus revolutionized the conduct of the people. Such sudden outbreaks as the so-called

French Revolution and similar political changes, which simultaneously occur throughout the ranks of the people, without any preliminary period of development which is sufficient to account for the growth of the motives which they exhibit, probably come into the same class of actions. They can best be explained by gradual changes in the equation of the unperceived yet functioning impulses which control the course of human conduct.

A slow and long-continued change in the organization of internal motives, terminating in a revolution in all that regards the conduct of the creature, is observable in many groups of animals below the level of man. Thus in the case of the lemming, a little Norwegian mammal resembling the rat, which dwells normally in the mountain district of the Kolen near the borders of Finland, we find that the animal for many years dwells quietly in its native country, but at intervals of

a few decades is seized with a migratory impulse which leads it to march forth in great bands across the country to the westward. In these marches of the lemming the creatures pursue direct paths, turning aside only when they meet an insuperable obstacle; when they attain the sea, they leap into it and swim away until they are drowned. Although more insensate than the human migrations, these sudden forced marches of the lemmings in a striking way resemble those of the Goths who, in the early centuries of our era, went forth from the same Scandinavian country and devastated the civilization of southern Europe. In both cases the migrations appear to be without distinct purpose, and to have been induced through the accumulation of impulses to a point where their gratification became imperatively necessary.

In the realm of morals, whether we consider it from the point of view of individual conduct, or the more massive phe-

nomena which may be exhibited by assemblages of men, something of the same effects arising from the accumulation of impulses may be discerned. A man or a race may continue steadfastly in a given course of conduct, which is determined by certain equations of the spiritual motives which are effective in regulating deeds. At a particular time a hitherto latent but long-accumulating impulse may become of critical importance, and in a sudden way transform the emotions and change the way of life, in a measure which would be inexplicable to psychologists if they had to suppose the determination of sudden origin. It seems to me evident that through the further consideration of this series of facts we may be able to support a theory of moral conscience in a way that is at once satisfactory and scientific. We may conceive the moral state of each individual to be determined in part by his inheritances from his ancestors and in part by that other form of derivation which is

proper to his individuality and is established by his personal conduct. If with this understanding as to the origin of his motives the individual further conceives that his conduct depends upon an equation between the array of his motives, he will find a new sanction applied to his departures from the moral law. Every act serves to stimulate and develop some of these motives which are active or dormant in his mind. He cannot know to what extent the particular deeds may affect the equation, but it will generally be clear to him whether that influence is to be for good or evil. He knows it to be his duty, for instance, to be merciful and helpful to his fellow-men. The motives of his conscience alone are enough to direct his conduct in such matters. The scientific aspect of the problem, however, may well add reason to the array of impulses which lead to such good deeds. This work science can accomplish by showing how each action serves to in-

crease the effective power of some ancestral or recently acquired tendency, thereby operating to magnify a power which helps in the higher life. Above all it may serve in a way that makes for profit by showing us how easily though insensibly revolutions which lead to good or evil may be brought about in the unseen realm wherein the nature of the individual is determined.

We may sum up the considerations which have been set forth in the foregoing pages, briefly as follows: It appears that we have to be on our guard lest we extend our notions of continuity in the natural world beyond the point where the evidence of continuous action justifies the conception. The notion of continuity of causation is so overwhelming in its magnitude that we cannot adopt it without danger of extending it far beyond the limits of proof. We need to check the course of our imagination when it considers this problem by a frequent contem-

plation of the facts which show the existence of revolution-bringing conditions. These critical conditions we find clearly manifested to us in the inorganic world, in the primary revolutionary actions of matter, and in the more complicated sudden changes which arise from the interaction of these primary crises. Viewed in this way, the physical universe is seen to be a field in which phenomena, though derived from preceding actions, occur, in a way, spontaneously. Turning from the physical to the organic world, we find something like the same interaction of conditions producing also critical stages in the development of living beings. We can best understand the variations in the organic realm by supposing that they are in part due to interaction of impulses similar to those which we clearly trace in the more visible realm of organic matter.

In the field of human conduct we also find that this view as to the occurrence of certain changes brought about through

the coöperation of separately developed impulses appears to have considerable importance. The evidence goes to show the existence of these hidden equations among the inherited and individually acquired capacities, and it moreover indicates that the changes in the tide of impulse which regulate conduct may thereby be suddenly brought about. Furthermore, the consideration of the moral aspect of critical points vastly enhances the dignity of every act, for however the deed may vanish in the great world of phenomena it substantially remains as a contribution to the motives of the individual.

Speaking from my own experience alone, I may say in conclusion that by dwelling on these considerations we may attain to a view concerning the course of nature which differs widely from that which seems to be held by most naturalists. We see that this world, though moving onward in its path of change under conditions which are determined by the per-

sistence of energy and of matter, is subject to endless revolutionary changes. These crises seem to be arranged in a certain large and orderly way. The minor of them occur with infinite frequency, appearing in every combination of matter; the greater happen but rarely, the greatest only from age to age. After all, the supreme test of our general opinion concerning the material world is the satisfaction which the view may give to the beholder. For my own part I find this rational introduction of the unexpected and the unforeseeable into the conception of nature more satisfying than the purely mechanical view which is so commonly held by my brethren in science.

CHAPTER III.

THE PLACE OF ORGANIC LIFE IN NATURE.

It should require no extended argument to show that the amplest test of all learning is found in its final effect on the conduct of life.

The knowledge which we may gain from the universe is indeed infinite in its extent; however much of it we may compass, the sum of the unknown remains unchanged. The learning which has already been won to the storehouses of scholars vastly transcends the understanding of any man, and the harvest is so rapidly increasing that the store gained in any decade is beyond the comprehension of the individual student. While we may not seek to limit this noble work of men of science who are exploring all the ways of nature for truths, — for it is beyond our power to determine

the limitations in the usefulness of that which they may secure, — the value of their acquisitions to their kindred must in the end be measured by the effect of the learning on the destiny of mankind. As finite beings we can be interested only in that which affects ourselves. If we be devotees to a particular branch of recondite learning, the most abstruse phenomena, things which are utterly remote from the relations of ordinary men, may be of vital importance to us, because they enlarge our conceptions and afford the precious sense of conquest from the unknown, which is one of the most soul-inspiring of experiences; but in the large and general life of the world they may be trivialities, matters which are properly "caviare to the general."

It is these simple and just considerations which lead many educated people to look upon the swift advance of modern science as boding little good to the higher intellectual and spiritual interests of man-

kind. They see in these gains so much of material profit, so much that contributes to mere physical necessities and comforts, that they fear for the integrity of the ancient humanistic learning and devotion. All thoughtful naturalists hope to show that while the substantial advantages which have come to us from the exploration of nature are very great, so extensive indeed that to the casual onlooker they conceal all the moral qualities which they contain, there is behind this veil of commonplace affairs much which may profoundly influence our souls. When the almost childlike surprise with which we look upon the physical discoveries of our day has passed away, when we cease to treat these truths as toys or as mere garments of our ordinary life, when, in a word, we are sufficiently familiar with them to see their spiritual meaning, then alone will we find our way to the higher blessings which they bring. Although this stage of the relation of

science to culture is as yet in great part to be attained, there are certain fields in which the better work of interpretation can be begun, — fields from which we may gather some forerunning of the harvest, which in its fullness can be garnered only by those who come after our time.

It is in the realm of the organic world that we may expect to win the most that makes for moral advancement; that physical realm is still, in a certain way, remote from our finer perceptions; only our grosser senses can as yet seize upon its phenomena; there is majesty and beauty in its vistas, but the ways of men have not yet traversed them. It is otherwise with the realm of life, which we now see to be clearly akin to our own. It is because we now recognize this kinship and view all living things as sharers with ourselves in this gift of sentiency, this capacity to profit by experience, this privilege of handing on a bettered life to the ages which are to be, that organic beings afford

a surer if not a higher teaching than does the material of which they are composed. Of all the marvelous gains in understanding which this century has afforded, none other is destined to be so profitable as this conception of the essential unity of life. Through this view the history of man has gained a vast perspective; in place of an arbitrary beginning of our life in this moment of time, we behold an orderly succession which extends back to the inconceivably remote ages. We appear to ourselves no longer as unrelated beings akin to similar creatures of the earth only by a mysterious connection with an inconceivable supreme power, but germane to all the creatures of this and vanished ages; each animal and plant becomes an interpreter of our life and stands ready to testify as to the laws of our body or our mind.

It is impossible to overestimate the influence of the new-found truth on the destiny of man. It will require, indeed,

centuries of study before these wildernesses of facts which await interpretation are brought to order and applied to their fit use in guiding the conduct of individuals and of societies. Already we see the effect of this better understanding of human nature in the inquiries concerning the principles of heredity which are now going on, and which promise to throw great light on the treatment of diseases, the management of criminals, and the methods of educational work. The effect of the wider view may also be discovered in the studies of the psychologists, who are now free to consider the mind of man as open to explanation through the mental habits and experiences of our lower kindred among the brutes. My present aim is to show that by the same reference of our own conditions of existence to the lower life, which we are free to study in the records of past ages as well as in the multitudinous beings of to-day, we may arrive at certain general conclusions as to

the nature of those obligations which require each individual to tread the fatal round from the mother's womb to the grave.

To primitive men of all races the supreme incidents of birth and death have ever been mysteries which were to be explained only by including them under the even more mysterious class of decrees of a superior power. With all these accounts of the origin of death it has ever remained to men a violent and unreasonable infringement of their personality. It has colored all their views of this world and denied them access to the true light. It has often led them to believe that the universe was essentially cruel. Where they have found consolation in their fear and affliction, they have not often discovered it in the nature about them, but in the belief in some powers which they have conceived to be acting beyond this sphere; some strength which in the end might lift them above the brutal rule of these des-

pots of the dust. It seems to me that an unprejudiced inquiry into the history of birth and death, or in other words into this generational order of the organic world, may in certain ways enlarge our conceptions concerning the place of these incidents in the system of life, and thereby spiritualize our judgments concerning them. If I may judge of others by myself this better understanding will do much to exalt the student's conception of the great machinery of the universe, which by its operation lifts his body for a moment into the light, and then lets it fall again into the lower inanimate realm.

Taking it as our first task to examine into the place of death in nature, we must ask the reader at the outset to make sure that he has apprehended in a general way the more evident features which separate organic forms, the creatures with which we have mainly to deal, from the array of the mineral kingdom. It seemed to the ancient naturalists a relatively simple mat-

ter to define the living thing in a manner which would trenchantly separate it from the things which had not life. The ability to move, the capacity to assimilate food, the power of generating its kind, have all been selected as exclusive characteristics of living things. A closer study of the facts has made it impossible any longer to regard these old definitions as sufficient. It has been found that finely divided particles of many substances when suspended in a fluid will, under the influence of some forces as yet not well understood, take on an incessant movement. So perfectly does this motion resemble that of some of the microscopic forms of the lower simple organisms, that naturalists at first supposed that in observing these movements they were dealing with living beings. The crystals of the rocks perform functions which were once supposed to be peculiar to animals and plants; they undergo changes in their constitution, often taking in new materials, which they

sometimes decompose into their elements and rebuild in the new growth. So, too, crystals are in a way capable of multiplying themselves, for when one begins to form, others of the same species, as it were, sprout from it, much in the manner of certain lowly forms which are certainly alive. In truth, we can no longer maintain the existence of a clear physical difference between the organic and the inorganic world, and must regard these realms as divided from each other by features which when measured in a formal way are most unsubstantial.

Looking at the organization of the physical universe, and seeking to learn the nature of its divisions, we readily perceive that the material parts, the chemical substances in whose varied forms matter presents itself to us, tend ever to take on individual shapes, and to exercise specific functions. From the primitive condition of diffused nebulous material, where the only definite structures were the ultimate

atoms of which the mass was composed, matter hastens ever towards aggregations of diverse natures: falling together into centres of union, they evolve the solar systems, the fixed stars of space with their attendant planetary spheres. In each of these bodies or aggregations matter develops other groups of individualities; the atoms combine in more and more complicated associations, and these from time to time associate themselves in regular geometric shapes as crystals, or in less definite forms as concretions. In all of these associations we have a certain measure of action which is indistinguishable from that which takes place in the organic forms. These aggregations of matter grow to definite shapes; they have a show of functions, they sometimes appear to breed their kind, and they often perish after a more or less lengthened though indeterminate period of existence. Finally, this struggle for advance out of the primal confusion of material things leads to the

creation of that last-formed and highest state of association of materials with which we have as yet become acquainted, the forms we term "living."

To the eye of the philosophical observer, organic things appear as the consummation of an effort towards organization which has pervaded the universe since the earliest stages of which we can have any conception. As we advance in the steps of this great on-going, we find that the fields in which the augmenting successes are attained ever become more limited in their conditions. The formation of matter in the celestial spheres is the most universal and complete of all these processes of organizing nature. Nearly the whole of the visible universe has thus been cast into the spheroidal shape, there being only here and there masses which retain the nebulous form, and the greater part of these are evidently converging towards the next state of organization. The molecular order of

grouping in the atoms is also far advanced throughout the visible universe. The crystalline state has been instituted in certain portions of the earth's crust, and probably in the outer parts at least of several other planets in this solar system, and may indeed be a common feature in the similar bodies which we with reason believe to exist about the other suns. The whole of these solar centres, the central portions of the planets, and perhaps of the whole of the lesser satellites which attend them, in all probability at least nine hundred and ninety-nine one thousandths of the material world, remain so far heated that the forces which lead to organization have not as yet been able to bring the substances into the crystalline form. Although the crystal-making energies are as yet ineffective in all save a small part of the matter of the spheres, the domain of the organic processes measured by the field it occupies is infinitely less manifested.

Looking at this vast assemblage of or-

ganic forms which on this earth at present contains not less than a million species, beholding these forms occupying nearly every available point on the earth's surface, the spaces of the air, the depths of the sea, the darkness of the caverns, even the surfaces of the snow-fields, it may seem to the observer that life is endowed with the power to maintain itself under a great variety of conditions; but when we consider the extent of that dot in space, our solar system, and compare its area and its mass with the field occupied by animals and plants, we see how truly insignificant are the dimensions in which life finds a dwelling-place.

Life as we know it depends upon conditions so limited in their nature that it seems almost a miracle that it exists at all. So narrow is the way this higher organization has to tread that we must marvel that it ever found its way into being. The existence of all organic forms depends in the first place upon the maintenance on the

earth, during at least a part of the year, of a temperature which does not fall below the freezing point or rise much above 100° Fahr. The range of heat which life can sustain may be taken as less than 100°; but in the sun we have a temperature which cannot well be estimated as less than 100,000° Fahr., and in the depths of the earth is probably to be measured by tens of thousands of degrees on that scale, while in the realm of ether between the solar and terrestrial spheres there is a degree of cold which is certainly to be reckoned as some hundreds of degrees below zero. Amid these contending extremes of heat and cold life must find its narrow place. It happens by a combination of circumstances, which, if a matter of pure fortuity, must have been a most rare chance, that on the surface of the earth the proper conditions were secured in a very ancient day. Since the beginning of the geological record there has probably never been a time when at the height of

six miles above the earth's surface, even over the equator, the temperature necessary for the life of animals and plants has existed, and in all these ages the death-dealing level of cold has probably lain much nearer the surface in all high latitudes. Beneath the surface of the earth, life does not exist except in the crevices of the soil and in the chambers of caverns; and even in this subterranean realm it attains only a lowly estate and could not be preserved save for the contributions of food derived from the sun-lit realm.

Being in an essential way the product of solar irradiation, of which the field it occupies must receive definite and very accurately measured quantities, organic life is necessarily limited to the surface of those planets where a temperature a little above the freezing and below the boiling point of water is maintained. Few of those spheres of our solar system can present the conditions which permit matter to rise to this highest form of aggregation in animals and plants.

The planet Mercury from its nearness to the sun must have a temperature too high for these delicate forms. Even Venus, though much more remote from the solar centre, probably has a degree of heat making its climatal conditions almost impossible for life. Beyond the orbit of the earth the power of the sun's rays to maintain sufficient warmth rapidly diminishes. Mars seems to be the only one of the exterior planets which can have living tenants, and even there it is hardly to be believed that life can exist. As to the status of the planetary bodies which probably circle around the fixed stars, we are not only uninformed, but seem debarred from all chance of knowledge. As a basis of conjecture as to the condition of the innumerable minor spheres of space, we have only the simple facts revealed to us by the spectroscope, which tells us something as to the chemical nature of the matter contained in those stellar masses. This information is clearly to the effect that their

chemical constitution is the same as that of our own sphere. The telescope, moreover, shows by the facts concerning the nebulæ it discloses, that the law of organization, by virtue of which matter takes on its shape in those remote suns, is the same as that which determines the form of our own celestial family; it is therefore a fair presumption that planets are a common feature in the universe. This, even though it may be inspiring to the imagination, leads to no other definite conclusion than that to which we attain from the study of our own planetary spheres. This is in effect as follows: organic life is necessarily limited to an almost inconceivably small part of the space and the mass of the visible universe.

