THE DOGMA OF EVOLUTION

LOUIS T. MORE

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BY

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DEDICATION

To Mr. and Mrs. Charles Phelps Taft

My dear Mr. and Mrs. Taft:

In *earlier times, which we so complacently call the Dark Ages, those who wished to obtain an insight into spiritual mysteries or to learn the fortunate or unfortunate outcome of their enterprise were wont to consult astrologers. For it was foolishly believed that our spiritual and temporal affairs were determined by the positions and motions of the planets in their orbits. Is it not true that men, today, are seeking the source and law of our spiritual being in the configurations and motions of the atoms which compose our corporeal substance? Is there any real difference between the attempts of the ancient astrologers and the modern biologists? Only time will tell.*

But, whatever cause we assign to our being, every one accepts the fact that friendship is one of the qualities nearest to an immaterial source. And I, who am trying to vindicate the belief in our spiritual nature, would wish to offer this book to you who have for so many years given me such abundant proofs of friendship in its rarest form.

Affectionately yours,

Louis Trenchard More

Cincinnati
December, 1924

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CHAPTER ONE

Introduction

Evolution as Science and Faith

SINCE the Renaissance, which reached its full development in Italy during the fifteenth century, man has fallen more and more under the domination of science and has correspondingly relaxed the authority of religion. It is this fundamental change in attitude of mind which most distinguishes us from the Middle Ages. Try as we will, we utterly fail to understand the mental state of those who subordinated reason to faith, who regarded the miraculous as more trustworthy than the natural, and who condemned mortal desires as the enemy of the soul. On the other hand the history of civilization, since the Renaissance, is like the unfolding of the connected biography of a man from youth to maturity.

The rise of modern science may be dated from the publication of the heliocentric system of Copernicus in 1543. The profound change in thought, which the mere substitution of the sun as the centre of our planetary system and the ascription of two motions to the earth were destined to produce, was not recognized at first. In fact, the Church did not foresee the theological and social consequences of this theory until they were openly promulgated by Galileo. His trial for heresy, in 1633, first proved how essential to the Aristotelian philosophy of the day and to the dogmas of the Church was the belief that the earth is the immovable centre of the universe. This trial was the dramatic beginning of the persistent conflict between the scientific attitude which relies on observation and reason as the criteria of truth and the opposing conviction which holds that truth is revealed by the inspiration of faith.

The leaders of scientific thought, in the sixteenth century, believed that the question involved an organized revolution of method. If the earth, and all it contained, were merely a part of a universe subject solely to mechanical laws and forces, then a deathblow had been given to the dogma of the Church, founded on the inspiration of the Scriptures and on the interpretation of Aristotelian philosophy, that the world was fashioned for man by a Creator and Ruler of the universe who could, and frequently did, supersede natural law.

While the verdict of heresy apparently crushed the new movement, it actually focused attention on the deeper aspects of the controversy and created a wider acceptance of Galileo's ideas than they had previously enjoyed. Galileo warns his adversaries not to oppose the interpretation of his observations and experiments with the authority of Aristotle. Descartes, on learning the decision of the trial, laid aside the manuscript of his treatise on a new cosmical system, on the ground that if the world would not accept the mechanical principles of Galileo there was no chance for his far more daring attempt to exalt natural law. Pascal advises us to limit our respect and admiration for the ancient writers. But of all the leaders of the period, Francis Bacon saw most clearly the impending break between modern and ancient times. He reiterates, over and over again, that the Greek philosophers had failed, however brilliantly they may have reasoned, because they had not based their work on observation and experiment. To him the old gospel was dead, and he would give a *novum organum* which would install science by inductive reasoning as the guide to truth.

This revolt, which began in the sciences of astronomy and mechanics, spread until it embraced the phenomena of all the inorganic world. But so long as the nature and actions of living organisms, and especially of man, remained outside the laws of physics, the revolution was manifestly incomplete. During the nineteenth century, science reached out to include the biological phenomena. The movement against the authority of religion, in this field, takes the form of biological evolution which finds its most frequent expression in Darwinism. It is true that evolution is a much more general term and signifies merely any continuous variation of forms of fauna and flora in contradistinction to the special creation of fixed species; while Darwinism is an attempt to discover the causes and method of such variation. Yet, in the popular mind, Darwinism has been so confused with evolution that the two are likely to stand or fall together as a philosophical explanation of the problems of society and religion.

That the controversy which arose over evolution is a continuation of the earlier revolt accomplished by the physical sciences was thoroughly understood by its leaders. Darwin writes to Lyell: "I was much interested by finding accidentally in Brewster's *Life of Newton* that Leibnitz objected to the law of gravity because Newton could not show what gravity itself is. As it has chanced, I have used in letters this very same argument, little knowing that any one had really thus objected to the law of gravity. . . . Leibnitz further objected that the law of gravity was opposed to Natural Religion! Is this not curious? I really think I shall use the facts for some introductory remarks for my bigger book."[1]

And, as might be expected, Huxley was clearer and more emphatic in linking evolution with physical science. He wrathfully explodes during a defence of the *Origin of Species*: "I hardly know of a great physical truth, whose universal reception has not been preceded by an epoch in which most estimable persons have maintained that the phenomena investigated

[1] *Life and Letters of Charles Darwin*, by F. Darwin; Appleton, 1887, vol. II, p. 83.

were directly dependent on the Divine Will, and that the attempt to investigate them was not only futile, but blasphemous. And there is a wonderful tenacity of life about this sort of opposition to physical science. Crushed and maimed in every battle, it yet seems never to be slain; and after a hundred defeats it is at this day as rampant, though happily not so mischievous, as in the time of Galileo. . . . To those who watch the signs of the times, it seems plain that this nineteenth century will see revolutions of thought and practice as great as those which the sixteenth witnessed."[2]

The analogy is the specious one that, because the Galilean revolution was successful, so also Darwinism and sociological evolution must be accepted. The fallacy lies in the fact that the physical sciences dealt with a specialized field. Physicists had rigorously abstracted from their problems all considerations of what we call life. And they could do this because living organisms are associated with the physical and chemical machines we call their bodies, and no one has ever doubted that many actions of the body are physical and chemical. Thus, the problem of physics was to find laws of force and energy acting on matter. But, when biology arose, men of science were confronted with the fact that the gap between the inorganic and the organic worlds must be bridged. In brief, they must show that a dead man is the same as

[2] *Ibid.*, vol. II, p. 77.

a live one except for certain chemical changes. That this is not an exaggeration of the problem as it presented itself to the biological evolutionists can be seen from the opinion of Huxley: "Remarkable as are the powers or, in other words, as are the FORCES which are exerted by living beings, yet all these forces are either identical with those which exist in the inorganic world, or they are convertible into them."[3] The biologists naturally used the methods of the older sciences and indeed we know no other practice, at least of measurement, except in terms of mechanical quantities. But, they overlooked the fact that while physical forces and energy may satisfactorily explain the phenomena of matter, they may not be adequate to account for those phenomena of matter to which has been added the attribute of life.

There is a widespread belief, particularly amongst men of science, that the opposition to Galileo in the seventeenth century was directed against the physical sciences themselves. This is not true. Public opinion was then, and is now, singularly indifferent to scientific theories so long as they are restricted to their own field. Interest is aroused, which inevitably drifts into active hostility, only in the cases when a new discovery or theory threatens to affect directly the social and ethical habits and aspirations of society.

[3] *Collected Essays: Darwiniana*, p. 316. The reader should consult the whole of Essay XI.

If we call to mind the innumerable attempts to regenerate civilization by new formulae, the conservatism of society towards change is not altogether to be condemned. There is much justification for the feeling that known evils can be endured more easily than uncertain benefits.

If one will read carefully the acrimonious discussions which broke out with the appearance of Darwin's *Origin of Species* in 1859, one will find there are few references to the scientific problems involved in the theory of natural selection. The attacks centred on this obvious fact;—if man is but a phenomenon of the physical world, then his thoughts and instincts, with all that comprises his consciousness and personality, are essentially the same as the physical and chemical forces which diversify and move matter. There could be but one conclusion, his dearest possession (call it illusion if you will) that he was in some unknown manner immortal and a special creation of the Divine Will, was shattered. Thus Adam Sedgwick, Woodwardian Professor of Geology in the University of Cambridge, immediately wrote to Darwin: "This view of nature you have stated admirably, though admitted by all naturalists and denied by no one of common sense. We all admit development as a fact of history: but how came it about? Here, in language, and still more in logic, we are point blank at issue. There is a moral or metaphysical part of nature as well as a physical. A man who denies this is deep in the mire of folly."[4] And Samuel Butler, who was himself an evolutionist, declared with penetrating accuracy that Darwin had banished mind from the universe, since the theory of natural selection would envelop us in the unbreathable atmosphere of fatalism which is the characteristic blight of Darwinism.[5] This, too, was the gravamen of the argument, not always judiciously expressed, of the clergy. They were right; step by step with the advance of biological evolution as a scientific hypothesis there grew up the monistic philosophy of naturalism which endeavored to express the whole universe, organic and inorganic, in the single formula of evolution.

Darwin's theory of evolution by natural selection, after the first attacks made on it by a shocked clergy, was passionately preached by men of the most different points of view. The captains of industry attached its flag to their masts because they found natural selection gave them the right to exploit the less endowed of their fellow men; the humanitarians and social workers used it as a shibboleth for the equality and brotherhood of men; the irreligious pointed to it as a proof that no god ruled the world; the clergy preached it from the pulpit as not inconsistent with the teachings and life of Jesus; the pacifists claimed

[4] *Life and Letters of Darwin*, vol. II, p. 44.
[5] *Evolution, Old and New.*

it; and the warriors of the Nietzschean school of the superman justified the attempt of the Germans for world domination by its doctrine.

We may sum it all up by saying that Darwin's theory came at a psychological moment, but that is, after all, merely a phrase to label a movement of thought after it has occurred. My own opinion is that the abnormally rapid scientific and industrial advance of the nineteenth century had undermined the religious and social life to such a point that a revolution was bound to occur. Skeptical of the teachings of the Church and impatient of domination by the privileged classes, many could find in the doctrine of natural selection proofs that religion was a failure because the mythological statements of the Bible were contrary to the now easily demonstrated facts of observation; others could claim that the rights of property were but the protection for a privileged class. They were thus ready to grasp at a new and rational doctrine, fortified by the authority of science, if only it could be preached clearly by the properly qualified persons; and the disciples of Darwin were ready and prepared for the task. The most important was undoubtedly Huxley, a practical man of science, a brilliant writer, who could make Darwin's dry treatise appeal to men of affairs,—and one who dearly loved a fight. He soon gathered a brilliant band of young men about him, of whom William Kingdon Clifford was probably the premier, and he went out to do battle with the churchmen and with the humanists, and his logic routed them in one pitched battle after another. With an increasing popular approval behind him, Huxley finally drew clergy and laymen to his faith of agnosticism, or at least left them with the scientific virus in their veins. Spencer, who had been groping to find some law which would animate his doctrine that society was an organism, turned with a sigh of relief to natural selection. In his hands, society evolved by natural selection and contained within it a force which swept it along indifferent to the vagaries of the individual. His system penetrated to the people through such popular expositors as Kidd and Mallock. Tennyson and Fiske embraced natural selection and added to it a sentimental side by replacing a Calvinistic God with a divine tendency in the human race which carries it on to perfection;—the ideal of a hazy divinity who watches in complacent leisure the amoeba rising to man, and man approaching a state of perfect justice and virtue by the survival of the fittest,—the fittest to them no longer meaning, as it did with Darwin and Spencer, those capable by good or evil means of surviving, but those nearest to their own preconceived ideal of the good, the true, and the beautiful.

But the nineteenth century, while preaching justice and brotherly love, not because the individual should purify himself from sin but because the individual should submerge himself in the advancement of the race, was really storing up a passion of fear, of hatred, and of envy. It is true that evolution fostered humanitarianism and the alleviation of physical ills on the utilitarian ground of efficiency and of protection of society, but science also showed the possibilities and the domination of power; the superman became the ideal and all who failed to measure up to the standard to be established as proper for progenitors of the new race must be obliterated, or at least thrust into an asylum. Industrialism led to class opposition, and medicine, with its insistence on the omnipresent deadly germ, promoted the abandonment of a fearless outlook on life and death.

The awakening was the world war, a havoc of mechanistic materialism and the subordination of the individual. And this awakening is today accompanied by signs of revolt from the outside against the domination of science and particularly of mechanistic evolution. Omitting other clear indications of this revolt, it is sufficient to point out that Bernard Shaw, with his unerring instinct for sensational popularity, has bitterly attacked Darwin in *Back to Methuselah*. And Shaw knows his subject. In the preface to this weird play, he has, in a masterly survey, shown why evolution has dominated thought and why it has not accomplished socially and ethically what it promised. Although he ridicules the neo-Darwinians and touches them in tender spots with his swift rapier thrusts, it is hardly to be expected that he would discover the chief causes of the domination of science.

In the first place, science flatters us by making a direct appeal to the reason. It offers an apparently simple and logical explanation not only of the world about us, but also of ourselves, our acts, and our thoughts. For the doctrine of free-will which assumed man to be personally responsible for his choice between good and evil, the substitution of impersonal natural law could not fail to lull the conscience with the comforting thought that what is, is right, or rather is unavoidable because natural law knows neither right nor wrong. Science, also, places man in a middle world of law and order and relegates all perturbing complexities to the incomprehensible background of the immeasurably small or the indefinitely great. Life and matter on the earth are the dance of atoms, and atoms are so small that we can forget their variations: and the earth itself is in so vast a universe that its perturbations are negligible.

Again, the marvellous inventions of science and its conquest of external conditions affect the imagination. Criticism is abashed and overawed by the array of facts which men of science have predicted and which have been verified. And so we become convinced that the facts of science are adequate as a basis for the most elaborate and far-reaching hypotheses on all questions, however contrary to experience and common sense they may seem to be. Our doubts are dulled to a quiescence which would, otherwise, be active if we kept clearly in mind that science is based on the same sort of evidence as are all other methods of human knowledge and that men of science are, as Newton pictured them, wanderers on the shore of a vast sea of unknown phenomena, picking up here and there a bright coloured pebble or shell.

Whatever facts and laws, connected with living organisms, biologists may discover, the positive evidence of evolution, that existing species of fauna and flora are the continuously modified forms of previously existing types, must rest on the preservation, and on our discovery, of earlier extinct forms. If we had not found fossils which were different from existing species, our argument for evolution would be academic, to say the least.

There is probably nothing more fascinating and more stimulating to the person of a contemplative mind than to view in a great museum the collections of past life recovered from the buried rocks and soils of the earth. In these show-cases, there are the fossil shells and plants of the most primitive eras; in others, there are strange and grotesque monsters reconstructed in plaster from a few insignificant bones, or the most improbable plants built up from a fallen leaf or a petrified splinter; in still others, there are spread out the even more appalling remains of primitive man-like creatures placed in what are supposed to be their natural or in artificial surroundings. So prehistoric life is portrayed until the time is reached when man, having attained self-consciousness and the habit of recording his impressions and acts, leaves a more or less continuous history of himself and his environment.

At first sight, we are impressed by the great quantities of relics which have been retrieved from the desolation of the past and have been collected and noted in the many museums established throughout the civilized world. These relics have been studied and classified, both as to character and time, by patient men of science; until they have at last pieced them together as a mosaic and fitted them into a frame of time. We are, for a while, impressed with the abundance of these evidences of past history until, with something of a shock, we begin to speculate on the inconceivable number of plant and animal forms which have come and gone. The earth comprises some two hundred million square miles of surface and there is scarcely a portion of it which does not teem with life. And this population has lived and died and been replaced endless times in the hundreds of millions of years which have elapsed since the earth has been cool enough to permit organic life to exist. Of all this multitude of once living things, only a minute portion which possessed calcareous bones or shells, or chanced to have its softer parts petrified, *could* have left any trace behind it; and only a minute portion of these can ever be accessible to discovery. Then we begin to realize that the display cases before us contain all the organic beings which have been preserved from those which peopled a continent during millions of years. This bone is the sole relic of many genera of animals; and this handful of shells is the recovered remnant of the countless life of the sea during other millions of years. From what we have collected from the past and from observation of forms at present alive, a theory of evolution has been laboriously developed which explains our existing life as the result of a continuous modification of previous forms, going back to simpler and simpler organisms until we reach a world of inorganic matter with here and there tiny masses of protoplasmic jelly scattered on the shores of the ocean, themselves indistinguishable from the mud in which they lie.

Yet from these few and wholly inadequate facts, the history of the world, from the time when it was a molten and fiery mass to the present time, is given to us by geologists and biologists. The changing structure of land and sea is traced; the succession of plants and animals is outlined, not in vague and general terms, but specifically from type to type; a table of time is worked out which, although it may vary in details of a million years here and there, is nevertheless agreed upon in its main groups. The ages of rock strata and of mountains and seas are specified, and the changes coincident in organic life are noted. Not only these things are laid down for us to believe, but also the causes of the changes from one type to another are described as matters of scientific verity; even obscure and insignificant habits of men are traced back to the prehistoric traits of our animal forefathers. For example, a baby clings to the finger of its parent because one of its progenitors, as a monkey, clung to the branch of a tree, or, as others hold, we have a curved back and a tottering walk because we have descended from monkeys which were inhabitants of treeless plains, and we have not yet learned to move upright. The biological history which thus not only marks the gigantic steps of time but also descends to a multitude of minute facts and incidents, which occurred millions of years before man with his records inhabited the earth, should have a certain and adequate basis of fact. Does this ground-work of observation and fact exist?

The biographical history of contemporaneous men is a much cultivated art or science, whichever one may choose to call it. The biographer has access to correspondence; he may have known personally the subject of the essay or, at least, he can learn all the facts which acquaintances and friends may know. The subject may have been a Napoleon or a Disraeli on whom the attention of the world has been centred, and yet how few of the continuous thoughts and actions of his short life can be deciphered, and how little of the real man can be transferred to the pages of the long-est book! The despair of the biographer has never been more lucidly expressed than by St. John: "And there are also many other things which Jesus did, the which, if they should be written every one, I suppose that even the world itself could not contain all the books that should be written."

There is an insidious temptation presented to the writer of the natural history of prehistoric times to construct a consistent outline of the changes in the inorganic and in the organic world. He approaches the subject, usually, with a belief in one or another cause for evolution which has been elucidated from experiments on the now existing forms of life. He unconsciously emphasizes those facts which agree with his theory, and this bias is the more harmful because the accumulation of exact knowledge in palaeontology is so slow that there is comparatively little risk of definite discoveries being made which will enable the reader to check the errors or to see clearly the bias. In this respect, he must remain far more untrustworthy, and consequently more dangerous, than the narrator of human history. Thus, Macaulay, with his bias towards the Whig theories of government, could find in the archives of England only facts which glorified Whig or dimmed Tory achievements. The fascination of his style may sway the reader but, in the end, he is able to regain his balance because the records at his disposal are ample and, even if he does not consult them for himself, he may learn their character from the work of other historians. The human bias of the historian is generally admitted and the reader, from experience, soon learns to render due allowance for the fallibility of desire. But the historian of evolution bases his work on the supposedly exact evidence of science; he has imposed on the mind of the reader, from the start, the impression that his deductions are those of a man of science which flow logically and dispassionately from an adequate reservoir of experimental observations, and that he is not swayed by the predilections shown by the writers of the pseudo-science of human history. From his descriptions, the scientific artist portrays the picture of a prehistoric forest or plain with an exactness of detail equal to the canvasses of the Barbizon school of painters who have preserved for us the forest of Fontainebleau. From his bits of bones and shells and rocks, and from his observations on contemporary organisms, the historian of evolution arranges the sequence of palaeontological animals and plants with as elaborate care as the follower of the turf records the pedigree of a famous horse, or as the pigeon fancier follows the varieties of that mutable bird. One cannot but feel that the palaeontologist has assumed the rôle of the stock breeder who mates his animals to produce offspring consonant with his purposes. An important and even unavoidable difference between the methods of stock breeder and evolutionist must persist. The stock breeder follows and can to some extent direct the progress and variation from parent to offspring. He can record his successes and failures, and he can advance his experiments by preserving his successes and destroying his failures. He thus, to a limited degree, can maintain a detached and powerful influence over his result; he is almost an omnipotent creator in his biological world. On the other hand, the palaeontologist has no influence in his past world; if there were a creator or ruler it was one, not only distinct from himself but also one whose nature and methods are absolutely unknown to him. He must work, so to speak, backwards from offspring to parent; picture their receding and diminishing changes, and discover the secret causes for the changes. If the pedigree of palaeontological organisms is thus a matter of guesswork, what can be said of the certainty of the theories as to the causes of the changes from one species to another?

In spite of this totally inadequate foundation which palaeontology offers for a scientific theory of evolution and the causes of variation, there has never been known such a campaign of organized propaganda in the name of science as took place during the latter half of the last century. Huxley, protagonist of this movement, preached on all occasions that: "The man of science is the sworn interpreter of nature in the high court of reason. But of what avail is his honest speech, if ignorance is the assessor of the judge, and prejudice the foreman of the jury? . . . Surely it is the duty of the public to discourage anything of this kind [the opposition to science], to discredit these foolish meddlers who think they do the Almighty a service by preventing a thorough study of His works."[6] I would not accuse Huxley of intentional intellectual dishonesty but the evidence of his own arguments shows that he, too, was swayed by human prejudice. For example, in 1862, when under the sobering influence of addressing the Royal Geological Society and not on the lecture platform, his thesis was to prove that the temporal history of the earth *cannot* be determined by geological records and that: "In view of the immense diversity of known animal and vegetable forms, and the enormous lapse of time indicated by the accumulation of fossiliferous strata, the only circumstance to be wondered at is, not that the changes of life, as exhibited by positive evidence, have been so great, but that they have been so small."[7] In the following year during a course of popular lectures to working men he enlarged on the thesis that palaeontology is a proof not only of evolution but also "shows us many facts which are perfectly harmonious with these observed effects of the process by which Mr. Darwin supposes species to have originated, but which appear to me to be totally inconsistent with any other hypothesis which has been

[6] Darwin, *Life and Letters*, vol. II, p. 76.
[7] Huxley, *Collected Essays*, vol. VIII, "Discourses Biological and Geological," p. 297. See also vol. II, p. 239, where he affirms: "Primary and direct evidence in favour of evolution can be furnished only by palaeontology."

proposed."[8] In plain language, Huxley tells men of science that the positive evidence of palaeontology points to the persistence of species, and he instructs working men that the same science not only verifies evolution, but it can discriminate between different methods of variation.

With what is now known to have been a pitifully meagre supply of facts, observations, and experiments, the Darwinians preached the gospel of evolution as an established scientific law and crushed all opposition to natural selection by hurling the anathema that, if you did not believe, you were not fit to survive. Every trick of habit and every reminiscent thought was traced back to some mammalian or reptilian monster; even such insignificant facts as that the hair on a man's wrist lay in a certain direction were sufficient to link him with simian ancestry; and daily search was made for the "missing link."

All this restlessness and discussion resulted in one real service. Interest was directed to the biological sciences and they were cultivated as never before. Laboratories multiplied, and the phenomena of life were studied systematically. The results of this investigation have been that, today, the evidence available supports our faith in a general law of evolution. We accept it as we accept the law of conservation of matter, not because it can be proved to be true from experience, but because without it natural law is not

[8] Vol. II, Essay XI, p. 462.

intelligible. The only alternative is the doctrine of special creation which may be true but is irrational. The origins of the human races certainly go far back in time. But, on the other hand, the causes and method of evolution have become a matter of such doubt that the better biologists, themselves, admit they are not on the track of any satisfactory proofs. In addition to what may be called the scientific confusion amongst biologists, they have been shocked, and even dazed, by recent sudden attacks from the outside on them and on their work. They are driven to the defensive and agree with Professor Conklin who introduces the subject of human evolution with the outburst that: "During the past few years, and especially within the past twelvemonth, there has been a remarkable recrudescence of the old theological opposition to the theory of evolution, especially as applied to man."[9] And he characterizes this outbreak as the most ignorant, frenzied, and intolerant that has ever been uttered against this theory.

We now learn that after sixty years of persistent research, the causes of evolution are unknown; natural selection, with its catch-words of struggle for existence and survival of the fittest, is losing ground; the despised Lamarckism with its metaphysical background is gaining in favour. Is it, then, surprising that laymen should confuse mere faith in evolution of some sort with the controversies as to its cause, and

[9] *The Direction of Human Evolution*, Scribner's, 1922, 2d ed., p. v.

condemn the whole doctrine? They remember, only too well, the haughty assurance of the Darwinians that evolution was a demonstrated fact and not a faith, and that natural selection was an adequate cause. And with popular acceptance of these assertions as truths, society was reorganized according to the philosophy of naturalism with the universe a machine. If now, the biologists cannot tell us how evolution will proceed in the future and what causes variations, how can we predict what we should do or how apply evolution to guide us socially and ethically? As a laboratory science evolution does not especially interest us.

While this note of uncertainty and confusion is clearly apparent in the minds of the biologists, they seem to miss the point that evolution is a far broader subject than a laboratory problem in biology; that it is one affecting the entire physical and spiritual outlook of man. Instead of aiding society to re-orientate itself, they still try to soothe us into quiescence by saying our knowledge merely is lacking but the mechanistic method still remains the only true "open sesame." Let us, therefore, withdraw for a time from discussing evolution and its applications and gather more facts until we have sufficient data wherewith to give the solution to the world. They cannot understand that it is not more facts which are needed but some little indication to show that the laws of physics are adequate to include life and its attributes. They are blind to the evidence that the world is fast losing faith in the ability of science to solve the riddle of man, to coordinate his physical and mental worlds by scientific experiments and logical formulae, and is turning again to the precepts of those who are wise from human experience. Two or three examples will be sufficient to show how biologists, who recognize the revolt against scientific naturalism, propose to meet the situation.

Professor Conklin, who by his scientific achievements and by his position as biologist in Princeton University exerts a great influence, sketches the probable direction of human evolution with the avowed purpose of combating these frenzied attacks on the study of evolution. I may say at once, that I am quite in sympathy with his purpose in so far as he opposes the futile and foolish attempts to prohibit by law the teaching of the science of biology and of evolution, or to limit the full inquiry of biological phenomena. But, his irritation under fire seems to have confused the clarity of his scientific reasoning to such an extent that he fails to distinguish between evolution as a scientific theory to be investigated in the biological laboratory, which will stand or fall on the evidence of scientific investigation, and the metaphysical hypothesis of evolution as a guide to social and religious affairs, which is not a problem of biology.

Professor Conklin apparently believes that the real opposition is due to the ignorant and clamorous objections of those who may be classed under his description of the religious: "Undoubtedly the usual conception of God as Creator and Ruler is that he is a supernatural being, a Great and Good Man in the skies, who created the universe out of nothing, set it going, and watches over it to see that it goes right; that he established natural laws by his word but now and again suspends them in order to accomplish particular purposes or to benefit his worshippers."[10] But, I doubt very much whether such persons are his dangerous antagonists. They are rather those who accept on faith a general law of change but who wish to know his answer to the question of how we develop and change. He does not tell us how natural law was instituted nor why, if it was instituted, it *cannot* be superseded by its institutor. Many of us do not see why the idea of an incomprehensible natural law is more rational than the idea of a God. Again, is a universe created out of nothing and set going by a Creator and Ruler a less satisfactory belief than a universe uncreated, or self-created, and set going by its own natural laws? It almost seems as if men of science believed that a natural law was an entity existing before the phenomena which it classifies; for example, that the law of organic evolution brought into being the first organism which appeared on the earth.

[10] *Direction of Human Evolution*, p. 209.

Professor Conklin apparently believes that some form of natural selection is the only scientific cause and method of evolution, he certainly believes that the man of science is the guide to truth, and yet he also admits that natural selection is an unproved hypothesis. We must feel, therefore, that when he passes from the strictly scientific statement of biological evolution to the evolution of society and religion, he has forsaken scientific methods and is merely expressing an unverifiable opinion as to the future of the race. If natural selection is not a proved hypothesis but one which is steadily losing ground, then it must be a very treacherous guide to lead us through the intricacies of our social and religious life, a guide more likely to confuse than to aid.