A similar consideration as to the portion of the materials of the universe which have won their way to the organic state will show us that the share which this living impulse has in the mass of matter is as limited as its measure of extension. At

the present moment the living beings of all kinds on the earth do not altogether amount to more than would form a thin sheet if they were evenly spread out upon its surface. If we could reduce all these living forms to such a sheet, it would probably be less than a foot in thickness over the surface of this sphere, or somewhere near one ten-millionth part of the whole mass. It is not likely that at any time since life came into existence it has ever lifted more than some such infinitesimal portion of the mass to the organic state. Trifling as is this proportion of living matter to that which abides in the lower physical condition, we must yet further diminish its proportion to the body of the visible universe by the consideration that the sun and the greater part of the planets and their attendant satellites, as well as all the vast realm of the ethereal spaces, are utterly beyond the possibility of organic existence.

We should go yet further, and note that

in time the place of life is limited as it is in space and mass. Although the period during which life has endured on this earth is great beyond comprehension, — it cannot indeed well be less than 100,000,000 years, — its duration is but as an instant when compared with the ages through which the material universe has endured. Beyond this period of life lie dim ages during which the concentration of matter from the state of nebulous dispersion into the solar system was brought about, and yet other ages in which this globe was cooling from its original very heated state to that in which its surface became fit for tenancy by animals and plants. It may be that one hundred or one thousand times the vital period was required for the accomplishment of these processes which led to the formation of our solar system. Thus taking no account of the infinite past which elapsed before the aggregation of the spheres was begun, or of the infinite future after the sun's heat shall have been so far

diminished that living beings can no longer endure, we behold that these noblest forms of existence are limited to what we may fairly term a moment of time.

This glance at the larger circumstances of organic life, though but superficial, shows us very clearly that, measured in terms of space, time, and mass, this form of being has an inconceivably small place in the universe. If we should reckon its importance solely by these tests, we should be justified in ranking it as a trifling and temporary incident in the march of the greater inanimate nature. It is impossible, indeed, for the first time to contemplate these limitations of that form of existence to which we ourselves belong without being appalled at the physical conditions of all our kind. The ancients in their more solemn hours were stricken with dismay when they considered the place which the individual man had in this ample nature; but it is left to us in the

modern day so to extend the perspectives of the universe that not only the race of man but all the assemblage of living beings appear to be more the creatures of the moment than our forefathers conceived the most ephemeral insect to be. Awful as is this conception of the universe which modern science, by breaking down the comfortable prison of ancient belief, has opened to us, it is not likely that it will long affright mankind. At the moment of surprise we are like the wayfarer who, wandering over some flowery upland, comes unexpectedly to the edge of a great precipice. For the instant his mind is overwhelmed by the profound depths before him, but when his eyes become accustomed to the scene his senses go forth again, and he sees that the depth is still a part of his own beautiful world.

Many persons, when they come for the first time to consider these great conceptions of the place of life in nature, or even that small part of the view which concerns

the position which they individually or their race really occupies, are, in the tumult of soul which the revelation induces, impelled to a revolt against the universe. Some of the largest and gentlest of men, who have been nurtured in the languid and rather enervating air of purely humanized interests, look upon this physical infinite as a vast and terrible engine moving with relentless and merciless energy over the tender forms of those creatures which, cursed with sentiency, are doomed to be crushed beneath its wheels. There can be no question that this is a very natural first view as to man's place in nature; of the place, indeed, in which all life belongs. If it were the final view of those relations, even the dearest lovers of the truth might well doubt the good of our better knowledge. They might be tempted to believe that it would have been better to have stayed in the world of fiction than to have been forced to face such realities. But all that there is of gloom in this vista which

modern knowledge opens to us comes from within ourselves. It is due to the false attitude which old beliefs as to the position of man in nature have engendered in us. For ages the trend of the common thinking, indeed of the greater part of philosophical speculation and of nearly all religious teaching, has been directed as if to the end of setting man apart from and against nature. So effective has this teaching been that the separation of the human spirit from the environing world is almost complete. In this, their very cradle, men have been taught to look upon themselves as in a prison; they have considered the vast machinery of the material universe which has brought them into being as something alien to their better selves, as a realm to be escaped from through the gates of death.

It is by no means difficult to see how this singular attitude of man to his immediate master, the material world, has come to be. To obtain a clear understanding as

to the way in which our present view has been forced upon us, it is important that we now turn aside for the moment to consider its genesis. While our life was in the keeping of the creatures below the level of man, the reconciliation with nature was essentially complete, as it is between the spheres of our solar system or the atoms of which they are composed; but as the advancing beings in our ancestral line began to do more and more difficult tasks, deeds requiring ever a greater share of thought, they were compelled little by little to take themselves into account. As long as actions were instinctive, even if they were movements such as those we make in fencing, or in any other well-learned tasks which are familiar to an animal or a man, the sense of self did not have to be awakened in their execution, for the being acts in an automatic manner. When, however, the thing to be done requires forethought, and in the measure of the fore-thinking a self-

hood is aroused, a great change comes over the conditions of life. With this change to consciousness in action men find that they are set over and against nature in their efforts to wring their gratification from a rather unyielding world. Generation by generation this antagonism increases, until man becomes what we now find him, a self-seer and a self-seeker, his personality grown beyond all account, and all the capacities which it can master arraigned in combat with the world about him. To this anomalous being there is a simple twofold division of the universe, himself on one side and all else on the other. The classification, though preposterous, is perfectly natural and marks a stage in his moral and spiritual development.

Almost as soon as our ancestors found their way to this strange knowledge of themselves which self-consciousness gives, and began their long war with the world about them, making of all else an age-

long enemy, the peculiar loneliness of their situation began to be apparent to man. The love of kindred inherited from the lower life, though it might assuage, could not cure this hunger for a union with eternal things. At first, perhaps altogether and ever in large part, this impulse towards a friendly relation with some assuring permanence came from fear, — fear of that dark and mysterious realm, the world of phenomena, from which he was in enduring peril, and which in the end was sure to overcome him. It was impossible for him to turn to this environing nature for consolation, for it seemed his implacable enemy. The only way open to him was through his imagination, which led him to conceive a realm beyond the natural, which he filled with friendly or at least with propitiable beings, strong enough to give him some aid in the path of life, and willing to lift him to their more exalted sphere when the fight was over. These gods and the place in which they abode

were conceived as foreign to the every-day world, comfortably beyond its inimical realm of familiar material things. In a half-conceived way these overruling powers were supposed to exercise a kind of sovereignty over the ruder forces of the universe. Their world was a better world than this, but it was too much to believe that they had entirely escaped from the arch-enemy, matter. Gradually, with the advance in intellectual power, with the accumulated store of possessions, this conception of a blessed alien realm became with certain peoples so adorned, so magnificent, so captivating, that by the very multitude and array of its fictions it became very real to their minds. When this dual view of man's place in nature was completed as far as his mind could affect its shape, by slow going and at first slight beginnings, now here, now there, but altogether among the men of our own Aryan race, students began to satisfy their curiosity concerning the phenomenal

world by closely observing its effects. At first these inquiries were clouded by supernatural conceptions. The Greeks alone among the ancients succeeded in separating the facts from their religious belief, and thereby they instituted the first pure study of nature. With the extension of the Roman spirit in Pagan and early Christian days the spirit of natural inquiry was lost, and it was not entirely revived until just after the overthrow of Byzantium by the Turks in 1452. This historic event led to the migration of Greek scholars to western Europe, and especially to northern Italy. With them they brought what remained in their possession of the manuscripts which contained the records of Greek science. Other fragments of this learning — perhaps even more valuable, for they had been treasured by their keepers for some centuries — came to western Europe from the Arabian followers of Mahomet. These seeds from the ancient naturalism did not

fall on stony ground; they came upon a fertile soil, where they grew apace. The arts of architecture, painting, and sculpture, and the study of human anatomy had done much to prepare the mind of man for a living contact with the phenomenal world.

Since the beginning of the sixteenth century the growth of this modern reconciliation of the human mind with nature has gone forward with great rapidity. Only in the best ages of Grecian learning, when that hive of thought was most active, do we find anything like this gain in naturalistic motives. Despite the sturdy and well-directed opposition of the Roman Church, the glow of the new learning, arising among the separate peoples of Italy, France, Germany, and England, has grown to a great light which illuminates the way of man. Before it the shadowy, because imaginary, world is fading away. Day by day men are more clearly perceiving that the ancient hostile

attitude towards the material universe was the greatest of the many errors of their intellectual infancy; one which it is their first duty to set aright. In this correction of the great primitive blunder the naturalists seem to the supernaturalists to be doing a cruel work. It is not a matter of surprise that in this overturning there should be a great deal of heart-burning and much distress brought about. It is easy, however, for the calmer spirits to see that the cause of truth will not suffer by the change, and that the best of the old view will be preserved in the new. There is room in the actual universe for all the good which the ideals of man have ever contained. There is on earth a firmer foundation for heaven than it has had before.

Thus we see that the existing attitude of half-fear, half-trust which men hold to the material world is explained by their history and their mental development. The fear represents the remains of the

immemorial terror derived from man's old attitude towards the nature about him, which he conceived to be his enemy; the trust arises from the new sense of the order, the majesty, the immense purposefulness of the material universe. Man has not yet learned to feel that his heaven is to be made in the world about his door; it is hard for him to change the habits of thought which millenniums have bred in him, and which are embodied in the mightiest traditions of his race. It may yet require centuries to effect this great and momentous change, to turn into the fields of his daily life the tide of hope and love which had gone into the barren realm of the imagined supernatural. It is, however, clear to all those who believe that naturalism is to replace supernaturalism that this end should be speedily and effectively attained; first, in order that the transition should be effected as rapidly and clearly as possible, and second, that the measure of the necessary change

should not be overlooked. All the true advocates of the natural view of man's relations should do what in them lies to secure these results, for on them depends the avoidance of many dangers.

The greatest peril which may be encountered in this transition will be found in the destruction of the old ideals before the new have been established. At present the old implicit confidence in the supernatural is in good part shaken. The moral standards which that trust upheld are imperfectly supported, and there is a certain amount of risk that the ancient control over the conduct of life may be lost before the new sense of obligation is insured. As I shall try to show hereafter, the admonitions of right doing and the denunciations of evil conduct which come to us from the world of fact are as mandatory as any which have been delivered to men from the supernatural realm. But the voice of nature can be heard only by those whose ears are attuned thereto, while blind faith has a place in all men.

There is reason to fear that men are being led to abandon the old trust in tradition before they have any confidence in or indeed any knowledge of the other teaching.

The other and perhaps equally serious risk is seen in the hasty conclusion often expressed by religious-minded people, that naturalism inevitably means the overthrow of all faith in things unseen; that those who love and trust the visible universe are committed to base and carnal views, and that they give no place to things beyond the touch of hand and sight of eye. This judgment of naturalism, though it doubtless finds a certain justification in the attitude of many narrow-minded persons who deem themselves true students of nature, is nevertheless unjustifiable. Whoever deals with a realm of the actual in a proper way finds himself persuaded that he has to do with the infinite; he keenly feels that what he or his kind can ever learn from it is as nothing to that which must remain un-

known. He, the naturalist, differs from the supernaturalist not in the lesser measure of his willingness to postulate the existence of many things which elude his senses, armed though he may be with skill and instruments to aid his powers, but by his belief, based on what he knows in the ways of experience, that there is but one kingdom, one order, and one control in the universe. He objects to the conception of a supernal realm separated in its character from the lower world; moreover, he questions the trustworthiness of the view, fundamental in many religions, which holds to the existence of a dual principle of good and evil throughout nature. Beyond these important differences as to primal concepts there is really little of moment to separate the men who approach the unknown through the old ways of the imagination and those who find their path into the depths from the newer avenues of science. It cannot be denied that the differences in methods are to a certain extent radical, but the re-

sults obtained may not be far apart. The moral interpretation of the universe, which is the essence of religion, will be accomplished as well by the priests who go with the naturalist to the verge of the fields which have been won by science as it has been in the past by the purely imaginative method. The difference will exist in the acceptance, on the part of all inquirers, of the unity, trustworthiness, and teaching value of material things.

There is abundant room for spiritual truths in the universe. In fact, our modern physical science is ever tending away from the crude conceptions of matter held by the ancients. It seems now as if the end of the long dispute between the materialists and the spiritualists may soon come about through the growing conviction of physicists that all matter is but a mode of action of energy; that the physical universe is not a congeries of atoms, which are inert except when stirred by the dynamic powers; that all phenomena whatever

are but manifestations of power. In other words, the students of nature are now nearer to those who have trusted for guidance to the divining sense than ever before. The only thing which really divides their motives is the shadow of the old fear of the tangible world, which came into existence in the earlier combats of man with his environment.

It seems to me of the utmost importance that all those who perceive the necessity of conjoining the two methods of interpreting nature should use their best efforts to clear away this old, unnatural, yet most historic division which parts the thoughtful men of our time. The way to accomplish this end is not clear. While we may trust much to the course of nature, to the trends of thought which are insensibly and yet urgently driving philosophical minds into a sense that the field of their inquiries has no boundaries, we may also effect something by a deliberate consideration of the nature of this ideal division. It is

manifest that the real difficulty, however, consists in the nature of the evidence on which the two schools base their work. The naturalist rests his conclusions on facts which are or may be known to all men whatsoever; the supernaturalist rests his contention on observations which are patent only to a particular class of persons. So far as religion bares its doctrines on the hypothesis that events in the natural world occur outside of the realm of law, there seems at present no prospect of a real reconciliation between these views. So far as religion is founded or may be made to rest on phenomena of man's moral nature and on the sense of the depth of the universe, the limitless possibility of its conditions, we are entitled to expect a substantial unity between these two schools of interpreters.

Even in the matter of miracles it seems not improbable that science is likely to come nearer to religion than in the earlier days of that learning. The occurrence of

the exceptional under the control still of natural law is now more clear to naturalists than it was a century ago. We have come to see something of the latent in nature. We have come, moreover, to perceive how far the state of mind of the individual observer affects his perceptions. In other words, the naturalist of to-day more than his predecessors feels how difficult it is to discern the exact truth by any observations which are not made under the most critical conditions.

CHAPTER IV.

THE MARCH OF THE GENERATIONS.

THE simpler realm of nature, that in which the organization of matter is under the control of purely physical laws of aggregation, so far as our knowledge goes, gives us the visible forms and shapes of the celestial bodies, the crystals and concretions and the invisible aggregations of molecules made up of more or less numerous atoms grouped together in definite order. These shapes in the organic world, as they pervade every portion of its mass and are formed wherever the conditions permit, show us that matter inevitably inclines towards a shapely order. All our knowledge concerning the realm of material things leads us to a belief in the universality of this impulse towards organization. The original nebulous or fragmental con-

dition in which substances were diffused through space everywhere tends to give place to the state in which the materials are aggregated into the spheres. When this advance is attained, the substances enter into the more complex associations which give rise to chemical combinations or to crystalline bodies. When the adjustment of temperature on the surface of our own planet permits, and perhaps also on the similarly situated attendants of our own sun and of the far-away fixed stars, the grouping of atoms and molecules becomes much more complicated. A higher mode of existence develops, and sentient life begins to perceive the world about it.

As the life of animals and plants is merely a higher stage in the ancient and universal process of development, such as is exhibited in the lower plane of physical being, it should not surprise us to find that the lower orders of creation in many ways prefigure the higher, that the shapes of crystals and concretions somewhat resem-

ble the organic forms. In the present state of our knowledge it is indeed not easy to draw the precise line between the lower and the higher orders of being. It is only in the general results to which they attain that we can secure the foundation on which to rest a philosophical discrimination between them. Looking upon nature in a large way, we readily perceive that the tendency of all matter is towards more complicated forms in the association of its ultimate parts. Below the plane of organic life the successes in this effort are limited to a few groups of forms, none of which in complication compare with that feature as exhibited by truly living beings. The limitation in the advance obtained by the purely physical individualities of nature is apparently in large part due to the fact that they are but slightly, if at all, endowed with the capacity of varying according to the circumstances which environ them. The celestial spheres, the various substances arising from the arrangement

of the molecules, the crystals and concretions, which together include all the definite aggregations of matter, are substantially the same, whatsoever be the conditions in which they come to exist. They depend for their organization altogether upon internal impulses. They are but little influenced by actions which come from without. In this feature the physical units differ in a most important way from associations of matter which we recognize as really endowed with life; but there is a yet more important difference correlated with that first described, which makes it possible for organic individuals to store experience and transmit the ever-accumulated harvest of profit from generation to generation.

All the individualities of the physical world, except the elementary atoms, exhibit more or less clearly a tendency to give birth to forms like themselves. The solar centres in their contraction throw off planets and these in turn develop satellites.

Molecular combinations appear to lead to the grouping of other atoms into a similar order. Crystals breed by some kind of contagion other crystals like themselves; but all of these foreshadowings of the generational process are obscure, and in no case does the individual rise above the level of the forms whence it came. It is otherwise in organic nature. There the creatures are vastly more flexible than the individuals of the lower life. They adapt themselves in an immediate manner to the peculiarities of their environment. Those conditions which surround them make an impression on their bodies which is transmitted to their progeny, and these influences, accumulating from age to age, become the precious store of influences which lead organisms ever upward to higher planes of existence.

It is indeed in the ability of living beings to inherit experience that we find the most general and the most important, if it be not the sole characteristic

feature which separates them from the lower classes of individuals which compose the universe. These grosser organizations profit nothing from their succession. The first crystals of the primal molecules were doubtless in all regards the same as those formed in the latest time. The organic form is never exactly like its ancestors.