As a second example of the biologist's position, we may cite from Professor Henry Fairfield Osborn. As Curator of the American Museum of Natural History he is an authority on palaeontology, and as a popular writer on the history of evolution his opinions have a great circulation. "In contrast to the unity of opinion on the *law* of evolution is the wide diversity of opinion on the *causes* of evolution. In fact, the causes of the evolution of life are as mysterious as the law of evolution is certain. Some contend that we already know the chief causes of evolution, others contend that we know little or nothing of them. In this open court of conjecture, of hypothesis, of more or less heated controversy, the great names of

Lamarck, of Darwin, of Weissmann figure prominently as leaders of different schools of opinion; while there are others, like myself, who for various reasons belong to no school, and are as agnostic about Lamarckism as they are about Darwinism or Weissmannism, or the more recent form of Darwinism termed Mutation by DeVries."[11] And he is willing to go even further by confessing: "We have no scientific explanation for those processes of development from within, which Bergson has termed '*l'évolution créatrice*,' and for which Driesch has abandoned a natural explanation and assumed the existence of an *entelechy*, that is, an internal perfecting influence."[12] And is it come to this, the agnosticism towards religion or philosophy, call it which you will, of the Darwinians now embraces the *truths* of their science also? Yet even this confession does not make Professor Osborn understand that belief in evolution does not make a science unless we can also agree equally on some method of variation. To know that organic beings have varied, but not to know how they will vary in the future is about as useful as to know that a ball will move and not to know the path and distance of the motion. His solution is to propose a new mechanistic theory of variation based on mechanical energy of a type unknown to physicists.

The last illustration I shall give is from an ad-

[11] Osborn, *The Origin and Evolution of Life*, p. ix.
[12] *Ibid.*, p. x.

dress by Professor William Bateson,[13] a leading biologist of England. As a frank and authoritative statement of the position of modern evolution, its effect has been to startle even the less thoughtful scientists out of their complacency; it should be read in full. Professor Bateson says: "Discussions of evolution came to an end primarily because it was obvious that no progress was being made. . . . When students of other sciences ask us what is now currently believed about the origin of species we have no clear answer to give. Faith has given place to agnosticism. . . . Biological science has returned to its rightful place, investigation of the structure and properties of the concrete and visible world. We cannot see how the differentiation into species came about. Variation of many kinds, often considerable, we daily witness, but no origin of species. . . . I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. . . . Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken." Again, we see that men of science are still under the delusion that they are hounded by a host of enemies. Can they contemplate the course of history for the last half century and not see that implicit belief in Darwinian evolu-

[13] "Evolutionary Faith and Modern Doubts." An address delivered to the American Association for the Advancement of Science, 28 December, 1921. *Science*, vol. LV, p. 55.

tion, accepted because we naïvely believed in the facts and theories given us by biologists, has dominated society? Is it astonishing that a revolt occurs when the prop to our faith is thus knocked out? It cannot reassure us to have Professor Bateson tell us, at the close of his address, to be of good cheer because the mystery may be solved tomorrow; we cannot forget that, after sixty years of diligent search to clear this mystery of the origin of species and of the method of their variations, he confesses that not even a beginning has been made. The tomorrow of the biologist may be as long as the million years or so necessary for the horse to eliminate his four toes.

No settlement of this question need be expected from the inside for the man of science is at heart a monist; the opposition from without is almost certain, if it be not wisely directed, to go too far and to smash what science has done, and can do, so marvellously well when it keeps within its own field. And men of science should not be deceived as to the extent of the reaction against the domination of science; only the sociologists, historians, and humanitarian clergy, go on calmly as if all were well in the sanctuary.

The critic should, I think, justify his right to criticise, as there is often flung at him the remark that the man of creative ability will continue to work as his powers direct and criticism is of little use. Yet, so great a genius as Faraday tells us it is as important to root out weeds as it is to plant flowers. At all events, he who feels the strong impulse to examine the work of others critically will probably, also, follow his bent whether it be useful or not. In the spirit of trying to satisfy myself what were the true methods and aims of science, I published a book called *The Limitations of Science* in which I tried to separate the problems which lay within and without its field. I specifically called attention to the danger of attempting to make science the Arbiter of Ethics, concluding that of all such attempts the domination of thought by the doctrine of evolution was likely to lead to the greatest harm. As the book was completed in 1914 and as the chapter in question had been written as an essay some time previously, when the storm which was to shatter the peace of the world was hardly above the horizon, I may be allowed some feeling of justification for my views. The book was also designed to be the introductory volume of a critical history of science.

As I am by training a physicist, it may be asked why I undertake a discussion of biology and of evolution in particular. My reasons are that there is a more urgent need for a critique of biology as it is the science which is furthest out of its field, and also its influence on life and thought is more direct and readily seen than is that of the physical sciences and, consequently, may be more pernicious. While the physical sciences have endeavoured to dominate thought, they do recognize that the field of life lies outside their boundaries and they continue to exclude its problems from their discussions.

At least, the biologists cannot reproach me with being a "paper philosopher," since I have had a pretty severe and long training as a laboratory experimenter. I am quite prepared to accept the conclusions of biological experimentation and I shall depend on the statements of biologists to show that they have not bridged the gap between the organic and inorganic worlds; that they are not prepared to explain living processes as physical force and energy; that biological evolution as a guide to human society is a delusion. Anyone trained adequately in physics, which the biologists acknowledge to be the foundation of their science, ought surely to be able to follow and to understand their deductions. If this be not true, how can biologists use the facts and laws of physics with such freedom and assurance? And when we remember that the data of biology must be interpreted by historians, sociologists, philosophers, and the clergy, before the doctrine of evolution can be used as a guide to human affairs the argument becomes a two-edged sword and cuts both ways. There are even good grounds for believing that physics, with its dependence on the technical use of mathematics, is the most difficult and avoided of the sciences. Biologists and social evolutionists preach its essential value as a necessary foundation for their authority, but they successfully avoid its practice and their interpretations of its laws seem, at times, rather weird.

I agree fully with Huxley, the biologist, when he said, in justification of his critical discussion of physics, that there is but one scientific method. It seems a bit presumptuous for biologists, as so generally happens, to insist on great technical training and ability in anyone who dares to criticise the deductions of biology, and then to apply their theories to the far more difficult and complex fields of sociology and religion in which their own study and training is perhaps not thorough and first-hand. Is it not a fact that men of science habitually assume accurate knowledge to be necessary in science, and agree with a negro student who wished to take graduate courses in sociology, without any previous training in the subject, on the plea that everybody knows sociology,—more or less?

I would not go quite so far as William James once expressed himself: "When you defer to what you suppose a certain authority in scientists as confirming these negations, I am surprised. Of all insufficient authorities as to the total nature of reality, give me the 'scientists' from Münsterberg up, or down. Their interests are most incomplete and their professional conceit and bigotry immense. I know no narrower sect or club, in spite of their excellent authority in the lines of fact they have explored, and their splendid achievement there. Their only authority *at large* is for *method*—and the pragmatic method completes and enlarges them there."[14] But there does seem much truth in the criticism that historians of science are singularly lacking in the critical spirit and content themselves with giving a thin, isolated thread of scientific facts and discoveries from the past to the present. As chroniclers, they are usually accurate when dealing with recent events and, until recently, they assumed that past scientific history of a century ago was of little value. Now, it is the fashion for historians, especially of evolution, to develop that subject as an evolution of thought from the earliest times. If Democritus, Empedocles, Aristotle, St. Augustine, but mention the word "change" in connection with life they are portrayed as fathers or corner-stones of evolution. And, apparently, little search is made to discover their attitude of mind so as to determine in what sense the word was used. To give to opinions and expressions of past writers their modern significance, is generally to falsify history.

A final word should be given in justification of the fact that I have based my criticism, and have placed most of my emphasis, on the work and ideas of the founders of the evolution theory, Lamarck, Spencer, Darwin, Huxley, Fiske, and Haeckel. Objection will almost certainly be made that, as their work has been superseded or at least revised by modern scientific work, I should criticise the facts and hypotheses of

[14] *Life and Letters of William James*, vol. II, p. 270.

living biologists. But the objection will not be just, if it is kept in mind that the purpose of the book is not to discuss the validity of evolution as a scientific biological theory but rather to trace the effects of its application to the broader fields of social life and religion. The doctrine of the founders of evolution was clear and it was pronounced with authority; to-day it is confused and broken with so many cross-currents that it is very doubtful if many of those who confidently subscribe to the dogma of evolution as the explanation of life, of society, and of religion, know what it really requires us to believe. In spite of the fact that much of the earlier specific work has been discredited, it is equally true that *modern biologists are still using the ideas and methods of their predecessors.* If these ideas and methods are fundamentally wrong, then the monistic and naturalistic philosophy, which has followed from the doctrine of evolution and which is still dominant, will fall also.

CHAPTER TWO

The Greek Attitude Towards Science

It is so customary for us to consider all phenomena, of both the organic and inorganic world, as a continuous and gradual development during long periods of time, and we have come to use the word, *evolution*, so loosely, as synonymous with mere change, that we should, at the outset of our historical survey, make it as clear as possible what is meant by evolution as a scientific term. This is especially necessary as it has grown to be the habit for historians of biology to trace the doctrine of evolution as itself a growth, the germ of which existed in the minds of the Greek philosophers. In dealing with times so distant and so different from our own, it is not safe to connect ideas by words whose sound has remained the same but whose meaning has been altered by long use. We persist in retaining words when they have once been acquired and prefer to change their significance to meet new conditions.

Evolution, as a scientific term to express a law of continuous development of species from previous and different species, must be used in a far more restricted sense than in its general definition of unfolding or variation. Also, before evolution can be classed as a scientific law, some natural cause or method, by which such transformations are brought about, must be added to the general idea of change. As Professor Adam Sedgwick once admirably expressed it, everybody admits development as a fact, this is mere common observation and common sense, but the question really is: how did it come about?

From our earliest historical records and from the present state of various savage tribes, everybody admits that civilization has slowly changed from very simple beginnings. Evidence, also, shows conclusively that, at a very distant past, many of our domesticated animals and plants had already been modified from their wild state. Those primitive peoples must, then, have recognized that variation occurs from generation to generation, and they must have practised selective breeding with animals and plants in order to establish and to intensify new and desirable traits. Indeed, the fact that the child is different from its parents is so obvious that there is no need to determine when it became known.

The question really is, when did the belief arise that variations become progressively greater and greater so as to link together all the existing flora and fauna in one common remote ancestry? Did the Greeks or, in fact, did anyone have the germ of such an idea of evolution before the latter part of the eighteenth century when biology was established as a science?

As we gradually recover the records of the peoples who inhabited the eastern shores of the Mediterranean we recognize more clearly that a high state of civilization can be attained in government, literature, art, and religion with, at the same time, almost no knowledge of natural law and with but little interest in physical phenomena. In Greece, in Egypt, and in Asia Minor, even so late as the Homeric period, not only ethical ideas were personified as anthropomorphic gods but also every natural phenomenon was thought of as directed by, and imbued with, a living spirit or minor god. Each spring had its nymph, each tree its dryad, and the winds and waves were controlled by their deities. How far clearly, if at all, men could separate the material nature of the world from these personified forces which they supposed controlled matter, we are unable to imagine. But we find faint indications that there had grown up in the minds of the more thoughtful Greeks the conviction that behind the gods, who were swayed by human emotions and passions, was an unalterable and inexorable Fate which guided the apparently free decisions of the gods on Mt. Olympus in a predetermined path. This idea of Fate may very well have arisen from the appreciation, dimly foreseen and shadowy in the beginning, of natural forces which acted indifferently to the desires of gods and men. However this may be, we are confronted by the fact that this animistic conception of nature was suddenly replaced by a far more rationalistic idea which is stated to have been due to Thales of Miletus.

We know little about Thales, and will probably never know whether his ideas were his own, or whether he merely enlarged on those of others. Even two centuries after his birth, he had become a legendary figure. Tradition tells us merely that he was born in the year 640 B.C.; that he studied in Egypt and attained note as a scientific thinker; and that he established a school of natural philosophy. The Greeks regarded him as the founder of Greek philosophy because he replaced the ordinary mythical explanation of phenomena by teaching that all things are due to a single principle which he held to be water.[1] If this opinion of the Greeks be correct, that Thales, of his own initiative, arrived at such an astounding conception of the world, then this fact marks one of the greatest revolutions in thought. At a single step, man passed from a crude animism to a conception of objective law. At any rate, we can date the beginning of scientific or rational thought with Thales, and since his time we have records of a continuous search to determine the nature of substance and the cause of phenomena.

It matters little to us that Thales held that water is the first principle of all things; that his successor, Anaximander, changed the first principle, or *arché*,

[1] Fairbanks, *The First Philosophers of Greece*, Scribner's, p. 1.

into an infinite substance which alternately generated and destroyed the universe; that the pupil of this philosopher, Anaximenes, returned to the doctrine of Thales, merely changing the *arché* from water to air; or that Heraclitus, the greatest of the natural philosophers, saw in pure celestial fire and in motion the unifying principles of the world. But it does signify a great deal that these philosophers were the first to see that matter, however diverse it may seem to our senses, must have some common property, some link which binds its phenomena together; this unifying principle is the first intimation of what we now call natural law. We, who have come to look on matter as inert substance and have endued it with a separate active principle which we call force or energy, can get no clear conception of what they meant by water, air, or fire. And they, themselves, were undoubtedly quite vague in their own minds. They seem to have meant that this fundamental substance changed in nature from one kind of matter to another and that action was brought about by moisture and heat.

This, at least, was the opinion of Aristotle who sums up the ideas of the school of Natural Philosophers as follows: "Thales, the founder of this school of philosophy, says the principle is water, getting the notion perhaps from seeing that the nutriment of all things is moist, and that heat itself is generated from the moist and kept alive by it (and that from which they come to be is a principle of all things). He got his notion from this fact, and from the fact that the seeds of all things have a moist nature, and that water is the origin of the nature of moist things."[2] Because of the attempt of these philosophers to find a unity between matter and life, we can classify them as monists. Their doctrine is a form of hylozoism since they also endowed matter with life. They are therefore highly extolled by the modern school of monistic thinkers. Haeckel, for example, goes to the absurd length of calling Anaximander the prophet of Kant and Laplace who originated the nebular hypothesis, because he is said to have taught that an infinite number of worlds have been generated and have perished again. And he is, on the same authority, the prophet of Lamarck and Darwin because he states, according to Plutarch, that at the beginning man was generated from all sorts of animals; and from another commentator, that the first animals were generated in moisture, and were covered with a prickly skin.

In their attempt to find a single cause for all phenomena, these philosophers had carried over into their conception of nature something of the mythical, or animistic, beliefs of their contemporaries. They, therefore, endowed inert matter with a form of life or sensation and were the founders of the doctrine of hylozoistic monism. It is but natural to expect that a monistic view of phenomena would be early recog-

[2] Aristotle, *Meta.*, i, 3, 983 b. 20. English trans. by W. D. Ross, Oxford.

nized, and the same unity accomplished, by supposing that life is but a form of matter and motion. This atomistic philosophy was proposed by Leucippus, but the form, in which we know it, was developed by Democritus. This philosopher has hardly received the recognition which he deserves. With no data of experience he conceived and stated a theory of the world by pure deduction and intuition which is still the foundation of modern science. According to Democritus, the elementary substance is not one we can recognize by our senses; it consists of an infinite number of exceedingly small particles which he calls *atoms* because they are indivisible. They can differ among themselves only in shape, in order or sequence, and in position. These postulates, according to the Atomists, are sufficient to explain all the diversities of matter and its phenomena. In order to compound themselves to form the world, the atoms possess a primordial and eternal motion. This motion was of two kinds; the larger atoms drift downwards in straight lines towards what is now the centre of the earth, and thus displace or compel the lighter ones to move upwards; the collisions between these two streams cause them to have lateral movements. In this way, rotations were started which, extending farther and farther, occasioned the formation of worlds. Democritus also introduced the idea of a vacuum or empty space between the atoms which has played so prominent a rôle in modern physics. And he gives in quite modern fashion the reasons for this postulate; first, motion can take place only in unoccupied space; second, bodies cannot contract or expand unless they do not occupy all the space within their boundary; third, fluids may penetrate into solids; and fourth, organic beings depend on the penetration of fluids in their solid portions. Democritus also is strictly scientific in discarding such causes for motion or combination as an Animate Will in the atoms or a Ruling Mind in the universe. The atoms combine and separate, they move and come to rest in obedience to *natural law;* "In virtue of which things of like weight and shape must come to the same places; just as we observe in the winnowing of grain."[3]

If Democritus had had at his command such a force as Newton afterwards expressed in his law of universal gravitation—that all atoms attract each other with a force inversely as the square of the distance between them—he would have given the identical picture of the creation of the solar system which Kant and Laplace, in the eighteenth century, embodied in their famous nebular hypothesis. And this would have been an example of pure deductive reasoning as the basis of science. By the mere substitution of the idea of force and energy as an attribute of substance, in place of the undefined motions and the principle of each kind of matter seeking its like kind of Democritus, we have been able to measure quan-

[3] Überweg-Prächter, *Gesch. der Phil.*, p. 121.

titatively the actions of atoms, and to found on this atomic postulate the entire theory of the modern sciences of physics and chemistry.

Almost contemporaneously with the atomic theory of Democritus two natural philosophers, Empedocles and Anaxagoras, should be studied at some length, as to them we owe the foundation of the sharply contrasted doctrine of a *dualistic* universe; that life is not explainable by physical causes nor by substantial elements, since the phenomena of the organic world require us to postulate a hyperphysical or psychic force.

In a criticism of the philosophy of Thales, who was held by some to believe that all things were filled with gods, Aristotle expressly says that Anaxagoras was the first to introduce the idea of a dualistic philosophy.[4] He had, apparently, first sought for mechanical causes, but having failed to find them adequate, he then turned to the agency of a divine reason, or world-ordering Mind, which he termed *nous*. Instead of the primal substance of the earlier natural philosophers which was changed into all the various materials of the world by active principles not clearly distinguished from the substance itself, Anaxagoras supposed that there was an unlimited number of primitive substances, or seeds as he called them, which were arranged, but not transmuted, by the *nous* to change chaos into the ordered world.

[4] *Meta.*, i, 3, 984 b.

The essence of each kind of material substance is thus immutable; creation means, not to bring substance into existence out of nothing, but to separate and to sort a mixture already existing by giving it motion. In a fragment preserved for us, Anaxagoras explains his idea in this manner: "When mind had once set things in motion, it [mind] began to withdraw from all that was moving; and whatever mind set in motion, all this was differentiated. During this process of motion and differentiation, the rotation caused the things to be much more differentiated."[5] He answers the argument for mutation by saying, how can hair come from anything else than hair, or flesh from anything but flesh?[6] Thus the World Mind or *nous* of Anaxagoras is somewhat like the Jehovah of the Jews, a spiritual power creating the world according to a design. It is distinguished absolutely from matter and has supreme power over matter, which remains chaotic until directed motion is given to its inertia, neither by fate nor by chance; and the ordered world is created according to the preconceived plan of its creator and ruler. This is a complete dualistic philosophy, in that organic and inorganic bodies are essentially different because to the former is added a principle of life or mind. While

[5] This translation of an obscure and possibly corrupt passage of Anaxagoras in which he attempts to explain his idea of the creation is taken from Diel's *Vorsokratiker* with Heidel's interpretation that the mind withdrew from the motion it caused. The translation as given by Fairbanks, *op. cit.*, p. 243, is not so satisfactory.
[6] Fairbanks, *op.cit.*, p. 245.

Anaxagoras is generally given credit as the founder of dualistic philosophy, yet, in the opinion of Plato and Aristotle, he fell far short of accomplishing his purpose. Plato, in a famous passage in the *Phaedo*,[7] makes Socrates say: "I rejoiced to think that I had found in Anaxagoras a teacher of the causes of existence such as I had desired, and I imagined that he would tell me first whether the earth is flat or round; and whichever was true, he would proceed to explain the cause and necessity of this being so, and then he would teach me the nature of the best and show that this was best. . . . What expectations I had formed, and how grievously was I disappointed! As I proceeded, I found my philosopher altogether forsaking mind or any other principle of order, but having recourse to air, and aether, and water, and other eccentricities." Aristotle's opinion is somewhat conflicting. He says that Anaxagoras seemed like a sober man, in contrast to those who before spoke at random, because he argued that since mind exists in animals, so it also exists in nature as the cause of the universe.[8] But he says elsewhere: "Anaxagoras uses reason as a *deus ex machina* for the making of the world, and when he is at a loss to tell for what cause something necessarily is, then he drags reason in, but in all other cases ascribes events to anything rather than to reason."[9]

[7] Jowett's translation, *Phaedo*, 97c and 98c.
[8] *Meta.*, i. 3; 984 b.
[9] *Meta.*, i, 4; 985 a 18.

A much inferior dualism was elucidated by Empedocles, a contemporary of Anaxagoras, and it would not be necessary to dwell on his ideas if he had not drawn a picture of creation which many modern evolutionists extravagantly maintain to be the *ancestor* of our present theory.[10] From the rather extensive fragments of his didactic poem, *On Nature*, and from comments of later writers we know that Empedocles believed that all material substance is formed out of the mixture of four prime elements, earth, water, air, and fire. To them, he adds two active principles, love which causes them to unite, and hate to separate. He thus forsakes the clear-cut and fundamental distinction of the material and the spiritual, which Anaxagoras had grasped, and introduces the ambiguous terms, love and hate. Sometimes, he treats them as if they were the ethical principles of good and evil, and sometimes they are like the physical forces of attraction and repulsion. Originally, the elements were mingled together to form a sphere. In this state, love was supreme; but hate becomes stronger and the elements separate into individual bodies. The power of hate then wanes and again the elements return to the

[10] Haeckel: "Empedocles must be regarded as Darwin's earliest predecessor." *Hist. of Creation*, I, p. 296. Fritz Schultze: "To have first conceived the grand thought of a theory of tracing the origin of what is suitable from what is unsuitable, is the brilliant merit of Empedocles." Osborn: "Empedocles may justly be called the father of the Evolution idea. . . . We find [in his teachings] the germ of the theory of the survival of the fittest, or of natural selection. . . . Note the remote parallel with the modern notion of the struggle for existence as, mainly, success in feeding and in leaving progeny." *From the Greeks to Darwin*, pp. 37-40.

original sphere. These changes continue without end and follow each other periodically.

When he turns to the organic world, he declares that while the earth was developing, plants sprang into being, and after them animals appeared. At first separate parts, such as arms, or torsos, or heads, or feet, formed themselves. Afterwards, by the action of love, some of these united together; but, since they joined as they chanced to meet, the first combinations were mostly monstrosities such as the centaur with the head of a man affixed to the body of a horse. These mixed monsters were dominated by hate or repulsion and fell apart; only gradually did the proper parts of each existing animal become joined to form the permanent type. To these ideas, he added the Pythagorean doctrine of transmigration of souls: "Before this I was born once a boy, and a maiden, and a plant, and a bird, and a darting fish in the sea."

Nowhere in the preserved portions of the writings of Empedocles, nor in the ancient references to him, is there a statement that he had grasped the idea of evolution. He says the inorganic world was formed first; after that plants appeared, and then imperfect monsters changed into the animals which he knew. Each rises directly from the earth and there is no hint that he had any conception of prehistoric forms or of any succession of real plants and animals modified to make new forms.

It is a mystery why the evolutionists take comfort from Empedocles and are hostile to the Mosaic legend in Genesis. If we substitute a divine Creator for the vague self-creative principles of love and hate and if we accept a final and perfect creation of each species which was progressive in time for a tentative and fortuitous creation which by stages produced the fixed type, there is little to choose between the two cosmogonies, except that the Biblical account is not ludicrous.

No biologist or evolutionist ever refers to Milton except to sneer at him as the refuge of bigoted special creationists, and yet his description of the creation in the seventh book of *Paradise Lost* is quite Empedoclean, barring the monstrosities, and gives us a well-ordered progression in the creation from lower to higher forms. Certainly Empedocles would not have objected to these lines:

> The grassy clods now calved; now half appeared
> The tawny lion, pawing to get free
> His hinder parts.

If evolutionists must find a corner-stone in Greek philosophy for their doctrine, they should give this honour to Democritus. His doctrine of mechanical and atomistic monism in which all phenomena are reduced to material particles moving according to natural law is, in the real sense of the word, modern science. But those who hold that evolution, and all science, must be inductive and rest only on a foundation of observation, will derive but little comfort even from him, as his ideas show that the basis of science was laid by deductive reasoning and intuition.

In this brief review of early Greek scientific thought I have endeavoured to show that the two principal modes of viewing the objective world had been displayed with a certain amount of definiteness. On the one hand, the doctrine of monism had been advanced, according to which there exists but one substance and but one active principle in the world; this idea took the form either that inorganic matter possessed life, or at least sensation—the doctrine of hylozoism; or that organic matter was but a more complicated structure of material substance—the atomistic doctrine. On the other hand, we find the doctrine of dualism which distinguished two substances, the organic and inorganic, and two principles, the physical and the vital. In its most complete development, dualism postulated a ruling and guiding principle, the *nous* which planned the universe. These early thinkers had also discovered deductively the fundamental laws of science, those laws without which the human mind can find no certainty or order in the complexity of phenomena.

At this point the stage was set for the two master minds of antiquity, Plato and Aristotle, who by their genius absorbed all previous thought and erected upon it such an imposing system that philosophy, to the present day, is mostly a commentary for or against one or the other. While their differences are well marked, they were closely united in maintaining a dualistic world.[11] And they both were fundamentally concerned with the problem of the reality of ideas and in seeking a final cause for phenomena. They both were much influenced by Anaxagoras and adopted his postulate of the *nous*, which they enlarged into the belief of a divine and spiritual ruler of the universe who created and ruled all things according to a standard of justice and righteousness. The certainty of knowledge of the Demiurgos was given to man by his possession of a divine spirit which was joined to his body at his creation, and which gave him an absolute but incomplete knowledge of virtue. His soul enabled him to appreciate the divine standards of right and wrong as fundamental realities and not as the outgrowth of social custom.

Plato, following the example of his master, Socrates, is only slightly concerned with the objective world and makes few references in his *Dialogues* to its phenomena and laws. He is mainly engaged in the discussion of the nature of God and in attempting to establish the laws of right and wrong. Only in his later life,—and perhaps then in answer to the criticism that while he had discussed God, man, and the State, theoretically, he had nowhere shown how man

[11] While it is true that Plato has been classed by Zeller as a monist because of his belief in the reality of ideas, we are safe in holding that Zeller, who was an Hegelian, cannot be trusted in his interpretation of Plato. Because of Plato's absolute separation of the nature of organic and inorganic things, and of spirit and body, there can be no doubt that he was truly a dualist.

could practise virtue nor how he could conduct a State,—does he lay aside his Socratic indifference as if he felt it to be necessary to show that he could create also a practical philosophical system. In the *Republic*, he outlines an ideal State which has served as a model to all later attempts which pass now under the name of Utopias. In contrast to the care and accuracy with which he there elaborated the laws of government for the State, we find him vague and showing a decided lack of real interest when he attempts, in the *Timaeus*, to define his ideas of physical and biological laws.

We can pass over his discussion of phenomena, although he does give us in broad outline the first scientific cosmogony; but, we must not fail to note that he seized on the principle that by mathematics alone, through its laws of number and measure, man can imagine boundaries of things in the unlimited or infinite extent of space. Plato, by the introduction of mathematical form as the determination of individual things, accomplished an undying service to science. He is unquestionably the source of the Greek school of mathematics, astronomy, and physics, which began with his pupil, Euclid, and reached its height in the genius of Archimedes, Hipparchus, and Ptolemy. If this great school of physical science had not suffered shipwreck through the apathy of the Romans and the hostility of the Christians, we should probably not have had to wait for a Galileo and a Newton to establish the laws of rational mechanics. Instead of developing Plato's reliance on mathematical law: "It is rather the poetic visions and hypotheses of the *Timaeus* which influenced the later Greek philosophy and absorbed the entire Christian thought. The neo-Aristotelian scholasticism was occupied with the cosmic system of the *Timaeus* rather than with classifying phenomena in mathematical laws."[12]

While we may class Aristotle with his teacher, Plato, as a philosopher whose chief purposes are to seek for the final cause of phenomena and to establish the laws of justice and righteousness, we also find him as sharply contrasted to Plato because of his predilection for knowledge of the objective world. His indefatigable industry in collecting and classifying data of the animal world; his foresight in seeing that for exact knowledge we must begin with the phenomena presented by each group of animals, and when this is done, proceed afterwards to state the causes of those phenomena; his recognition that he had no body of facts from which to generalize; and his determination to leave to his successors as great a collection of the data of observation as he could obtain, make him worthy to be called the first master of science. But we must not overlook the fact that although he announces for the first time the inductive scientific method, he was forced, both by his training and by his lack of data, to derive his laws deduc-

[12] Lasswitz, *Geschichte der Atomistik*, vol. I, p. 61.

tively and to explain phenomena by causes postulated as necessary and from *a priori* grounds.