Closely related to this ability to profit by experience is another less eminent peculiarity of organic life, namely, the capacity of appropriating materials which it finds stored in previously existing combinations of matter, taking to itself such portion as it needs of their material part, and converting the energy involved in their chemical combinations to its use. On these two foundations rests the great difference in the nature of organic forms as compared with those not endowed with the principle of life. Before this organic grade of structures was attained, all the processes of nature led only to an endless repetition of

similar forms. We seem to see in the efforts of matter to rise above its primitive simplicity a ceaseless, untiring striving towards the higher life, which, as we have seen, is attained only in the strangely rare conditions which this earth and possibly other planets afford, but which cannot have any place on the stellar spheres.

Considered merely from the point of view of their physical variety, the structures of the organic world vastly exceed those of inorganic nature. In that lower realm we know a few score of elemental substances combined in a few hundred molecular forms and associated in perhaps a thousand distinct crystalline shapes.[1]

In the higher order of life the state of matter permits the development of an inconceivably greater variety of individuali-

[1] I am fully aware of the fact that in the chemist's laboratory an almost infinite range of combinations of atoms and molecules can be effected. These, however, appear to me to be essentially unnatural associations. Nothing like as numerous combinations exist in the world about us.

ties. There are at present on this sphere not less than a million, some estimate a million and a half species of animals and plants, and no one who is familiar with the geological record can doubt that since living things began to exist, at least a hundred times as many species have dwelt upon the earth. But even these vast and inconceivable numbers give us no adequate impression as to the variety of the organic world, for we must bear in mind the fact that each of the countless individuals of these numerous species exhibits a measure of difference from its kindred much greater than is found in the diverse units of the mineral varieties. The molecules, the crystals, or the celestial spheres are substantially cast in the same mould for each kind; so far as our senses can discern, they are as much characterized by similarity as are the higher organisms by diversity. It is thus clear that the diversification of the universe has been far more effectively secured in the relatively

trifling amount of matter which has ever been animated than in all the enormously greater volume which as yet has felt the influence of the physical powers alone. A due consideration of these striking facts will make it clear to the student that the flower and the fruit of the universal striving after organization is to be found, not in the vast aggregations of the solar systems nor in the endless simple repetitions of association in molecules and crystals, but in the rare fields where the conditions are so balanced and related to each other as to permit the materials to enter on the organic state.

Although the diversification of matter, the end which seems to have been everywhere and unceasingly sought, is generally advanced by the organic structures, the most important novelty which life introduces into the world consists in the principle of progressive accumulation of inheritances, so that the properties of the structure are determined, not as in the

case of the physical unit, by laws dependent upon the primal conditions of matter, but by experiences won in the earlier life, either in that of the individual or in that of its ancestors since the beginning of the series to which it belongs. Material forms remain unchanged, or if destroyed fall back to more simple states of being, leaving no trace of their previous existence. Organic structures are ceaselessly changing the store of experience, and this store is transmitted by each generation to its successor, and so age by age they vary in their attitude towards the world. They alone can harvest the light and transmit it in ever-increasing store.

It is impossible to observe the contrast between animate and inanimate creatures without coming to the conclusion that the capacity to acquire and transmit is the infinitely peculiar and important gain which living creatures have won. All their other characteristics are of relatively slight value when compared with this feature. Mea-

sured in the terms of our own understanding, this introduction of truly historic beings into the universe is the greatest revolution which we can conceive to have occurred in all the processes of nature since that atom of the all which we term the visible universe came forth from that which was before. By the slight but steadfast increment of profit which contact with the neighboring world affords living beings, they rise farther above the plain of material existence, generation by generation. The simpler ways of appreciating the surrounding nature are gradually developed until the higher or intellectual state of sentiency is attained. Finally in ourselves the age's product of understanding looks off upon the universe with comprehending mind.

Assuming, as we are entitled to do, that the progressive development of life in structure and intellectual power is the crowning achievement of the organizing motives in the universe, let us now con-

sider the limits which the physical conditions set upon this process of advancement. As we shall at once see, this is a question of transcendent importance, for it affects the whole aspect of the animate world in the profoundest manner. On it depend the processes of birth, life, and death, and all the other features connected with the march of the generations. There is indeed no other problem which the naturalist has to consider which is so full of importance to the student of life. Whether he approaches the question from a purely historic or from a moral point of view, he will find that he is almost appalled by the momentous nature of the considerations which are presented to him.

The most important result attained by the organic system of this planet manifestly consists in the invention of individual organic beings, each of which endures but for a moment of time and then gives place to its successors. If we could but divest ourselves of that commonplace view

of nature which dims the vision of the keenest-eyed and limits the sight of less cultivated men, we should perceive the singular momentariness of the individual in the organic series to which it belongs. If we look upon the creatures of any field or forest, we observe that the greater part of them endure but for a summer. Within the limits of a single square mile of fertile ground there may in the summer time be three or four thousand species, counting only plants, insects, and the higher forms of animals. Nearly all of these perish after a brief term of individual life, first bringing forth their eggs or seed, which they place where the next season's sun may quicken them; then they return to that great store of the soil whence all life springs. Nothing else in nature, save the waves of light and heat, which by their pulsations bear forth the blessed power of the sun, or the swift successive whirlings of the celestial spheres on their axes of rotation, bringing the recurrence of day

and night, is parallel to this endless coming and going of the generations. Nor can these waves of ether or planetary spinnings be compared with the succession of living things; for they are but motions, while in the organic forms the process of change involves the rapid concurrence of a host of molecules of matter into definite order, and their equally rapid return to a lower state of relative disorganization. With each of these surges of life which the generational impulse sends on, millions and millions of atoms and molecules spring into order, and by their complicated accord lift the association into the organic state; then in a moment the mastering impulse goes from them and they fall back into the inanimate realm. To an intellectual being, whose lifetime was framed in terms of the geologic ages, this generational movement of the organic forms of the earth would probably appear as do the waves of sound or of light to ourselves. To such a creature the successive oscillations would prob-

ably be hidden from the senses, and only a continuous impression of advancement in the really unbroken series of existence would be presented to his attention. If such a supposed being were endowed with continuous life, and should proceed to analyze the phenomena of animate nature, he would gain certain impressions denied to us by the exceeding brevity of our lives. He would quickly and clearly see what we but half perceive, — that in a physical sense and in the large reckoning the individual is of but little account, is in fact but a stepping-stone over which the great processes of being pass in their upward and onward going. So trifling an element would the separate life seem that this inquirer might well ask the question why the individual is subjected to this endless separation from and return to the animate world; why the primal form should not go on unfolding its possibilities of development without the use of this costly machinery of the generations. It

is not worth while for us to essay the explanation which that age-enduring spirit would have to give. We must be content with the finite answer we derive from our scanty opportunities for studying the phenomena. This is in effect as follows:

All advance in organization depends upon processes of reconstruction, on the rearrangement of molecules in definite and somewhat stable order, and the creation of new parts by their combinations. At the same time all life depends as well on the simultaneous orderly correlation of the material parts of which the being is composed; on the continuous activity of the organs and their material accord. Thus the execution of the work on which the existence of the body depends makes it impossible for the frame to be in a state of flux, which advancement demands. Like other structures, it must cease to function if important improvements in the design are to be effected. It would have been possible, we may assume, for an infinite

power to have so arranged the vital engines that there need have been only a certain limited number of them in the world, each enduring for all the geologic ages. This is not the plan which nature presents to us. All the manifold series of organic beings exhibit the scheme in which each individual is brought under the best attainable conditions, which guide it to maturity. When its structure is complete, it profits by the inheritances transmitted to it by its ancestors, and hands on that body of profit along with the accretions won during the individual life, and then passes away.

In observing the march of the generations the student cannot afford to limit his inquiry to the general aspects of the phenomena; he needs to trace in much detail the process by which the unending advance in the grade of organization has been secured. As yet the researches of naturalists have mainly been directed to the simpler facts connected with the his-

tory of life upon this earth. Geologists have used those "medals of creation" which the fossils afford in the same way as the historian uses the coins which he finds in ancient cities. In both cases, the remains serve to identify periods and to trace the succession in the peopling of a district. Paleontologists, who consider fossils from the point of view of the relations of species, have, it is true, to a certain extent essayed to determine the genealogical trees of the organic series; but on the whole their labors, until the reign of Darwin, were confined to very limited fields. Thus, although we have a vast body of information concerning the development of animals and plants in geologic time, there is little of it which is suited to afford the unprofessional reader a clear idea as to the steps by which the organic series advance. Although the time is not yet ripe for the presentation of this great problem in a clear manner, we have secured enough information to enable us to pre-

sent, at least in a general way, a statement as to the process by which development is attained.

In considering the advance of the organic series it is by no means necessary to approach the matter with any prepossessions concerning the nature of the laws which determine the ongoing. For our purpose, indeed, it is better to put aside the question as to the measure of the truth which the Darwinian and other views afford, and to consider animals and plants in their purely phenomenal aspect. Important as are the several doctrines which have been adduced in explanation of the facts presented by these creatures, the visible truth demands the first attention of all students. Limiting ourselves, therefore, to the phenomenal aspects exhibited in the successions of life, we shall briefly set forth, somewhat in the manner of a catalogue, the general truths which have been secured by the study of the earth's organic history.

Organic life began with exceedingly simple combinations of a structural sort, which were formed in the earlier geologic ages, and has advanced by successive stages of evolution from its primitive simplicity to its present exceeding complication. This advance is exhibited not only in the material body but in the intelligence as well. The foregoing propositions contain the most important and generally well-founded truths which natural science has contributed to human knowledge. Although they were affirmed of old, for the Greeks had some vague perception of them, their demonstration has been the triumph of this century. As is the case with many other scientific truths, the general understanding of these maxims is somewhat in error, and these errors are too important to be passed without correction. It is in all cases difficult to keep the popular understanding in such matters in the qualified shape in which framed by men of science; thus the gen-

eral conception as to the nature of the earth's path around the sun is exceedingly erroneous. Most people imagine that our sphere has a circular orbit ; those who are better informed are aware that its way is elliptical; but few save astronomers conceive the almost indescribable irregularities in its course. In fact, it would be safer to say that all the complications of movement have never been at one time compassed by any human intelligence. When, by means of diagrams and explanations, which take account only of the larger truths, we bring this apparently simple matter of the earth's movement around the sun into a condition to be understood, we at the same time neglect a great body of facts concerning the motions some of which have great influence on the organic history of this planet.

Seeing how much is necessarily neglected in our account of the earth's orbit, it is not difficult to imagine how much greater is the amount of the omission

which we make in our general propositions concerning the path of organic life. In fact, the qualifications which we have to apply to the statements are much more extensive and vastly more important than are those which have to be introduced if we would express the truth with reference to the planetary motions. The first of these corrections to which the student should attend relates to the extent of our information concerning the earlier stages of the organic series. It is not true that we have found, even in the most ancient rocks, the first steps of any organic series. The fact is that we trace living forms from the present day downward through the rocks and backward through the geologic ages to the plane of the Lower Cambrian, in which horizon life is abundant; and though of a lower grade than that of to-day, still vastly removed from what we may term conditions of primitive simplicity. In general it may be said that we have followed in outline the steps which

form the upper half of the long ladder which has led to the higher forms of plants and animals such as now exist on the earth. In the earliest legible chapter of the great stone book we readily perceive that the record begins somewhere near half-way down in the history of organic events. There is not much reason to hope that we shall ever recover the missing volumes of the great chronicle. The dead past has not only buried its dead, but has quite effaced the burial-places.

It must not be supposed that the great blank in the geologic records which concerns the history of life before the Cambrian time is the only destroyed portion of the period. It is indeed only the first and greatest of the many missing parts of the history. Beginning with the present day and going backward step by step through the records, we find a great number of these lapses, each of which has to be bridged with conjecture until the students of the earth are able, through the

discovery of other strata, to fill the gaps. A large part of the vast labor which is devoted to the interpretation of rocks is directed to this end of supplying the missing links. It is readily to be conceived that all these breaks in the record make it difficult for those who seek to interpret the history of life to trace the march of the generations from the earlier ages to the present day. Fragmentary as the work as yet is, it may fairly be said that even to the most critical the evidence is sufficient to warrant the statements which we shall now present.

It is a very evident fact that in the process of organic advance the steps of the ongoing are attained through the institution of distinct species, each composed of innumerable individuals which for a time preserve something like similar forms, and then with more or less suddenness change their aspect so that they must be regarded as specifically distinct from the creatures which gave them birth. Without under-

taking the almost impossible task of defining what we mean or should mean by the term species, we may for our present purpose say that the word is to be applied to an assemblage of living beings which freely interbreed, and which have for the time effected a certain measure of adjustment of their conditions and relations with the organic and inorganic world with which they come in contact. So long as this adjustment does not vary through the action of the many perturbing causes, the like reproduces like, and the species remains in what we may term a static condition. When the change occurs, a portion or the whole of the individuals contained in the group undergo variations which — sometimes speedily, sometimes slowly — lead to departures from the ancestral state. The range in the pliability of these cohorts of organisms which we term species is exceedingly great. In some groups, as for instance in the brachiopoda, a species may remain almost

constant through all the geologic ages from the Lower Cambrian to the present day. Thus in the genus lingula, the best-known member of this group, there are existing forms which, so far as we can judge from their well-preserved shells, depart less from their ancestors which lived in the earliest geologic periods where distinct fossils have been found, than do the individuals in ordinarily variable species. If we rested our opinion on the facts presented by the remains of these creatures, we might fairly conclude that the earliest varieties and those now living might have bred together.

In the same group which contains the lingula we find other genera, in which the species are in such a state of flux, as regards all the important features of the organism, that within the limits of a few feet of strata the shapes undergo a greater change than has come about in the lingulas in all the period of their history which we can trace. We may indeed say that

the rate of alteration among animals and plants, even in species which are somewhat nearly akin, varies in the ratio of at least one to a thousand. If we could measure the range accurately, it might well prove to be ten times as great as the proportion which we have just indicated. In general the swiftness with which organic species are modified is greater in the higher than in the lower forms. The numerous instances of permanence allied to that just above noted are almost all found in the groups which may fairly be ranked as low in the scale of being. They all fall into the classes of animals commonly known as invertebrates; that is, below the series of backboned creatures to which man belongs. In most cases the changelessness is associated with unvarying habits of life, yet there are not wanting instances in which along with a total change in the mode of living the form remains unaltered. The most notable example of this nature is found in the species of cr

fishes, which have the habit of excavating complicated subterranean chambers, in which they dwell for the greater part of their lives. Although the crayfishes belong to a group of animals which in general possess a very elastic body, forms which vary readily with the alteration of habit, they have undergone no change in shape to fit them for this peculiar method of life. All their parts are very similar to those of the kindred lobsters, a group from which they appear to have sprung at some time during the paleozoic era. Our wonder at the rigid form of the crayfish is the greater when we consider that the group has revolutionized the stages by which it passes from the egg to the adult. While the lobsters, which it so closely resembles, exhibit in common with the other crustaceans a series of metamorphoses occurring after extrusion from the egg, the crayfishes have abandoned these stages, which would be inconvenient in their habit of life, and

proceed, even in the first epochs of their independent life, directly to the adult form.

Such instances as those afforded by the crayfish are rare, but the naturalist knows hundreds of cases which serve, though in a less effective way, to indicate that the measure of change which alterations of environment can produce in a species varies in a great and remarkable manner. It is therefore evident that the rate at which organic forms may alter is dependent on other influences besides those which arise from the immediate instance of environment. I have elsewhere (see page 90) undertaken to show that the variability of animals and plants may depend in large measure upon an internal and invisible contest among and between the host of their inheritances. For our present purpose, it is sufficient to note that something else besides the surrounding nature and the expressed motives which serve to determine the habits of life enters into the

equation which controls the shape of the creature. In the present state of our science the conditions which bring about organic variation are rarely discernible. We only perceive the endless flow of change. All our theories as to the cause thereof are still in the field of working hypotheses, or, in simpler phrase, they are conjectures; though, be it said, of a scientific sort.

The next point which the student will do well to note concerns the end to which the variation of species naturally leads. It is a common supposition that the direction of the movement is ever upward. The fact is that in a large number of cases, perhaps in the aggregate in more than half, the change gives rise to a form which, by all the canons by which we determine relative rank, is to be regarded as regressive or degradational. In many cases the advancement or retrogression appears to be determined by the conditions of the environment. Thus the kin-

dred of the shrimps may, by the better adjustment of their bodily parts to the needs of an active life, go onward to the higher structure of the lobsters and crabs; or, on the other hand, certain varieties, taking up the habit of dwelling in the gills of the fishes, where their life is of the simplest sort, may sink downward through many gradations of decline to a state in which they closely resemble the worms. A yet more common cause of degradation is found in those cases in which a group, such as the ammonites, after flourishing for geologic ages, and developing a great variety of species, appears gradually to enter on a state of decrepitude, in which the variations which before led upward afterwards bring about a steadfast decline. Although this last-described class of degradation has only been traced in a clear manner in a few organic series, it probably occurs throughout the animal and vegetable kingdoms. Species, genera, families, and orders have all, like the individ-

uals of which they are composed, a period of decay in which the organic gain won with infinite toil and pains is altogether lost in the old age of the group.