Before we can understand his ideas on evolution we must look first at his concepts of physics, Aristotle accepts the four elements—earth, water, air, and fire—first proposed by Empedocles and adds to them a fifth essence, the aether. He reviews the atomic theory of Democritus and finally discards it as involving the principle of chance rather than the teleological basis of purpose to which he was unwaveringly committed. These five elements are, as he expresses it, the substratum of reality, the stuff out of which the universe was fashioned. The centre of the earth is the centre of the universe and the first four elements have their natural places in the order mentioned from this centre. If by external causes the elements become mixed, as for example, earth and water, they endeavour to return to their natural levels. The proof of this law is that water exists on the surface of the earth; while above it is the shell of air; and furthest from the solid globe is the region of celestial fire. The fifth element is the essence of the celestial bodies and is perfect and unchangeable in contradistinction to the mutable and corruptible four terrestrial essences.

In order that there may be individual things or bodies, he postulates form as the cause by which the elements change from potentiality to actuality. Thus, the proportionate combination of the elements and form determine the individual object.

Aristotle had criticised the earlier natural philosophers in that they had confused substance and action, and to avoid this confusion of thought he supposes that the four elements may change from one to another by the inherent active principles of moist and dry, warm and cold. Thus earth which is cold and wet becomes water if it be made warm and wet. By an apparent contradiction, he also defines motion as the active principle which produces form and change of form. But this contradiction is cleared by his definition of motion as meaning any change in quantity, in quality, or in space position; thus, the active principles fall in the second category of motion, the size of the body in the first, and its position in the third category.[13]

We may sum up Aristotle's postulates as four principles—substance as potential, form as actual, the moving cause which changes potential matter into actual bodies, and the final, or end cause, which explains the reason for creation. Over all, regulating and dominating all things, is God, an immaterial spirit. To Aristotle, God is a necessary postulate because wherever he looks he sees design and order.

[13] It is interesting to note that although we now *define* motion as being solely change of position in time, yet we still adhere to Aristotle's three categories. For example; we explain colour as vibratory motion of particles although there is no sense connection in our minds between colour and position. When a body changes its quality from red to green we explain it as due to motion. Many chemists explain the difference between any two elementary substances, as hydrogen and oxygen, as merely a change of position of electrons in the atom, etc.

This is, of course, the same argument which was used by Paley in his *Evidences of Christianity*. Just as a person who had never known of a watch would be compelled to postulate the existence of a watchmaker, if he unexpectedly found such an object in a field, because it exhibited every sign of purpose and of an orderly arrangement of its parts; so the observer of nature sees everywhere about him the unmistakable evidences of purpose and order, and is forced to the conclusion that there is a Creator and Ruler of the world.

As houses or chairs are constructed according to the plans of their designers, so there is in the mind of God an idea or image which is the perfect and fixed pattern of each kind of material objects and according to which they are fashioned. Because the soul, or *psuché*, of man is a part of God, we, too, know these divine images and thus can recognize objects such as houses or chairs however they may differ in appearance and details. Also, God has endowed each kind, or class, of objects with the tendency to attain a form as nearly as possible like that of its perfect pattern.

There is thus a series of classes of forms from material objects in an ascending scale through plants to animals and finally to man, who is nearest to perfection, because he, alone having a soul, is most like to God. In the organic world, what we now call a species of plants or animals varies in its characteristics so as to attain as nearly as possible to the qualities of its ideal pattern; but, by the very nature of things, one species cannot evolve into another species because that would be equivalent to acknowledging that its own divine pattern was imperfect and variable.

While Aristotle wrote voluminously of physics, and was accepted as the final arbiter of physical law down to the time of the Renaissance, his influence was on the whole unfortunate. His natural causes were accepted and became the touchstone of truth; in mechanics the inductive method of Archimedes, and in astronomy the solar system of Hipparchus, were abandoned for the *a priori* postulates of Aristotle. His rejection of the atomic theory of Democritus, according to which the idea of motion was confined to the modern concept of change of position and occurred only according to natural necessity or mathematical law, practically made impossible any sound advance in the physical sciences. His dicta, that all motion in nature is directed to an end and that God and nature do nothing in vain, prevented later writers from seeing that God and nature could act towards an end through natural or mathematical law. That is, according to modern concepts, the laws of chance are as certain as are *a priori* causes.

Thus, his physical laws that bodies have a natural motion and a natural position, that nature abhors a vacuum, etc., became rules of dogmatic faith and superior to observation. The method of Plato, Euclid, Archimedes, and Hipparchus was discarded and the physical sciences languished until they were awakened by the return of Copernicus and Galileo to the sounder method.

When we return to Aristotle, the biologist, we meet an entirely different person. As he himself says, he had to start from the beginning; and, after a long life of indefatigable labour, he left a great collection of facts regarding the animal world in which several hundred animal forms were described and classified. He points out that classification must be based on many parts and that internal similarities of structure were generally more important in determining species than outward resemblance of form. His great works on biology are, however, much more than a mere catalogue of the kinds and habits of animals. His *De Partibus Animalium* is really a treatise on comparative anatomy and comparative physiology, undertaken to establish how "far the existence and structure of each part are due to necessity and how far to design." He thus tries to show that throughout the whole animal kingdom the various parts have been constructed in order to fulfil a definite design; because of this purpose, similarities of structure must exist in different species and genera since they have many functions, such as digestion, locomotion, and propagation, in common.

Aristotle was keenly interested in problems of heredity and makes many acute observations in regard to the transmission of traits. He was acquainted with atavism, or reversion to a distant ancestor, and saw that a detailed study of the embryo was of importance in problems of heredity. Thus, he quotes from the collection of Hippocratic writings that, if on succeeding days an egg of a setting of chickens is opened and observed, we can learn the full history of the growth of the embryo of the chick and will find that the same process of development occurs in the embryos of other animals.

When he describes what he, himself, has observed he is extraordinarily accurate, but, as he was forced to depend also upon hearsay and on the observations of others, there are many false and worthless statements in his three great biological treatises. In common with the belief of his day, he thought many insects were spontaneously generated from putrefying earth and vegetable matter, and that others were generated in the insides of animals out of the secretions of their several organs. As he also expressly states that each kind of animal is begotten only by its own kind, he reconciles the two statements by supposing that insects spontaneously generated are imperfect species and, when so generated, the adult males and females produce offspring never identical in shape with the parents but something imperfect. For instance, lice, spontaneously arising from dust afterwards produce nits; and flies produce grubs.[14] He thus could reconcile his belief that animals are

[14] *Hist. Animal.*, V, 1; 539 b.

begotten only by like animals with spontaneous generation because he had no knowledge of the third stage of the larva which intervenes between the egg and the adult in most insects.

Throughout the whole discussion of Aristotle's biological work we find he is primarily attempting to illustrate the fundamental principle of design in the mind of the Creator of the universe. Because of this perfection of design: "We must postulate the principles we are accustomed constantly to use for our scientific investigation of nature; that is, we must take for granted principles of this universal character which appear in all Nature's work. Of these one is that Nature creates nothing without a purpose, but always the best possible in each kind of living creature by reference to its essential constitution. Accordingly if one way is better than another that is the way of Nature."[15] So every part of the body has some predestined function, and we may say that the soul is the function of the entire body for the organ is made for the function and not the function for the organ. Thus the heart is the seat of vital functions, the head of the reasoning functions, and so on. The principles by which the organs function are the four abstractions: heat and cold, moisture and dryness. And, however acute his observations often are, he is led into gross blunders by his attempts to apply these principles to the actions of the organism, as when he states that

[15] *De Incessu*, 704 b.

the lungs are bellows to cool the blood mounting from the heart to the head.

Not content with the admiration the accomplishments of Aristotle as a biologist awake in us, the historians of the evolution theory go much further. They make him the cornerstone of evolution—thus Osborn supposes that because "Aristotle believed in a complete gradation in Nature, a progressive development corresponding with the progressive life of the soul," we can examine, "how he put his facts together into an Evolution system which had the teachings of Plato and Socrates for its primary philosophical basis."[16]

If Aristotle had believed and had been able to give any reasons for believing in a system of evolution, he would have been more than a mortal man. To believe in a progressive development by the aid of gradual transitions from the imperfect to a more perfect type within a species is one thing; but to believe that the types of animals which he knew had developed from previous and different species of creatures which had passed out of existence is quite a different thing. The animals and plants which existed contemporaneously with Aristotle were the only ones which he knew or could know anything about, as he had no collection of fossil remains from which to derive inferences; the only exceptions were the mythological monsters

[16] Osborn, *From the Greeks to Darwin*, p. 48.

supposed by Empedocles to be the *sketches* of the creating force.[17] His perfecting principle of variation worked within the different classes, but he nowhere even suggests that one species of animal may evolve into another; in fact, he expressly denies such a transformation. Biologists are guilty of the frequent error of using the word, evolution, in two different senses and thus of fusing two ideas into one. As a modern hypothesis they mean by evolution a transmutation from one species to another; Aristotle is merely expressing what must have been common knowledge, the change or difference between parents and offspring.

In proof of this, let us turn to Aristotle's own ideas which he gives with the greatest care in his *De Partibus Animalium*:[18] "The best course appears to be that we should . . . begin with the phenomena presented by each group of animals, and, when this is done, pro-

[17] The fact that a knowledge of prehistoric or palaeontological fossils is necessary as a positive foundation before evolution, in its modern sense, would even be guessed seems almost self-evident. Without the evidence that types of fauna and flora once existed different from those existing now, what possible ground could there be for picturing a gradual succession of changing forms? Although the evidence of palaeontology will be treated rather fully, it is well to mention here that Darwin was attracted first to Lyell's Geology with its thesis of slow change; that he devotes four chapters in the *Origin of Species* to palaeontological and geological records; that on page 49, vol. II, he says "that the most obvious and serious objection to his theory is the imperfection of the palaeontological record"; on page 125, he claims that "he who rejects his explanation of the imperfection of the record will rightly reject his whole theory." If Darwin was so worried because the record is imperfect, is it likely that he would have thought it worth while to advance his theory or would he even seriously have considered it if he had had *no* palaeontological record?

[18] Book I, 640 a to 646.

ceed afterwards to state the causes of those phenomena, and to deal with their evolution. . . . Empedocles, then, was in error when he said that many of the characters presented by animals were merely the results of incidental occurrences during their development; for instance, that the backbone was divided as it is into vertebrae, because it happened to be broken owing to the contorted position of the foetus in the womb. In so saying he overlooked the fact that propagation implies a creative seed endowed with certain formative properties. Secondly, he neglected another fact, namely that the parent animal pre-exists, not only in idea but actually in time. For man is generated from man; and thus it is the possession of certain characters by the parent that determines the development of like characters in the child."[19] From our knowledge of Aristotle's fixed belief in a Creator who designs all created things for a purpose and who uses a perfecting principle in each kind of created things which will continually strive to make each class of objects as perfect as its kind will permit, we can at once understand that Aristotle's idea of evolution is change within the species corresponding to his knowledge that breeders could vary and improve domesticated animals within their species.

Passing on to the next point, that Aristotle held

[19] Book I, 640 a.

that organic bodies evolved from inorganic matter. He, of course, knew that the material parts of animals are made of inorganic matter, but that life was but an evolution of the physical elements and forces is quite contrary to his thought: "But if men and animals and their several parts are *natural phenomena*, then the natural philosopher must take into consideration not merely the ultimate substances of which they are made, but also flesh, bone, blood, and all the other homogeneous parts; not only these, but also the heterogeneous parts, such as face, hand, foot; and must examine how each of these comes to be what it is, and in virtue of what force. For to say what are the ultimate substances out of which animal is formed, to state, for instance, that it is made of fire or earth, is no more sufficient than would be a similar account in the case of a couch or the like. For we should not be content with saying that the couch was made of bronze or wood or whatever it might be, but should try to describe its design or mode of composition in preference to the material."[20] He then answers Democritus, who thought that form and colour constitute the essence of the various animals by saying: "And yet a dead body has exactly the same configuration as a living one; but for all that is not a man."[21]

We may conclude this discussion of Aristotle's

[20] 640 b.
[21] 640 b.

ideas and prove that he was in no sense an evolutionist, but that, on the contrary, he believed that each kind of animal was created for a definite and fixed purpose. He says that there are three degrees of composition. "The first in order is composition out of what some call the elements, such as earth, air, water, fire. Perhaps, however, it would be more accurate to say composition out of the elementary forces; nor indeed out of all of these, but out of a limited number of them, as defined in previous treatises. For fluid and solid, hot and cold, form the material of all composite bodies. . . . The second degree of composition is that by which the homogeneous parts of animals, such as bone, flesh, and the like, are constituted out of the primary substances. The third and last state is the composition which forms the heterogeneous parts such as face, hand, and the rest."[22]

This third heterogeneous part is that which constitutes the *living* animal, as distinguished not only from inorganic matter but also from the matter of the tissues, and it further distinguishes the different kinds of animals. "For generation is a process from a something to a something; that which is generated having a cause in which it originates and a cause in which it ends. The originating cause is the primary efficient cause, which is something already endowed with tangible existence, while the final cause is some definite

[22] 646 a.

form or similar end; *for man generates man, and plant generates plant*, in each case out of the underlying material."[23] But this elementary material substratum is of minor importance since the form or essence is derived from a like parent. Aristotle illustrates this by referring to a house which is not a collection of bricks, stones, and other material, but the idea or pattern of the house which exists in the mind of the builder, and the house is not transformable into any other thing constructed of like materials.

Both Plato and Aristotle had examined, and finally discarded the monistic philosophy of their predecessors and had developed in place of it a comprehensive dualism. They recognized a material and objective world obedient to physical or natural law, but they could not conceive of the origin of such law without a Creator; and as they saw in the world evidences of design and purpose, rather than the operation of mathematical chance, the Creator must also rule his creation. Thus, associated with the material world and distinct from it, there exists a realm of *ideas* governed by hyperphysical or spiritual forces. It is the highest function of the philosopher to distinguish these two realms and to show how the soul, as it were imprisoned in the body, is still a separate entity, superior to the body and directing it. While our knowledge of objective and of subjective phenomena

[23] 646 a.

comes to us in different ways, yet the facts of the mind are as certain as those of the sensations.[24]

After Aristotle's death, Greek thought gradually divided into the two schools of the Stoics and the Epicureans. In essence, both were a retrogression from dualism to a materialistic monism and a concession to our desire for unity and simplicity. As these two schools held the world of thought in allegiance well into the Roman Empire and exerted much influence on Christian writers, their ideas of science and evolution are very important.

[24] I have pointed out the frequent reference by historians of science to Aristotle as a founder of the doctrine of evolution. To me, this was an impossible assumption which I believe is due to a superficial knowledge of Aristotle's philosophy and to a misconception of his use of the words continuity, gradations, etc. It is fortunate to find my opinion confirmed by so authoritative an Aristotelian scholar as M. Clodius Piat. He quotes the following passage of Aristotle, *Historia Animalium*, VIII, 1, 588b, as the nearest approach to evolution to be found in his works: "The passage from inanimate to animate beings is so gradual that we cannot distinguish where their common limit is and to which of the two belong the intermediate forms. To the inanimate kingdom succeeds immediately the kingdom of plants. . . . The passage from plants to animals is equally continuous." He comments on this apparently explicit statement of evolution as follows: "Is this theory of Aristotle a first sketch of evolution? We might be tempted to believe so because of his manner of speaking of continuity and analogy. But we shall very quickly change this opinion, if we consider his fundamental ideas of metaphysics. The First Cause, being immovable, involves eternally the same efficiency, the same power of expansion externally as internally; consequently nature gives at once all that it is capable of giving: it does not advance by steps. It is not because the *ideal forms* do not tend to improve; of themselves, there are no immobile types, as others have often believed. On the contrary, they work always to deliver and purify themselves, to conquer some new degree of perfection; if nothing opposed their inner energy which pushes them onwards they would lose themselves by one leap into pure *Action*: there would remain only the thought of thought. But matter also exists which resists such love of the better; and this resistance holds the *ideal Forms* at the same point. Nature as a result can recreate anew the Forms which death has destroyed; it can repair only the losses." C. Piat, *Aristote*, Alcan et Cie., p. 158.

The Epicureans were materialistic monists without any reservations. They accepted and made more precise the atomic theory of Democritus. The earth and all the visible stars form but one of an infinite number of worlds, whose stuff is nothing but minute, indivisible, and eternal atoms which combine and separate according to natural law. Gods may exist, but, in agreement with many modern evolutionists, when they have created the atoms and have instituted physical law, their further intervention is unnecessary for the explanation of phenomena. Our knowledge of the Epicurean philosophy is mostly derived from the *De Rerum Natura* of Lucretius. In Book V, there is a highly poetic account of the creation which is the nearest approach to a doctrine of evolution in any classical writer. All forms of life spring directly from the earth; they appear as a succession from lower to higher species, but there is no suggestion of a mutation from one species to another.

The Stoics were also materialistic monists but of a less thoroughgoing type. They were very like Huxley in believing that the spiritual world exists as well as the material, but the facts and laws of the latter were to them, and to him, so much more comprehensible and certain that it was better to explain all phenomena of life as if they were mechanical. Matter and force are the only realities and are the two ultimate principles. But as matter is entirely inert all phenomena must be due to an active principle, force. Although the natural law is the only law, yet the beauty and orderliness of the world prove the existence of God. Then arises the unavoidable difficulty of making matter, at the same time, inert and active. After endless and profitless circumlocutions the Stoics reconcile the two antinomies by identifying God with the active force. The result is a pure pantheism in which matter is vitalized because God has implanted in it from the beginning a *ratio seminalis*, or rational seed.[25] Having once made a start, the cosmos develops according to natural law in succession of time. If the Stoics, and to a less degree the Epicureans, had known of fossils sufficiently to have imagined a science of palaeontology, there is little doubt they would have been true evolutionists, but the possibility of mutation from one species to another never even presented itself to their minds.[26]

Beginning with a purely animistic viewpoint, the Greeks developed and elucidated what are, in my opinion, the four possible types of thought which have persisted to the present day. First is the school

[25] This vivification of matter has been persistent in philosophy. Starting with the *logoi spermatikoi*, or *ratio seminalis*, of the Stoics, we find it in the *logos* of St. John, and today it is probably to be identified with the *évolution créatrice* of Bergson and the *entelechy* or perfecting principle of Driesch. It has its counterpart in science in the postulate of Newton that matter is inert but at the same time attracts through space all other matter. We shall probably never weary of trying to reconcile these two ideas of what may be called the static and the kinetic dualism of nature by rational means. It would promote peace of mind if we should simply admit that the problem is insoluble.

[26] For this survey of the doctrines of the Stoics and Epicureans I am greatly indebted to Überweg-Prächter's *History of Philosophy* and to my brother, Paul Elmer More.

of immaterialistic monism in which unity of the inorganic and organic worlds is sought by endowing matter with sensation or life. As modern examples, we may cite Spinoza, the classic type of pantheist, who developed his doctrine on purely rationalistic lines,[27] and Berkeley, the idealist, who held that the reality of matter lay in its perception by the mind; for a thing which is not perceived cannot be known, and that which is not known cannot exist. The second mode of thought is materialistic monism. Laplace, who is the author of the nebular hypothesis, according to which if we should know, at any time, the positions and motions of all the atoms then we could determine with mathematical precision the past and future history of the universe, and Haeckel, the biologist, who wished to reduce all phenomena of life to physical law, are well known examples. For dualism, we may cite Plato and Aristotle to illustrate the dualism of the philosopher who recognizes two sepa-

[27]Haeckel, in his fervour of advocacy of the monistic philosophy, apparently identified all monism with the mechanistic view, and overlooked entirely the fact that monism can be equally well attained by submerging materialism in pantheism or vitalism, a belief utterly abhorrent to him. In the following passage he does violence to Spinoza and Bruno by linking them with Democritus. "These first principles of the mechanical conception of the universe have been taught by the great monistic philosophers of all ages. Even Democritus of Abdera, the immortal founder of the atomic theory, clearly expressed them about 500 years before Christ; but grand Spinoza, and the great Dominican friar, Giordano Bruno, did so even more explicitly." *History of Creation*, Eng. trans., I, p. 22. Haeckel is only so far right in calling Spinoza a mechanist in that he was an absolute monist and rigorously excluded teleology. Emotionally he was a pantheist. But, you have precisely this same conflation of intellectual mechanism and emotional pantheism in the Stoics. There is simply no use in asking a monist to be consistent,—to be consistent is not a part of his philosophy.

rate realms and investigates their relations. As the fourth and last mode of thought, we can instance a dualism of the physical scientist. The two realms are here recognized as existent but the phenomena of life are excluded as not subject to scientific investigation. Newton and Lord Kelvin are eminent types. They maintained an attitude of piety and accepted the inspiration of the Bible as entirely consistent with a belief in a rigorous natural law in the physical world.

There is wide difference of opinion as to the value of the achievements of the Greeks in science. Their successes and failures can be distinguished best by keeping clearly in mind the two aspects of science. Before we can derive particular laws or generalizations from our data of observation, we must agree on certain fundamental ideas, or postulates, which are to be kept as few in number as possible. These postulates are deductive, or even intuitional; that is, they are not founded on experience, but they are true because the consensus of opinion accepts them and believes them to be necessary if we are to find any law and order in the world. A famous instance of such deduction is the postulate of geometry that the straight line is the shortest distance between two points, evidently a truth not based on experience.

There are certainly four of these deductive postulates in science which have a direct bearing on evolution. We must accept the conservation of matter.

Without it we lose all sense of identity and the history of an object is impossible if the material of it may disappear or reappear. No chemist can do more than find a rough approximation of quantities of matter with his balance. And even if he could attain absolute accuracy, the generalization would still remain a pure deduction because it must include the matter of the sun and stars which is absolutely outside our determination by measurement. The same arguments apply to the law of conservation of energy. Both of these ideas were recognized and stated accurately by Democritus. The third scientific postulate is the law of cause and effect which was best formulated by Aristotle. While the bearing of these three on biology is readily seen, the fourth postulate of continuity of all actions in time is perhaps the most directly applicable to evolution. This concept, which in physics is assumed to be true of all mechanical motions, takes the form in biology of variation as the origin of species instead of special creation. The significance of continuity in both space and time in organic phenomena was never fully appreciated by the Greeks; the clearest formulation by them of it is due to Aristotle and may be stated: Every organic form has a parent not only in *idea* but also in time, and there is variation within any species which the soul (*psuché*) of the individual effects.

These deductive laws are the real achievement of the Greeks in science. By themselves they are not sufficient; in order to find working laws which will classify phenomena, we must accumulate a great body of facts obtained from observation and experimentation, and we must measure actions quantitatively. By this method we establish the inductive laws which form what we now call scientific knowledge. The gas law is a good example of inductive reasoning; by experiments Boyle found that the quotient of the pressure by the density of a gas is always constant. This formula is the basis of calculations for all steam engines and could not have been found *a priori*. In biology, Darwin's law of natural selection and Lamarck's of the inheritance of acquired traits to be accepted must be the result of observation and induction.

The Greeks failed almost completely to accumulate scientific data, to formulate inductive laws, and to devise an adequate system of quantitative measurement. Without these, it is impossible to predict future events from generalizations of past experience, and such prediction is the function of science. To solve any problem in mechanics we must employ inductive laws, such as that of Least Action which specifies *how* the energy of any system of bodies will change under definite conditions and at the same time does not contradict the basic principle that energy is conservative. So, also, the belief that organic forms vary is of little scientific value until we can add to this principle the method, or mechanism, of evolution.

The method or mechanism, by which variations are accomplished, thus requires the inductive method based on observations showing that existing organic forms have a continuous ancestry, gradually changing more and more in form and habits as we extend backwards our period of time; the causes of these changes may be either natural or supernatural. But before a theory of evolution as we think of it at the present time, if we eliminate mere guessing, can ever be proposed we must have data not only of variations within the species but also from species to species and from genus to genus. Thus, a science of evolution requires as positive evidence a great store of fossil remains of animal and plant life which differ from existing forms. And we must arrange and classify these fossils in a closely related chronological series. The systematic collecting of fossils is then the first necessity; and the second is to develop the science of geology to such a degree of accuracy that we can use the conclusions of geologists to determine a time record showing when the organism which produced a fossil was living and imbedded in the stratum of rock in which it was found. We then have to rely upon the successive deposition of rock as the clock of the evolutionist who must consider the order and thickness of strata as the successive beats of the world-clock.

We must finally know not only that variation has occurred from generation to generation, but also the causes for variations in past generations and how these causes will proceed in future generations. No science is of much value unless from knowledge of the past we can predict the future course of events. If we should note accurately the path of a projectile for a part of its flight, what value would this knowledge have, if we were unacquainted how the force of gravitation would act to direct the remainder of its path? Our real interest lies in our ability to foretell where the projectile will continue to go. On this foundation, the biologist must build his theory of the causes of such variation and show the mechanism by which we may predict the characteristics of future forms. All this is the attempt of modern and not of earlier thinkers, and the discovery of those special or inductive laws is what distinguishes science from philosophy.

CHAPTER THREE

The Mediaeval Attitude Towards Science

With the collapse of Greek thought, we enter a long period of nearly eighteen and one-half centuries in which science and natural philosophy have practically no influence on thought. When the soldier of Marcellus slew Archimedes at the siege of Syracuse in the year 212 B.C., he not only took from the world the greatest engineer and physicist of ancient times, but he also by his deed symbolized the death of science itself. Rome, relieved of the fear of the Carthaginians, immediately turned her energies to the conquest of Greece. And while, as a tribute to the intellectual glory of Athens, an appearance of liberty was granted her citizens, their spirit and vivacity of thought were crushed. The world for the following seven centuries was Roman, and Rome in her entire history never produced either a philosopher or a man of science of true originality. The Roman youth either studied in Greece or was taught by Greeks at home, but the life of the mature man was one of affairs, and such time as he gave to letters was the period of leisure rather than of serious concern for the intellectual life.

A gradual dissolution of the original Roman fortitude and morals set in with the despotic splendour of the Empire. The thoughtless sought relief in gross materialism or tried to dull their apprehensions by cultivating the mystical religions of the Orient. In the ferment of the times, there appeared the new religion of Christianity which gradually permeated society from below and brought to its allegiance those who could find no satisfaction in life. Its power lay in the emphasis it placed on the inner peace of mind which comes from a virtuous and simple life, and in the hope of immortality by a communion with the miraculous divinity of Jesus. While the spread of Christianity was undoubtedly to be the greatest factor in the regeneration of European civilization, it is equally true that its success added a spirit of active hostility to the indifference of Rome towards the investigation of natural phenomena and law.

We may roughly trace the periods from the downfall of Greece to the renaissance of science. We first note an interval of decline of scientific inquiry which lasted for three centuries owing to the indifference of Rome. Interest is limited to the cultivation of the mathematical sciences in the school of Alexandria which, besides a number of men of ability, produced two of great originality and power—Hipparchus (160-120 B.C.) in astronomy, and Hero (170-117 B.C.) in physics.

Beginning with the second century after Christ, the attitude towards science became increasingly influenced by the absorption of the Christians in the idea that the study of natural phenomena was not only a matter of little import, but was to be avoided as likely to turn attention from the religious life which had come to be dependent upon a separation from the world and a preparation for an immortal existence. In the period of the Christian Roman Empire, philosophy is engrossed with the reconciliation of the dogmas of Catholicism with Greek thought. There is but one name, that of Ptolemy (A.D. 128-168) which means anything in science.

The end of the ancient culture can be placed as coincident with the successful inroads of the barbarians about the year 500. The intellectual life of Europe faded to the merest glow, and the effort of Charlemagne, in 800, to suppress anarchy and to restore the solidarity of the Roman Empire could not prevent the two following centuries from sinking into a state of apathy and despair, which has significantly given to them the title of the Dark Ages.

With the year 1000 there began a real revival of thought and hope which found its expression in the religious life and in art. At its height, in the twelfth and thirteenth centuries, the beauty and mysticism of this movement can be typified by the life of St. Francis of Assisi. And, suffering no eclipse in its onward sweep towards a new culture and civilization, Europe, led by Italy, burst into that full flower of the Renaissance which has made the fifteenth and sixteenth centuries in many respects the most fascinating and the most glorious in human history.

After the long and sterile interval of eighteen hundred years from the death of Archimedes, the spell is at last broken by the founder of modern science, Galileo, a youth of twenty years of age who was then beginning that career which not only surpassed individually the achievements of the Greeks but became the symbol of the new inductive philosophy. The barrenness of those centuries requires no further comment when, to the three names already mentioned, we need to add only Roger Bacon (1214-1294), Leonardo da Vinci (1452-1519), and Copernicus (1473-1543). The other names preserved on the rolls of science are those of men who have the high credit of composing the thin line of scholars who carried on the tradition of learning but who themselves added but little of permanent value.

If it be correct to define the spirit of the Middle Ages as one dominated by the religious idea, there are sufficient grounds for beginning the period, from this point of view, with the Council of Nice. The Christian Church, at last supreme in the Roman Empire, established then its fundamental dogma and initiated its ecclesiastical and civil polity. The spirit of Greece with its keen interest in human affairs was condemned, and in its place there was adopted the cardinal thesis that man had lost his fellowship with God through the sin of Adam and had been redeemed by the vicarious sacrifice of the Son of God. Salvation depended not on his own efforts but on repentance from sin as shown by a holy life and by communion with Christ. The aspiration of the pagan had been to live as full a life as possible, undisturbed by hope or fear of future reward or punishment; the attention of the Christian was now to be directed solely towards preparing for a future and immortal existence. This world and our carnal life thus became a purely transitory state likely to interfere with the purpose of God at the creation. The highest ideal was a life of pious meditation to save one's own soul and of exhortation and charitable works in order to induce others to turn to the godly life. Truth was to be found in the direct revelation of God as first given in the Bible and continued in a living and infallible Church, and was expressed mostly by miracles and not by observation and reason. The very object of life had become fundamentally antithetic to the scientific spirit, and St. Thomas Aquinas can declare that the desire to know phenomena was a sin in so far as it did not tend to a knowledge of God.

The attitude of the religious thinkers towards phenomena of both the organic and inorganic worlds ranged from indifference to bitter condemnation. Even the most tolerant of the mediaeval philosophers regarded the study of worldly affairs as useless and a waste of the precious and brief time granted us to prepare for judgement, and they limited their discussion of natural phenomena to an attempt to reconcile them with Holy Writ. The majority were hostile because the asceticism which had early been introduced into Christianity from the Orient carried with it the conviction that the world itself was evil and was under the rule of the devil, the personification of evil. The mediaeval attitude of mind can be strikingly summed up in that exclamation of St. Augustine, himself one of the most liberal and profound of the Fathers: "God and my soul will I strive to know. And nothing more? Absolutely nothing."[1]

It seems to me, to say the least, quite unscientific to condemn the Middle Ages for neglecting science and putting their whole intellectual energy to the problem of leading a completely disorganized society into a new civilization by developing the religious idea rather than the rational method. If natural law is supreme, as science assumes, then men, as well as other animals, must develop according to destiny, or as the result of preceding acts of nature, and they cannot choose the path of their development. And yet modern scientific criticism is directed against the Middle Ages on the ground that the ecclesiastical power deliberately crushed the study of science and persecuted those who would persist in cultivating science in spite of this oppression. Possibly, for the sake of propaganda it was necessary, during the height of the Darwinian movement in the last cen-

[1] Augustine, *Soliloquia*, I, 2, n (7). "Deum et animam scire cupio. Nihilne plus? Nihil omnino."

tury, for the Evolutionists to use the same method of repression, I might say of bigotry, against the religious idea,—although this repression took the form of logical rather than of corporeal restraint. At any rate, the Evolutionists expressed unqualified contempt for the Middle Ages because of a lack of interest in science and of submission to the religious idea, and did not hesitate to apply the verbal whip of scorn to their contemporaries who still believed in the miraculous and opposed the dominance of science.

Leaders of the scientific movement, such as Huxley and Haeckel, condemned the centuries before the Renaissance as a futile and wasted period when the mind was held in ecclesiastical bondage. The historian, Buckle, fascinated his readers with the thesis that civilization was the result of natural and economic causes and that, to attain a worthy state, we should study the supply of corn and rice rather than the impulses of men; and Draper pictured society as perpetually engaged in a mortal conflict between religion and science in which the latter always displayed the banner of truth and was always the ultimate victor. Such a view of society may have been advisable as propaganda, but at the present time the Evolutionists are finding this inheritance decidedly embarrassing. If civilization is the result of a slow but steady progress, then even the Middle Ages, which brought men to an exalted religious state from a spiritual chaos, should have an honoured place in a human evolution which includes both the physical and ethical sides of man, and historians are now keen to find rationalistic tendencies where they would be least expected.

While it is quite true that the centuries preceding the Renaissance are barren so far as scientific discoveries are concerned, there is little, or no, evidence of a definite and organized opposition to science by the Church. In fact, there was little need for repression when the general belief was that both observation and reason were the source of error rather than of truth.

When the fall of the Roman Empire broke society into fragments, the only remaining unity and peace was to be found in the Church and it was inevitable that the attempts to restore order would be first centred on the task of converting the barbarians. And by their conversion, nominal as it may have been, some little humility and some regard for peaceful living could be instilled into the rude minds of the people. It was also natural that the revival of learning would be first in the field of religion. What little science there was from the twelfth to the sixteenth centuries was limited almost entirely to alchemy, astrology, medicine, and a very desultory interest in mathematics. With the exception of mathematics, even these sciences were not cultivated from the desire to acquire a knowledge of nature, but to discover the influences of the stars and chemicals on the spiritual and natural fortunes of men, and to relieve them from disease and death. In the popular mind and even, frequently, amongst the learned, such studies were held to be allied to magic and the black arts; the masters of these sciences were often either Arabs or Jews who were execrated as damnable heretics and against whom the Christians, in their crusades, found the only sufficient cause for any general unity of action. Far outnumbering the genuine seekers of knowledge, charlatans infested society and claimed to know how to find the philosopher's stone and to transmute lead into gold, or to tell fortunes by the stars. Civil and ecclesiastical rulers frequently maintained alchemists and astrologers in their courts in order to obtain material and supernatural advantages from their skill, and at the same time feared and detested them lest these advantages should be reaped at the risk of their own damnation.

There is no evidence of organized opposition to the sciences themselves, as shown by edicts of the Church, until the twelfth and thirteenth centuries when the power of the ascetic monkish orders was at its height. Even then, we find none against the study of mathematics because it was regarded as purely a mental exercise and did not concern man's place in this world or his relation to God. Both the Church and the University of Paris strictly forbade the study and teaching of physics because that science was based on the atomic theory and the principle of natural law; both of which were held to be heresies and contrary to revelation. No restrictions were placed on biology and geology; they were not even mentioned for the simple reason that there were no such sciences. The Church did forbid human dissection, but that was because the body was looked upon as the temple of God and should not be desecrated.[2]

Much emphasis also has been laid on the persecution of men of science and of learning. We certainly cannot cite the universal and alternate use and abuse of the Arabian and Jewish astrologers and alchemists as proof of such persecution, as that was the result of racial and religious antipathy. Evidence of repression before the Renaissance rests mainly on the treatment of Roger Bacon, and one gets the impression, even in his case, that the opposition of the Franciscans which resulted in his imprisonment was mainly personal antagonism playing on the superstitions of the peo-

[2] Lasswitz, *Geschichte der Atomistik*, vol. I, p. 13: "They were convinced that the atomic theory of Leucippus and Democritus tended to atheism, and that when it was joined to the philosophy of Epicurus it became an aid to the damnable doctrine of materialism." p. 86: The reading of natural philosophy was forbidden in 1210 by the Provincial Council at Paris, and also by a statute of the University of Paris in 1215. This decision of the Provincial Council was ended by Pope Gregory IX in 1231, except for such writings as could be proved to contain error. Also the ban of the University of Paris against the works of Roger Bacon lasted only until 1237, and in 1254 the physics as well as the metaphysics of Aristotle are listed in the courses of the University. In 1245, the Dominicans forbade the study of physics by members of their order. Lasswitz clearly shows that the objection to physical science rested on the early conviction that its atomic theory was materialistic in philosophy and it would be difficult to prove that it is not. Yet, even then, restrictions on the study of physics by the Church were of very short duration. It is quite certain to me that men of science have greatly exaggerated repressive measures by the Church.

ple. Bacon, himself, was a Franciscan and his *Opus Majus* is not only a marvellous storehouse of information and a treatise on science far in advance of his day, but it is also interspersed with bitter, and probably just, attacks on the vices of his own Order. We can, at any rate, place to the liberality of the Church the fact that Pope Clement IV ordered his release from prison after he had read the book.

The burning of Giordano Bruno in 1600 is often cited as an example of the prevailing attitude of the Church towards science. While it was a futile attempt to crush heresy, science was not in the least involved, as Bruno was in no sense a man of science. The most celebrated case, of course, is that of Galileo. But even here, Galileo had aroused personal enemies by incessant attacks of the most bitter sort on the Jesuits. Not content with the convincing nature of the scientific discoveries which came from his fertile mind, he used his proofs of the Copernican theory as a weapon against the dogmas of the Church, and he wrote his *Dialogues* with a pen dipped in vitriol. And it is true, as Kepler is reported to have said, that the theory had quietly been gaining ground unmolested for eighty years and had found support amongst many of the more enlightened of the ecclesiastics. His trial was the personal reply of the Jesuits, his enemies, rather than an attack on science. And one is rather struck with the reluctance of the Popes to bring the question to an issue.

For an estimate of the attitude of the Middle Ages towards science to have any sound basis we must keep clearly in mind the postulates upon which the body of thought of the times rested. The dominant influence was undoubtedly the religious idea. Until the Protestant Reformation, the interpretation and direction of this idea was confined to a single homogeneous Church whose decisions did not rest on the fallible opinions of man but on the absolute truth as revealed by an omnipotent and omniscient God. This body of truth consisted of the books of the Bible, which had been accepted at the Council of Nice, and on the later dogmas of the Church. The influence of the Bible thus became enormous as a guide both to the spiritual problems of life and to the interpretation of natural phenomena. The men of science, with few exceptions, strove to reconcile their observations and laws with the Mosaic cosmogony so that natural philosophy gradually came to be an exposition of this primitive conception of the world glossed with the philosophical principles of Aristotle and Plato which, because of their emphasis on teleology, lent themselves to this conflation of Greek philosophy and Christian ethics. For this reason, the early conceptions of the Jews brought a new element into thought, and a people who were themselves singularly indifferent to science became the arbiters of the scientific method. The essence of Jewish thought, as shown in the Bible, is to exemplify the existence of a personal

God, who may establish law, but who may and does set it aside, and who depends on the miraculous rather than on law when transmitting His will to men.

The date of the Book of Genesis is not known, but it is believed that the earliest portion goes back to the ninth or tenth century before Christ, and that there is mixed with it the narrative of a somewhat later chronicler. The story of the creation, as we have it, is the work of a compiler who drew his material from both of these earlier sources and is supposed to have been written about 700 B.C. The earliest ideas in the text are thus fairly contemporaneous with the Homeric poems. One cannot but be amazed at the difference between the two conceptions. The Greeks were still in the period of pure mythological animism, but in the mind of the prophet of Judah the world is the act of a single creative spirit. Inorganic phenomena are not personified and living forms are brought into existence according to a pre-ordained classification in species. The final and crowning act of the creation was man, fashioned from the dust and endued with a portion of the divine spirit in order that he might comprehend the work of God and govern all other living forms which had been created for his use and for the glory of the Creator. While there is an undoubted denial of the transmutation of species, there is a quite remarkable sequence in the order of creation of the various types of forms which, by a guess or by an acute perception of relationship of form, agrees with the succession according to modern evolutionists. There is first the appearance of land and water; then follow in order the vegetable world, fish, birds, land animals, and lastly man.

The Judaic author is an unqualified pluralist in his separation of the organic from the inorganic, and the former has in addition a spiritual nature. It is customary for the rationalist to sneer at the crudeness of this conception of the creation, but if it had not been forced upon him as a literal statement of fact and had not been used as the chief argument against evolution, the criticism would be puerile; especially so, if the creation according to Empedocles is held to contain the germ of transmutation. There is, indeed, little to choose between these two accounts as rational ideas, for they both are the imaginative guesses of unscientific minds, except that Empedocles is grotesque and the Biblical account is not. The real difference between the two lies in the fact that the Greek legend does not specify time, while the Jewish chronicle states that the creation was a matter of six days and then gives a list of patriarchs and their genealogy. From these tables attempts were early made to fix the exact date of the creation; the accepted date of 4004 B.C. was finally calculated by Bishop Ussher in the seventeenth century. The method of determining this date was the same as that used by geologists to determine the length of geological periods and the age of the earth; the attempts of the timid who would now reconcile Biblical narrative with evolution by taking the week of creation as a figurative expression for the long lapse of geological periods can satisfy neither side. On the other hand, while there is in the extant poems of Empedocles no mention of time, there is also no warrant for the claims of the evolutionists who see in his cosmogony the germ of transmutation and who have allowed their own bias to lead them out of the path of scientific procedure as surely as those who vainly try to reconcile the Bible and science.

Before closing this discussion of the attitude of the Middle Ages towards science we must pause for a moment to discuss the opinions of St. Augustine, not because he departed from the general belief which, in fact, he had done much to form, but because of all the Christian Fathers he is looked upon with most favour by historians of evolution. We have already referred to the statements of Haeckel and Conklin regarding him as being without foundation. Unfortunately, two of the most popular histories of evolution—*From the Greeks to Darwin* by Osborn, and *Biology and its Makers* by Locy—are so palpably mere unverified compilations that they are certain to give students of biology a quite erroneous view of evolution. Osborn, with facile superficiality, quotes with approval the opinion of Aubrey Moore that: "Augustine distinctly rejected Special Creation in favour of a doctrine which, without any violence to language, we may call a theory of Evolution."[3] He also quotes from Cotterill as support for the evolutionary bias of Augustine: "We observe that both the language itself and, yet more, Augustine's profound sense of the impossibility of representing in the forms of finite thought the operations of the infinite and eternal Mind compelled this great theologian to look beyond the mere letter of the inspired history of Creation, and to indicate principles of interpretation which supply by anticipation very valuable guidance, when we compare other conclusions of modern science [the evolutionary theory] with this teaching of Holy Scripture."[4] Osborn's own opinion of Augustine is that: "He thus sought a naturalistic interpretation of the Mosaic record, or potential rather than special creation, and taught that in the institution of Nature we should not look for miracles but for the laws of Nature."[5]

[3] Moore, *Science and Faith*.

[4] Henry Cotterill, *Does Science Aid Faith in Regard to Creation?* London, 1883.

[5] Osborn, *From the Greeks to Darwin*, p. 72. As another example of his inaccuracy, he says of John Scotus Erigena on p. 74 that he "simply borrowed from Aristotle and Augustine." Now it is well-known that Erigena was a neo-Platonist; that he translated the pantheistic writings of Dionysius Areopagiticus; that he advanced an idealistic theory of atoms; all of which are quite opposed to Aristotelianism. Osborn could have learned from so readily accessible a source as Überweg-Baumgarten that John Scotus was only indirectly acquainted with the metaphysical teachings of Aristotle although *traces* of Aristotelian influences are to be found in his works. The suspicion might be entertained that Osborn has confused John Scotus with Duns Scotus who flourished nearly five centuries later. While Duns Scotus is known as the greatest critical opponent of Thomas Aquinas, he was much more affected by Aristotle than was the earlier Scotus.

If these are the real opinions of the historians of biology, we can only hope that they are better acquainted with modern biology and science than they are with Augustine and the Middle Ages. Against the statements of these writers we may place the conclusion of so exact a scholar as Lasswitz that: "In the mind of Augustine the *miraculous* overshadowed all; it came to pass at the creation of the world; it was completed in the life of the Saviour; and it is experienced daily in the soul of the Christian, which feels itself redeemed by the grace of God. Why then should one be at pains to give a detailed interpretation of the wonders of nature? Leave that to the heathen!"[6]

To estimate Augustine's attitude towards science we must keep constantly in mind his purpose of life. His engrossing aim was to induce the world to repent and to lead the religious life. He was not a philosopher engaged in elucidating abstract principles; he was first and last a priest exerting all his powers to influence men to choose the Christian rule of conduct, and he used philosophy only as an aid to his purpose. He, for the most part, embraces the philosophy of the Stoics because it was the most influential of the contemporaneous schools of thought, and because the principles of conduct of the Stoics most nearly resembled those of the Christians. This accounts for those vague statements which can be taken to favour

[6] *Geschichte der Atomistik*, vol. I, p. 29.

the idea that God created the actual world from potential seeds, or the *logoi spermatikoi*, of the Stoics, and which these historians have erroneously interpreted to mean progressive and naturalistic development. Augustine also began as a Manichaeist and thus held less strongly to the literal interpretation of the Scriptures as an infallible statement of natural phenomena. He was liberal enough to warn Christians not to try to controvert the statements of the heathens in regard to obviously true facts of nature by quoting the Scriptures which must be held to be authoritative only in ethics. Although he was a Stoic in philosophy he added nothing to their doctrine and he was quick enough to part company with them in their most important belief in the atomic theory as he saw that this view of nature tended inevitably to materialism. In his *Letter to Dioscurus*, he pronounced the keenest criticism against the atomic theory which has ever been written: "The bitterest of all these follies lies in this, that the mere statement of it does not suffice, without any argument, to arouse horror. On the contrary, men of great ability have undertaken the task of carrying out extended arguments of things whose mere mention prove them to be silly. When one assumes atoms to exist; when one assumes that they meet and separate in chance collisions, so also one must assume that these mutually colliding atoms affect a thing to determine its existence, to limit its form, to determine its surface, deck it with colour, and enliven it with a soul. But all this can happen only by the art of a godly thought, as any one can grasp who sees with the spiritual rather than with the material eye."

While Augustine may use the idea of nature and natural law, and may question philosophically many things, he never hesitates to postulate the existence of a living personal God who is external to natural law and constantly contravenes law by the employment of the miraculous. His conception of the relations of God to the world is that of the governor of a city towards its inhabitants. If any one had put the question to him that by a law of nature an ape had descended from a fish he would have repelled the idea as inconceivable; the statement that a man came from an ape would have been sheer blasphemy.

There is, however, little need to comment on one who has left so clear and full a statement of his beliefs. Augustine accepted the Mosaic cosmogony literally with very few and insignificant reservations. The evolutionist can get little support from his words which I have taken from the *City of God*.[7]

God who made the world has made it so that all things are admirable, and the beauty and order show its divine authorship (*De Civ. Dei*, XI, 22). If we ask who made it. The answer is God. He also made it out of *nothing* and He made it because it was good (*ibid.*, XI, 21). All things were made in six days as revealed to Moses. Not only terrestrial things

[7] St. Augustine, *The City of God*, trans. by Rev. Marcus Dods. T. and T. Clark, 1888.

but also the angels were created at that time. Although it is not explicitly stated on which day the angels were created, we are justified in understanding that they came into being when God said: "Let there be light." And when God separated light from darkness, he divided the pure angels from the impure ones who now live in darkness (*ibid.*, XI, 9). What kind of days these were it is difficult, and perhaps impossible, for us to conceive, and how much more to say (*ibid.*, XI, 6). The human race began with one man whom God placed in Paradise. He was created upright but was corrupted by his own will and begot corrupted and condemned children (*ibid.*, XIII, 12 and 14). They are deceived who, like Apuleius, hold that individually a man is mortal but that the race is immortal. They are deceived, too, by those highly mendacious documents which profess to give the history of many thousand years when, reckoning by the sacred writings, not six thousand years have yet passed (*ibid.*, XII, 10).

How lightly the Stoic philosophy was regarded by Augustine in comparison with what he regarded as the miraculous revelation of God in the Holy Scriptures can be understood by the readiness with which he discarded one of the fundamental doctrines of that school: "The belief, that, after its destruction, the world is renewed and that all events repeat themselves in successive cycles of time, is altogether false; Christ has died only once and will not again enter into the bonds of death, and we shall in the future be eternally in the presence of God" (*ibid.*, XII, 13 *seq.*).

In passing from the Middle Ages to the Renaissance, we should keep in mind what Pater has so sympathetically expressed as the spirit of the age: "The word Renaissance, indeed, is now generally used to denote not merely that revival of classical antiquity which took place in the fifteenth century, and to which the word was first applied, but a whole complex movement, of which that revival of classical antiquity was but one element or symptom. For us the Renaissance is the name of a many-sided but yet united movement, in which the love of the things of the intellect and the imagination for their own sake, the desire for a more liberal and comely way of conceiving life, make themselves felt."[8] And he finds the roots of this great outbreak of the human spirit reaching far down into the Middle Ages themselves when, then at last, began the care of the human body and the love of beauty which should ultimately break down the limits that the religious domination had imposed on the heart and the imagination; the new-born spirit, finally freed from ecclesiastical authority, showed itself by that marvellous efflorescence in art, literature, and erudition. Although many contributory causes for the Renaissance may be found, and sociologists may try to trace it as a progressive evolution, this complex movement still remains a mystery; if it be an evolution, then there must have happened one of those rare cases when, with suddenly aroused energy, Nature takes a leap and forsakes the slow and painful gradations of change. We may admit and add together such contributory causes as

[8] Pater, *The Renaissance*, p. 2.

these; the Italians awoke to the power and beauty of classical antiquity with the acquisition of Greek and Roman manuscripts; the new and amazing geographical discoveries exalted the imagination; the crusades had brought strange stirrings for freedom; and the vigour of the human body was capable of great draughts on it of both work and pleasure; but we can have all these, and they, apparently, might have contributed just as readily to a cultivation of material despotism, to luxury, to pleasure, and to gross wantonness. It is true we find all these baser characteristics; young men, like Pico della Mirandola, almost wearied out from "wandering over the crooked hills of delicious pleasure" because they had loved much and had been beloved by women; yet we find also that these same young votaries of pleasure swiftly climbed the rugged hills of thought and art. So, too, we fail to understand how men like da Vinci could combine life at a luxurious and wanton court with an inexhaustible, unrivalled thirst for knowledge and art.

Much emphasis might be laid on the indirect influence which the revival of literature and art during the fifteenth century exerted upon the later development of science. The assurance which came that life was in itself a noble thing, that the cultivation of intellectual powers was not destructive to the soul, and that admiration of physical perfection was not antagonistic to the search for spiritual beauty,—all these influences must have had a powerful and lasting effect in directing attention to natural phenomena and to man's place in nature, but our concern is rather with the more direct impulse given to biology by the rise of modern physics.

The scientific Renaissance came last, and began with an aroused interest in pure mathematics; it next turned to astronomy; and then to mechanics. This order is a natural and almost inevitable one. These sciences are the most abstract, and they are the least dependent in their early development on the use of apparatus which at the time was not available. Biology, as a science, hardly existed before the middle of the eighteenth century. What interest there was in the investigation of animal and plant life was confined to physicians, and was limited to medicine, anatomy, and a little physiology; but the rapid advance of the physical sciences prepared the way both for biology and evolution. They promoted liberalism and taught men to rely on observation and reason, and thus broke the domination of the Church. They early developed an adequate supply of instruments of precision, such as the telescope and microscope, and they discovered and used freely the inductive scientific method. Thus, when the time was ripe, biologists found the ground fully prepared for their science. They could use the method and results of the physical sciences as a basis for their new science and almost immediately they attempted to ally it to the mechanistic theory.

Towards the end of the sixteenth century the rigid bands restraining scientific thought began to show signs of weakness and to give way under the pressure of the new freedom. The credit for the rupture belongs to two men, Copernicus and Galileo. In 1543, Nicolaus Copernicus published his treatise *De revolutionibus orbium coelestium* which was destined to change our whole point of view towards the universe. His postulate was simply that the sun should be taken as the centre of the planetary system and that the earth, instead of being a fixed body about which all the celestial bodies revolved, was merely a planet like the others with two motions, an annual revolution about the sun and a diurnal rotation about its polar axis. At first, the Church received this work without opposition, and in fact the Pope, Paul III, permitted it to be dedicated to him. Perhaps its significance was not appreciated, because the author, in a preface, states that this new system was devised to reduce the labour of computation of planetary orbits; whereas, the reality was according to the Bible and the ecclesiastic doctrine of geocentrism. There has been some controversy concerning this subterfuge as to whether it was due to Copernicus; it is probable that it was interpolated by Osiander as a thin veil to ward off danger, not, however, to the author who had died before his treatise was printed. Amongst the ardent believers in the new system was Galileo, and in his hands the veil was rudely torn away and the system brought forth boldly as a fact. Armed with the new telescope which he had invented, he discovered the libration of Venus and the moons of Jupiter. By the first discovery he proved that the planet was not made of celestial substance, as was firmly believed by the Aristotelians, since it shone only by light reflected from the sun and, also, that it revolved about the sun. By the second discovery he brought out the astounding fact that there existed celestial bodies invisible to the human eye.[9] In the opinion of the day the existence of invisible stars was flat heresy and contrary to Holy Scripture. The stars were made for man, that the glory of the firmament might be a constant sign of the power of God; and would it not be accusing God of folly or deceit to suppose He had made stars which we could not see? Glowing with the pure, celestial fire which was also symbolical of the soul, and being made by God, they could neither be added to, nor destroyed. Comets and other trans-

[9] Galileo also discovered sun-spots which were an impossibility according to the Aristotelian conception of the purity of the celestial substance. The Jesuit Father Christopher Scheiner was rash enough to claim priority to Galileo. When he communicated his discovery to the Provincial of his Order, the latter replied: "I have read Aristotle's writings from end to end many times, and I can assure you I have nowhere found anything similar to what you describe. Go, my son, and tranquillize yourself; be assured that what you take for spots on the sun are the fault of your glasses, or of your eyes."

itory stars which occasionally burst into brilliance and then faded out of sight were explained to be luminous exhalations from the earth or mocking bodies created by devils.

Galileo gathered together all his evidence and published his great treatise, the *Dialoghi delle due massime systeme*, in which he contrasted the Ptolemaic and Copernican systems and proved with irresistible arguments that the latter is an actual representation of the solar system. But the work was much more than an impersonal presentation of scientific facts. It was a passionate plea for the recognition that truth was to be obtained from observation and reason and not from the authority of either the Bible or Aristotle. In order to drive home his argument he attacked bitterly and personally the Aristotelian philosophers and the Jesuits. The Church finally saw clearly the danger to its authority and, after a long controversy, Galileo was brought before the Inquisition; when, upon his formal recantation, a light sentence for the time was imposed upon him, his book was suppressed, and the doctrine that the earth possessed two real motions was declared to be a damnable heresy. The effect of his trial and condemnation, which struck at the scientific work then beginning to show great vigour, was widespread. In Holland, Descartes had just completed his mechanical theory of the universe. When the news reached him, he contemplated the destruction of his work, but he finally published it with the subterfuge that his ideas were purely imaginary, as the true cosmogony was that revealed to Moses.

The trial and condemnation of Galileo is one of the *causes célèbres*, and, even today, it arouses bitter comment. After making every allowance for personal provocation, the trial was a colossal blunder. It would have been wiser to have followed the advice of St. Augustine not to oppose obvious facts with the authority of the Scriptures. Instead of crushing the new rational movement, it strengthened the determination to expand the work and to oppose the authority of the Church. In all controversies between religion and science since then, it has been the rallying cry of the rationalists who have pointed to it as an example of what the religious would always do if they had the power. It was used most effectively by Huxley in combating attacks on Darwinism. On the other hand, the attitude of many modern writers on science is quite unjustifiable when they give the impression that the Church was persecuting an innocent and inoffensive old man. It is quite certain that Galileo intended his work to be a bitter polemic against the most cherished convictions of the world, and that he drove the authorities at Rome to action by his caustic and domineering temper which never neglected an opportunity to cover the Jesuits and Aristotelians with ridicule.