When any organic species rapidly varies in shape or habits, it seems to be in danger of extermination. The danger probably arises from the change in the relation of the body to its environment, which the alterations bring about. It is easy to see that these innovations have an experimental quality, and the result of the essay is to bring the individuals who make it more or less in peril. So long as a form remains quietly within the adjustment which may have preserved it unharmed for ages, its estate is secure; when it seeks new methods of life, it encounters unwonted risks. If by the variation it is led into a field of being where the equations which affect it are distinctly and permanently profitable, a new specific form may be established and maintained. It is clear, however, that a large part of the

new forms which arise in any organic series are necessarily unsuited to endure. Where the variations occur with reference to the habits of some other animal or plant, where they are so arranged as to give the creature immunity from a particular enemy, or to secure it food from some peculiar source, a modification in a single feature of the environment may lead to its death. Thus it comes about that the general feeders, those forms like the lingulæ which take their sustenance from a great variety of organic materials such as float in sea water, appear to be very persisting forms; so, too, the species which have devised peculiar and effective methods of protection which secure them immunity from enemies are apt to maintain their shapes unchanged for ages. A familiar instance of this is found in certain mollusks, such as our common clam, where the individuals excavate chambers in the mud of the sea bottom which are admirably devised to secure them against assault. These well-

sheltered forms retain their characteristics for geologic periods, while the more superficial inhabitants of the sea-floor are subject to relatively great alteration. A contrasted instance may be found in the case of such insects as depend for their subsistence on particular species of plants. The definiteness of their conditions renders them liable to speedy destruction.

The foregoing considerations, which could be indefinitely extended and still leave us without an adequate conception as to the accidents which may befall species, may serve as a foundation on which to build a better understanding concerning the difficulties which beset the continuous advance of animal and vegetable life. To insure the passage from a lower to a higher grade of organization, it is necessary that the variation in form should be such as will lead it to break through the wall of environment in that part of its periphery which leads towards a higher plane of being. Attaining a new plane,

the ongoing host appears in most cases to regain a temporary permanence of shape, and by thus becoming more or less fixed in its characteristics is enabled to balance itself with its environment. Then again variations occur which may lead another step upward, but which are far more likely to bring the procession of life into some unprofitable field, in which degradation or death ensues. In order to conceive the relative infrequency with which the variations occur in such a way as to insure organic advance, we must now turn our attention to the number of specific forms which have been developed during the march of the generations, and compare the total with the sum of successes in the way of advancement which has been attained.

Although the census of organic beings now in existence on the earth's surface is as yet incomplete, enough is known to make it clear that the total number of these discriminated forms is somewhere near a million. If we could go back to

the time of the middle tertiary and compare the forms then existing with those now alive, we should find that the number of species in the earlier time was nearly as great as at present, but that by far the larger portion of these forms were evidently distinct from those now living on the earth. If we could in a similar manner proceed backward through the geologic ages to the dawn of life, it seems quite certain that the total number of species which could be observed would exceed one hundred million. Although this estimate may seem to some naturalists unreasonably high, few if any of those who have endeavored to ascertain the specific variety exhibited by the animals in the paleozoic seas, and who at the same time have taken account of the vast unrecorded time before the deposition of the Cambrian beds, will esteem the reckoning excessive.

Turning now to the consideration of the numbers of the highly successful organic

forms which have come into existence through the vast experiments of the past, we see at once how infrequent are the ways which lead through the ages steadfastly and unbrokenly towards eminent success. Considered merely from the point of view of organic perfection, the greater part of the living forms, whether of animals or of plants, may fairly be regarded as successful. If, however, we take account of intellectual advancement as well as of physical construction, we may well be surprised at the few instances in which a high grade of development has been attained. It requires no argument to show the student that the transcendent successes of life are to be found among those forms where something like a social system has been instituted, — where the individuals of a species exchange their services in mutually helpful coöperation, which results in the creation of a commonwealth. This, the highest grade of organization, has been in a mea-

sure attained in but a few hundred species. The bees, the ants, and the termites among the insects, a number of species among the birds, a few score forms of mammals, make up the total of these accomplishments. In only one genus, that in which we ourselves belong, has the success been preëminent. It indeed so far transcends all the other accomplishments as to lie in a realm apart from the rest of organic life. We thus see that even if we take into account all the animals which have invented a society, calling the number of these species one thousand, the ratio of the eventual triumphs to the relative failures is about one to one hundred thousand. If we count man, as we well may, as the solitary distinguished success, then the proportion is something like one to a hundred million.

With the above described conception as to the position of man, let us proceed with our task of framing a picture of the stages of advance upon which his develop-

ment has absolutely depended. Taking no account of the collateral kindred, and reckoning only the species which have afforded the steps on the long way from the dawn of life to the estate of man, we find the number of these specific steps in the organic genealogy of mankind to be inconceivably numerous. It is certain that they must have been counted by the thousand. It is difficult indeed to conceive an upward gradation from the inorganic basis of life to the station of man without a succession of specifically different forms which would vastly transcend the last-named number. It is my individual opinion that the specific variations which have led to the human form may well have amounted to near a hundred thousand. Even if we limit the species in our ancestry to as small a total as ten thousand, we have to assume an almost impossible rate of change to bring the development within the limits which are commonly set for the duration of recorded

geologic time. Most observers are disposed to assume that organic life began at something like a hundred million years ago. Dividing this period into ten thousand intervals, we should have to come to the conclusion that the average time required to effect the transition from one species to another did not exceed ten thousand years. If the number of specific forms in the series which leads to man was a hundred thousand, then the time required for each of the transitions was not more than a millennium. All the evidence goes to show that even the greater of these durations would have been insufficient in length.

We next come to a point of great importance, one which is generally neglected in the considerations which are now occupying our attention, and which may be briefly stated as follows: The development of a continuous organic series, such as that which has led to man, or any other of the higher organisms existing at the

present day, depends upon the institution of each new species in the chain of being at a certain time and place in the life of the antecedent form. The ascending branch must go forth and establish itself in relation to its environment before the immediate progenitors have become seriously enfeebled. The advance must be made from somewhere near the highest plane of the antecedent life. Thus in our degradational series, we do not find new ascending stems which attain the development which has been lost in the descent. Moreover, if any species in the direct line of advancement fails to give off the ascending shoot, but passes away without leaving the improved generation, all chance of further advance on that particular line is lost. To perceive the momentousness of this fact, we must note that nowhere have paleontologists found a species, genus, or other group which has passed away, afterwards reinstituted. It thus seems to me tolerably clear that if

any considerable step in the progress of the species which held the future of man had been omitted, the result would have been the failure of the series. In a very short time the possible ancestors of our species would have departed from the narrow way in which advance was possible, or have been overcome by death, thus making a break in the path of our life, — a break which could not have been bridged over by any variations which might have occurred in the collateral related forms.

If the foregoing considerations have the validity which they seem to me to possess, we may fairly say that the appearance of man has depended upon the institution of thousands of new species, each of which had to appear at the right time and place in order to accomplish the succession. The question may naturally suggest itself whether, instead of the peculiar form of man, in case that form had been rendered impossible by a failure in the chain of being, another related and perhaps equally

effective offshoot might not have appeared in its stead. To this suggestion, which may seem at first sight very plausible, the geologist may make the following answer.

If the system of successions in species had been such as to permit the replacement of the lost stem in the growth which led to man by offshoots from collateral branches, we should expect to find evidence of many parallel series of organisms all trending in the direction which the kinship of man has attained. It needs but little knowledge of the facts of paleontology to show the observer that such is not the case. Considering only the last important step in the series, that which led from the anthropoid level to the estate of man, we readily note the fact that, although there are a number of species still existing which represent the pre-human state of development, none of them appear to be trending towards the human state. If tomorrow man should disappear from the planet, there is no reason to suppose that

by any process of change a similar creature would be evolved, however long the animal kingdom continued to exist. Our nearest kindred among the quadrumanous animals are on paths of development or retrogression which give no promise that they will arrive at a lofty goal.

We may sum up the foregoing considerations as follows: In the process of organic development, the first important step consists in the organization of individuals, each of which can gather experience, and build the results into a form in which they can be transmitted to its successors. The function of the individual is thus accomplished, and it then passes away to make room for its offspring. The separate beings of the several generations are gathered into associations of like forms, which we term species, each of which, for a greater or less period, remains in a somewhat stable state, but usually, after a time, by some process of change through selection or other influences, alters its shape

and reconstructs itself in relation to another assemblage of environing conditions. Generally these changes end in the destruction of the form without any great advance in station having been secured. Here and there some influences, the nature of which we cannot discern in the present state of our knowledge, leads the varying life on pathways which are directed upward. In very few cases have these forms succeeded in attaining to the plane of social organizations which may be termed elevated, and in only one case has a transcendent success been attained.

The success of man has been due, not to any very peculiar accomplishment of an organic kind, for in his frame he is much like his kindred, the anthropoids. It has been won by an entire change in the limitations of his psychic development. Until we arrive at the estate of man, the rate of mental development in the various intellectual animals is, on the whole, not more rapid than that of their organic modifica-

tions. In most cases it seems limited by the purely physical progress of the several forms. When, however, we come to man, we appear to find the old bondage of the mind to the body swept away; and the intellectual parts develop with extraordinary rapidity, while the frame remains essentially unchanged. It is in this new freedom that we find the one dominant characteristic of man, the feature which entitles us to class him as an entirely new kind of animal.

It is safe to say that there have been a hundred million species of organisms developed on the earth since life began to be. At the present time there are about a million such forms tenanting this planet. Thus our own species appears, from the point of view of its supreme success, not only most exceptional, but absolutely alone in the history of this sphere. When this peculiarity in the position of man comes to be well understood, when it is distinctly seen that in his case the organic

order has undergone a unique and complete revolution, the place of humanity in the world will begin to be understood. The inquiries of biologists, showing so clearly the close physical relation between man and the lower animals, naturally led to an undue approximation of our own kind to the lower life. The evidences of psychic identity which have been accumulated seemed at first sight to affirm the relation. Many naturalists at the present day perceive little reason for making any very trenchant division between our own kind and our kindred among the higher apes. It appears to me that this classification is overthrown when we consider the curious emancipation from the dominance of the body which man exhibits. He alone with an unchanged frame is enabled to undergo enormous alterations in the measure of his intellectual power, and to accomplish these changes at a rate which, in a geologic sense, is exceedingly swift.

A reasonable construction of the facts warrants the statement that the law of generational advance has in man undergone a sudden, indeed we may say a paroxysmal, alteration ; in truth, the most startling change which the history of organic life exhibits. In the ongoing of the generations before man, the physical and the psychic development went forward at nearly equal rates. In man alone do we find the body remaining relatively invariable, showing no capacity for opening up new lines of development, while the intellectual powers appear almost unlimited in their possibilities of advance. It is hardly too much to say that the measure of advance in mental power, which has been attained in human kind and won in a few thousand years, exceeds all which was accomplished in the tens of thousands of species through which our life has passed in its advance to the estate of man. The naturalist knows no miracles ; to him this departure from the old generational

principle is a part of the great order of events. Nevertheless, he must confess that there is nothing in the history of life up to the level of man, which has met his view, in any way calculated to explain the psychic freedom of our species, — the ease with which the mental powers advance while the bodily parts undergo no attendant change.

CHAPTER V.

THE BOND OF THE GENERATIONS.

EVERYWHERE in organic nature, in animals and plants alike, we find evidence of certain similar needs. First of these comes the necessity of providing for the sustenance of the creature by means of food. No sooner in the history of the individual is this primal condition satisfied than the problem of reproduction has to be dealt with. Here, as in the matter of nutrition, the method of dealing with the question, though different in the several organic groups, exhibits in them all an essential similarity. The life of the race is given for a time into the keeping of individuals, who, rising from the egg or seed, try their powers in the tasks of life, give birth to their successors, and then pass away. Death is in all cases accepted as

a condition of advancement. The series which have attained the highest development have evidently won their place in good part by organizing the method in which the old give way to the young. As this system of generational succession becomes affirmed, the difficulties attendant on the ever-recurring return of the life to the simplicity of the egg, and the dangers which the feeble germs incur, lead to continual efforts to increase the measure of the help which the parents may give their offspring, and from these efforts there arise a host of contrivances, partly structural, partly instinctive or intellectual, by which the adult life helps that which is germinating. The last of these great structural advances were made in the mammalian series; the latest and incomparably the most important of the intellectual gains which look to this end were begun, or at least foreshadowed, in the lower groups, but were only carried very far in human society.

The mechanical gains of the series of animals whence man has derived his frame and the cardinal motives of his mind consist in the development of the milk-glands and teats in the earlier forms of the group, and the creation of the placenta in the later members of the series. By these contrivances the young are enabled to profit by the strength of the mother until they have passed by the peculiar weaknesses of their early development. By these improvements in the relation of mother and child development can be maintained for a much longer time than in the more primitive system of parental relations, and thereby a greater measure of advance is made possible. Vast as is the profit of these singular bonds between the mother and infant, the greatest step towards the union of the strong with the weak is afforded by the expansion of the sympathies, by the growth of the affection between the elders and the young of the species. Parental care exists in

many of the lower forms of animals; a love of the tribe is shown in the social insects, such as the ants and bees; but while this is to these lower beings at once very profitable, and so well developed as to bring about the formation of very elaborate social systems, such as those of the ant-hill and the bee-hive, it is only in the mammalia and the birds that the family affection leads to the formation of tribal sympathies which we recognize by their manifestations to be clearly akin to our own motives. These altruistic emotions are evidently valuable to creatures even in groups far below the level of man.

Considerable as is this sympathetic bond which causes the leaders of the herding mammalia to risk their lives for the safety of the weaker members of their association, in most cases it leads only to a certain rude defense of the young and the females against the assaults of the larger beasts of prey. Although the danger from this source is by no means unimpor-

tant, this is not the exigency in which the young are in the most constant need of help. Their most serious requirement is that of food in the season of scanty supply. The husbanding habit, though common among the insects, where it is in some cases most ingeniously elaborated, is rare and clumsy in its modes of action among the vertebrates. Curiously enough its development among the mammals, save in man, is almost entirely limited to the group of rodents, creatures which in other regards than their mental parts show no features which entitle them to high place in the class to which they belong. In this structurally rather inferior order, we find nearly all the species which have a well-determined habit of providing during the summer or autumn against the dearth of the winter season. The squirrels, rats, mice, but above all the beaver, have the custom of hoarding provisions which they gather with laborious determination and store away with skill. It would be easy

to show that this habit depends in a great measure on the physical structure of these creatures, which structure greatly favors the resort to roots and seeds for food, and lends itself naturally to the formation of an instinctive habit of storing these articles in hoards for winter use. Except in the case of the beaver, this habit cannot be deemed social, for the creatures make the provision, each for itself alone, and with little reference to its kindred of the tribe or family.

In general among the mammals below the level of man, we find only the merest rudiments of a social system. There is no trace of anything like institutions or special rules of conduct, such as create the framework of human society. We see one form of these devices in the insects. In that group, at least among the communal forms, habits are so ordered that the members of the commonwealth greatly aid each other in the varied needs of life: some gather and distribute food; others

provide for the need of reproduction; in some cases, as in certain groups of ants, yet other classes of the society act as soldiers. In some of the species, by a rude process of adoption, feebler but industrious varieties are taken into the colony and there retained as slaves. In yet other instances the ants cultivate aphids, from which they derive a honey-like secretion. They bear these little animals to suitable places on the stems or branches of the plants, and guard them from enemies. Sometimes the ants carry this protective work so far that they inclose the aphids within walls of clay, so that they may be secured from various dangers. But all these marvelous things are done by the insects in a purely formal way. They act by the mental process which characterizes their class, and which leads to deeds done under the impulse of mere habit, in which neither immediate sympathy nor distinct rationality appears to have any share in shaping the act.

The great advantage we find in the group of mammals is that whatever may be done for the fellow-being is accomplished through emotions guided by a sympathetic understanding of the fellow-creature, and with a certain measure of reason in the act. It is true that many of these actions become in a way habitual, and all tend to be affected in this manner; but the ever-increasing importance of rationality causes all the acts of these mammalian species to have much higher intellectual quality than those of the insects. When the creature is moved to action, the stimulus operates on the passions, and the deed is the expression of these motives. It is not accomplished in the automatic way in which it is brought about in the case of the bees and ants. The effect of this increase in rationality is that as soon as the ancient and deeply-rooted sympathies which are firmly implanted in this series of animals in their age-long experience come to be guided by the higher intelli-

gence of mankind, the connection between the generations begins to be established by means of institutions, if by this word we may designate the permanent conditions which are exhibited in the relations between men. In place of the vague and incoherent feeling for and with the kindred, which we find among the lower mammals, or the formal and limited co-operative work of the communal insects, we have in the social order of our species a vast advance in the bond between the generations, which is effected through the same habitual, but still sympathetically enlivened, institutions which more developed memory and reason foster.

First of all we must note the great advance in the care-taking motives among men. Foresight, that creature of the memory and of the constructive imagination, is scarcely developed among the lower mammals; except in the very special instance of the beavers and the other lesser rodents, there are only rare in-

stances of forelooking, such as are exhibited by the herds of the suck-giving animals, who post sentinels to warn the congregation when enemies approach. Thus this motive of foresight, on which all advance depends, is broadly indicated below the level of man. But among the lowest men we find perhaps one hundred times the capacity for anticipating needs which exists in any of the lower vertebrate series. Even the most primitive savages make some deliberate preparation for the demands of to-morrow or the next season of dearth. When the Andaman islander or other low savage shapes any tool, he does his labor with reference to actions in the more or less remote future; he shapes it from his memory of experiences and his expectations of actions which he is hereafter to perform. With all such people there is some husbanding of food, some preparation of garners.