Even after he abjured his heresy, Galileo continued his scientific work and at the end of his life, during his retirement, he published his second great treatise, the *Dialoghi delle nuove scienze*. The effect of this work was even more profound than the former, as he here clearly established the inductive method as one dependent on observation and reason. He laid the foundation of the science of mechanics which, when completed by Newton's discovery of the law of universal gravitation, has developed into the only complete and satisfactory exemplification of the inductive method. This mechanical theory, according to which phenomena are due to the positions of bodies and to the force of attraction between them, became the goal, as an explanation, of all physical phenomena, and today it is the basis for the attempt of biologists to explain life as a manifestation of mechanical energy. Its most complete expression is the nebular hypothesis of Kant and Laplace which as a form of inorganic evolution prepared the way for the later doctrine that life is also progressive.

The earliest attempt to adapt the mechanistic theory to an explanation of the universe was made by Descartes. He first identified substance with space and then considered space itself as a continuum which later became the model for the luminiferous aether. The varieties of matter and of phenomena, he attributed to different forms of vortical, or whirling, motion in this continuum.[10] This theory, so far as inorganic phenomena are involved, is a pure monistic doctrine,

[10] For the details of the Cartesian cosmogony the reader may refer to the chapter on the subject in my *Limitations of Science*.

and Descartes, in a tentative way, even attempted the explanation of life on the same basis. He advanced the idea of animal automatism, according to which the motions and sensations of animals are the result of mechanical stimuli and not of intelligence and will. He even asserted that animals, being machines, felt no pain. This part of his theory fell dead until it was revived by Huxley who, rather as a *tour de force*, instanced a number of experiments to prove that many organic actions are automatic. Huxley's revival of Cartesianism was apparently for the purpose of propaganda, to lead others to adopt the monistic theory, or at least to discredit the total separation of the organic from the inorganic. This opinion seems probable because Huxley himself goes only to the brink of monism and then draws back with the declaration that he believes in a separate spiritual world; only, as he cannot understand spiritual phenomena, he will reason as if they do not exist. Descartes thus extended the principle of mechanistic monism from the inorganic world to include plants and animals; but, at this point, he made a break by adding a soul to man, just as Huxley proposed a break in natural evolution at the point when man attained self-consciousness and the power of inhibition. It is not an arbitrary assumption to harmonize thus the *soul* of Descartes and the *self-consciousness* of Huxley. In fact, we can be certain that somewhere in the argument of the monist, he has slipped in a factor which cannot be identified with matter or mechanical force. That convenient assumption of the *logoi spermatikoi* still plays its part in modern biology to fool us under various new names; disguise it as one may, matter somewhere in the chain of reasoning loses its mechanical inertness and acquires a non-mechanical vitality.

Of all the leaders of the revolt against the mediaeval attitude, Francis Bacon saw the most clearly that an attack against the authority of the Church could be waged most effectively by first overthrowing the reign of the classical deductive philosophy. If the mind could be weaned from its awe and reverence for antiquity, then only there would be a chance of substituting the new scientific, or inductive method. With the grandiose plan in his mind of reviving the intellectual life according to a new philosophy, he projected his *Instauratio Magna* which was to embrace all human activity. He did actually publish, in 1620, the part in which the fruits of the understanding were set forth. The title of this part, the *Novum Organum Scientiarum*, is in itself a challenge to the *Organon* of Aristotle. All through his plea for the new knowledge there runs a comment warning his readers: "That the reverence for antiquity and the authority of men, who have been esteemed great in philosophy and general unanimity, have retarded men from advancing in science and almost enchanted them. . . . The Greeks were a vain and disputatious people, the desire to shine, the taste for dispute, hastiness to arrive at conclusions, the mania for systems of thought, multiplied error. . . . Plato was a man of sublime genius; he even knew the proper method, but he applied it badly. . . . Aristotle, that great man, was certainly also a great philosopher. In his writings he was painstaking and exact, but, a Greek, he was too prompt in deciding. . . . Plato subordinated the world to ideas and Aristotle, ideas to words. The one corrupted science by theology and the other by dialectics, as later Proclus did by mathematics."

Bacon stated the proper method of scientific procedure in these excellent terms: "For man, being a member and interpreter of Nature, acts and understands so far as he has observed of the order, the works, and the mind of Nature, and can proceed no further, for no power is able to loose or break the chain of cause, nor is Nature to be conquered, but by submission. . . . And, thus, we hope to establish forever a true and legitimate union between the experimental and rational faculty, whose fallen and inauspicious divorces and repudiations have disturbed everything in the family of mankind." He believed that knowledge can be advanced only slowly by the unsystematic efforts of individuals who work according to their personal impulses and frequently experiment in order to verify a preconceived hypothesis. Whereas science can be furthered best by a steady advance along pre-defined lines by an association of scientists. Therefore, there should be close fellowship in societies whose sole object is the progress of knowledge.

As a beginning of this plan, Bacon classified the sciences and allotted to each the problems it was best fitted to solve. The next step should be to collect and verify all data known about each problem and from that point devise and carry out new experiments. When sufficient data are accumulated, their classification in laws will follow necessarily. The obtaining of facts of nature and their classification in laws are the sole fruits of science, since man cannot penetrate into the causes or mechanism of phenomena. Science is thus valuable for its fruits, or for the power it gives to us, as I have elsewhere expressed it. Finally in the *New Atlantis* he outlined the organization of a university, which would train youths to engage in science, and of a scientific society which would direct research according to this inductive method.

The weakness of the, otherwise, excellent plan of Bacon lies in its subordination of the idiosyncrasies of the individual which drive him to select problems according to his desire and to work them out as he sees fit. Schemes of collectivism generally fail because men are, at least to the present time, not like a community of ants or bees in which the individual is entirely lost in the common life of the society. It may, however, be admitted that since the war the spirit of collective work has greatly increased amongst men of science. His new method has had an enormous influence on thought. It did make an end to the almost purely deductive method of the Greeks and, while modern science does make use of unverifiable hypotheses of a deductive character, the main emphasis is now placed on the inductive method. And it is no exaggeration to say that biology and evolution were indirectly advanced to sciences by Bacon because he proposed to treat organic phenomena on a rational basis to the exclusion of the miraculous; he was the chief influence in preparing men to consider life as a rational problem.

Bacon's work has been the object of extravagant praise and blame, but the most virulent and unjust attack on him is that of Huxley[11] who, in his *Essay on the Progress of Science*, pauses in his laudatory review of our acquisition of knowledge to hold the great Chancellor up to scorn. He despises him as one who sold his birth-right for a mess of pottage of Court favour, although the retort is ready to hand that Huxley is discussing the intellectual achievements of men of genius and not analysing their characters, nor does he consider the contemporaneous state of society which did not forbid a Judge to receive gifts unless it could be proved that they had affected his judgements. Huxley also ridicules him because he instructed others how to become men of science and did not himself add anything of value to the acquisi-

[11] *Collected Essays*, vol. I, p. 42.

tion of science. Such a criticism is altogether futile; it would eliminate the critic and, coming from Huxley, it is especially obnoxious when we remember how he subordinated his own research work to promote Darwinism, and to attack all those who could not immediately and unreservedly give allegiance to that totally unverified hypothesis. The surprising thing is that Bacon could, in the midst of the distractions of his busy life of affairs, find time to consider abstract questions at all. Nor is it inexcusable and indicative of an unscientific mind that Bacon did not fully appreciate the great work of Harvey and Gilbert.

Huxley indulges in this extraordinary criticism of Bacon's great plan of creating scientific associations: "To anyone who knows the business of investigation practically, Bacon's notion of establishing a company of investigators to work for 'fruits,' as if the pursuit of knowledge were a kind of mining operation and only required well-directed picks and shovels, seems very strange. In science, as in art, and, as I believe, in every other sphere of human activity, there may be wisdom in a multitude of counsellors, but it is only in one or two of them."[12] It is unworthy of a man of science to depreciate the distinguished achievement of another in order to indulge in a flippant epigram. If we turn to the official *Record of the Royal Society* we shall find that it opens with this generous acknowledgement: "The foundation of the Royal Society

[12] *Collected Essays*, vol. I, p. 57.

was one of the earliest practical fruits of the philosophical labours of Francis Bacon. The experimental method of research which that great man so strenuously expounded in his writings was a vehement protest against the deductive method which till then had been in vogue. His great aim was to enforce the patient investigation of Nature by observation and experiment. He desired that a body of accurately ascertained facts should be amassed, from which alone, in his opinion, the processes of Nature could be understood, and a solid foundation could be laid on which discovery and invention might proceed apace."[13] The Association proposed by Bacon thus became that Royal Society which later was to include Huxley in its membership and to honour him with its presidency. Huxley's own opinion of the superlative influence on science which this Society has exerted can be easily found elsewhere in his writings when he bewails the fact that England neglects such societies and supports many things of the baser sort.

Huxley, finally, in his criticism, states: "Any one who has studied the history of science knows that almost every great step therein has been made by the 'anticipation of Nature,' that is, by the invention of hypothesis, which, though *verifiable*, often had very little foundation to start with; and, not unfrequently, in spite of a long career of usefulness, turned out to be

[13] *Record of the Royal Society*, supervised and edited by the President, Sir Archibald Geikie, K.C.B. Oxford University Press, 1912.

wholly erroneous in the long run."[14] A few pages later he adds: "The progress of physical science, since the revival of learning, is largely due to the fact that men have gradually learned to lay aside the consideration of unverifiable hypotheses; to guide observation and experiment by verifiable hypotheses."[15] This sounds like good advice, but he neglects to say how, when an hypothesis is advanced, one can tell whether it will turn out later to be of the verifiable or of the unverifiable sort. The history of the hypothesis of the nature of light is one of the best examples in the history of physics. Newton proposed the hypothesis of corpuscles; it was a century later shown to be unverifiable by Young who proposed the hypothesis of waves in an elastic aether; three-quarters of a century later this proved to be unverifiable and was replaced by Maxwell's hypothesis of waves in an electro-magnetic aether; today many physicists say there is no aether. One cannot but suspect that Huxley thus condemned a too strict adhesion to Bacon's inductive method because he, himself, was passionately determined to "put over" Darwin's hypothesis of natural selection as a sufficient cause for evolution, although he knew, and had stated, that it did not rest on an adequate basis of observation and experiment. And, today, we find it discarded as an unverifiable hypothesis. Some day, men of science will learn that hypotheses cannot

[14] Huxley, *op. cit.*, p. 62.
[15] *Ibid.*, p. 65.

always be avoided, but that they are to be used only as a confession of ignorance, and never be permitted to stand in the way of the certain and sure progress of induction. Bacon may justly be criticised for mistaken notions, but when all has been said, he stands as the one who best understood the revolt of the Renaissance, and who pointed out most lucidly the way for the revival of science. And for this reason, such a criticism as Huxley's should be discussed at length because we are, today, lapsing again into metaphysical scientific methods through our unrestrained use of unverifiable hypotheses. A return to the sober and wholesome method of Bacon would do us a world of good. Our debauch of evolution, of aethers, and of electrons is fast carrying us back into the state of mediaeval absurdities.

The supreme importance of Bacon's work lay in the fact that it gave men self-confidence in their powers of elucidation. The acceptance of the new scientific method, together with the rapid growth of physics, mathematics, astronomy, and the rise of chemistry, necessarily had a profound effect in awakening the mind to observe and to depend on the reason. Possibly even more important, as an indirect influence on the new tendency towards rationalism, was the growing power of the Protestant Reformation. The very essence of protestantism is that the individual is the final arbiter of his beliefs and may not escape the burden of responsibility by submission of the will to the dictates of a single and infallible Church; the protestant having declared his right to decide for himself in religious questions could no longer forbid inquiry into hitherto closed fields of scientific knowledge. Galileo could withstand the personal contumely of Luther and Melancthon with impunity; but, in the end, he was forced to bend his proud will to the Pope, backed by a Church fortified with both temporal and spiritual power.

The physical sciences quickly developed into true modern sciences in the fields of both theory and experimentation, but the extension of the inductive method to biology and geology was slow and hesitating. Geology does, indeed, deal solely with inorganic phenomena and its phenomena are due solely to physical forces, but there still remained two great obstacles in the way of its advance. The first was the question of the age of the earth; the changes of the earth's surface, if they were brought about solely by physical force, would undoubtedly require an enormous lapse of time, and this idea was unreservedly opposed by the Church. The Reformation afforded no relief as the Protestants were, if anything, more rigid in holding to the literal interpretation of the Bible than were the Catholics. They accepted the chronology of Bishop Ussher which assigned the year 4004 B.C. as the exact date of creation and permitted only the one break of the Deluge, in the year 2348 B.C., in the continuity of history as set forth by the

Jewish writers. In the second place, geology, unlike physics, requires elaborate collections of rocks, minerals and fossils to be made and classified before any systematic work can be attempted; such collections were not in existence and little interest was shown in establishing museums.

The biological sciences, in addition to the disadvantages under which geology suffered, were further restricted by the fact that no means of bridging the gap between the physical forces and life could then be imagined. No forces were known but those of a mechanical and electrical nature, and no one saw how these could be applied by the inductive method to what they termed vital actions. Thus biology was limited for two or three hundred years to the slow accumulation of facts about living species of plants and animals. Even the discovery of the microscope did not accomplish more than to awaken some interest in the composition of tissues and to extend our acquaintance with a few minute organisms. On the other hand, the progress in the knowledge of human anatomy and physiology was much more rapid.

Before closing this survey of the ideas which preceded our modern theory of evolution, a discovery should be discussed because it had a profound influence in furthering the mechanistic, doctrine of life which, if my ideas are correct, is the foundation for any scientific theory of evolution. In 1628, Harvey published his discovery of the circulation of the blood; although its full significance was not appreciated until much later, yet the knowledge that the blood made a complete circuit in the body, was what was needed to link biology to the physical sciences. And since then, it has been more and more persistently the aim of biologists to emphasize the mechanical functions of the living body, to point out its analogies to a machine, and to minimize the unknown causes which still pass under the name of vitality.

It was the universally accepted belief that organic bodies were composed of the four Aristotelian elements—earth, water, air, and fire; by the operation of the active principles of heat and moisture, the elements were metamorphosed into three primary substances, called salt, sulphur, and mercury, which in their proper and balanced proportions make up the frame and tissue of living bodies. The character of the individual was assumed to be determined by four humours which composed the fluid portion of the body; it is not clear how these were related to the primary elements and substances, as they seem in some way to have involved the principle of life. The humours were classified as blood, bile, phlegm, and water, and are still currently used to characterize the disposition as phlegmatic, melancholic, etc. Both health and character were held to depend on the right balance of the three substances and four humours; it was the business of the physician to determine the disturbance, and by the aid of herbs, magic, and alchemy, to restore the balance when mind or body suffered from disease.

Out of a complicated and obscure mass of guesses and conflicting details, we can be certain that life, itself, was supposed to be bound up with the breath, or spirit. In some way, also, the heart and the brain converted the physical air we breathe into the mystical breath of life. In them was created or, at least, maintained this life force which subdivided into vital, natural, and animal spirits. The heart sent out two of these living streams; the natural spirit, or blood, through the veins, and the vital spirit, or air, through the arteries. The brain disseminated the animal spirits by means of the nerves. How these fluids returned to the brain and heart, if they did flow back at all, was not known, but in some mysterious way these spirits passed into the system and nourished and vivified the organism. Before a science of biology could be established this metaphysical idea must be replaced by a form of mechanism which would, at least, push spiritism further into the background. This great step, as I have said, was made by Harvey. The first consequences of the discovery of the circulation of the blood were quickly discerned; the heart becomes a pump, self-acting to be sure, and the circulating blood loses its mysterious properties; as a fluid stream in a net-work of pipes, it bears the nutriment to the various parts of the body. The cause of the beating of the heart and of the other so-called vital activities was, and still remains, unknown, but at least the mediaeval age of spiritism was at an end.

CHAPTER FOUR

Palaeontology and Geology

The Positive Evidence for Evolution

THE evidence for the evolution of plants and animals is commonly said to be derived from many sources. When, however, we examine these causes for our belief we find that, excepting our desire to eliminate special creation and, generally, what we call the miraculous, most of them can be considered only as secondary reasons to confirm a theory already advanced. Darwin, in his *Origin of Species*, enumerated with the greatest care what factors led him to his adoption of the theory of evolution by natural selection, and what lines of observation and experimentation would be likely to confirm the reasonableness of his ideas. It is quite certain that, for positive proof, he relied on the existence of fossil remains of plants and animals and on the geological record which shows that during the long history of the earth it has been occupied by a succession of different forms, many of which are now extinct. He devoted four chapters to the discussion of palaeontology and made it clear that to his mind the discovery and knowledge of fossils is the evidence which alone can change his doctrine of evolution from an abstract hypothesis to a concrete fact. We might create an imaginary succession of forms gradually developing new parts and new functions, but in order that such a chain may resemble the facts we must have before us these links in actual fossils. And he answered the query whether we have such evidence by the confession: "Geology assuredly does not reveal any such finely-graduated organic chain; and this, perhaps, is the most obvious and serious objection which can be urged against the theory [of natural selection]. The explanation lies, as I believe, in the extreme imperfection of the geological record."[1] Huxley, also, follows his master and tells us that: "In view of the immense diversity of known animal and vegetable forms, and the enormous lapse of time indicated by the accumulation of fossiliferous strata, the only circumstance to be wondered at is, not that the changes of life, as exhibited by *positive* evidence, have been so great, but that they have been so small."[2] And it is quite safe to say that today in spite of an immensely increased collection of fossils, the positive evidence of geology, considering the vastness and intricacy of the problem of evolution, is as incomplete as it was in the time of Darwin and Huxley. It is equally safe to say that it will always be thus incomplete; that, lacking this concrete presentment of the structure of our ancestors, evolution must continue to be a

[1] *Origin of Species*, vol. II, p. 49. Authorized edition from the sixth English edition. Appleton & Co.
[2] *Biological and Geological Essays*, p. 297.

faith, or deductive hypothesis, which will gradually be strengthened or contradicted by evidence found in the structure and growth of living forms, but cannot be satisfactorily established by such secondary evidence.

Let us imagine that none of the plants and animals of past times had left any remains behind them but had lived, died, and vanished or, if that supposition should be too difficult, let us suppose that the remains we find are similar to parts of existing flora and fauna. Would anyone, with such a supposition granted, hazard the hypothesis that life had begun as a simple protoplasmic mass and had gradually changed from that condition, step by step from parent to offspring, until the present forms were developed; that the intermediate links had died and left us no trace of their existence?

We heard much, during the last century, of "missing links"; but we should remember, since each offspring varies from both of its parents, that the chain of organic evolution, connecting two different species or genera back to their common ancestor, has as many links as there have been generations in both species. Each ancestor, as we go back in a genealogical table, is thus a link in the chain of evolution and if we think of man as the descendant of the first protoplasm, the number of these steps, or generations, becomes inconceivably great. In the popular mind "the missing link" has become identified with the hope of finding the bones of some wretched, filthy being which could not be called a monkey and which no one would be willing to call a man. It is, perhaps, an odd fact that the ancestors of animals are presented to us by evolutionists as other animals well fitted to thrive in their environment and adapted to enjoy life; only in the case of man, do we get the picture of inefficiency, half man, half monkey, which is indecent and degraded.

Without an extensive palaeontological record to direct our attention to the possibility of evolution which is supported by the experiments and observations of biologists in other fields of work, it seems evident that evolution might have been proposed as a guess and have been developed by fancy, but that it would never have been advanced as a scientific hypothesis or theory. And certainly, we never could have imagined a method of evolution such as natural selection or the inheritance of acquired traits. Without such a palaeontological record our only sources of proof would have rested on our reluctance to accept the special creation of each species by a divine Creator; on the fact that species are so numerous and so complex that we cannot classify them; on the fact that we can cause animals and plants to vary by selective breeding; and lastly, because we have found that an embryo goes through a series of structural changes which apparently connects different species. The first source is purely a matter of temperament, as we certainly cannot deny the power of a Creator to act; the second is merely a question of the number of existing forms and their complexity of structure, as no one supposes that evolutionary links connect two species by existing intermediate forms; the third source does show us that variation is the law of life, but it also points to the persistence of species even more strongly than to their variation, since with all our contriving we have never been able to produce a new species, and reversion to the common type occurs when indiscriminate breeding takes place; and lastly, embryology may show relations and connections between different types, but we cannot argue that, for example, a mammal had a piscine ancestry because at one stage its embryo has a gill organ instead of a lung.

It is this necessity for a palaeontological record which first made me doubt the assertion of historians of evolution that any of the early philosophers, or men of science, had a conception of evolution. They, to be sure, used the words, *variation and change*, but they did so in a quite different sense from that now attached to them. Their discussions about the duration of the world and the changes which have occurred were purely academic, and we cannot find any records to show that they ever considered the form and structure of prehistoric life. Because of the importance of the evidence of palaeontology, it is necessary to state the current beliefs as to the real causes of the variation of the earth's surface and the nature of fossils down to the nineteenth century.[3]

We have only two references on the subject from philosophers before Aristotle. It is recorded that Anaximander and Diogenes of Apollonia believed that the relative proportions of ocean and land are not constant and that the sea is gradually drying up by evaporation.[4] A more detailed statement by Xenophanes is preserved: "And Xenophanes believes that once the earth was mingled with the sea, but in the course of time it became freed from moisture; and his proofs are such as these: that shells are found in the midst of the land and among the mountains, that in the quarries of Syracuse the imprints of a fish and of seals had been found, and in Paros the imprint of an anchovy fish at some depth in the stone, and in Melite shallow impressions of all sorts of sea products. He says that these imprints were made when everything long ago was covered with mud, and then the imprint dried in the mud."[5] Empedocles, whom we might have expected to note such remains, is silent on the subject. We must not impart to his idea that imperfect monsters, the fictitious creatures of mythology, had been created before nature knew how to fashion

[3] The material for this survey of geology and palaeontology down to the remarkable speculations of da Vinci on the nature and cause of fossils is taken principally from the investigations of Professor Duhem undertaken in connection with his monograph *Les Études sur Léonard de Vinci*, 2 vols. Librairie A. Hermann.
[4] Fairbanks, *First Philosophers of Greece*, p. 12.
[5] *Ibid.*, p. 83.

real animals any belief that an evolution from prehistoric forms had occurred. His sequence of creation of plants, water animals, land animals, and man, undoubtedly refers to the creation of organisms known to him as then existing.

The fact that even two unequivocal references to the variability of the proportions of sea and land, and to the presence of fossil shells have escaped the accidents of time is significant that those were probably live and discussed questions of importance. With Aristotle, we can pass from tradition to an authentic statement. In his treatise *On Meteors* he argued: "Not always are the same places of the earth submerged under water nor always dry, but they change with the floods and failures of the rivers. Wherefore also the continents change as do the seas; these places do not remain land for all time, and those places sea, but sea becomes where there is dry land, and where now there is sea, again land becomes. We must also remember that these things come to pass in a certain order and period."[6] But Aristotle placed but little importance on the fact of the variability of the earth's surface and accounted for it mostly by the variation in rainfall in the different seasons. What he was interested in was the, to him, far more important metaphysical question whether the world had, or had not, a beginning and what bearing variability of the

[6] *Meteors*, Book I, chap. XIV.

earth's surface had on that problem. He continues: "Those who have their eyes on little things assign as cause of these effects the changeableness of the whole, as if the universe had a beginning and were in a state of becoming. And for this reason they say that the sea becomes less by drying up. . . . But we do not admit as cause of these things that the universe had a beginning and is in a state of becoming; for it is absurd to set the whole in motion because of these small and momentary changes." To see the connection in Aristotle's mind between the drying up of the sea and the finite duration of the universe, we must bear in mind that he held water to be one of the eternal elements and, if it should disappear, due to the actual disappearance of the sea, the universe itself loses an eternal element and is finite in duration, and must also have had a beginning in time, for he stated elsewhere that a finite end presupposes a finite beginning. Following the explicit authority of Aristotle, all later writers approached the question from the same standpoint. The significance of the transformation of the earth was lost in the larger problem of the finite duration of the universe.

References which Duhem has gathered from Herodotus, Strabo, and others, show that the question of the emergence and subsidence of the sea-level had attracted a very considerable interest, and a correct interpretation of fossils as the remains of sea animals had been given as a proof that portions of the earth which were then dry land had formerly been below the sea. The most important discussion of the subject is found in the *Liber De Mundo*, formerly attributed to Philo Judaeus. This unknown author has a passage purporting to give the argument of Theophrastus, the favorite pupil of Aristotle, in support of the infinite duration of the world. Theophrastus is quoted as saying that those who believe the world had a beginning and will have an end base their claim on the fact that, since the earth's surface is broken and full of inequalities, and since the sea level is sinking in many places, then the earth should now be a perfectly smooth body if it had had no beginning or even if it had been in existence a very great length of time, because the constant action of the streams and rivers must, in a great duration of time, wear away the elevated portions and fill up the depressions until all the surface is level. As proof from the second point, they point to the fact that the Mediterranean Sea is lower in level than formerly because the Islands of Rhodes and Delos were once completely submerged and have been emerging gradually as known from ancient records. Other places also prove the same fact because elevated portions of them contain sea-sand and rocks with shells and other products of the sea imbedded in them. Unless this action were limited in time all the seas would be completely dried up. To this argument, Theophrastus proposes a counter-action which tends to increase the inequalities of the earth. As an Aristotelian he points out that the element, fire, is as important a constituent of the world as is water. The tendency of fire is to rise and, in its effort to seek its natural place, it raises the earth's crust with it, as is proved by volcanic action. These two opposing forces, the gravitation of water and the levitation of fire can evidently account for a cyclic action of the earth's surface, now tending to smooth it and now to make it unequal, according as the one or the other force is predominant. For the refutation of the second point, he admits the evidence of the emergence of some places, but he adds that other places show an equal subsidence since, for example, the Island of Sicily was once, undoubtedly, joined to the main-land of Italy. Thus, the second point fails to prove the finite duration of the world since the sea may not be sinking, but the land alternately rising and falling. Theophrastus had grasped clearly the scientific and basic principle of geology; that the changes in the earth's surface are caused by two opposing forces, aqueous erosion and igneous eruption. But, on the other hand, he entirely fails to inquire whether the fossils were the remains of marine animals which had become extinct.

The correct geological ideas of Theophrastus were carried down through the Middle Ages by the Arabic philosophers as we know from several references. The most important evidence is probably that of Albertus Magnus who refers to a treatise *On Minerals* by Avicenna. This reference is worth quoting as, besides repeating the geologic theory of Theophrastus, Avicenna attempts to explain the cause of fossils. He says: "Rocks are formed from a viscous mud by the heat of the sun or from water which coagulates a dry and terrestrial virtue. Likewise, certain vegetables and animals can be converted into stone by a certain mineral and petrifying virtue." Thus the mysterious term *virtue*[7] entered into literature as a force of nature and became the easy explanation, or rather one should say the satisfying avoidance, of all incomprehensible problems.