Morally naked as these brutal men seem to be, we still find that there exist among

them the elements of institutions which regulate the conditions of their conduct towards each other. Although the sense of possession, with reference to property in their wives, children, or chattels, is often weak in the lower grades of human kind, there are still some accepted principles which determine the rights of ownership and of inheritance. These principles are commonly founded on the sympathetic relations between individuals who abide together in the primitive family or its later product, the tribe or clan. At first these institutions concerning property have relatively little value, for there is not much to possess or to inherit, yet the scanty raiment and the rude tools which the dying leave are the beginnings of that vast store of hereditaments which in large measure control the shape and regulate the advance of modern society. In the tribal state the most important bond between the members of the society is that which obliges men to risk their lives for the common

safety. Hence we have the institutions of defense and valor and obedience to the chosen leader, which are so well provided in the early states of society that they remain in the traditions of civilization long after the immediate needs which secured their existence have passed away.

The institutions of valor and loyalty, the first of the moral bonds of society to be well affirmed, were naturally among the first products of human sympathy, for on their efficient action depends the chance which may be afforded to all the other motives of a social sort to find a place in which to take root.

Until a body of people is gathered together, bound in association by a common pride, and fended from the assaults of their enemies by the devotion of vassals and the skill of chieftains, there is no soil in which the other higher motives may find a chance to plant themselves: hence these primal forms of sympathetic institutions are or have been of overwhelming value to hu-

man interests. That which is, at least in its more advanced form, the feudal spirit, has also certain very important effects in linking one generation to another. Under it, as a reward for valor, there arise certain privileges and considerations which belong to particular men; in almost all cases these immunities, on death, pass to the kindred of the man: hence we have the bond of the family strengthened, and at the same time there is awakened a sense of the principle of inheritance, which, though it at first may relate only to the descent of privileges, comes in time to have a more important meaning. In the very lowest state of savagery there is but little consideration given to the individual because of his ancestors, and for a long time in the upward going, men are valued by their individual power in action, rather than for any qualities of their ancestors. Incidentally, however, in all social development the family bond, in which the tribal organization began, again most potently

These family units are well-determined elements of the nascent state; they often gather about them as retainers or as slaves the feebler elements of society, those who have never had ancestors strong enough to secure a social place for their stock.

With the next step in the advancing social order, the gentile system commonly disappears, and the separate family rises in dignity; the measure of the enhancement in the importance of the household is generally in proportion to the degree in which security against external or internecine danger has been affirmed. The status of the family is indeed the best index of the development of law in a society, for only in a well-regulated state can these separate units, the families, be sufficiently protected to maintain themselves, and only in such a state can the man be left free enough from other demands on his allegiance to do his part as master of a well-organized household. The peculiar advantage of the limited family consists in the

fact that it permits the elders of a group, in which the affections are strong, to do their will in giving to the children the largest possible share of the help which the adult members of the society can spare for their nurture. There are not wanting theorists who look upon the somewhat selfish limitation of the exclusive household as a damage to society in general; some of them propose to help the social order by turning the life which is now shut in by the home walls into the common field of national activity. Such people mistake the essential position of the home; they fail to see that the family is a most perfect contrivance for the difficult task of conveying from parent to child the varied nurture which is necessary to lift the human infant to the state in which it must come to its adult work. It is the only traversable bridge over which the successive generations of this vastly complicated being can pass across the gap which death is ever making between the individual

stages of life. The width and depth of this interval increase with each advance in the status of man. It is now the most serious of our social problems, the more so because it is unseen, to lift the youth of our time to the ever more exalted station of our kind.

While the family is to be reckoned as the most effective instrument for applying the resources of society in the task of conveying the social store to the young, our whole system of schooling, an outgrowth of the household education, is a later, and, in the higher stages of society, a very important supplement to the domestic work. The history of systematic teaching is one of the most interesting chapters in the records of civilization. To tell it in a sufficient manner would require a great treatise; we can only note the outlines of the story. All true literature is the expression of the sympathies; it is the product of those motives deeply stamped in the mammalian series, whence man derives

his store of qualities which leads the creature to go out towards its kindred: first towards its own children, and then in ever-widening circles to its more distant relations, the other members of the gens, the tribe, the nation, all mankind, and even all nature. This, the primal form of learning, the product of the affections, begins in all cases with the song or chant, in which the sentiments receive the peculiar mould which the metric impulse gives to them. At first it concerns the simpler motives of men: war, the chase, sexual love, all of which are primal interests, and the very foundations of the literary motive. As records are developed, the task of the bard enlarges; as national ongoing begins, the store of the scholar soon becomes larger than the household teaching can impart, and in the natural division of labor a portion of the task of instructing is transferred to the helpers of the household labor, the teachers, whereby it becomes unfortunately in part severed from

the sympathetic motives which should attend all the work of uplifting the youth.[1]

The family and its adjunct — the school — are the means whereby the store of wealth of all kinds, that of learning as well as of more material quality, is applied to the supreme task of uplifting the weak youth to the strength of the mature. The process of accumulation, extremely imperfect in the primitive conditions of society, goes on apace with each step in the economic advance. Among the Australian savages or the Andaman Islanders the store of goods of all kinds available for the nurture of the weak is very small; taking account of the material elements

[1] The decadence of value in education, as it is removed from the household, — a decay due, I believe, to the loss of the sympathetic motive, — may be well measured by the effect on the teaching of art which has come from the modern practice of giving over all such instruction to public schools. While art work was done in the family or in the household workshops, but little removed from the influences of the hearth, it was more direct, more appealing to man than in its modern school form.

of subsistence alone, it is probably not on the average equal to more than a month's labor per capita of the total population. In our most civilized states, counting all the "plant" of civilization, houses, roads, care which has gone to the improvement of fields, etc., it is at least one hundred times as much as among the lower savages; it may indeed amount to a thousand times that sum. Among the more primitive peoples there is only a small share of human endeavor embodied in the intangible yet precious heritage of the folk; their literature, their science, and their law can hardly be valued at a higher price in terms of labor than their chattels; but in civilized states these products of thought and experience are of incalculable importance. Age by age this store has increased until now it has gone quite beyond the distributive efficiency of our family or school system; the very wealth of the people clogs the channels by which it should find its way to the rising generation.

It is an almost impossible task in a work such as this to do more than help the reader's imagination to conceive the vast harvest of good which the race has won, and is constantly augmenting, all of which is in effect a garment to shelter the individual, a strong and flexible chain to knit the generations together, and thus to unify mankind. We can clearly see how vast is the importance of the mechanical method of binding the child to the mother through the placenta, by which the young is permitted to enjoy for a greater time the advantages of the mother's vigor. The great accumulation of disposable wealth which is at the command of human society in a certain broad way is analogous to that bond between the parent and the child. It connects the mental, moral, and physical labor of the generations in the same effective way as the placenta unites the bodily organization of the generations together. The devices of capital, currency, credit, wages, etc., are all

means whereby this store of inherited profit can be made to serve the needs for which it so admirably provides. These needs are, in general, the maintenance of the individual and the nurture of the youth. The family is the principal agent in securing the second and more important object accomplished by wealth, namely, its distribution. With every advance in social structure, the share of this store, which, through the household, is devoted to the uses of the youth, is increased; in truth, the proportion of its gains which the community consecrates to this purpose is the best possible measure of the grade of its organization.

Although our habits of thought inevitably lead us to consider the position of man as apart from that of the lower animated nature, it is easy to see that this store of inheritances, which constitutes the moral and material transmittenda of society, is essentially like, in all save its mass, to that which binds the flocks and

herds of the lower life together; their sympathetic motives which have led to the affection for children or associates or chieftains, their friendly definite rules of conduct, their stores of food when such are amassed, are all more than mere foreshadowings of the institutions of human society. They all alike point to the accomplishment of the great end, namely, the union, by a community of goods, of creatures which are severed from each other through the law by which the life of the species is but temporarily given into the keeping of individuals. Thus while nature recognizes that severance is necessary to success in development, the parting is no sooner secured than the reunion is sought by every possible means. Great as are the gains in the physical union of the generations by the food stored in the egg, the action of the milk glands or the placenta, the results brought about are trifling compared with those attained by intellectual processes which man unend-

ingly employs to accomplish the same end. In fact, the organic and the intellectual union which the mammalian series exhibit have in many regards essentially different results. The contrivances of milk glands and placenta serve to nourish the young in the more infantile period, and thus lead it past the difficulties which it encounters in the first stages of development; their effect is to keep the body plastic for a longer time than would otherwise be possible, and so to favor a higher physical and mental development. The social institutions accomplish another end; they directly contribute to the moral and intellectual nurture of the young by giving to them the experience and acquisitions of their predecessors.

So far in this process of developing the social resources of men or the coincident task of organizing the means whereby they are distributed, there has been no pervading rationality, no definite purpose. Each special part of the work has, it is

true, been done in a more or less conscious and determined manner, but the great general effects have been accomplished in a way hardly more regulated by the conscious will of men than are the processes of the seasons. Man has acted to gratify his momentary desires, and the ever-ruling powers have organized his actions into the assembled good. The tribal system grew from that of the family as directly and as simply as the tree from its seed; wealth followed from foresight and greed, learning from curiosity, law from just but momentary decisions. These social fragments were integrated without intention. They came together to form the bond between the individuals and the generations, with no more of human plan in the action than shapes the processes which unite the child with the mother in the period before its birth. It is only when the advancing curiosity and the organized inquiry which it brings about lead men to make researches into their own mental states, that

the marvel of it all appears to us. We then see that by following his instincts, with only a faint ray of reason to guide him in the immediate steps he had to take, man has by his sympathetic labor constructed in a nobler way the same kind of society which we find in the economy of a sponge or coral colony or the more intellectual bond of the ant-hill. The humanly contrived society binds the individuals in a common life, insures the elevation of the young, and minimizes, as far as seems to be possible, the evils which arise from the brief duration of the individual life. If it had been contrived with foresight to meet the peculiar needs, it could not, so far as we can see, have been better adjusted to them.

As yet the break which death makes in the process of being is imperfectly repaired by these social contrivances. The blow to the individual, the fear and sorrow which it brings to the sufferer and to those who are endeared to him, remain with only

the limited assuaging which the highest of social motives, religion, alone can afford. There is, however, reason to hope, or it may be to expect, that through the fuller understanding of the place of the individual being in the world there will be a further mitigation of this evil. When men come to feel how true it is that the life of their kind is the infinitely important matter for care, and that the individual is of moment mainly as he contributes to the sustenance, defense, and elevation of the kind, we may hope for a new moral support in the trial which death brings. It is through the modern view of science that we come to see how this nature, which holds men as the body of the mother does the unborn child, has provided that they spring from the lower creatures, inheriting their motives and unfolding them into a higher form, so that in a natural manner they are endowed with the marvelously perfect resources against the more evident dangers which the individualizing of life

brings about. It is now the task of the rational man to take up this work which has been done for him by the agents of the older and the outer nature, and to perfect it by the use of his sympathetic understanding and his rational toil. Every step he takes in this magnificent task will serve still further to make him free of the evils of his isolation, and thus to heal the ancient hurt of death; for it will lead him further from the consideration of self, in which all fear of death has its origin, and bring him more into the enduring life of his kind. When he enters on this way he indeed leaves death behind him.

It is evident that there are two ways by which men instinctively seek to guard themselves from the evils which they apprehend through death. In one of these they find their consolation in the hope of a personal immortality which shall afford them beyond the change a chance to resume their activities, and in due time to recover the associations which alone make

life precious. Although this way leads through hedonistic fields, it lies in the higher parts of that sterile realm, and has been to many a path of advancement. The other course, that along which the higher spirits travel, is altruistic. It leads to the sacrifice of the individual's interest in himself, and to the devotion of all his thought to the interests of his kind and to the purposes of his Maker. So far as these motives which lead to the expectation of immortal personal life, or to the devotion of a man's powers to his infinite or finite kindred, are matters of pure religion, I pass them by. There are, however, certain considerations of an immediately practical nature concerning which the man of science, as such, has a right to an opinion.

It is quite natural that the strong hand of death should be manifested in our social systems, for they are but the reflex of human experience, the present account of all which has gone before in the series

of being which has led to their evolution. The general conduct of every society, as well as that of the individuals which compose it, is to a great extent influenced by traditions which have been derived from a remote past. In most cases these customary actions are below the plane of feeling and understanding which prevail among the individuals in the association. In general we may say that the plane of social action is below the level of its effective elements; thus it comes about that while the congeries of influences which operate upon men who dwell together serves to elevate the inefficient members of the association, it operates to lower the grade of action of those who do the work of advance. Therefore society needs a constant revision in order that we may weed out the customs and the traditions on which they are founded, that serve to retard the upward going of men.

Considering our social system with reference to the impress which death has

made upon it, we at once note certain observances which are the relics and results of a state of mind much lower than that which exists among the better spirits of our own time. The first of these mortuary evils which we may note is found in the excessive grief for the dead which so extensively prevails even among people who are religious-minded; that is, who should look with perfect confidence upon the order of events in which they are placed. It is difficult to overestimate the gravity of the burden which grief imposes on mankind. The injuries which it brings arise in part from the essentially selfish direction of the energy of the person who indulges in sorrow which leads to the degradation of the individual mind, and partly from the loss which is thus brought about in the altruistic motives which alone can advance the moral culture of the people. The evil of grief is enhanced by the fact that like all the other emotions it is readily accumulated by inheritance. The ten-

dency to excessive sorrow is probably among the more transmissible of human qualities. The result is that the unhappy state of mind is handed on from generation to generation, and maintains itself against all the corrective influences which religion and philosophy should bring into action. Here and there it is true that we find individuals who have in a measure escaped from this burden of sorrow, but as a whole the corrective influence of our higher thinking has had but little effect in lightening the load of grief which death inflicts.

The customs connected with our disposition of the dead are well calculated, not only to maintain this burden, but to increase the tax which it imposes on society. The costs of inhumation are often greater than those incurred in the education of an individual; the cemeteries, at least those about our great cities, generally represent a much greater expenditure than do the schools of the people. Thus the cost of

the property contained in the cemetery of Mt. Auburn is probably as great as that of Harvard College. It is many times as great as that involved in all the school-buildings belonging to the people who bury their dead in that cemetery. As this is somewhat of a digression from the main path of this essay, we may not consider it further. It will, however, be clear to all considerate people that our methods with the dead not only do violence to our judgment as to the place of death in the world, but also withdraw from the living the help which they should receive from their fellow-men.

We now turn to consider the educational aspects of the matter which we have in hand. The question is, in what way and to what extent our knowledge concerning the development of life can be made to elevate the thought and action of man. It is clear that the conception concerning the place of the individual human being in the society to which he

belongs may be vastly improved by this larger understanding of his relations which science affords. It is also clear that it would be a difficult matter to bring the ideas home to the people. When the teacher essays this task, he at once finds a difficulty arising from the large and indefinable character of the knowledge which has to be presented to the pupil before the moral value of the teaching can be secured. Few indeed among our naturalists are led to take a moral view of the facts which their domain affords. If, therefore, the educative value of the truth concerning the history of organic life depended upon a system of teaching which would give the mass of our people any considerable part of the learning on which our conclusions rest, we might well doubt its value in general education.

Fortunately for those who would set forth clearly to all men the important truths of any science, there exists among all people a singular capacity for adopting

conclusions which they take, not by the way of detailed knowledge, but through maxims which present in a condensed form the essence of complicated truths. Almost all the useful lore which influences the masses of society secures its effective presentation in this epigrammatic form. So long as learning remains in the shape in which the investigator uses it, it is generally useless to the uninitiated in the science. It is only when the poet does his work, when he phrases the truth in a form to appeal to the imagination, or the more prosaic littérateur in a kindred way adapts the statement to ordinary understandings, that the public has a profit from the inquiry. A good instance of the way in which a recondite conclusion of science may be brought home to a people and greatly influence their thought and action may be found in the popular history of the Darwinian hypothesis. The currency of this view beyond the limits of the professional natu-

ralists is mainly due to its happy expression in Mr. Spencer's phrase, "the survival of the fittest." The term "natural selection," though a more consistent and logical expression of Mr. Darwin's main result, is purely scientific, and could never have had much meaning to the masses of men.

It is evident that we cannot expect much moral influence from science until its truths have obtained a currency which can alone be given them through the channels of sympathetic understanding. They must enter into that humanized body of knowledge which constitutes literature. It appears to me that the moral value of this learning cannot well be conveyed through our ordinary schools. The trend of the work done by these institutions appears to be steadily, and perhaps inevitably, towards other and more immediate ends. In our universities, it is true, there is fit time and place for the teacher of science to direct the attention of the student to the moral aspects of his inquiries. Yet

even there, as my own experience clearly indicates, this important task cannot demand much of the teacher's attention. He necessarily feels that his main duty is to present the truth in a purely scientific manner. A part of the work which has to be done in order to bring the moral aspects of science before the public may be accomplished, indeed is now being in a measure done, by those writers, such as Mr. Spencer, who without much detailed knowledge of nature possess quick understandings and the literary faculty which enables them to shape their knowledge for the needs of the ordinary man. Good as much of this work is, it appears to me incompetent to effect the end we have in view. The experience of the ages clearly shows that the inculcation of moral truths can only be successfully effected in the personal way. The instilling of such truths seems to demand the immediate influence of a personality. The weight of the impression depends upon the voice and the

eye of a teacher, and upon that indescribable atmosphere which surrounds those who lead the conduct of men. On this account we are led to look, for the inculcation of those scientific conclusions which concern morals, to the class of teachers to whom for ages the specific moral education of society has been committed.