As might be expected, Duhem finds that that universal genius Leonardo da Vinci, who found time to meditate upon and to adorn every phase of thought and art, had made a persistent search for the origin

[7] The word *virtue* has had a remarkable career. From its original meaning of manly strength, or courage, it came to have a significance of all the moral excellences. From our habit of personification of the attributes of men, virtue gradually was looked upon as a spirit residing in a man which caused him to act virtuously. So, when the translators of the Bible sought for a term to express the miraculous power of Jesus, they used this word as a synonym for the Greek word, *dunamis*, which means power and is now the scientific term for force, as in "dynamic" and "dynamo." This substitution occurs in the passage: "Jesus, immediately knowing in himself that *virtue* had gone out of him, turned him about." In the same way when Albertus Magnus sought for a word to express the meaning of Avicenna that some force exists in inert matter to change mud into rock he at once turned to *virtue*. The custom spread until there was a long category of *virtues* in matter which were the active principles of heat, electricity, magnetism, etc. Then the moral and physical principles were separated and physical forces were designated as *subtile fluids*; the next step was to dematerialize the fluids into *fields of force* to explain the attraction of matter, electricity, etc. At the present time, the final step in this remarkable chain has taken place and the attributes of matter,—energy, heat, and electricity—have become metaphysical entities while matter itself, as determined by inertia, has sunk into a state of innocuous lethargy.

of fossils and their geological significance. Duhem states emphatically that da Vinci created the science of palaeontology and quotes from da Vinci's manuscript notes to show that he had evolved the true method of fossil formation by the decay of the tissues of animals and the substitution of mud which had then gradually changed into stone.[8] There seems to be not the slightest doubt that da Vinci had found the true cause of fossiliferous remains and that he should be given the credit as the originator of the science of palaeontology. It is also well known that the notebooks of da Vinci became a storehouse of inspiration to others who, in the spirit of that free and easy time, appropriated his ideas. In particular, Duhem shows by the method of the deadly parallel that Cardan, the arch-pilferer of the sixteenth century, stole this explanation of fossils. And he also proves, I think conclusively, that Bernard Palissy, who is so generally called the father of palaeontology, pursued the same amiable method with Cardan's own appropriations. Palissy's explanation of the formation of fossils was identical with the original theory and language of da Vinci except that he evolved the brilliant idea that the skeletons of fish and the shells of molluscs, which we find as fossils, had been thrown out from the kitchens of people who had previously eaten the flesh. The slow development of geology and palaeontology from the time of Palissy is an open record.

[8] Duhem, *op. cit.*, vol. I, p. 38.

In their discussion of the geological changes of the earth's surface, the Greek thinkers were quite free to assign an indefinitely long duration to the world and to ascribe much importance to the slow action of erosion by water, but, with the introduction of Christianity, the point of view was changed. All the variations must be condensed into a period going back only four thousand years before Christ and the power of the active agents must be speeded up correspondingly. There, thus, grew up the idea that the slow action of water was insufficient and that most changes were due to the rapid action of heat as in volcanoes. This explanation gave rise to the doctrine of catastrophic action in which the forces of nature became more and more violent as one looked backward in time. We can easily trace the development towards our modern ideas of geology. There was, first, the naïve belief during the Middle Ages that in a single week chaos was transformed into the earth as it is now, except for minor changes such as are produced by erosion and the limited action of volcanoes and earthquakes. This may be called the static point of view, and it would satisfy the mind until attention was directed to the essential difference between igneous and metamorphic rocks, and the great mass of stratified rocks which point so certainly to the action of water as a cause. It was also gradually established that fossils were the remains of previously living sea animals. These two facts were the conquerors of the purely static theory. The next step was to assign to the Creation the establishment of the main framework of the earth and to think of that configuration as enduring with slight changes for sixteen hundred years. Then came the wrath of God to overwhelm men, animals, and the world, with a universal Deluge. During this convulsion, it was possible to imagine that any mysterious and unknown thing might occur. Clergy and laity turned with relief to this reconciliation of religion and science. It was generally agreed that the mysterious waters of the flood, which could mount higher than the mountains in about a month's time and then in another month subside, disappear, and leave the earth dry and vegetated, could also be endowed with cataclysmic activity. We find it to have been the accepted belief that the entire surface of the earth had been converted in that brief period into a general mass of paste. Unknown forces then acted upon this paste, sorted it, changed it into sedimentary rock, and laid it down in the general order we now find the different strata, although they have been more or less disturbed and crumpled by the later upheaving force of volcanoes and earthquakes. What was more likely than that an enormous number of animals and plants were caught and died in this ooze which afterwards became petrified as fossils? This theory satisfied the world as true science.

The great naturalist, Linnaeus, found no difficulty in reconciling his scientific work with complete acceptance of the Deluge. According to Haeckel,[9] he even went so far as to calculate the size of Mt. Ararat and found that it was ample to be a temporary refuge for representatives of all the species of animals known to him, and in that day no one else knew as many. He also pointed out the wisdom of the Creator in selecting a high mountain in a hot climate, since the diversity of its climate would permit tropical animals to cluster at its base, its middle portion could afford an asylum for inhabitants of the temperate zone, and, on the top, polar bears and other lovers of the cold could endure for a short time. However, he neglected to show how the polar bear passed from Mt. Ararat to the Arctic Zone without crossing the burning sands of Asia. This anecdote is not given to sneer at the frailty of a great man but, rather, to show that profundity in a special field of work is very frequently accompanied by naïveté when the subject is a little foreign to one's specialty. To show the persistence of this Noachian theory, we find that as late as 1821 fossil bones of large tropical animals which had been discovered in a cave in Yorkshire, England, were explained as the remains of animals caught in the ooze of the Deluge. The caves themselves were accounted for as being immense bubbles which had been blown in the soft mud by the pressure of the gases set free by the decaying bodies of the monsters. Judging from what Professor Conklin calls the pres-

[9] *History of Creation,* vol. I, p. 45.

ent wave of frenzied attack on Darwinianism many people are still unwilling to give up Eden and the Flood. Also, I am not certain but that Haeckel and others still show the same shutting of the eyes to facts in their absorption in the speculation that men are mere mechanical machines which have assembled themselves from the chemical elements.

As interest in geology slowly increased, attention began to be centred on fossils. Those who looked for natural causes thought that they were freaks of nature (*lusus naturae*). Others believed that they were the unsuccessful attempts of a mysterious formative power or instinct of nature (the *nisus formativus* or *vis plastica*) which could almost create life but succeeded only in producing counterfeits. The most nearly correct theorists imagined that a special air, or humour, penetrated the earth and, mixed with water, could fructify earth into petrifactions, or stony flesh (*caro fossilis*). Many ascribed them to the influence, or exhalations, from the stars.

It is probable that the majority saw in fossils, as in all things, the immediate work of God. The more humble merely dismissed the subject by stating that He made them for His own, to us incomprehensible, reasons. Others, who wished to lower the pride of the intellect, believed that He scattered them in the rocks to teach men, and especially geologists, the lesson of humility when they would try in vain to penetrate the mysteries of the Creation. There were also some who proposed that God, Himself, while learning the trade of creating, first made models out of earth; those which satisfied Him were changed into living beings and the rest, or sketches, became stony fossils.

In spite of the growing conviction that fossils were the remains of animals whose cavities had been filled with mud which had in time changed to stone, little progress could be made until they could be compared with living species. As I have noted before, both biology and geology owe their slow development to the lack of collections. The naturalist can do little more than to note the structure and traits of the few specimens which come before his own notice until he can compare them with the specimens which others have collected and arranged in museums.

Men have undoubtedly always collected and retained objects which appealed to them as beautiful or curious, but there were no museums in ancient times which corresponded in any sense with our modern ones. Aristotle, for his studies in zoology, made a great collection of specimens and rarities, and his royal patrons placed at his service much money and many collectors. The museum at Alexandria has become the symbol of the height of the greatest learning in ancient times, but this museum was really a generic term to include the library and what would now be called a university. According to Mr. Holland, Curator of the Carnegie Museum, even the word, museum, fell into disuse after the destruction of the institution at Alexandria and was not revived until the seventeenth century.

With the Renaissance, the taste for antiquity arose, and men of wealth began to collect memorials of the past; but it was not until 1683 that a museum for scientific purposes was established, which has been maintained to the present time. In that year the Ashmolean Museum, founded by Elias Ashmole, was housed in a suitable building at Oxford. This was a half century after Francis Bacon had outlined for the first time in his *New Atlantis* the plan for a great museum of art and science. In this century also arose the great learned societies of Germany, England, and France, which did such great work in promoting science. The British Museum was founded in 1759 from the nucleus of the collections of Sir Hans Sloane. At about the same time the Muséum d'Histoire Naturelle in Paris and the important museums in Germany began their comprehensive collections.

It is very significant that this movement to establish collections of fauna and flora was contemporaneous with the life of Linnaeus (1707-1778). Although Linnaeus was a steadfast believer in the fixity of species as created and continued by God and constantly endeavoured to strengthen this opinion by his classification of fauna and flora, yet his work, in the end, had just the opposite effect. His enormous labour of classification and his system of nomenclature, in which he first named the order and, by a second name, the species in the order, gave to the world for the first time a common ground for the communication of ideas. Very soon it was found that the distinctions he attempted to establish between species could not be maintained; new animals and plants must be placed in sub-species and new structures and traits demanded constant rearrangement of classification. In the end the close connections and the fluctuating gradations between species became a more prominent idea than their fixity.

The great work of Linnaeus awakened an enthusiastic interest in both botany and zoology, and was the beginning of the school of naturalists which attained its greatest height in France where Buffon, Cuvier, the two St. Hilaires, Lamarck, Jussieu, and others of less fame advanced the natural sciences by leaps and bounds. In the rapidly growing museums, specimens from all over the world were collected and classified. It was found that nothing was more difficult than to classify the multitude of the earth's inhabitants. So soon as a system was adopted, new discoveries would break it down until, in place of fixity of species, there grew up the belief that each species merged into others by imperceptible gradations.

Attention was also directed to fossils. They, too, were classified and compared with living specimens. As most fossils are the remains of marine animals and as a knowledge of sea forms is the most difficult to obtain, it is quite natural that the fossils which could not be identified with living specimens were assigned to existing, but as yet undiscovered, species. The first clear and distinct recognition of prehistoric animals of now extinct species, occurred in the year 1800, when workmen brought to Cuvier a number of bones found in a quarry near Paris. And he, with his vast knowledge of existing animals, pronounced them to be the remains of a species of elephant different from, and much larger than, any alive at the present time. From the bones he reconstructed the skeletons of the animals, themselves. His results were published in his celebrated *Mémoirs sur les espèces d'éléphants vivants et fossils. It is hardly too much to say that this discovery by Cuvier was the essential fact without which no scientific theory of evolution could be developed.*

By the end of the eighteenth century the stage was prepared for the enunciation of the doctrine of evolution. The subject was in the air—men of science recalled the earlier tentative guesses; Kant and the French Encyclopaedists incorporated the idea as a principle of abstract philosophy; Goethe sang it in poetry. The first steps were faltering ones. Even with this striking proof of extinct species in his possession, Lamarck, while proposing a comprehensive theory of evolution and eagerly seeking for its verification, could not grasp the idea of an almost infinite series of species coming into existence and then passing away during the periods of a remote past. This attitude of mind is so important that the recognition of the combination of such a succession of forms with an almost unlimited extent of time by Darwin is what made his theory meet with favour.

Lamarck[10] saw clearly the importance of the question, but with true scientific caution he decided that the evidence was against its acceptance. In a remarkable passage he says: "It is still a question in my mind whether the means nature has taken to assure the preservation of species or races have been so insufficient that entire races are now extinct or lost.

"Yet the fossils found buried in the ground in so many places, present to us the remains of a multitude of different animals which have existed and amongst

[10] The ideas of Lamarck have suffered from the inaccessibility of his works. There are in English only the *Life and Work of Lamarck* by Professor Packard which does not give more than excerpts from the *Philosophie Zoologique* and a translation of the whole treatise by Professor Hugh Elliot. Students of evolution owe a great debt of gratitude to Professor Packard for his indefatigable zeal in bringing to light the almost forgotten facts of the life of the great naturalist and in giving to him the recognition which was his due, but in spite of the fact that the author is a fervent Lamarckian he does not seem to understand Lamarck's philosophical point of view. As for Professor Elliot, he has assumed the ungrateful task of writing an introductory critique of Lamarck's ideas in which he not only attempts to show that his theory of acquired traits is entirely inferior to Darwin's theory of natural selection but he also shows himself to be lamentably unable to present Lamarck's theory clearly and accurately.

After a careful reading of Lamarck's original treatise, I have tried, in the next chapter, to present his ideas simply, and to give them the very high credit which so profound a thinker deserves. It is certainly time that justice should be done him and that the Darwinians should take the theory of acquired traits as a serious competitor and as a doctrine which in many ways is superior scientifically to natural selection. Quotations are made from the French edition of the *Philosophie Zoologique* edited by Charles Martins, Paris, 1873. Parallel references to Professor Elliot's translation are added in brackets.

which there are to be found only a very small number that have exactly similar living analogues.

"From this fact, may we conclude, with some appearance of certainty, that the species found in the fossiliferous state, and of which no living and exactly similar examples are known to us, no longer exist in nature? There are still so many portions of the surface of the globe where we have not penetrated, so many where men trained to observe have only casually passed through, and finally so many others, such as the various parts of the sea-bottom, where we have but slight means of discovering the animals which exist in such parts; these various places could easily conceal the species which we do not know.

"If there are species really extinct, it can be without doubt only amongst the large animals inhabiting the dry portions of the earth, where man, because of the absolute domination which he exercises, has been able to destroy all the individuals of some of those species which he has wished neither to preserve nor to domesticate. From this fact arises the possibility that the animals of the genera of palaeotherium, anoplotherium, magalonix, megatherium, mastodon of M. Cuvier, and some other species of genera already known, no longer exist in the living state; nevertheless even this is only a mere possibility.

"But the animals which live in water, especially marine animals, and, in addition, all those races of minute animals, which inhabit the surface of the earth and breathe air, are safe from the destruction of their entire species by man. Their powers of multiplication are so great and the methods by which they can avoid his pursuit or his snares are so effective that there is no likelihood that he can destroy the entire species of any such animals."[11]

This most important point of the slow and hesitating acceptance of the idea that the world has been peopled by dead and gone species, historians of evolution seem not to have appreciated.[12] Even Lamarck, eager to find support for his ridiculed theory and ready to grasp at the smallest facts to confirm his ideas, could not believe that Nature or God could create anything so imperfect and so little fitted to withstand the rigours of life as to become extinct except by the ruthless hands of dominating man.

While evolution was thus knocking at the door, there still remained the need for someone to change speculative into rational theory. This last and most

[11] Lamarck, *Philosophie Zoologique*, vol. I, p. 91 [p. 44].

[12] It is interesting to quote from Osborn's *From the Greeks to Darwin*, p. 176, to show how he could misunderstand Lamarck's attitude and change the entire meaning of this most important passage: "It is strange that Lamarck grasped the true idea of *extinction of the lower types, but not of the higher types.* He could not credit the extinction of such perfect forms as the Mastodon or the Palaeotherium by any of the forces of Nature, but believed that they had probably been exterminated by man, or that these species might still be found alive elsewhere. He thoroughly believed in the extinction of lower types, for example, of the Molluscs, and that the lower types had given way to the higher, the ranks of the lower types being constantly replenished by incessant creation of the lowest forms." It is, perhaps, to be expected that he would misinterpret such distant authors as Aristotle or St. Augustine, but it is hard to understand how he could turn Lamarck so completely around if he had read that author with any care.

important step was, according to Darwin, taken by Buffon who, he says in his historical preface to the *Origin of Species*, was the first author to treat evolution in a scientific spirit. Amongst the naturalists of the eighteenth century, Buffon ranked easily first in the combination of erudition and a philosophical bent of mind. Like Laplace and Humboldt he aimed at omniscience. Profoundly impressed with the nebular hypothesis of Laplace, he attempted in his *Histoire Naturelle* to annex the history of the earth to that rational and mechanistic theory. He would give the progress of the earth from the beginning both biologically and geologically. Endowed with all the advantages of wealth, high birth, and indefatigable industry, he endeavoured to support his conclusions with facts drawn from great collections and comprehensive experiments.

Buffon first postulates the existence of God who created the world not in a static condition, but subject to change in obedience to natural law. The first living organisms were created with the ability to react to their environment and to change their structure in order to meet new requirements of food and other vital needs. God then revealed to man His laws and His plan of creation in the Bible, not fully, but as a parable suited to the intelligence of the times. The real truths of nature can unfold themselves only as man progresses in knowledge. Thus the six days of creation signify six periods of time in the evolution of the world, which has slowly cooled from a condition of incandescence to its present temperature, gradually changing its inhabitants to adapt themselves to new conditions; and the world will continue to cool until animal life can no longer be supported.

As Buffon relied on the energy of universal gravitation and on heat as the causes of secular changes, his first effort was to calculate the duration of the earth. For this purpose he carried on many experiments to determine the rate of cooling of various minerals and rocks. In particular, he heated great iron globes to a very high temperature in order to estimate from their rate of cooling how long the earth would require to reach its present temperature. His conclusion was that it needed about 75,000 years to change from a molten mass to its present state. It is not necessary to follow in detail his elaborate guesses as to the duration of each of his epochs, or geological ages, or to enumerate his succession of flora and fauna. The important fact is that this scheme is one quite different from the fanciful accounts of classical or renaissance authors. It is modern. He derived his periods from the thickness and character of rock strata and the physical laws of cooling of the earth. He freely employed long periods of time with the forces of gravitation and heat as the only active agents, and he divided his epochs by the corresponding prevalence of fossils. All these methods we rely on now; our advance has been in accuracy of details and not in method.

It is very difficult to determine Buffon's positive contribution to the mutability of species, but there is no doubt as to his indirect influence on both Erasmus Darwin and on Lamarck. He is generally supposed to have passed through three phases of thought; first, of accepting the special creation of fixed species, of then changing to the advanced position of advocating a thorough theory of evolution, and of finally retreating to the more conservative view of variation within the species only.

Buffon's study of the classifications of Linnaeus and Cuvier, and his own attempts to find a satisfactory system, deeply impressed him with the hopelessness of forming a definite and adequate classification of fauna and flora. As soon as a method is proposed, new types are found which lie between two classes so that, in the end, any one species merges into other species by imperceptible gradations. He even goes so far as to lament the waste of time and effort spent on devising new systems and inventing elaborate nomenclatures until it is more difficult to learn them than it is to know botany and zoology. While under the influence of this idea of the fluidity of species, he comes nearest to the doctrine of evolution. His most unreserved statement is probably the following: "We see that there is no absolute and essential difference between animals and vegetables, but that nature descends by subtle gradations from what we deem the most perfect animal to one which is less so, and again from this to the vegetable. The fresh-water polypus may perhaps be considered as the lowest animal, and as at the same time the highest plant."[13]

Variation within a species is caused, in Buffon's opinion, by the direct effect on the organism of changes in food and climate. Such variations are slower and less pronounced upon animals in the wild state than they are upon domesticated animals, which are forced by man to follow him into different climates and to consume the food he imposes on them. But he becomes doubtful when one tries to extend this principle of variation to the extent of changing a species into a different one, because then it must be assumed that the effect of food and climate is sufficient, "to change radically the nature of beings which have had their impress stamped upon them in that surest of moulds —heredity." Probably his most mature belief is expressed by the moderate opinion that: "The type of each species is founded in a mould of which the principal features have been cut in characters that are *ineffaceable and eternally permanent*, but all the accessory traits vary; no one individual is the exact facsimile of any other, and no species exists without a large number of variations." But, here, too, the problem is complicated by the fact that he practically

[13] *Histoire naturelle*, Furne et Cie., 1842, tome III, p. 3.

denies the distinction of species. Perhaps, his idea is that variation is possible within undefinably wide limits. Fixed species do exist, although, because of complexity of structure and habits, we cannot satisfactorily separate them. Just as we distinguish black from white, although between them lie any number of shades of gray, so there are types of animals sufficiently different to prevent variation from one to the other and yet between them are gradations which to our observations shade from one to the other.

It is unnecessary to discuss further Buffon's rather baffling ideas because we can turn to a contemporaneous statement of evolution without any qualifications. In 1794, Dr. Erasmus Darwin published his *Zoonomia* in which he explicitly advocates the idea of transmutation of species. His thesis may be given in his own words: "Would it be too bold to imagine that, in the great length of time since the world began to exist, perhaps millions of ages before the commencement of the history of mankind—would it be too bold to imagine that all warm-blooded animals have arisen from one *living filament*, which the great First Cause endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations, and thus possessing the faculty of continuing to improve by its own inherent activity and of delivering down these improvements by generation to its posterity, world without end?" The cause of variation is the desire of adapting themselves to their environment which all animals have in order to satisfy their craving for food and other needs. The exertions, which animals thus undertake, produce perpetual transformations in them and many of these acquired forms or propensities are transmitted to their posterity.

Although Dr. Darwin deserves the honour of originating the idea of the transmutation of species from the cause of use and disuse, or as we now say the inheritance of acquired traits, the doctrine will always be associated with the name of Lamarck, who, by his great genius, changed the somewhat fugitive work of Dr. Darwin into a scientific theory. The views of the two authors are so nearly identical that it has been a matter of great interest to determine whether it was a case of independent discovery or whether Lamarck knew the substance of Dr. Darwin's theory. Samuel Butler[14] states the problem by asking how Lamarck remained a partisan of immutability until 1801, although he, as Buffon's intimate friend and tutor to his son, had been thoroughly conversant with Buffon's theory of descent with modification for some years. His answer is that Lamarck, at the time of his sudden conversion, did know the substance of the *Zoonomia* because he would almost certainly have heard of, and have seen, the French translation by M. Deleuze of Darwin's poem, *The*

[14] *Evolution, Old and New,* p. 258.

Loves of the Plants, which appeared in 1800 and would have learned from the translator this new cause of mutation.

I have so far in this chapter traced the chronological development of geological and palaeontological ideas and have shown that the doctrine of evolution did not, and could not, become a question for scientific inquiry until those ideas had been formulated in their general modern outline. The critical date for evolution I have placed specifically as the year 1800, when Cuvier announced his discovery of prehistoric, and now extinct, species of elephants. The logical plan, since I then passed to the ideas of Buffon and of Dr. Darwin, would be to proceed now to the discussion of Lamarck's hypothesis of evolution by the method of the inheritance of acquired traits; but, I think, it is more expedient to make a break in the argument and to close this chapter with a brief account of the state of geological and palaeontological knowledge when Darwin proposed his hypothesis of natural selection and to follow this with a summary of our knowledge to-day.

The importance of geology to the doctrine of evolution is immediate and profound. The preservation of fossils is purely a geological problem and the estimation of the time when these prehistoric animals and plants lived can be made only by determining when the different strata of rock were deposited. Thus geology is the indispensable science by which we estimate the time factor of evolution and arrange our chain of variation. In the first place, we must remember that fossils can be found only in sedimentary rocks and history is a blank as soon as we reach the metamorphic and igneous rocks which form the core of the earth a few miles below the surface. In the second place, material of the sedimentary rocks is derived from the surface disintegration of metamorphic and igneous rocks exposed to the slow action of chemical and physical forces and to the rearrangement of disintegrated earlier strata of sedimentary rocks. Our fossiliferous material in the earlier strata is thus constantly destroyed and re-deposited and, in the process, the fossils are either destroyed or are shifted to the newer strata. Their mute evidence of the time when they lived is either lost or correspondingly shifted, it may be, to a period millions of years later; so that the geologist must detect and rearrange this displaced material. It is altogether improbable that this has been sufficiently accomplished. We must expect fossils to become less and less abundant as the age of the rocks increases and the mingling of fossils of different epochs of time to increase as the strata become more recent.

Our estimation of time by geological methods depends on our ability to arrange the strata of rocks in the order of their actual deposition; on measuring the original thickness of each stratum; on knowing the rate of deposition and of erosion, and the intensity of the forces involved. Such estimation, which in fact amounts almost to mere guessing, eliminates the possibility of what are usually classed as catastrophic actions or any sudden change in the surface conditions. Since the time of Lyell, geology has adopted the uniformitarian hypothesis which assumes that the physical and chemical actions of today are the guides in estimating all previous times. It is, in truth, an unavoidable hypothesis; but, at the same time, it works havoc if it is applied as a criterion of time, because we are practically certain that we do not, and never can know, the state of the earth in remote times. At the height of the evolutionary enthusiasm, geologists indulged in the practice of translating the thicknesses of different strata into time and published chronological tables of the age of the earth and its epochs. In turn, these purely fanciful figures were taken seriously by propagandists of the new theory and the impression was given the thinking public that science could establish prehistoric chronology. Such chronological tables have been abandoned by conservative geologists who now limit themselves to establishing the thickness of the various strata, in restricted localities, in hundreds of feet and of arranging them as far as possible in the order of their deposition. But the older vicious habit still persists, and we still find in histories of science and in popular accounts of evolution these unreliable and misleading chronological tables reckoned in years.

In spite of the necessity of postulating that we must estimate the time involved in the formation of strata by applying conditions approximately those of today, we have unmistakable evidence that the forces of nature vary greatly at different times. The deposition of sedimentary rocks depends on the rate of rise or fall of the floor of the sea, on the amount of rainfall, temperature, the composition of the air, the abundance of animal and vegetable life, and many other factors. In addition, during periods of no deposition in an area, there is no time record and, as all deposition in one place means erosion somewhere else, we can assume as a general law that every foot of rock which we find today is the unknown remnant of more than a foot of deposition or, translated into time, every geological time interval must be lengthened by an unknown amount. Finally, equal thicknesses of strata do not signify equal intervals of time, as the rate of deposition is dependent closely on the rate of subsidence of the floor on which the deposit is laid. The eminent geologist, Sir Archibald Geikie, is fully alive to the danger of such estimates of past time. He is of the opinion that: "The few centuries, wherein man has been observing nature, obviously form much too brief an interval by which to measure the intensity of geological action in all past time. . . . The present may be an era of quietude."

It is, I think, often assumed by evolutionists that if deposits of the same fossil forms are found in different parts of the earth we are justified in assuming them to be contemporaneous. I am certain that the laity believes that a period classed as, for example, the Carboniferous in America is exactly contemporaneous with the period of the same name in Europe or Asia. A moment's consideration will convince one that such is not the case; geology can point with certainty to succession of time only at each limited area. The indirect methods of correlation cannot do more than to show that the strata designated by the name of one period were deposited within the same division of time; but, such a division of time is estimated in hundreds of thousands, or perhaps millions, of years.

The cause of our inability to establish a chronological system is not due to our lack of data, but is fundamental. Huxley has discussed this question and we cannot do better than to follow his reasoning.[15] He says: "Standard writers on palaeontology take it for granted, that deposits containing similar organic remains are synchronous, at any rate in a broad sense. . . . Sir Henry De La Beche[16] adduces conclusive evidence to show that the different parts of one and the same stratum, having a similar composition

[15] Huxley, *Discourses; Biological and Geological Essays.* The reader should refer particularly to pp. 275-307 and 343-92, although the entire volume should be read in order to get a clear idea of the positive value of geology and palaeontology.
[16] *Researches in Theoretical Geology.*

throughout, containing the same organic remains, and having similar beds above and below it, may yet differ to any conceivable extent in age. . . . All that geology can prove is local order of succession. It is mathematically certain that, in any given vertical linear section of an undisturbed series of sedimentary deposits, the bed which lies lowest is the oldest. . . . For anything that geology and palaeontology is able to show to the contrary, a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa." *We can then be certain that geology cannot, and never will be able to, translate the thickness of any one stratum into an equivalent length of time and that it cannot, and never will be able to, establish real contemporaneousness of time in different parts of the world.*

Let us now turn to the positive evidence of palaeontology, giving first the opinion of Huxley, at the time when he was advancing the doctrine of evolution with such assurance, and then a brief summary of the science at the present time. In the same essay just quoted, Huxley sums up as follows: "We are all accustomed to speak of the number and the extent of the changes in the living population of the globe during geologic time as something enormous; and indeed they are so, if we regard only the negative differences which separate the older rocks from the more modern, and if we look upon specific and generic changes as great changes, which, from one point of view, they truly are. But, leaving the negative differences out of consideration, and looking only at the positive data furnished by the fossil world from a broader point of view—from that of the comparative anatomist who has made the study of the greater modifications of animal form his chief business—a surprise of another kind dawns upon the mind; and under *this* aspect the smallness of the total change becomes as astonishing as was its greatness under the other.

"There are two hundred known orders of plants; of these not one is certainly known to exist exclusively in the fossil state. The whole lapse of geological time has as yet yielded not a single new ordinal type of vegetable structure.