I am aware that the foregoing proposition, that instruction in those truths of natural science which are of most concern to the masses of men should be left to the order of pastors, will not commend itself to most naturalists. They will generally apprehend that such a channel of presentation will lead to very distorted statements, in which the natural facts will be warped to suit the exigencies of particular creeds. It may be confessed that this fear is reasonable. In answer to this objection we should consider the following points: Out of the necessities of their situation men have determined that their moral conduct shall be supervised by a

body of clergy. No one who acquires a reasonably good conception of the conditions of society can expect a state of the social order in which these care-takers of conduct will cease to have their appointed work to do. To this clergy naturally falls the task of disseminating and inculcating moral truth. We cannot imagine the division of their functions between two classes of men, the one dealing with the moral considerations which are founded on religious creeds, and the other with those which are contributed by natural science. Such a division of labor would be preposterous.

It is impossible to foresee the steps by which this practical unification of science and religion may be brought about. It is clear that the way which leads to it is long and the obstacles are many, but the result appears inevitable. Although the endeavor to forecast the process by which the facts of science which affect the conduct of life may become embodied with

our older moral teaching would be futile, there are certain considerations concerning the matter which we have at this time to face. It is clearly necessary that our clergy should be so far informed concerning the truths which natural science affords that they may at once proceed with their use. This duty is the more immediate for the reason that the general public, even in the less educated parts of our society, already begin to perceive that the new learning has a moral aspect; they are indeed making a rude and half-informed use of these new acquisitions. Thus in the case of the maxim "the survival of the fittest," the half-conceived idea leads many persons to the pernicious corollary that whatever is, is right, or to the less objectionable, but utterly erroneous notion, that the forces of the environing nature will of themselves alone secure moral advancement. Moreover, certain half-conceptions of scientific truth are leading men to regard their individuality

as unimportant. The naturalist alone, however he may labor within his appointed field, can never hope to show to men the moral significance of their personality, which is disclosed by his peculiar inquiries, and which can be made vastly to reinforce our ancient canons of conduct. It is for the preacher to bear in upon men the fact that each person is the keeper of all the good which with infinite toil and pains has been won by the generations of life which have led to the estate of man.

CHAPTER VI.

THE NATURAL HISTORY OF SYMPATHY.

THE mental qualities which we term altruistic are those instinctive emotions which lead the mind to actions which have no relation to personal gratification, but on the contrary involve some subjugation of the immediate desires of the self. Every intelligent student of mental phenomena has recognized the extreme difficulty which is encountered in the effort to explain the origin of these motives. Selfishness, or hedonism, in all its moods, is readily explained. As long as the mind inclines to do those things which bring immediate profit in the gratification of personal desires, its action is within the limits which we term natural; but when the emotions lead to self-sacrifice, which can have no reference to profit, to acts

which have their satisfaction in unprofitableness, the observer is at a loss for an explanation. All students of the mind have more or less clearly perceived the essential mystery of altruism. Kant found it insoluble. Schopenhauer sets forth the problem in the beginning of his essay on the foundation of morality (Die Grundlage der Moral) with delightful clearness, and then wraps it in his cold fog of pessimism. A score of other students have wrestled with the problem, have seen its essential mystery, but have left it as obscure as they found it. No one who has considered this question can doubt that of all metaphysical problems, it is the one which needs the most light. Any student is justified in making the almost inevitable failure which he sees must await his efforts to clear the doubts away. The importance of altruism is vastly increased by the fact that it is here that religion finds its foundations in the nature of man. It is because the mind of man is altruistic, because it

goes out to his fellows, to the world of phenomena which lies beyond his appetites, or yet further to that realm which lies beyond the visible world, that religion exists or duty finds a chance to be.

As long as man was looked upon as independently created, as long as he was regarded as a thing outside of the other life of the world, the naturalist had no reason to consider the question of altruism as within his province. But the modern advance in the theory of life has made it perfectly clear that man is, in all his parts, both physical and mental, the last term in an organic series which has led in an unbroken succession of links from the lowest forms of life to his present estate. This brings the question clearly within the province of the naturalist, and gives him a right to take a part in the study of the altruistic motive.

Before we undertake to see what aid the naturalist can give in this inquiry, let us examine a little more closely into the

facts; let us see in a rapid way what classification can be made in the phenomena of altruism. Thus we shall set the problem clearly before our minds. Defining altruism as the unselfish expenditure of mental power upon things outside of the limits of individuality, an expenditure made with no reference to the organic needs of the individual, we give to the word a wider connotation than is commonly assigned to it. In the ordinary use of the word, sympathy is regarded as an affection pertaining to one's fellow-men alone; but if we look closely we see that it includes in many modern minds a precisely similar emotion toward all those animals which can be conceived of feeling as men feel. Following it further, we see that, with some variation in intensity, it includes the love of nature. There is, it seems to me, only a difference in degree and in certain minor concomitants between the emotion with which we caress a dog and that we experience when we

enjoy a beautiful landscape. The essential feature in both is the going out of the mind into the field of life beyond itself; so it is with the impulse to religion. Differing widely from the other forms of sympathy in its mixture of motives, it is still essentially altruistic; but for the personal motive of sympathy, that outward going of the mind, it could not exist.

These three forms of the altruistic motive, namely, the sympathy with the fellow-man, the sympathy with nature, and the sympathy with the Infinite, have very different degrees of intensity, and are otherwise divisible from each other in many ways. Sympathy with the fellow-man is the most intense of the three. It is the simplest form of the motive; it may exist with less admixture of related motives than the other divisions of altruistic impulses. It is the most universal among men, and the most frequently active in any mind. Moreover, as we shall hereafter see, it is the form of this instinct

that we can trace among the lower animals.

The impulse to sympathy with the Infinite or with a God is next in intensity, but in its quality very much less simple and unmixed than that with the fellow-man; while the sympathy with nature, the outgoing of the mind to the world of life, organic and physical, is the least intense of all. This last is a mode of altruism that is essentially modern in origin, and as yet has but slight effect upon most minds. The love of nature seems to be not only a motive of modern days, but it appears to be mainly limited to the Aryan people. It is not unlikely that it is in effect an overflowing of the sympathies which were originally developed in our kind, by the love of kindred, of chieftains, or of the Supreme. In the progress of social development, we can, in a general way at least, trace the stages of development from the more primal conditions of the altruistic motives, to the more developed form in

which they now find a place in the minds of the more cultivated men.

These facts lead the naturalist to regard the sympathy with the fellow-being as probably the original form of all the modes of altruism, the others being of later origin in the process of development of this motive in the animal life below the level of man. Anything which he can discover which will throw light on the conditions under which this altruistic motive had its origin will, he may be sure, be a welcome contribution to the matter.

Before we undertake this inquiry, let us notice the fact that, although the evolution of altruism is a matter which lies well within the province of the naturalist, it belongs to a class of questions that he is not well fitted to examine. The organic world has two distinct realms: the one includes the vast assemblage of specific forms, — visible, tangible bodies, explaining themselves to the senses, and afford-

ing an infinite field for the employment of all the observer's skill of eye and hand; the other realm is that of mental parts. Here the field of observation is as shadowy and perplexed as it is evident and clear in the physical realm. That which the naturalist sees of animal mind he sees at an immense disadvantage. In the first place he cannot perceive the mind of any being directly; he can only infer the mental constitution of the creature from its acts, and these acts are performed by parts that are, in most cases, utterly unlike those with which he is accustomed to see emotions expressed. It is only when the creatures belong in the upper part of the animal kingdom and are akin to himself in the nature of their emotions and their modes of expression, that he can attain much certainty in his observations. Moreover, the whole training of the naturalist, as it is now pursued, tends to blind him to the observation of such obscure things as the mental phenomena of

nature. Every pursuit, if it become devoted to its ends, creates an idol of prejudice in the mind. With the naturalist it is the idol of clearness, what we might perhaps better call the idol of evident fact, that is created. Accustomed to see all with which he deals, the invisible is sure to be with him the non-existent. Every now and then some experience tells him that the invisible element in the operation of this life is really greater than the visible element. He sees, for instance, the little transparent sphere of the egg, apparently no more specialized than a small bit of calf's-foot jelly, yet he knows that it is charged with the history and the profit of a hundred million years of life, which it will hand down to the beings which are to come from it. Despite these lessons, which he may have at any hour of his work, the naturalist must bow before the matter-of-fact, and shun this indefinite field. His life must be in the open day of plainly seen things. There are few

naturalists, and those mainly of the class that did not enter on the study of zoölogy by the anatomical path, who have shown any skill in the study of the mental parts of animals. With these limitations well in mind, we may enter on the inquiry into the natural history of altruism, free from any over-expectation of the results that may be attained.

It is not possible to determine whereabouts in the ascending scale of animal life the mental powers began to exist. The lowest organized creatures that we may safely term animals are, to our senses, only shapeless, tiny bits of jelly, transparent, with no trace of organs of any description. They move by protruding the semi-fluid mass on one side and drawing it in on the other; they feed by rolling themselves around the bit of food, absorbing its nutriment into their body, and then rolling their elastic forms away from the undigested matter; and they reproduce by a simple division of the body. Of one in-

dividual we may make two or ten by dividing it with a knife, and each bit will accept the separate existence with no shock to the organism. Yet it is difficult to watch these creatures without forming the opinion that they have some mode of mind in them. Their acts seem to involve volition; they may be automatic, yet some mental quality must be the governor of the automatism.

There is a whole sub-kingdom — the protozoa — which shows little structural advance on the primitive simplicity of its lower members. Individuals learn the art of combining themselves into associations that build wonderful communities, such as our sponges; but nowhere in them do we find the mark of mental habits. If there be anything like a mind in their level of life, it must be limited to the simplest reflection of desires, and to a volition which gives activities for their gratification. The next step higher, we find ourselves among the radiated animals. Here,

at the outset, a great advance in machinery for sentiency is developed. There is a nervous system; there are the beginnings of sight and touch organs. The machinery of the nerves thus begins to recognize the existence of an outer world, from which impressions are to be gained, which may guide the life of the individual. Still these impressions must be of the dimmest sort. The life is gathered within the walls of the animal. There is hardly more than the faintest mental reaction of the creature upon the outer world.

One great advance the creatures in the highest group of the radiates effect. They discover the art of moving in a definite direction over the sea bottom in such a way that the head, or the part that bears the most important sense organs, is foremost in the advance. This organization of the body, in such a manner that the motion is in a determined axis, and the instruments of perception at its anterior end, is replete with momentous consequences to animal

life. It determines that the means of cognition shall not be distributed over the whole periphery of the body, but shall be concentrated at the point where they can, in the main, alone do effective work. Only with something like a head, with its instruments of sensation, and of action with reference to that sensation, can the creature begin to understand its environment, and to reconcile itself, by its activities, to its conditions.

In the group of mollusca, which is yet higher in the scale of living beings, the intellectual machinery is greatly advanced. The nervous system becomes well developed in the highest forms; in the cuttle-fishes, there is something like a brain, a well-developed eye, which, unlike the lower eyes that give only a sense of light and darkness, affords a distinct image, as our eyes do; a sense of touch, and a sense of hearing. With this advance in the means whereby mental contact with the outer world is secured, there is a proportionate

gain in the mental power. The creature is no longer locked within itself. The squid, at least, among the mollusca is one of the most acutely sensitive animals. Impressions from the outer world are received by its organism and expressed in its actions as well as they are in the true fishes. It is noteworthy as the lowest animal which shows anything of these ready reactions upon the outer world. Curiosity and fear are certainly indicated in its movements, and some of its acts seem to show rage as well.

Among the higher groups of mollusca we begin to find actions which are related to the care of the offspring. The mother seeks the place for the nest with care and deposits her eggs, often with extraordinary precautions. Although this care-taking is in a way mechanical or organic, it represents the beginning of parental affection, which, like all the other of our moral and intellectual gains, has its roots in the lower unconscious world. The organic

forethoughts with reference to the protection of the young, which are found in the history of many marine gasteropods, exceed in complication any contrivances which are known to us in the higher realms of life.

Although in the mollusca we find no traces of sympathy, we may say that its highest members show that they have advanced to a point where there is a keen consciousness of an outer world, so that the necessary foundations for altruism are there indicated.

Turning now to another series of organic forms, the articulates, we find the most rapid and wonderful advances toward intellectual powers. The three other and lower groups of animals, protozoans, radiates, and mollusca, have types of structure that do not well admit of sense organs or the machinery for the use of volition; but beginning with the lowest articulates we find a many-jointed body provided with a well-developed nervous system, elaborating

mechanisms for receiving sensations and numerous means for executing the behests of the will. Already in the crustacea, or in the middle part of the group of articulates, we find nimble bodies and keen senses, showing that the animal has become capable of an alert perception of the outer world. Among the insects this advance is completed as far as the articulate series goes. Our familiar experience with many forms of insect life shows us how quick is this reaction of the mental parts upon the outer world. Observe a spider or a wasp with its prey, or the bees at work in a hive. What could show a more complete perception of environment than their actions? If we compare the behavior of articulated animals with that of a polyp or amœba, we easily perceive how far the animal body has advanced in its fitness to be the habitation of intelligence.

Though it can hardly be doubted that among the highest mollusca there is a rec-

ognition of the fellow life, it is among the articulates that we first find clear evidence of sympathetic motives. The development of this primal sympathy is undoubtedly connected with the separation of the sexes, which in the lower animals, as in many plants, are generally united in one individual. When the sexes become distinct, some recognition of kindred life becomes necessary. We find another stage in its development in the relation of parent and offspring. The continuous care which one or both parents exercise over the young is a very strong means of pushing onward the growth of the altruistic motives. The complete recognition of the external life, which is the basis of altruism in all its moods, as well as of the higher power of hedonism, is helped by the combat of the males with each other, and by the life of flight and chase which becomes so conspicuous a feature in these highly developed forms.

Until we rise to the level of the insects,

there is no distinct mark of a sympathy which goes beyond the love of parent for offspring; but among the higher animals the motive goes one step farther and gives us sympathy with the fellow-being within the limits of the tribe. This is best seen in the colonies of ants and bees, in which there is clearly a distinct recognition of the companion workers in the hive or ant-hill. At no point, however, does it go so far as to include the species within its bounds. The ant will aid his clansmen, but his sympathy is limited by the bounds of his community. The member of another tribe is his enemy.

In most cases the sympathy which prevails among associated insects appears to be limited to the work which it is necessary for them to do in order to maintain and extend the power of their colonies. Nevertheless, there are instances where we are forced to believe that the mutual help which they render one another is based upon something more humanlike than a

blind automatic devotion to their social labors. Thus ants will assist each other with their burdens, working together in perfect harmony. Where a member of their society is in trouble, as, for instance, by having his feet entangled in a sticky substance, his fellow-workers will labor assiduously, though generally with little skill, to free him from his difficulties. In other instances, such as among our dung beetles, two or more individuals will often combine their forces in a way to show a spirit of mutual help and some sense of the conditions under which it may be best rendered. There are those who hold to the view that all these associated actions of insects are performed in an automatic way, the creatures acting with no more consciousness than exists in the case of a decapitated frog, when, through the reflex action of its spinal column, it scratches a portion of the skin which the experimenter irritates. This view concerning the nature of the animal intelligence is

probably entertained by few persons who have attentively studied the behavior of bees and ants. A careful consideration of their actions more generally leads to the supposition that their motives, though without the element of self-consciousness, are of a truly intellectual nature.

While we must marvel at the altruistic accord which makes it possible for thousands of creatures to combine their work, we must not suppose that there is a perfect likeness between the motives that actuate a wasp or a bee and the sympathy that we find in the higher forms of life. The principal use of these instances of altruistic relation in the articulates is to show us that this class of motives is no peculiar property of the vertebrate animals, in which man belongs, but that it originates in other series of animals, which have no blood kinship with man.

Coming now to the series of forms which lead up to man, the vertebrates, or backboned animals, we find very complete

proof of a separate development of the altruistic motives, leading to results that, while they are akin to those attained by the articulates, are different from those less advanced forms in many important ways. Low down in the fishes we find the sexes separated; and very early in the series, sexual affection apparently gives the beginning of the sympathetic motives. As we advance in the vertebrate series to the level of the birds and mammals, we find that the young are born in a more and more perfect condition and demand a larger amount of parental aid and care. Thus the parental relation, in place of being a momentary affair, as in the lower forms, becomes an element in the emotions of the mother for the greater part of her life. The public owes to John Fiske the first statement of this important truth.

Among the lower vertebrates, as is the case with the lowlier forms of all the great series of animals, the care of the offspring is a task which is almost entirely assigned

to the female. The duties connected with the function of reproduction which can enter upon the plane of consciousness are few, and usually occupy but a brief time in her life. The sympathetic motives connected with the task are thus in their nature very temporary, their period of awakening being limited to the time in which their operation is necessary. As we advance in the vertebrate series, the duration of infancy, the period when the young are dependent on the mother for food or protection, ever becomes greater, until in the ordinary life of the higher mammalia, the child of one year is hardly weaned and discarded before the succeeding offspring claims a place in the parent's affection. Thus many of these creatures below the level of man have the females of the species placed under conditions which insure an almost perennial activity of the maternal sympathies. Among the animal progenitors of man there were probably thousands of forms which were subjected

to this primal education of the altruistic sense.