"The positive change in passing from the recent to the ancient animal world is greater, but still singularly small. No fossil animal is so distinct from those now living as to require to be arranged even in a separate class from those which contain existing forms. It is only when we come to the orders, which may be roughly estimated at about a hundred and thirty, that we meet with fossil animals so distinct from those now living as to require orders for themselves; and these do not amount, on the most liberal estimate, to more than about ten per cent of the whole."[17]

Enough has been quoted to justify the statement that, in view of the immense diversity of known ani-

[17] *Discourses; Biological and Geological Essays*, pp. 292, 293.

mal and vegetable forms, and the enormous lapse of time indicated by the accumulation of fossiliferous strata, the only circumstance to be wondered at is, not that the changes of life, as exhibited by positive evidence, have been so great, but that they have been so small. Bearing these opinions of Huxley in mind, it is surprising, to say the least, to find that this passionate advocate of rigorous scientific thinking preached, at the same time, the established certainty of evolution, not only in its broad outlines but also tracing its course in minute detail and teaching that natural selection was its cause and method.

We have, of course, since Huxley's time, increased our accumulations of fossils and have filled in some of the imperfections of the palaeontological record, but in essentials we are in the same state of uncertainty. I have made a selection of some of the most important breaks in our present record, and the reader may refer to the end of the chapter for a table of the geological periods. The material has been abstracted from Chamberlain and Salisbury's *Geology*.

The duration of the Archaeozoic and Proterozoic ages is estimated to be much longer than all the later ages taken together. Fossil remains are found only in the upper Proterozoic strata and are at best rare and poorly preserved.

Abundant fossils of trilobites and other shell-fish are first found in the Cambrian sedimentary rocks of the Palaeozoic age. These animals were quite complex in character and had already developed nearly, or quite, all the fundamental organs of existing animals. Thus evolution must begin with animals high up in the scale of differentiation and all stages from them to the prototypes which were originated supposedly in the warm ocean slime of the Proterozoic epoch are pure conjecture.

In the next period, the Ordovician, fish-like organisms appear which have complete dermal plates and have acquired the power of locomotion. Thus in a period of great quiet in which no break in time can be noted, a most important new type, with the power of locomotion by swimming and vastly different from shell-fish, suddenly appears.

The acquisition of a vertebra is acknowledged to be one of the most important advances in structure. A vertebra is found first in the fishes of the Silurian age. Palaeontologists have imagined many supposititious forms of earlier fishes to link the vertebrates with the earlier fishes which have notochords, but the simple fact is that when the Silurian vertebrates appeared they did so without any transitional form having been preserved.

Again, one of the greatest steps in evolution occurred when amphibians with feet and legs and with an air-breathing apparatus appeared in the Carboniferous age. It is customary to assume that these animals developed from fish which lived in such shallow water that they were driven to adopt land locomotion and life because of lack of food. But we have no relics of amphibians in a transitional state in the Subcarboniferous age. "Relics of amphibians appear in abundance only in later Coal Measures. They were already differentiated into five sub-orders."[18] The whole gap of this enormous change has to be filled by this single discovery in the Subcarboniferous period: "The most interesting suggestion of advance in land life is found in the footprints of a *supposed* amphibian named *Peleosauropus primaevus*, described by Lea from the Mauch Chunk shale near Pottsville, Pennsylvania. There are six double imprints, in which the track of the hind foot partially covers that of the front foot. The trail of a tail an inch wide accompanies the footprints. The slab on which they are impressed is ripple-marked and pitted by rain-drops, implying a freshly emerged mud-flat again covered before the impressions were lost."[19] The positive evidence of so momentous a change of structure to be derived from six footprints seems a slender one on which to base the continuity of evolution.

We may now pass to the Jurassic period. Just as land locomotion appeared fully developed so also does the presence of feathered birds, and their ancestry is admitted to be a puzzle. "The ancestors of the pterosaurs [reptiles with batlike wings] and the birds may doubtless have been closely allied far back

[18] Chamberlain and Salisbury, vol. II, p. 607.
[19] *Ibid.*, vol. II, p. 537.

towards the point of common saurian or stegocephalian divergence, but there is *no evidence whatever that the pterosaurs developed into true birds.* The two are types of analogous and parallel evolution and not of successive relationship. The earliest known bird, Archaeopteryx-macrura [two nearly perfect skeletons have been found] shows an advanced state of evolution, and at the same time clear traces of reptilian ancestry. . . . Its head and brain were bird-like, its anterior limbs adapted to flying in bird-like fashion, not in pterosaurian fashion, its posterior limbs modified for bird-like walking, and most distinctive of all, it was clothed with feathers."[20] We might pass over all these points, but the appearance of feathers as an apparatus for flying is as nearly impossible a fact to explain by evolution as can be imagined. By no known theory can a feather be accounted for; unless a scale or a dermal plate can change to a feather in a single jump there is no reason or advantage for the change during the intermediate stages, and a single jump savours too strongly of special design and creation. In addition, the complicated apparatus of bones, muscles, and nerves, for flying must have developed during the time the scales or dermal plates were changing to feathers and while there was no possibility of flight or other use for this complex modification. The most ardent believer in Creation by Design never exceeded this submission of the reason of the

[20] Chamberlain and Salisbury, vol. III, p. 102.

evolutionist to the dogma of the prescience of Natural Law. So far as I can learn evolutionists have wisely and persistently avoided the solution of this problem.

Although we have neglected, so far, plant evolution, the radical change in plant forms which occurred without previous transitional links in the Cretaceous period when the angiosperms, plants with seeds enclosed in an ovary, suddenly appeared as the dominant type of flora, is one of the impossible questions to explain by evolution. Darwin was keenly interested in this, to him, inexplicable problem. He writes to Hooker: "Nothing is more extraordinary in the history of the Vegetable Kingdom, as it seems to me, than the *apparently* very sudden or abrupt development of the higher plants [angiosperms]. I have sometimes speculated whether there did not exist somewhere during long ages an extremely isolated continent, perhaps near the South Pole."[21] It must be great necessity which would make a cautious inductive man of science create a whole continent in order that angiosperms might develop in complete isolation from the rest of the world, and then join this continent to the other land systems so that this new type of plants may spread rapidly over all the world. It has been a favourite device for social reformers to invent an island, isolated from the rest of the confused world, where an ideal type of society has developed and flourished. Thus, we have the *Utopia* of Thomas

[21] Darwin, *Life and Letters*, vol. II, p. 424.

More and the *New Atlantis* of Francis Bacon, but, in each case, the author is careful to warn the reader that the island is fictitious; *Utopia* is derived from the Greek and means nowhere, and the *New Atlantis* is evidently a second edition of Plato's mythical island of the same name. The authors are also careful to warn us that the bridges which finally connect these islands with European civilization are built out of the hyperphysical material of their minds. Social reformers of today give us with much assurance new ideal types of society which they describe as the state of Eugenics. They follow tradition so far as to choose a descriptive name which is constructed from the Greek and means to be *well-born*, and to outline a government and laws which might be a blessing to harassed humanity but which are admitted to be, at the present time, an ideal. Are they as careful, as were their predecessors, to point out that an Eugenical Society, based on the laws of Darwin's theory of natural selection, involves also Darwin's Angiospermian continent as a habitat?

That the problem of the origin of angiosperms is still unsolved is clear from the recent opinion of Bateson.[22] He first states that angiosperms are known not to have existed in carboniferous times, but that we must *believe* they are the lineal descendants of the carboniferous plants. He then adds: "Where is the difficulty? If the angiosperms came from the car-

22 "Address before the American Association for the Advancement of Science," published in *Science*, p. 58, 1922.

boniferous flora why may we not believe the old, comfortable theory in the old way? Well so we may if by belief we mean faith, the substance, the foundation of things hoped for, the evidence of things not seen. In dim outline evolution is evident enough. From the facts it is a conclusion which inevitably follows. *But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of species remains utterly mysterious.* We no longer feel as we used to do, that the process of variation, now contemporaneously occurring, is the beginning of a work which needs merely the element of time for its completion; for even time cannot complete that which has not yet begun." These are perilous words for those who are trying to build a comprehensive system of sociological and ethical knowledge on the certain facts of evolution by variation. They have the tone of religious faith and, if they are true, they knock the whole prop from under Darwinism as a logical guide to human action and thought. How can we be certain that humanitarians have any surer guide than did the great religious teachers who, to humble men, seemed to have been able to fathom human motives and conduct? If we cannot find the ancestor of any of the great types of life, how can we expect to foretell our descendants and their needs?

It used to be assumed that while the origins of the earlier types are so remote that we should not hope to find their succession, yet we may expect to close the gaps in the later periods. But geologists still ask, whence came the recent placental mammals, and their answer is: "Their origin is one of the great outstanding problems in palaeontology."[23] As for man, we have found the roof of a skull, two molar teeth, and an abnormal femur in the Pliocene deposits and from them there has been constructed a man-like skeleton. In the next period, or Pleistocene, man is found well scattered over the earth and well advanced in civilization, using fire and implements of stone and wood. Here, again, a dominant form arises suddenly and without close ancestry, as monkeys and men are now supposed to be collateral branches from an earlier mammalian type.

The more one studies palaeontology, the more certain one becomes that evolution is based on faith alone; exactly the same sort of faith which it is necessary to have when one encounters the great mysteries of religion. The changes that are noted as time progresses show no orderly and no consecutive evolutionary chain and, above all, they give us no clue whatever as to the cause of variations. Evolutionists would have us believe that they have photographed the succession of fauna and flora, and have arranged them on a vast moving picture film. Its slow unrolling takes millions of years. A few pictures, mostly vague, defaced and tattered, occasionally attract our attention. Between these memorials of the past are

[23] *Op. cit.*, vol. III, p. 222.

enormous lengths of films containing no pictures at all. And we cannot tell whether these parts are blanks or whether the impression has faded from sight. Is the scenario a continuous changing show or is it a succession of static events? The evidence from palaeontology is for discontinuity; only by faith and imagination is there continuity of variation.

Embryologists, however, tell us that the imperfections of the palaeontological record are removed by a parallel and continuous change in the embryo. The embryo of the man begins as a cell, hardly to be distinguished from the first stages of other animal forms, and passes through a series of changes which resemble the lower forms from which he has evolved. Thus, the embryo has at one stage the gills of a fish; next, the tail of a reptile; and again the placenta of an early mammal. Even if we concede this argument, how much do we gain? In the short life of the embryo, differentiation from so apparently simple a form as the ovum to the final complex form must be exceedingly rapid, and it is not surprising that similarities of structure occur. Is it any more significant that the embryo of the dog and of man can hardly be distinguished than that the shell of a turtle can be marked out as an articulated skeleton? The embryologist wishes us to take the film of the palaeontologist and to speed it up until the whole vast temporal evolution from protoplasm to man passes before our eyes in nine months. We may catch a momentary glimpse now and then of similarities between the embryos of different types of animals as the blur of the film rushes by; just as, by careful winking of the eyes, we can see a spoke of a fast revolving wheel stand out as if it were stationary. But such transitory and evanescent glimpses cannot serve as guides to unravel the enormously complex phenomena of evolution which stretch back into the unconscious abyss of time, nor give us any clue to the picture which will represent the future form of man.

GEOLOGICAL TABLE

Cenozoic	Present
	Pleistocene
	Pliocene
	Miocene
	Oligocene
	Eocene
Mesozoic	Upper Cretaceous
	Lower Cretaceous
	Jurassic
	Triassic
Palaeozoic	Permian
	Coal Measures or Carboniferous
	Subcarboniferous
	Devonian
	Silurian
	Ordovician
	Cambrian
Proterozoic	
Archaeozoic	

CHAPTER FIVE

Lamarck

THE doctrine of evolution in its broad sense covers a very large field of science and its influence extends to almost every human activity. Before beginning the discussion of evolution as a modern scientific theory and its bearing on thought in general, the particular purpose of this study should be stated clearly and should be kept in mind by the reader.

In the first place, I accept the general doctrine of the evolution of organisms as a deductive theory on the same grounds that I subscribe to the atomic theory of matter. It is the most satisfactory *rational* theory to account for those relations between existing flora and fauna which undoubtedly exist. But this is not equivalent to accepting the metaphysical hypotheses which attempt to give the causes and methods of evolution, nor does it mean that the biological theory of evolution can be applied with success to the problems of man's mental and spiritual nature. We are certain of the long duration of the earth, and that it has been inhabited by a long succession of plant and animal forms which were different in the past, and which are at present linked together by an heredity that varies in a greater or less degree from generation to generation. Such a belief is the common property of practically all thoughtful persons. We shall accept the scientific conclusions of biologists who have experimentally determined many remarkable relations between organisms, and who have with great patience and acumen elucidated possible lines of evolutionary connection and descent. Not to base our arguments on the sound work of biology would be to destroy the value of a critical study of the subject.

But, having accepted evolution in its broad outline, we find that biologists have attempted to find the cause of evolution and the method by which variations take place. In the general scheme of evolution, man naturally finds his place amongst other animal forms, but to the scientist the problem of human evolution is no more important than is the ancestry of any other form of life. On the other hand, the problem of human evolution is the supreme problem to the student of human affairs. Since the middle of the last century, the idea of progress, of an evolution of society and of civilization in all its aspects, has been developed from an analogy with biological evolution. It has been assumed that science has determined, or at least can determine, the ancestry of man and, from the character of his ancestors, may deduce the characteristics of his thought and actions. When this shall have been achieved we may also apply the conclusions of natural selection, or of the inheritance of acquired traits, so as to formulate a rational polity and ethics. And lastly, after we determine the gradations of our ancestral changes we can proceed to predict the future development of society. To sum up all these points; can we use the conclusions of biological evolution as a guide to conduct and as a rational system of philosophy? It is the purpose of the present work to trace these applications of evolution, to test the validity of their claims, and to trace their effect on thought.

So far, two hypotheses have been advanced to account for the method of evolution, which are considered to be plausible; the inheritance of acquired traits by Lamarck which was outlined in his *Philosophie Zoologique* in 1809, and Darwin's variation by natural selection which was the thesis of his *Origin of Species*, published in 1859.

Lamarck's theory was first misunderstood and, after years of neglect, it was ridiculed by Darwin and his followers. At present, it is growing rapidly in favour as a valuable scientific theory. The publication of the *Origin of Species*, on the other hand, at once aroused a tempest of discussion. The doctrine of natural selection was bitterly condemned by the majority of scientists and was proclaimed pure atheism by the clergy. But it was passionately advocated by a small band of keen adherents who, by a remarkable campaign, advanced its claims in the teeth of opposition. By the end of the century it had become the dominant factor in biology and had been extended to practically all fields of thought. When his theory was at the height of its reputation, Darwin was looked upon as the master intellect of the age and Darwinism became the synonym for evolution. The very dominance of the ideas of Darwinian evolution and of fatalistic progress caused a revulsion of feeling, and today the doctrine is rapidly waning.

While there are probably many causes for the difference in the historical reception of the two theories, it is safe to say that Darwin's quick success was due to the claim of his followers that he was the greatest exponent of the inductive method. Because he had based his theory of natural selection on a mass of carefully selected observations and experiments, so he had been able for the first time to proceed step by step on sure ground to lay the experimental foundations of an adequate theory. Lamarck was, on the other hand, pictured as a deductive philosopher who had jumped by a guess at his theory and had left it unsupported by observation or experiment. Whatever may be the relative merits of the two theories, the converse of this idea is the truth.

Lamarck begins his scientific career as a special creationist and continues in that belief, in spite of his intimacy with Buffon, until the age of fifty-five, as nearly as we can determine. He finally sketches his theory of variation and then waits eight years longer before he gives it a full exposition as the result of the mature reflection of a life spent in scientific work. And we must remember that he had been one of the most distinguished botanists and palaeontologists of his time; he had been professor of invertebrate zoology in Paris for many years, and had, in fact, created the science of those lower forms of animals which are especially valuable to the theory of evolution. And finally, he draws on this immense and varied store of information to confirm his theory of evolution. Surely there are few cases of more perfect induction.

If we turn to the development of Darwin's theory we shall encounter an unusually clear example of deduction. As a youth of twenty-three years, Darwin, who was practically untrained as a biologist or geologist, takes his trip on the *Beagle*. During the five years of this voyage he collects specimens of the rocks and the fauna and flora of southern lands and waters. He reads Lyell's geology with great care and becomes a convert to this uniformitarian doctrine; he also notes the biological and geological relations between the continent of South America and the islands of the Pacific Ocean and is struck with the changes which the habitat produces on both flora and fauna. He undoubtedly loses his faith in special creation and adopts a tentative belief in variation, in accordance with the ideas of Lyell. After his return, he quickly becomes a convinced evolutionist. At the age of twenty-eight he opens his first note-book on variation caused by natural selection. After many efforts to find a cause for evolution, he suddenly obtains his clue from the Malthusian principle of economics which then had its greatest vogue and from Spencer's dictum of the survival of the fittest. After his theory is settled upon, in advance of any real experimental proof, he determines to verify it by collecting facts of every sort which might bear on variation. He devotes twenty-two years to this work and finally publishes a sketch of his theory not because he felt that it was proved, but because Wallace had also arrived at the identical theory. Certainly, if there ever were a more perfect example of a deductive theory it would be hard to find one.[1]

The time is past for discussing Lamarck's work as merely an early and abortive attempt to formulate a theory. The doctrine of the inheritance of acquired traits must be considered as a theory equal in rank

[1] It should be clearly understood that I am not discussing what is the most efficient scientific method, but whether Lamarck was a deductive philosopher and Darwin, an exponent of inductive reasoning. Darwin certainly classed himself as following that method, for he writes (*Life and Letters*, vol. I, p. 68): "I worked on true Baconian principles, and, *without any theory*, collected facts on a wholesale scale. . . . Here, then, I had at last got a theory [*i.e.*, at the age of twenty-nine] by which to work; but I was so anxious to avoid prejudice that I determined not for some time to write even the briefest sketch of it." This, as I have pointed out is the reverse of the Baconian method. Karl Pearson, in discussing the method of science (*Grammar of Science*, 3d edition, p. 30) says it is imagination disciplined by severe criticism and quotes the above passage as an illustration. Huxley is also clear on this point, as he begins his essays on Darwiniana by discussing the *hypothesis* of Mr. Darwin, and, in his essay on the Progress of Science, he makes an elaborate attack on Bacon and the Baconian method and defends Darwin's method by claiming that hypothesis and preconceived ideas are necessary. However that may be, the Baconian method does not proceed from hypothesis, and considering the gradual minimising of the hypothesis of natural selection in Darwin's own mind and its present state, there is some question as to the ultimate profit of working to support hypothesis.

with Darwin's natural selection. In contrast with the abundant literature dealing with Darwin's life and work, it is amazing to find that our knowledge of Lamarck, who in his life-time enjoyed the highest reputation as a scientist, is excessively meagre. With the exception of the eulogies pronounced at his death, there was not even a biography or a book dealing with his work until Professor Packard of Brown University undertook to do justice to the memory of so great a man.

Lamarck, born in 1744, was educated to be a Jesuit priest, but, on the death of his father, he entered the army. An accident cut short his career as a soldier and he then pursued the study of medicine for four years. During this period he became intimate with Rousseau and, through his influence, gave up medicine in order to devote himself exclusively to botany. At the age of twenty-four he enrolled as a student under the distinguished botanist Jussieu and gave his unremitting attention to this subject for ten years. He published the results of his work under the title of the *Flore Française*. The work brought him immediate fame and placed him in the first rank as a botanist; it received the approval of Cuvier and cemented a friendship with Buffon, as it opposed the artificial classification of Linnaeus. As a result, he was elected to the Academy of Sciences the following year, in 1779, and became royal botanist. During this period of two years he travelled extensively in

Europe, visiting museums and universities, and sending great collections of ores, minerals, and botanical seeds and specimens to Paris which he afterwards arranged and classified. The organization of the Jardin du Roi was not effective, and in 1793 the new *Muséum d'Histoire Naturelle* was created by the National Convention. Lamarck took an active part in this reorganization, and the plans finally adopted were so satisfactory that they are still in force. It was natural to expect that he would have been put in charge of the section of botany, but this work was assigned to Desfontaines. To Lamarck fell the professorship of invertebrate zoology which was at that time an almost unknown branch of zoology. At the age of fifty and after twenty-five years of work in botany, Lamarck took up this new work with the greatest vigour. He made the subject, which really includes about nine-tenths of the animal kingdom, a real science, arranging the collections, inventing a new method of classification, and connecting the orders of living species with the palaeontological specimens of past forms. In both the fields of this zoology and of palaeontology he soon attained a commanding authority. As a result of this work he planned and published a great treatise on the *Système des animaux sans vertèbres*. A preliminary sketch of this monumental monograph was published in 1801 and is notable as the first indication that he had changed his life-long conviction as a special creationist to that of an exponent of variation. The sixth and last volume did not appear until 1822. During this period, he had evidently turned his mind with increasing earnestness to the problem of the origin and development of species, since, in 1809 he published his masterpiece, the *Philosophie Zoologique*. Lamarck's last years were pathetic as he became totally blind and suffered from extreme poverty and neglect.

At his death, appreciative eulogies were pronounced by De Blainville and by Geoffroy St. Hilaire who gave him the position of leading naturalist of France and who lamented the death and neglect of one of the greatest geniuses of the age. The official eulogy before the Academy was pronounced by Cuvier, then at the height of his powers and reputation. The eulogy was a disgrace, showing a spirit of envy and malice, ridiculing all Lamarck's theories and especially his evolutionary ideas, and aroused such a feeling of resentment that, as De Blainville tells us, it was not printed until after Cuvier's death and even then with portions omitted as not suitable for publication. It was undoubtedly the opposition and ridicule of the great Cuvier which started the long neglect and misunderstanding of Lamarck's ideas. His opinions were unknown in Germany and were first appreciated by Haeckel in 1882. In England Lyell had been drawn to his ideas and was deeply influenced by them while preparing his *Principles of Geology*. Huxley also has several half-hearted appreciations of his work. As all three of these writers were strong adherents of Darwinism, their only interest in Lamarck was as the founder of an evolution whose views were premature and lacking in any sound basis of fact, and their comparison of his ideas with those of Darwin succeeded only in causing biologists to misunderstand and to neglect his really scientific work. His theory of evolution became merely the foil to enhance the value of Darwinism. But the final and severest blow to a recognition of his genius was given by Darwin. We shall probably never know whether it was jealousy of his great rival which called forth his contemptuous references to Lamarck or whether that serious limitation of Darwin's mind, which prevented him from being able to follow abstract reasoning and which so frequently drew from him the lament that he could not understand philosophy, made it impossible for him to understand the ideas underlying the doctrine of the inheritance of acquired traits. It is, at least, certain that Darwin never referred to Lamarck except to characterize his ideas as futile, or absurd, or rubbish. With this example in their minds it was easy and natural for biologists, who had exalted Darwin's genius into a mythical cult, to ignore Lamarck; and even now during the revival of neo-Lamarckism, it is difficult to find biologists who know what Lamarck meant by his acquired traits. Even Packard who is his protagonist, and Elliot who translated his *Philosophie*, seem, at times, not to distinguish between traits which have been acquired by the activities of the organism itself and those which have been forced upon it by external agents. And yet, his doctrine is really simpler and is more explicitly and logically developed than is that of Darwin.

Lamarck begins with the postulate that the Sublime Author of all existing things creates directly only the simplest forms of organisms, what we now call protoplasmic monads, and also establishes, as a law of nature, "*an order of things* which should give existence successively to all that we see as well as to all that exists and that we do not know."[2] Thus, from the beginning, the protoplasm is endowed *per se* with the tendency to vary, in each generation, towards an increasing complexity of structure and also to respond to changes of environment. The cause of this innate tendency to vary is unknown but it is a fact, and, although Darwin and the Darwinians sneer at this assumption as being irrational and unscientific, we find that they, themselves, are forced to postulate this tendency to vary without having found the cause for it; they merely abolish the word, innate. If we could suppose the environment to remain unchanged and uniform, then each existing form would have descended linearly from some originally created protoplasm. But, since the environment has and does continually change, the succession of animals "form a branching series, irregularly graduated and which has

[2] *Philosophie Zoologique*, vol. I, p. 74 [Trans. by Elliot, p. 36].

no discontinuity in its parts, or which at least has not always had a discontinuity; although it may be true that because of some extinct species one may now occur. It follows that the *species* which end each branch of the general series join, at least on one side, to other neighbouring species which merge with them."[3] To show how even those who ascribe genius to Lamarck and are expounding his doctrine, yet accuse him of the most puerile ideas, we may stop for a moment to give Elliot's critique of this perfectly sound idea. He states that Lamarck believed that, if it were not for environmental influences, man's ancestors would include every existing species of animal and he then makes the absolutely frivolous comment that man could not once have been an intestinal worm when there were no intestines, and that his existence as a flea would have been precarious when there was nothing to bite but jelly-fishes. Such reasoning is not fit for a school-boy. We might take it for granted that Lamarck would have foreseen that if there had been no environmental changes then there would have been no intestinal worms and no fleas, but an entirely different chain. As a matter of fact Lamarck does not say that if there were no environmental changes there would have been a single linear succession, but each terminal species would have a linear chain without branches to a prototypal monad, which is a quite different matter.

[3] *Philosophie Zoologique*, vol. I, p. 76 [p. 37].

Lamarck immediately falls into a difficulty which seems to me inherent in any explanation of causes. He begins by assuming a Creator, or Sublime Author, as the architect and then transfers the construction of the world to natural law or to nature. All the organized bodies of the earth are true productions of nature which fashions immediately only the simplest organisms or the rudiments of organization by spontaneous generation. These rudiments possess the property of growth and of variation of form and functions so that they respond to environmental conditions. It may therefore be asserted that nature has by imperceptible changes fashioned the different species of animals known to us by the aid of much time and an infinite variation of environment.[4] Now, what is this natural law, or nature, which men of science are so fond of invoking? Is it blind chance, the mere statement of what has occurred after the occurrence, or is nature the personification of a true cause which foreordains actions? If it be the latter, how does it differ from a divine intelligence? Plato tried to solve the difficulty by supposing God created an idea or plan of the universe and then left to lesser gods the fashioning of the actual, or material world. Is the nature of the men of science to be identified with the lesser gods of Plato, the contractors who carry into fulfilment the ideas of the architect? We are again encountering the same fundamental difficulty which

[4] *Ibid.*, vol. I, p. 81 [p. 40].

faces all rationalistic theories when they attempt to start the beginning of action.

Lamarck begins his theory of variation by an important assumption that organisms can be divided into two classes according as they respond or not to internal stimuli. In the latter class, he places all plant forms and the lower orders of animals. Such forms "live only by the help of excitations which they receive from the exterior. That is to say, subtle and ever-moving fluids, which exist in the surrounding medium, penetrate incessantly these organized bodies and maintain life in them, so long as the state of these bodies permits of it."[5] This idea is the same as the theory of Descartes that plants and animals are automata, without feeling or internal impulses, responding only to such external stimuli as heat and electricity; an idea revived by Huxley and in fact the basis of all mechanistic theories which suppose life to be due to physical forces.[6]

As usual, Elliot fails to understand Lamarck's reasoning. He says that Lamarck assumes the mechanistic position, but not knowing physics, he postulated subtle fluids as caloric and electricity to be the exciting stimuli. He thus allies himself with Driesch and the modern school of vitalists who, by inventing "a factor that is wholly and unutterably new to science," exercise a pernicious and outrageous detri-

[5] *Philosophie Zoologique*, vol. I, p. 12 [p. 4].
[6] See Huxley's *Essays on Descartes*.

ment to the progress of science.[7] Elliot should know enough about physics to realise that the subtle fluids were but a name for the same forces of heat and electricity whose nature we do not understand to-day, and that we are again returning to the idea that they are entities, or subtle fluids. Also biologists are unable to show any physical basis of life and do postulate a vital force, disguise it as they may. Lamarck thus assumes that plants and the lower orders of animals vary by the direct action of the physical environment.

Somewhere in the progression of the animal, it begins to attain an inner power which increases with the growing complexity of the organism. The animal, at this stage, no longer merely reacts to external stimuli but possesses a nervous system so that "nature, although obliged at first to borrow from the surrounding medium the *excitatory power* for vital movements and actions of imperfect animals, knew how by a further elaboration of the animal organization to convey that power right into the interior itself of these beings, and finally was able to place that same power at the disposition of the individual."[8] The organism has reached the stage where it has desires, needs beyond mere subsistence and propagation, emotions, and will; it is more or less independent of its environment and institutes its own actions. These

[7] Elliot, *op. cit.*, p. lxxi.
[8] Lamarck, *op. cit.*, vol. I, p. 13 [p. 6].

needs lead to the formation of new habits which the animal acquires during its life; these acquired habits are transmitted to the next generation and if they, with the adaptations of structure which are necessary for their maintenance, fit in with the environment then there is a progressive change in the organism which ultimately establishes a new species.