In general, the male parent among the mammals exhibits little interest in his offspring; in fact, the sense of any personal relation cannot, under the customs of these animals, be expected to exist. In certain fishes, and many birds which have the pairing habit, and where the male comes to recognize a relation to his progeny, his sympathy with the young is very clearly expressed. It may, indeed, be as intense as it is in the female. The rapid development of the sympathetic motive among mankind may, in part, be attributed to the fact that they alone, among the mammals, have developed the monogamic habit, and thus attained to something like the mother's relation to the offspring. As soon as this condition of the family was established and the parental affection of the male thereby defined and concentrated, the conditions which make for the development of the sympathetic

motive in human kind were greatly enhanced; both parents being in this regard quickened, the energy of the motive, and the measure in which it was transmitted from generation to generation, was necessarily much increased.

After this primal affection for offspring, the next altruistic step leads to the sympathy of the tribe, which may possibly result from the extension of the parental motive over a larger field, though it seems to me that it arises from some more general causes. Until we rise to man, the advance in altruism seems to lead little farther than to the bounds of the herd, which is sometimes only the expanded family. Yet there are traces of a sympathy that takes cognizance of a whole species to which the creature belongs. Among our pigs, the cry of distress of any of the species arouses a self-sacrificing sympathy which is beautiful to behold. This much-abused animal gives us the most familiar evidence of a wide-reaching

altruism that we find in the ordinary domesticated animals. Traces of this motive are discernible in our horned cattle. The smell of the blood of their species will throw them into a state of excitement, but unlike the pigs, who are willing to do battle for a shrieking comrade, the motive does not impel them to action. The best evidence of distinct sympathetic emotion of the human sort may be found in the higher monkeys. All the evidence goes to show that the play of this emotion in their minds is singularly like our own. It is seen in the elephants, which are remarkably altruistic animals. Although sympathies of monkeys seem to be more like those of man than do those of the lower animals, it may be that this apparent greater likeness is due to the fact that the machinery of expression in the anthropoids is closely akin to that of man.

The best evidence as to the likeness which exists between the sympathetic motives of our vertebrate kindred and our

own is shown by the ease with which many of these creatures can be made the familiar and affectionate companions of man. Almost all the birds, except those of prey, and a large part of our mammals, including a number of predaceous forms, can be, in a complete sense, domesticated, and be made to acquire a distinct affection for their captors. Although much of this affection can be accounted for by the skill and other dominant qualities of the masters, the facts afford a strong presumption for the opinion that the fundamental motives of these beasts are clearly akin to those of our own species. The only logical explanation of the facts is found in the conclusion that the mind of the animal goes out to his master from the same sympathetic reason which leads the master to love him. Moreover, we often note among the animals themselves, at least among the domesticated forms, a tendency of individuals of widely different species to make pets of each other.

The foregoing brief glance at the progress of sympathies in the animal kingdom will justify the following general statement:—

In the beginning of the animal development, the mind germ is shut up within the body with no effective means of contact with the outer world. Slowly, on many different lines of development, through infinitely varied experiments, mechanisms are devised which give this nascent mind instruments of relation with the outer world. Sight, touch, hearing, taste, smell, perhaps other unperceived agents of sensibility, gradually bring these creatures to a sense of the outer world. The world of phenomena reacts on the mind, and in various ways aids in its development. All through this lower life the development is entirely hedonistic or selfish. The world is only for the gratification of greeds, and the mind does not appear to act at all, except under the stimulus of appetite. It sleeps between the demands of the several

forms of hunger. There is some recognition of the outer world and a capacity to act on this recognition at last. Sexual and parental love lay the foundations of true sympathy.

This sense of sympathy appears to widen apace as we rise in the scale of organization, but in its wider aspect it is substantially limited to those animals which go in herds or droves. It is not seen in the solitary animals, who, however devoted they may be to their young, exhibit no trace of affection for others of their species. When we come to consider the position of the sympathies in the lower races of men, we find that they afford us a singularly close likeness to the conditions that we find in the brute kindred of man. The maternal sympathy is the strongest of all the forms of the emotion. The tribal sympathy is hardly more ardent than among the monkeys, and there is scarcely a trace of the extended affection for the species which belongs in the higher

man. Of the outgoing of the mind in sympathy to nature or to a Creator, there is scarcely a trace. The recognition of a Divinity, if it exists at all, rests upon the impulse of fear, but not of love.

But from this animal form of the sympathies in the lower man there goes on, in certain races, a most rapid development of the whole range of altruistic motives. To the love of the mother for the young the love of the father is added, for among the lowest savages there is little trace of paternal care. Sympathy with the tribe is rapidly extended to sympathy with the race. The motive of love toward the gods grows in intensity as well as purity, and is finally gathered into the intense, life-absorbing devotion of the higher monotheism. In very modern days we have these motives yet more extended. The keen sympathy which included only the tribe has been extended, until at length it infolds all the life of the lower animals in its loving embrace. Yet more strangely,

there has been added to this set of affections a love of nature, an affection for the whole range of phenomena, which, though in its beginning, and as yet weak, promises to become, through inheritance and habit, one of the most important elements in the structure of the mind.

It is not easy too strongly to affirm the measure of the difference in the range of volume of the sympathetic motive between the most cultivated men of to-day and those of two thousand years ago. It seems to me that the essential, indeed we may say the vital difference between the Greeks in their prime and the more cultivated people of to-day consists in the scope of the sympathetic motives. In all that relates to merely human sympathy within the bounds of the family or of acquaintance, the difference between Athenian culture and that of the present day may perhaps be reckoned as not very great. Nevertheless, the affection in the domestic circle appears to have been less

strong than with our time and people, and the friendships between men less pure and trustworthy than in our own society. A remarkable feature of the Grecian mind consisted in the fact that the sympathies never went forth to the folk who were beyond the limits of their own race and language. To them the barbarian was absolutely uninteresting except, it might be, from mere curiosity. If the penetrating mind of Aristotle could consider the conditions of our modern life, nothing would surprise him so much as the interest of our people in far-away folk with whom we hold relation only through sympathy. In every other feature of our society he would see the amplification of motives which existed in his own time. From the point of view of altruism, he would be forced to the conviction that the modern man was, in a way, a new moral species. He would, for instance, be entirely puzzled by our missionary societies and those for the prevention of cruelty to animals.

It seems to me that all these various modes of altruism have much in common. They all rest upon the singular power the mind has to put itself beyond the sphere of its personal desires and appetites; on its having power to go in imagination into the place of the life it has in view. Manifestly the strongest of these modes or emotions of altruism is that which is the deepest stamped into the mind by long use, namely, sympathy with progeny. Next in intensity and constancy is the form we term friendship, which passes by insensible gradations into the larger affection for the race, or for life in general. The form of the emotion which we term the love of God, which manifests itself in a devotion to a divinity, is perhaps the most intense form of the altruistic sentiment, but it is far more variable in different individuals than either of the preceding. The faintest and newest of these modes of altruism is the love of nature, which has several obscure modes or subordinate divisions, such as the love of the beautiful.

It is now for us to consider a very important question concerning this series of development, which we can evidently trace in the altruistic motives. Has the formation of these motives been due, in any considerable degree, to the action of selective forces? Can we hope to explain the evolution of this class of impulses by the supposition that each stage in the advance of altruism was so far profitable that the creatures which made the advance survived, while those which did not failed to survive?

Although I believe that the theory of selection enables us to account for many of the structural peculiarities of animals, I confess it does not seem to me possible to extend the results of our observations to these mental peculiarities of animals. All we know of mind seems to indicate that it does not follow in its changes the same train of conditions as the body it occupies. We see this conspicuously in ourselves.

Man, in his physical frame, is, consider-

ing the length of his sojourn on earth, the variety of conditions he occupies, and the diversity of employment he pursues, a singularly invariable animal as regards his bodily frame, while his mental parts, and especially the altruistic elements thereof, have a very wide range of variations. If we consider the parental sympathy alone, we may fairly argue that the offspring have a better chance of surviving when the mother is moved to the care of them, so the strain of blood in which care-giving is best implanted will be most likely to bring the young to the adult condition. But beyond this point it is difficult to see how selective or hereditary action can have anything to do with the advance in the altruistic motive. When it comes to sympathy within the limits of the tribe, it is not possible to construct a tenable hypothesis to explain it, by means of selection. Although the fact that any individual is willing to sacrifice his life for the community is doubtless advantageous to

the association, it is clearly not profitable to the individual, at least not in a material way.

It will not do to say that those tribes which have the most self-sacrificing individuals are the most likely to survive in their contentions with other tribes, and that in this way the selection is brought about. It would be almost as reasonable to assert that the French nation was elevated in size and vigor by the Napoleonic wars, which took nearly all the well-grown and sturdy men to death on foreign battle-fields. Such reasoning reduces the valuable hypothesis of selection to the level of the doctrine of cycles and epicycles, which the old astronomy applied to the solar system. With another epicycle it was easy for the Ptolemaic astronomy to explain each peculiarity of the stars' motions as it was discovered, and so to keep the scheme in accord with the supposition that the earth stood still and the heavenly bodies moved around it. So, too, the believers in

the unlimited action of selection may, by adding another epicycle of wider range to their hypothesis, secure an available explanation of every fact in nature; but this method will not commend itself to naturalists who have not made a cult of this law.

Even if we should accept the second stage of development of altruism, as determined by selection, it would not aid us much. It would only help us to go a little farther in the guidance of this hypothesis, for when we come to the point where the altruistic emotions of man expand, so as to include all life and the power that lies beyond the realm of visible things, even the wildest advocate of selection would not claim that it could aid us to understand how this extension came about.

It seems to me that the facts compel us to believe that, though selection may account for the accumulation and increase of the earliest and simplest modes of altruism, it helps us but little to understand the conditions that have originated it or

have given it the great place in man's life that it now has. It seems to me most reasonable to suppose that the altruistic motive, the impulse to get beyond the bounds of self, owes its development, if not its origin, to determinative influences that we cannot recognize in any known natural laws, unless we assume a law of moral advance.

It is self-evident that the altruistic motives are the foundation of religion and morality. However formalized, however concealed by the superstructure they derive from the accidents of the mind, these elements of our human life have all their supports in the sympathetic motive. Therefore the way in which these motives have developed in the past and are to change in the future are matters of the very highest interest to all who care for the moral advance of man.

As to the future of the altruistic impulse, the naturalist has little right to speak. The motives of this division of the

mind are less distinctly connected with any developmental process than any other instincts, and they have long since escaped from the dominion of the laws which he studies. It is evident that the matter is now a subject for the psychologist alone. I venture, however, to follow the line of these considerations a little way beyond the limits of biological science. It is already clear to us that the altruistic motives lead creatures in which they originate, far beyond the narrow path trodden by our brute ancestors in their narrow round of greeds and satisfactions. All the mental and moral growth which could be had in the earlier life was gained through these altruistic impulses. From the lower life this seed of better things came to man. It has been the task of all religion to foster the development of the sympathetic motive, and to set its care above all other human interests. In this task it is doing the most natural work in the world, the work that is the most perfect

furtherance of the best in the earlier law. Hitherto it has been the peculiar work of religion to enforce the action and to direct the altruistic motives in two lines: namely, sympathy with the fellow-being and the love for the Supreme. There can be no doubt in the reasonable mind that the work has been, on the whole, well done. There has doubtless been a great advance of the altruistic motives from the worship of anthropomorphic gods in former time to the worship of a Supreme Being. It seems to me that this energetic form of altruism which religion has bred in men has flowed back upon the lower forms of the emotion, and that man is more sympathetic towards his fellows and towards the natural world than he ever could have been but for the worship of the Creator. In every field of human thought we find the influence of this vast awakening, which could only have come from the exercise of the altruistic impulse in its highest and most stimulating form. Only through religion

could man advance swiftly and surely to the sense of ordered control in nature, which is the breath of all science.

There is yet another and more important effect in part accomplished, in larger part yet to be secured, by the further advance of the altruistic motive. When, in the process of mental development, self-consciousness arises, a trial that probably did not come upon life until it attained to man's estate, the creature finds itself in a miserable plight. Then for the first time the soul feels itself naked and alone in the world. The old impulses, inherited from the animal ancestry, join issue with the emotions which the sympathies arouse. Then, it seems to me, awakens the sense of sin. The natural man is at war with the spiritual man, and the creature's self-hood grows sore from the conflict. No one of us but what has felt the almost mortal sickness which sometimes comes from the many varying moods of self-consciousness. Men seek some lightening of

the burden wherever they can find it. They give themselves back to the unconsciousness that blessed their animal ancestors, by means of alcohol or opium. They forget themselves on the battlefield or at the gaming-table, or, in a better way, they seek escape in human fellowship, in some battle with nature, or in the exercises of religion, downward or upward, any way out of this torment of self.

From this trouble of self-consciousness, which probably owes its origin, in part at least, to the exercise of altruistic motives, altruism itself opens a blessed way. Few mortals are so unhappily shaped that their souls may not become possessed with this outgoing power of sympathy, and thus attain this way of escape from self-consciousness. Religions have offered various paths of escape. Buddhism proposes that the mind shall free itself from self-consciousness by what to men of our time is an incomprehensible process of crushing the self within itself. The creed of Islam

seeks it by an excitation of a religious fury. It seems to me that the Christian doctrine, looked at purely from the point of view of natural science, has the merit of setting the altruistic motives on a wider foundation than any other form of religion. "Thou shalt love the Lord thy God with all thy soul and all thy might, and thy neighbor as thyself." Verily, this is the greatest of all commandments; on it, indeed, hang all the law and the prophets. It has carried man farther out of the prison of self than all the other teachings that have come to him. Far as this advance in altruistic habits has gone, there is no sign that it is near its end. Men live more out of themselves, through their sympathies, than ever before.

The love of nature has been added to the other loves, and in the well-developed man of to-day, every moment affords something to call the mind out into the universe. It gives promise of going yet farther. Under its beneficent forgetful-

ness, that ugliest incident of our personality, death, is losing something of the old darkness of its shadows. Men no longer spend so much of their life like prisoners under sentence, with the sound of the building scaffold ringing in their ears. Altruistic persons are too little in the narrow space of their selfhood to consider death. It seems to me that we may look for the time when men will live out their lives in sympathetic activities so far above the plane of self, that not only labor, but this end of all earthly labor, will be almost unfelt. If this comes, life will have completed its cycle from the dull unconsciousness of the lower brutes to the self-consciousness of man's early state, and thence by the escape from selfhood through sympathy, to that real absorption into the Infinite, that true *nirvana*, which nature offers by the way of the sympathies.

To the naturalist who looks upon the present estate of man as the result of the physical and organic influences to which

he has been subjected during all his course from the lowest life to the present time, religions appear to be the products of human history, and are to be estimated in the same way as other facts. Considering the religions of mankind as phenomena, and valuing them according to their relation with the series of organic developments, and leaving aside in the estimate all the prejudices of education, it seems to the student clear that Christianity occupies a peculiar place in these modes of thought. More than any other it is, in the essentials of its form, in the direct trend of psychic development. In my own mind, the doctrine of Christ is the summit and crown of the organic series. It expresses the final result of that directed striving which began hundreds of millions of years ago, and through infinite toil and pains has led to this supreme accomplishment. It offers the natural line of escape from the evils of hedonism, and the curse which self-consciousness brought upon mankind.

If this view of the relation of altruism to human development be true, then it is evident that we, who are in our various ways striving to better the condition of our fellows, may learn from it much that will give direction to our work as teachers. In the first place, it shows us that the key to education is in developing the altruistic powers. We must train the mind to go out of itself, and stay out of the self as far as possible. This habit of projecting the mind beyond the inner realm can only be attained by taking the strongly inherited forms of sympathy, those that are most easily awakened, and through their exercise, developing the general capacity for outgoing. The sympathy with the fellow-being and the power to adore the Infinite thus become the first objects of our education. With these sympathies aroused, we may hope to have a mind well fitted for all the forms of altruistic action. Therefore I think that education should begin with what we may, with a new and

better meaning, call the humanities; those lines of culture that lead the mind out on the easy way to sympathy and affection for one's fellow-men. From these inherited and therefore natural forms of altruism we may hope to win a place for that love of nature on which the man of science builds. I feel compelled to resent the efforts of those educators who would undertake the training for the work of life with the study of physical science alone. There may be minds that can be immediately awakened to life by physical science, for in the infinite variety of man almost any peculiarity can be found; but no observant teacher can feel it safe to begin the intellectual life of the child with things so remote from the old channels of the human mind. Man has had the world opened to him by the gateway of his sympathies, and by that portal he should always be led on his way into life.

CHAPTER VII.

THE IMMORTALITY OF THE SOUL FROM THE POINT OF VIEW OF NATURAL SCIENCE.

An excessive, and, in a way, unreasonable respect for the opinions of scientific men in the matter of the immortality of the soul is characteristic of our modern thought. It indicates the growing conviction as to the essential unity of all things; it shows that the mass of men are insensibly drifting to the great conclusion with which naturalists and supernaturalists have alike to reckon, the absolute unity in the government of nature. There is perhaps no other feature of public opinion which so clearly shows how deeply the general principles of modern science have penetrated into the body of public opinion, as this insistent desire

to test ancient faiths by the new knowledge.

The attitude of scientific men towards the doctrine of the personal immortality of the soul appears to be a matter of much interest to the public. Every teacher in this field of inquiry finds himself subject to frequent interrogations as to the measure of his belief in a future life, and he readily discovers that his answers have an undue weight with those who hear them. There is hardly sufficient reason for this desire to ascertain the views of naturalists concerning a problem which clearly lies beyond their province. The rules of their calling limit them to considerations which have a place in the phenomenal world alone. If they go far from the facts with which they have to deal, they transgress the limits of their clearly defined field, and enter wildernesses which they have no right to tread. If they essay journeys there, they must make them without the semblance of authority.

Although the students of nature are by the rules of their craft limited to the phenomenal world, they have been wont to express their convictions as to the possibilities of existence in forms independent of the body, and have often given their verdict as to the immortality of the soul in a very authoritative manner. In general their verdict has been adverse to the doctrine of immortality. I propose to consider the nature of the foundations of this judgment, and in general to take account of the facts which appear to make for or against the view that the essential qualities of men survive the process of death. The reader should not expect much profit from these considerations; yet while the results will have a negative rather than a positive value, they may serve in a way to clear the ground of certain incumbrances, and to show in a definite manner the proper attitude of those who cultivate physical science towards the large question of the hereafter.

When the method of interpreting nature by means of observations parted from the more ancient system in which the phenomena of the world were accounted for by the direct interference of a supernatural power, the votaries of the new science naturally became at once, and to a very great extent, emancipated from the bondage of ancient beliefs. They seemed to themselves to enter upon a terrestrial paradise which appeared well walled off from the mystical realm; they were in a measure excommunicated by the older faith, and they rejoiced in their new-found freedom. Many a man of to-day personally experiences the influence of this transition which he may trace in the whole history of natural science. If from the intangible realm of faith or philosophy, where he sees but dimly or not at all, he comes to the study of clear-cut natural facts, he is apt to be enchanted with the clear seeing which he at once enjoys. For a time he seems to be in a

realm of light; he fancies that his new province is so replete with certainties that he will never have again to deal with shadowy things. Antecedent and consequent are so distinctly enchained that there seems no place for doubt; but as the student goes on in his work he finds that his ways lead from beneath the vertical sun which illuminates simple truths to regions where the rays become more and more aslant, and in the end the light fails him altogether. He is then in the place of our science of to-day, where the men of science become conscious of the fact that they, too, have to explore the darkness if they would seek the answer of all their larger questions.

The sturdy, self-satisfied denials of immortality; the confident statements of men who said there was no soul because they could not find it with the knife or weigh it in the balance, were put forth in the days when naturalists had but begun their inquiries in the phenomenal world.

Year by year they have learned a fitter distrust as to their right to pass a final judgment in this matter. Steadfastly they have come to perceive more clearly the truth that they really abide in a universe, and that the part which is revealed to them is to the sum of the facts only as one to infinity. Gradually it has been forced upon them that they too have to assume the intangible if they would take any firm steps in explaining the series of facts with which they have to deal. A large part of this caution is due to our study of organic phenomena, especially in that part of the biologic field where the investigator has to consider the marvelous truths of inheritance. In face of these facts of descent, the most pragmatic naturalist is sure to learn some caution in his criticism of philosophers and theologians.

In general it may be said that the most insistent expressions of disbelief as to the endurance of the individual after the body has been resolved into its elements have

come from the students of biology, mainly from those who have been concerned in the anatomical study of the human body. In these men the habit of the commonplace, which so tends to degrade all our conceptions of nature, has led to the belief that the unseen was non-existent. It is difficult for the most fair-minded student of organic forms to perceive the magnitude of the unknown in all that pertains to psychic phenomena, so long as his inquiries are limited to an individual creature. The most important effect from that new aspect of our science which we term Darwinian is found in the fact that it has forced students to look upon each separate organism as a mere phase in the propagation of a great impulse, which has been transmitted through an inconceivably long series from the remote past. Here, indeed, we find the spiritual element in our modern biologic science, which has already greatly affected, though it has but begun to influence, the minds of naturalists.

Not only has this sense of the profound depth of the unknown sobered the minds of students who concern themselves with the organic world, but a change in the views concerning the constitution of matter has also done much to bring them to a new attitude as to the substantial foundations of the phenomena with which they have to deal. A generation ago we conceived that matter was an inert something which was quickened into activity by energy, and that this energy was in its nature essentially different from the physical basis of the universe. The confidence of those who held to the opinions commonly termed materialistic was largely due to this belief in the dual organization of nature. Observing the ever-changing character of the natural forces and the endless transmutations which they undergo in action, and noting at the same time what seemed to them the inert character of substance except when stirred into motion or built into form, they natu-

rally were led to deny the immortality of the soul, and to base their negations, as they supposed, on a firm material foundation. Of late years, however, the opinion has been gaining among physicists that matter itself is but a mode of action of energy, and so in place of the dualistic basis, naturalists are being driven to a conception of unity as regards the phenomenal world.

It is not difficult to see that in proportion as we come to the opinion that nature is but an exhibition of energy in various forms of presentation we are driven to a new conception as to the essential conditions of existence. It is obvious that we are less entitled than of old to make statements based upon the evanescent character of energy, or to suppose that we have compassed the range of its modes of action. The correction brings with it no affirmation, but it diminishes our trust in the ancient disbeliefs.

It is to modern studies in biology that

we owe the greatest pause in the tide of conceit or confidence that so long bore our naturalists comfortably onward. The old doctrine of archetypes or supposed unseen moulds which shaped organic forms conduced to theoretically definite views concerning the nature of life. Discerning naturalists for some centuries have had a vague sense as to the meaning of inheritance. They saw that within the limits of human kind, for instance, such features as race characteristics indicate the long-continued accumulation of peculiarities. It was not, however, until the students of plants and animals abandoned the theory of special separate creations and came to look upon the existing species as the lineal and normal descendants of ancestral forms which lead step by step backward to the dawn of life, that it was possible for them even to begin to see the vast nature of the problems with which they had to deal. As yet, we have made but a beginning in the work of exploring

this great shadowy realm, but even at the outset of the labors we perceive how great are the changes of view concerning the character of organic beings which we are there to obtain.

The main point in the theory of descent which deserves our attention concerns the accumulation and transmission of experience. It is evident that all the familiar creatures which now inhabit the planet derive the influences which form their bodies from the preceding geologic ages. They are not to be regarded as congeries of material so arranged that they operate in the manner of clocks, but each is in effect directed by influences which have been accumulated, it may be through millions of generations. The first hypothesis of inheritance is that of Charles Darwin, commonly known as pangenesis. According to this theory, each portion of the organic body is continually giving forth swarms of hypothetical gemmules or minute structural units, which have in them-

selves the capacity of reproducing or guiding the reproduction of parts essentially like those whence they came. In the process of birth of a new individual a sufficient quantity of these gemmules is handed on through the passage of the egg to control the shape of the new being. Thus we have to suppose that every cell of an animal or plant is constantly putting forth swarms of these gemmules, which, when they are transferred by the process of generation, in some unknown way find their path to the particular part of the body which they are to inform as to its correct shape.

Difficult as it is to form a conception of how descent in the first step is controlled by the method of pangenesis, the further application of the hypothesis to the more extended phenomena of inheritance leads us to suppositions which are not only impossible of conception, but appear utterly to transcend the powers of the imagination. Thus when we find in human kind

superfluous digits from time to time appearing, and discover that these excessive parts have the power of growing again after they have been removed by the knife, we are forced to believe, as Mr. Darwin has so well shown, that the tendency to the supernumerary parts as well as to their growth after they have been destroyed is due to the persistence in man of organic motives derived from ancestors characterized by polydactylic extremities. But as these many fingered and toed beasts are separated from the human race by millions of generations, how can these gemmules have continued in being through such extended series of transmissions ?

Admirable as is the hypothesis of pangenesis when considered merely as a daring feat of the scientific imagination, it is evident that it utterly fails to satisfy the first conditions of a theory, namely, that it shall bring a portion of the unknown within the limits of the understanding. It

does not in the least extend or simplify our conception, but leaves us in the densest fog of speculation. Although this supplementary element of Mr. Darwin's hypothesis has in general failed to commend itself to philosophical naturalists, it has in an indirect way been of much service to science. It has forced naturalists to perceive the magnitude and difficulty of the problems which they have to encounter in this field of inquiry. From this consideration they are naturally brought to a state of mind concerning the relations of life to matter which is very different from that which characterized their predecessors. It is difficult to set forth the nature of this change of view in precise phrase, but the modification is so important that we must now essay the task.

Until the phenomena of inheritance were in a measure appreciated, biologists generally considered psychic action to be a mere function of the nervous system and to owe its manifestations to some peculiar-

ity in the structure of that organic part. They regarded the mind of man as a direct product of the brain, and explained the coincidences which we find among all the individuals of a kind as fully accounted for by the likeness in the machinery of this great nerve centre. With this assumption, it seemed a relatively simple and direct conclusion that the mental qualities could be accounted for by the nature of the mechanism which produced them. It was therefore only necessary to explain the uniformity in structure of the cerebral parts in order sufficiently to explain the origin of the likeness of the mental phenomena in man or any other species of animal; they had but to suppose a law enforcing the shape of those parts to account for the uniformity of the product. Here, as elsewhere, they covered their ignorance by the use of that most question-begging of all scientific epithets, "law."

The facts already ascertained concerning the conditions of inheritance, although

they are only a small part of what we have to learn in the matter, show us clearly that the ancient apparently simple explanation of mental phenomena can no longer be safely trusted. If a mechanical explanation can be used at all, it must be vastly more complicated than that which has been hitherto adduced. It is clear that all the essential qualities of the mind pass from generation to generation over the reproductive bridge, borne onward in the keeping of chemical molecules. Although in the higher forms the ovum has the cell character, in all species, even up to man, the male element, which is at least as potent as the female, loses its cellular structure and transmits its qualities through its molecular organization alone. If there be any organization of these molecules other than that of a purely chemical kind, the fact entirely escapes our apprehension. It is moreover in a high degree improbable that any such unseen shaping actually occurs. We are thus forced to the conclu-

sion that the ongoing of life from generation to generation is brought about in large measure by influences which may be given over for transmission to the simpler aggregates of matter. We have to suppose that these associations of atoms, at most a few score or a few hundred in number, which are the units of the protoplasmic mass, can effectively contain and transmit the important elements of experience acquired by myriads of ancestors; that they can convey this experience to other molecules, and so from generation to generation of the molecular series; that the impulses will assert themselves at the right time and place in the developing organism.

The way in which the generational transmission is effected not only goes quite beyond our field of knowledge, but appears also to transcend the limits of the scientific imagination.

There is only one conclusion of evident value, at least at the present time, which

we can gain from the facts above noted, and this is in effect that matter, even in its simpler states of organization in the atom or molecule, may contain a practically infinite body of latent powers. So far, of course, we have seen this soul-bearing capacity of matter in its simpler states only in the organic realm; but he would be a rash man who should affirm that this was the only place in nature where the material or chemical substances were enabled to become the keepers of intellectual seed. From an *a priori* point of view, and without reference to the facts which we have gained concerning the sequences of organic life, it appears to me less difficult to suppose the capacities of an individual mind to be perpetuated after death, and this in a natural manner, than to explain the phenomena of inheritance which are clearly indicated in the organic series. To account for these evident truths demands the supposition of such colossal potentialities in the psychic capacities of

matter that we can hardly see a limit to the field of its possible action.

It is quite beyond the province of the naturalist to suggest any ways in which intelligence, parted by death from its habitation, can be preserved; he has no evidence that such preservation actually occurs. He should be the last man to deny that the vast body of individual experience, which seems to indicate the existence of visible forms representing the departed, is a mere mass of falsehoods; he can only say that the conditions of all such observations are such as make anything like scientific inquiry exceedingly difficult if not quite impossible. It is too soon to say what may come forth from the devoted inquiries of those persons who, in certain cases well trained in observation, are giving their lives in endeavoring to verify these ancient beliefs in apparitions. However, to the cold-minded critic, it appears doubtful whether, as yet, any substantial basis has been laid on

which we may hope to base conclusions of affirmative value. Not only are the reputed phenomena apparently uncontrollable in a scientific sense, but the state of mind of the observer appears to be so inevitably influenced by the ancient inherited emotions which induce what we may term the superstitious state of mind, that he is necessarily unfit for the task of gathering data in the moments when he should be in the most rational state.

Although naturalists may fairly hope for a science of apparitions, they in general feel uncertain, as yet, whether this learning will not show the phenomena to be due altogether to the action of the observer's mind. At the same time reasonable inquirers, however skeptical, in the original sense of that word, may fairly grant that if certain phenomena, apparently well observed, can be verified in the critical and thoroughgoing way which the difficulties of the matter make necessary, we will then have some slight beginnings of an altogether new science.

While the evidence which he is now gathering leads the thoughtful naturalist greatly to limit the range of his assertions as to the possibilities of psychic phenomena in the material world, the effect of his studies seems to be to decrease rather than to increase the personal interest which he is likely to feel in the question of immortality. In part this influence is due to the vast enlargement of the present which has come from the more extended knowledge of nature. Every well-informed observer of the phenomenal world finds himself day by day more concerned with the moment. If he be a dutiful man, the sense of responsibility with reference to immediate action is so great that he instinctively puts aside every consideration with which he does not feel himself obliged to deal. This vast extension of thought in our own horizon, in the plane of our daily life, has in a way forced men to dwell less upon matters of the hereafter. We are in the position of soldiers

in the heat of battle who are compelled to act with reference to the instant until the death-wound sets us free.

There is another effect which bears on the interest in immortality, one derived from the close study of nature, which is hard to set forth in words. When the student comes to feel, as the intellectually prosperous naturalist always does, that he is part of a vast tide, or rather a portion of a gigantic organization which is moving forward steadfastly in the control of an order, of a purpose, he becomes content to abandon himself to the power which controls his action, or rather we should say to go freely and energetically in the path on which he is impelled, without regard to the goal, but with perfect confidence that whatever the destination, it is in all senses fit. If he is to live forever, that life will be good for the whole; if he is to be extinguished or changed, as are the mere vibrations of matter, then that, too, is for the good of the whole.

It would be easy to show that this spirit of content with the universe has a somewhat religious character. The change in the form of our intellectual lives which has led men, metaphorically speaking, to broaden their interests in the horizontal plane and diminish them in the vertical, has been attended by a growth of keener interest in our fellow-men, and also we may say in our fellow-nature. Acting in the moment and for the best interests of their kind, there is no loss, there is rather a gain, in the sympathetic element of life. Men at least avoid the risk of that hedonism which Carlyle well describes as an effort "to save their dirty little souls." Good as have been many of the effects of the endeavor to secure a blessed immortality, it is clear to us all that much wrong-doing, much obdurate selfishness, has come from the greed with which men have sought that end. The content with which naturalists accept nature, the feeling that this nature is a part of themselves

and they of it, the unexpressed but ever-existing supposition that the whole is good, is closely akin to the reconciliation with the omnipotent which is the declared goal of most religions. In it there is something of the peace of God which passeth understanding.

There is yet another effect arising from the study of nature which is not without its influence on our views concerning immortality. This is due to the fact that most naturalists acquire a kind of instinct which leads them to suppose underlying purposes, or at least continuous trends, in the course of universal events. Thus they perceive a steadfast progress from the lower stages of inorganic to the higher forms of organic existence. It seems, in a way, a denial of the observed order to suppose that the series is interrupted with the death which overtakes each individual, and which must, with the cooling of the suns, overwhelm all the higher life which the planets bear. For one, I cannot help

looking upon absolute death, that kind of passing away which would leave organic life quite without issue, as in a way offensive to my understanding, and in a measure out of the observed order of phenomena. Clearly the trend of all the ages the history of which we can trace has led to the integration of energy in higher intelligence. It is a most unsatisfactory supposition that all this toil and pains is to be without fruit. It is by no means certain that the fit harvest is personal immortality; but, so far as we can see, the unknown continuation of the known is best satisfied by the hypothesis that life is in some way perpetuated, with all the personal profit which has been attained by that greatest of all natural results, the individual soul.

We may sum up the foregoing considerations in a brief way, as follows: the early materialistic conceptions of naturalists, which rested upon an assumed simplicity in the world with which they had

to deal, have of late been greatly shaken by the advance of their knowledge. In proportion as their inquiries have extended, they have been compelled to make suppositions concerning the action of natural forces which are almost, if not quite, as mystical as those which of old they condemned the theologians for holding. As the labors of these men of science have accumulated, they have begun to develop an interesting body of motives and instincts, such as the confidence in nature and in the underlying purposefulness of those sequences on which we found the so-called laws. These motives lie in the field of religion; they are properly to be called faiths, in the broader sense of the word. As yet the development of these habitual conceptions derived from the study of nature has not gone very far; but the trend is sufficiently clear to make it plain that much may be expected in the way of spiritual growth from this development of natural science.

It is not likely that observational methods will ever give us much help in determining the matter of fact in the problem of immortality. It would, however, be rash and unscientific to say that all the phenomena of so-called spiritualism are the result of fraud or self-deception. Naturalists have been blamed for not essaying inquiries which seem to give a hope of finding proof that the human soul survives death. With rare exceptions, scientific men feel little or no interest in such studies. Experience shows them that the field is not one which can be profitably cultivated with their instruments of inquiry. Moreover, they are overwhelmedly occupied with work in regions where they are sure of their harvest, and where each day's gain is replete with profit to their fellow-men.

It cannot be denied that the naturalists' way of regarding the facts of life and death has a certain narrowness. This feature, however, is inherent in the system