For some reason, partly due to a certain looseness of expression and partly, it almost seems, to a wilfulness of his readers, this doctrine of acquired traits of Lamarck is almost always misunderstood. Darwin and many of his followers accused him of relying solely on an innate tendency to develop; others, of asserting that the environment produced directly the acquired traits. Weissmann cut off the tails of many mice for many generations, and when each new generation persisted in having tails, he cast Lamarck's theory aside, ignoring absolutely the simple fact that mutilations inflicted on an animal can hardly be called a habit acquired by the animal and they certainly do not correspond with any of its needs or desires.

Now Lamarck is perfectly clear on this point, however vague he may be in other matters and there is no excuse for the persistent misrepresentation of his ideas. He says: "I must now explain what I mean by this statement: *the environment affects the shape and organization of animals*, that is to say that when the environment becomes very different, it produces in course of time corresponding modifications in the shape and organization of animals. It is true if this statement were to be taken literally, I should be convicted of an error; for, whatever the environment may be, it does not work any direct modification whatever in the shape and organization of animals. But great alterations in the environment of animals lead to great alterations in their needs, and such alterations in their needs necessarily bring about other actions. Now if the new needs become permanent, the animals then adopt new habits which last as long as the needs that evoked them."[9]

Lamarck embodies his doctrine of the inheritance of acquired traits in two laws which are as follows:

First Law

In every animal which has not exceeded the limit of its development, a more frequent and continuous use of any organ gradually strengthens, develops, and enlarges that organ, and gives to it a power proportional to the length of time it has been so used; while the permanent disuse of any organ imperceptibly weakens and deteriorates it, and progressively diminishes its functional capacity, until it finally disappears.

Second Law

All the acquisitions or losses wrought by nature on individuals, through the influence of the environment in which their race has long been placed, and hence through the influence of the predominant use or permanent disuse of any organ; all these are preserved by reproduction to the new individuals which arise, provided that the acquired modifica-

[9] Lamarck, *op. cit.*, vol. I, p. 223 [p. 107].

tions are common to both sexes, or at least to the individuals which produce the young.[10]

Lamarck, after formulating his laws on the changes produced in structure and organs by use and disuse and the indirect influence of the environment, gives many examples to illustrate the laws. We need to indicate only two to show the trend of his thought.

Birds which have the habit of feeding on land products may, by some change of conditions, have their supply reduced. If they also live near a body of water, they will endeavour to satisfy their need for food by obtaining it from the water where it may be abundant. Their efforts to reach this new kind of food stimulate the nervous actions and the blood supply of those parts which aid in obtaining this food. Some attempt to swim and strike the water with their feet. The skin which unites the digits of their feet is stretched and stimulated by this effort; thus, in course of time, there are formed the webbed feet of ducks and

[10] Lamarck, *op. cit.*, vol. I, p. 235 [p. 113]. Lamarck later, in his *Histoire naturelle des animaux sans vertèbres* divided these laws, and made them rather more explicit. In this later form they are as follows:

Première loi.—La vie, per ses propres forces, tend continuellement à accroître le volume de tout corps qui la possède, et à étendre les dimensions de ses parties, jusqu'à un terme qu'elle amène elle-même.

Deuxième loi.—La production d'un nouvel organe dans un corps animal résulte d'un nouveau besoin survenue qui continue de se faire sentir, et d'un nouveau mouvement que ce besoin fait naître et entretient.

Troisième loi.—Le developpement des organes et leur force d'action sont constamment en raison de l'emploi de ces organes.

Quatrième loi.—Tout ce qui a été acquis, tracé ou changé dans l'organisation des individus, pendant le cours de leur vie, est conservé par la génération et transmis aux nouveaux individus qui proviennent de ceux qui ont éprouvé ces changements.

other swimming birds; others wade and by the effort to escape from the mud stretch their legs, these grow long and the birds become long-legged waders; others stretch their necks and so develop long necks and bills.

His best known example is probably the explanation of the neck of the giraffe. "This animal, the largest of the mammals, inhabits the interior of Africa and, as it frequents places where the regions are nearly always arid and without grass, it is compelled to browse on the leaves of trees and is forced to reach upwards continually. This habit, indulged in for a long time by all the individuals of the race, has resulted in lengthening the fore-legs more than the hind-legs, and has so elongated the neck that the giraffe, without rising on its hind-legs, elevates its head and reaches upwards six metres, or almost twenty feet."[11]

These are typical examples of Lamarck's reasoning and will be used later when this theory is compared with that of natural selection.

The belief that use increases and modifies a muscle or an organ by stimulating its nervous and blood supply, and that disuse causes it to become atrophied, is pretty generally accepted; the only question is whether such variations, occurring during the life of the individual which has acquired the variation, are transmitted to its offspring or whether variations

[11] *Ibid.*, vol. I, pp. 240-65 [pp.115-27].

which are transmitted are limited to the genetic cells which are confined to the organs of generation, the sperm and the ovum.

As has been mentioned before, Darwin never allowed any credit to Lamarck. He states that he did not derive from him a single idea; that his ideas were poor.[12] It is well known that Lyell had a high estimation of Lamarck's work and theory, and that it had a great influence on him when he wrote his *Principles of Geology*, the work which led directly to Darwin's own belief in evolution. Darwin was always most eager to obtain Lyell's support. He was much hurt because his friend did not accept natural selection unreservedly and because he referred to the theory as a modification of Lamarck's doctrine of development and progression. In a letter to Lyell he wrote that Plato, Buffon, and Erasmus Darwin had stated the obvious truth that if species were not separately created, they must have descended from other species. Since Lamarck had done nothing more than this, there is nothing else in common between the *Origin of Species* and Lamarck. He thought Lyell was ruining the cause by such suggestions because: "I consider, after two deliberate readings, it [Lamarck's] is a wretched book, and one from which (I well remember my surprise) I gained nothing."[13]

[12] Darwin, *Life and Letters*, vol. II, p. 10.
[13] *Ibid.*, vol. II, p. 199.

Huxley also warned Darwin that he should acknowledge his debt to Lamarck, but he, too, is answered in the same strain. It is impossible to believe that Darwin could read the *Philosophie Zoologique* deliberately twice, as he says he did, and still find in the work a lack of facts and the opinion that Lamarck held that variations were produced by mere whim and desire. It is well known that Darwin changed from his early and passionate advocacy of natural selection as the sole and sufficient cause of evolution to the milder view that it was an important factor. That he regretted his change of opinion is shown in a letter to Hooker: "I hardly know why I am a little sorry, but my present work is leading me to believe rather more in the direct action of physical conditions. I presume I regret it, because it lessens the glory of natural selection, and is so confoundedly doubtful."[14] Again in 1872, he wrote to Moritz Wagner: "When I wrote the *Origin*, and for some years afterwards, I could find little good evidence of the direct action of the environment, now there is a large body of evidence, and your case of the Saturnia is one of the most remarkable of which I have heard."[15] But, in spite of this acknowledgement of fact, he never gave any credit to Lamarck or relaxed his contemptuous attitude. We are forced, unwillingly, to the belief that either Darwin could not understand Lamarck or deliberately

[14] *Ibid.*, vol. II, p. 182.
[15] *Ibid.*, vol. II, p. 338.

misrepresented him through jealousy. Whichever may be the truth, this attitude was most unfortunate for the reputation of a great man.

Owing to the reverence for Darwin and the blind submission to his views which prevailed for so many years, it was a difficult task to live down Darwin's contempt. Only after facts had multiplied, showing the inadequacy of natural selection, did biologists begin timidly to take Lamarck's doctrine seriously. If one can read the signs aright, we may expect to have an increasing attempt to explain the cause of evolution by the inheritance of acquired traits. The reluctance of the biologists to accept this doctrine does not rest so much on the lack of experimental verification as it does on the fact that Lamarck's cause of variation is fundamentally vitalistic in so far as it acknowledges the influence of the will or desire. To admit such a cause is contrary to scientific and to mechanistic monism.

CHAPTER SIX

Darwin

When Charles Darwin, at the age of twenty-eight, returned to London after his voyage of five years on the *Beagle*, he brought with him his diary of the voyage and a great mass of notes and natural specimens. But what was of far greater importance, he had absorbed the ideas of Lyell's new and epoch making *Principles of Geology* which, by its insistence on the importance of slow and minute changes in the structure of the earth, pointed to an evolutionary theory; and while pondering over this book he had noticed, in particular, the differences between the fauna and flora on islands and on the nearby mainland. As a result, although he had left home a believer in special creation, he returned a convert to the variation of species.

Darwin's first impulse was to prepare for the press the diary of his voyage, to classify and dispose of his collections, and to publish his scientific notes; he was apparently embarked on a distinguished career as a geologist or biologist. He soon made many friends and went moderately into society, and especially was warmly welcomed by Lyell. But, in the midst of this life and work, he was meditating on evolution and he notes in his autobiography that in July, 1837, less than a year after his return: "I opened my first notebook for facts in relation to the Origin of Species, about which I had long reflected, and never ceased working for the next twenty years." He married in 1842 and, after living in London for nearly four more years, he moved to Down on account of ill health and lived there the rest of his life, a confirmed invalid.

Although his belief in evolution was fixed, and he had determined to make its verification his life-work, he remained for a year unable to find a cause for a variation which would progressively change a species into a new one. The clue came to him in 1838, while reading Malthus, whose theory of population was then having its greatest vogue. He immediately adopted the idea of this writer that population tends to increase geometrically while the food supply can increase only arithmetically.[1] Thus, Malthus reasons

[1] The difference between a geometrical and an arithmetical progression can be best explained by the statement that a geometrical series of numbers is one in which each succeeding number changes by a constant multiplier and that an arithmetical series changes by a constant factor of addition or subtraction. For example, let 2 be the constant of such series. Then we have for a geometrical series the numbers 2, 4, 8, 16, 32, 64, etc., and for an arithmetical series 2, 4, 6, 8, 10, 12, etc. It is thus evident that a geometrical series increases much faster than an arithmetical series and no matter how small the multiplying factor may be and how large the factor of addition may be taken, if sufficient terms are taken, the end term of a geometrical series is necessarily greater than that of an arithmetical series. Malthus's idea was that each two parents will have, on an average, more than two children who reach maturity and leave offspring; for example, let us say four. Population will then double in each generation. On the other hand, by increase of land under cultivation and by other means, the food supply in any country can increase only arithmetically. Thus, under any constants of the two series, population is bound in time to pass the available food supply.

that the inevitable growth of the human race leads to overpopulation and an increasing "struggle for existence." In this conflict, the weaker sink into misery, sickness, and vice, and great numbers are eliminated by death due to these agents, which is greatly to the benefit of humanity because it postpones overpopulation and consequent misery of the whole country. Charity and the alleviation of sickness and vice are thus to be discouraged as they tend to increase the life and fertility of the unfit; the elimination of the weaker will permit the better and stronger individuals to live, temporarily, in more comfort and plenty. Darwin eagerly seized this amiable doctrine and extended it to include all organic beings, both plants and animals, assuming that the synonym of life is an incessant and ruthless struggle with physical environment and with all other organisms to attain the two essential factors of life,—food and procreation. It should be borne clearly in mind that the sentimental humanitarianism of Rousseau was the seed from which grew our modern scientific philosophy of brotherly love and eugenics, when fertilized by the pleasant and altruistic doctrine of Malthus. Having settled upon this postulate, Darwin then argued that those individuals of any species, which happen to possess by inheritance any slight advantage, will have a better chance of surviving and of leaving progeny which will also possess this advantageous trait. Favourable changes, he assumed, would become fixed traits constantly increasing until a new species was formed. He also took for granted, as a fact of nature, although we cannot give any satisfactory cause, that all progeny vary in slight particulars from their ancestors.

Darwin hesitated for a long time as to what name to apply to this cause of evolution. He favoured the striking phrase "the survival of the fittest," with which Spencer had caught the popular fancy, as being in the closest agreement to his own views of evolution, but finally decided on the title of "natural selection" as best expressing the idea that nature selects for preservation every least change of structure or habit which tends to the advantage of the species.

With his ideas fixed in this purely *a priori* or deductive fashion, Darwin, now settled at Down, determined to devote his life to collecting data for and against his doctrine and, in spite of the temptation to favour those things which confirm one's preconceived ideas and to explain away those which are antithetical, he was extraordinarily anxious to record all facts which were unfavourable. At intervals, he carried on extensive and most important research work on other problems, although their subject-matter usually had a somewhat close connection with the mutation of species; the only systematic work in zoology which he undertook was a laborious and important monograph on cirripedes or barnacles.[2]

It is necessary to consider at some length the personal character of Darwin as its strength and weakness had much to do with both the scientific and general aspects of his theory of natural selection. And it is peculiarly difficult to keep to a just medium in criticism because his followers struck from the beginning so high a note of praise. Darwin's reputation was made into a sort of mythical cult; every weakness of character was transferred to the credit side of the ledger. He was said to be a second Newton, to have done for biology what his predecessor had accomplished for mechanics; the latter had given us a universal law for the inorganic world and Darwin had completed our knowledge for the living world by his law of natural selection; the nineteenth century was frequently called the Darwinian age. Except in the rarest of cases, such eulogy brings a revulsion of feeling while later, and calmer, judgement finds flaws where there had been proclaimed only perfect workmanship.

Darwin must have been one of the gentlest and most lovable of men, with a peculiar power of at-

[2] The following is the list of Darwin's important books: The *Diary* and scientific monographs connected with the voyage of the *Beagle; Origin of Species*— brief abstract in 1842, an enlarged abstract in 1844, an extended treatise begun in 1856 but not finished, the first published edition in 1859; *Fertilization of Orchids*, 1862; *Variation of Animals and Plants under Domestication*, 1868; *Descent of Man*, 1871; *Climbing Plants, Insectivorous Plants*, 1875; *Influence of Earth Worms*, 1881; *Monograph on Cirripedes*, 1846.

tracting and of keeping friends. In early life he was sociable and was broadly interested in art and literature, but his break-down in health forbade an active life and prevented him from cultivating society, although he maintained his keen love for his friends; and his absorption in his work and the necessity of conserving each moment of time seem to have drawn down the curtain of his life and to have made him lose interest gradually in the arts and literature. His life became a long chronicle of ill-health and of a struggle to work three or four hours a day, with even that privilege broken by long and frequent intervals of inability to do anything. Patient and uncomplaining, he became obsessed with the subject of his health. He hardly wrote a letter which did not refer to it and to his inability to work; he mourned because his mind was weak and dizzy; and he became morbidly apprehensive lest his children were, by heredity, doomed to the same fate. He gradually lost pleasure in most phases, even, of his work; he vacillated in his ideas; writing and the composition of his books became a heavy burden; he held aloof from the controversial battles which beat about him; but the one thing which remained a keen and never-failing delight was the observation of the habits of plants and animals.

When we examine Darwin's methods and results of observation and experimentation, we find all to be admirable. Working with the simplest apparatus and tools, he obtains great and permanent results of a far-reaching importance. He examines the habits and borings of earth-worms in a small area and shows their fundamental importance to agriculture; his work on climbing plants and on fertilization is a model of accuracy and acumen; his enormous accumulation of facts in regard to domesticated animals, and to evolution, is bewildering. He draws his conclusions with admirable certainty and he easily ranks as the foremost biologist of all times.

But when we turn to Darwin's theoretical and philosophical work we find an absolutely different man. He is the exact opposite to Newton, who never lost his sureness of aim and certainty of thought even when absorbed in the widest sweep of the imagination. Darwin vacillates when it becomes necessary to apply his strictly scientific observations and personal conclusions to the broad field of evolution which must include a whole world of phenomena, most of them impossible to place within the scope of his personal observation and explainable only by unerring genius of the imagination. Newton extended his law of gravitation to include the universe from a few simple observations and postulates, and then relied on his powers of logic and mathematics; Darwin made a great accumulation of facts in order to meet all objections and, in the end, this accumulation of facts overburdened him; he could not fall back upon verbal or philosophical logic, in which he was deficient, nor on mathematical logic, of which he had none. He became wearied by thinking and grew to be dissatisfied with his proofs. It is not unlikely that he would never have brought himself to the point of giving his theory to the world if he had not been first urged to do so by Hooker and then had been practically compelled to write the *Origin of Species*, which was only an abstract of the much larger work he had contemplated, lest he should lose priority because of Wallace's essay. And when the great controversy broke out and he became the centre of the battle, he stood aside dazed by the bitterness of the argument which he had not in the least anticipated.

Constitutionally unwilling and unable to attack or to meet attack, he writes incessantly to others to enlist their help. Most of all, he hopes Lyell will lend his support and is full of joy when that is attained, but he is much chagrined and complains that Lyell is hurting the cause when he does not give unqualified assent. He looks upon Haeckel as a vast help, but begs him not to be rash lest he excite opponents to anger. He regards Huxley as his ever-valiant and ever-ready swordsman. When troubles arise he invariably stands aside and urges him on to fight. Although Darwin was naturally a just man, when Mivart drew up a paper pointing out the chief objections to the theory of natural selection, he answered them to the best of his ability in the second edition of the *Origin*. Mivart had foreseen most of the scientific objections which have never been answered. Probably, for the only time in his life, Darwin was willing to have an adversary beaten by an unworthy trick, and he wrote a joyful letter to Huxley who had rushed on Mivart, a Catholic, and had turned his flank by unearthing and controverting an illustration from the Jesuit, Suarez, injecting the *odium theologicum* into Mivart's thoroughly scientific work.[3] This vacillation was attributed to modesty and was made a virtue, but such diffidence is not a virtue in a man of Darwin's power and reputation who was engaged in changing our whole idea of God and nature. And that it was a real inability to attain his end is made certain by the assurance with which he maintained the correctness of his true scientific work dealing with his experimentation.

Darwin was, by nature, unable to deal with theoretical and philosophical questions, to maintain an extended argument, or to see the larger conclusions to which it pointed. He was truly by nature an inductive and experimental scientist and he writes of himself: "I worked on true Baconian principles, and without any theory collected facts on a wholesale scale."[4]

[3] *Life and Letters*, vol. II, p. 328. Darwin writes to Huxley: "How you do smash Mivart's theology. . . . I have been preeminently glad to read your discussion on metaphysics, especially about reason and his definition of it. I felt sure he was wrong, but having only common observation and sense to trust to, I did not know what to say in my second edition of my *Descent*. Now a foot-note and a reference to you will do the work."
[4] *Ibid.*, vol. I, p. 68.

This is true of all his work except his hypotheses of natural selection and pangenesis, and it explains why his botanical and zoological work has stood the test of time and why his hypotheses are crumbling. He and his followers never saw the humour of this statement when it was applied to his life work on evolution. He had collected facts about evolution on a wholesale scale during twenty years, but instead of the theory of natural selection following this work, he had adopted it at the age of twenty-nine, and it had been in his mind as a fixed principle, unconsciously guiding his observations and experiments during the entire twenty years. Bacon would have prayed to be spared such a perversion of his principles.

Unfortunately for Darwin's future reputation, his life was spent on the problem of evolution which is deductive by nature. The enormous and complicated phenomena of life do not admit of solution by inductive reasoning; it is absurd to expect that many facts will not always be irreconcilable with any theory of evolution and, today, every one of his arguments is contradicted by facts. Our acceptance of any such theory must be, in the end, because of a slight preponderance in the balance of facts for and against it. It is a pathetic fact in his life, that after all his enormous labour to prove his theory he, himself, occasionally realized that it had not been accomplished. Four years after the publication of the *Origin*, he wrote to

Bentham that: "The belief in natural selection must at present be grounded entirely on general considerations. . . . When we descend to details, we can prove that no one species has changed (*i.e.*, we cannot prove that a single species has changed); nor can we prove that the supposed changes are beneficial, which is the groundwork of the theory."[5]

It is most unfortunate that Darwin should have devoted his life to a problem which required for its solution philosophical genius, the very trait which was foreign to his nature, rather than to those inductive questions which he was so eminently fitted to attack. It is almost unaccountable that his contemporaries regarded his *Origin of Species* as a model of scientific accuracy and thought and passed this estimate on to us, when a careful analysis of its contents shows that his argument for natural selection is based on the vague confirmation from geology that species have in some way changed and on the analogy of changes in domesticated animals and plants by man's selective breeding. Only a few in England, notably Sedgwick, realized at once, and wrote to Darwin, that he had taken the generally known law of change and had narrowed it down to a specific method of variation unsupported by any adequate body of facts, and had written of natural selection as if it were done consciously by a selecting agent; in Germany, Dar-

[5] *Life and Letters*, vol. II, p. 210.

winism quickly made progress; only the French were clear-sighted enough to see the insufficient character of the proofs.[6]

Darwin was singularly uninterested in the influence of natural selection on thought in general. After assuming it, as an hypothesis, with no real inquiry into the soundness of its philosophical basis but rather from the appositeness of two catch-phrases, he devoted a long period to the accumulation of facts. But it does not follow that an accumulation of facts may be classified into a law, and it is still less certain that they will verify an hypothesis. For example, the facts bearing on the subject may be so numerous and so complex that no final decision can be attained. And also, if a law can be derived and an hypothesis be verified, yet, if the law be extended to a field which cannot properly be included in the investigation, the

[6] The letter of Sedgwick (*Life and Letters*, vol. II, p. 42) should be read in its entirety.—To confirm my statement of the attitude of the French, see the same volume, p. 400. Darwin was not elected a member of the French Academy until 1878 and then in the Botanical Section. He writes to Dr. Gray that it was something of a joke as his knowledge of botany was rudimentary. Lyell always spoke of it as a scandal that he was so long kept out of the Academy. It appears that an eminent member of the Academy wrote to *Les Mondes* to the following effect: "What has closed the doors of the Academy to Mr. Darwin is that the science of those of his books which have made his chief title to fame—the *Origin of Species* and still more the *Descent of Man*—is not science, but a mass of assertions and absolutely gratuitous hypotheses, often evidently fallacious. This kind of publication and these theories are a bad example, which a body that respects itself cannot encourage." It is but too evident that time is slowly justifying this opinion and that ultimately Darwin's reputation will rest on his botanical work rather than on his hypotheses of natural selection and pangenesis; the value of the former is already fading and the latter is totally discredited.

effect of the result will be of no value in that field. Natural selection had the misfortune to fall into both of these categories. Darwin, himself, felt that many facts did not substantiate his theory and the accumulation of facts, since his time, has steadily reduced the value of natural selection as a scientific law. Of the application of natural selection and of the struggle for existence to sociology and ethics, he does not seem to have had the least anticipation. He was amazed and mortified to find himself the centre of a bitter theological dispute and to be classed as an atheist.

A doctrine, which bases the entire progress of the organic world on a bitter struggle for existence, from which only the few which are the strongest, or fittest, can survive, which accounts for the thoughts and the noblest ideals of mankind as the success of the dominant force,—such a doctrine is not a gentle idea. It is difficult to see how anyone could fail to draw the conclusion that the world is a scene of ruthless slaughter and that only by encouraging such slaughter could the unfit be eliminated and the strong and fit be given the chance to develop and continue the race; yet Darwin considers such a conclusion as amusing. He writes to Lyell: "I have received, in a Manchester newspaper, rather a good squib, showing that I have proved 'might is right,' and therefore that Napoleon is right, and every cheating tradesman is also right."[7]

[7] *Ibid.*, vol. II, p. 56.

If he had lived to see the consequences of the idea of the superman emerging from this struggle for existence as logically derived by Nietzsche and carried out practically by the Germans, he would have hesitated to publish his doctrine until forced to do so by the certainty of its proof. Nor did he ever apply the practice of his hypothesis to the conduct of his personal life; he may have worked to prove that the law of nature was ruthless suppression of the weak, but his life singularly exemplified the virtues of love, faith, and humility; he was known for his sympathy for, and protection of, the unfortunate, both animals and men.

Although sustained power of abstract reasoning and imagination were essential to the development of his hypothesis, Darwin showed a lack of interest in philosophy and was, by his own repeated statement, absolutely unable to follow an abstract argument. He was apparently limited in this respect temperamentally, and his continued ill-health greatly intensified this predisposition. His letters are full of confessions that he could not follow a metaphysical argument; that the attempt to do so invariably distressed his head and wearied him. And nothing is more surprising than his naïve admiration of Spencer, Huxley, Fiske, and others who were able to understand such reasoning. As we have seen, he adopts Spencer's philosophy and bases his hypothesis on the dictum of the survival of the fittest, and yet he confesses that: "With the exception of special points I did not even understand H. Spencer's general doctrine; for his style is too hard work for me."[8] Although he cannot understand this doctrine he is unrestrained in his admiration of it and gives his opinion that Spencer is perhaps equal to any philosopher that ever lived. One could, possibly, find some justification for such an estimate, but it is incomprehensible that a great leader of thought, such as Darwin, could have accepted the shallow reasoning of Malthus whom he calls "that great philosopher." Wearied by controversy and hostility to his own ideas, he consoles himself for the slow acceptance of his own theory. "It consoles me," he writes, "that ——— sneers at Malthus, for that clearly shows, mathematician though he may be, he cannot understand common reasoning. By the way what a discouraging example Malthus is, to show during what long years the plainest case may be misrepresented and misunderstood."[9] There are, perhaps, some cases where important scientific work is not linked to metaphysics; but, certainly, the theory of natural selection is not one of them; its failure is largely due to its foundation of false philosophy. Why such statements, as the above, should be impressed upon us as a virtue of innate modesty is hard to understand. They have the ring of simple statements of fact. It cannot be called a virtue

[8] *Life and Letters,* vol. II, p. 371.
[9] *Ibid.,* vol. II, p. 111.

in a man who is engaged in a difficult philosophical problem not to be able to comprehend philosophical thinking; the virtue lies merely in the recognition of such inability.

Darwin, himself, attempted only once to invade the field of philosophy. Although he usually admitted an unknown principle of variation, he advanced an hypothesis to account for heredity by what he called pangenesis. In brief, his idea was that each cell of an individual contributes minute particles, pangenes or gemmules, to the reproductive organs so that each ovum or sperm contains within itself all the distinguishing features of its parent body. There is hardly any need to discuss it, as pangenesis obviously was so improbable that it never lived except in the affection of its author. Huxley immediately saw the futility of the idea and begged Darwin not to emphasize it, lest such an explanation of evolution by natural selection would lower the probability of the larger theory and retard the great work of its acceptance; but Darwin clung to pangenesis with the blind affection of a parent for a defective child. In the first place, we have never had the slightest evidence that the organic cell does detach from itself such a part as a gemmule. In the next place, such a gemmule must be potentially the same as its parent cell, and we are left to explain the gemmule; we have merely changed the organism from an aggregation of cells to one of gemmules; we should, to say the least, have some difficulty in finding the force which causes the enormous number of gemmules to flow to the organs of reproduction and there arrange themselves so that each of the vast number of ova and sperms shall be a miniature of a possible offspring; again, not to mention other insuperable difficulties, if a child, for example, should lose a finger or any other part of the body at birth would not that mutilation necessarily be transmitted, since it would be difficult to see how the loss of the finger would not also include final loss of finger cells and gemmules of the finger cells? The whole idea is so preposterous that it ought not to be discussed at all and yet, at the time, the evolutionists were so certain that they were the repository of truth and that they merely had to persevere in order to give a mechanistic theory of life, that the eminent physicist, Maxwell, calculated the number of probable material atoms in a gemmule to show their variety of combinations could not account for the structure and complex characteristics of man. No other evidence is necessary to show that when Darwin left the field of observation and entered the more difficult region of speculation he showed a pitiful inability to grasp the problem, to see even its absurdities, or to foresee its conclusions. It is almost incomprehensible that the world, and particularly the biologist, has not taken into account this inherent inability of Darwin to think on abstract questions and is still willing, because he was a genius in one field, to follow him as a guide in all fields.

I have tried to point out elsewhere, without much apparent result, that men of science who have proposed hypotheses are very prone to believe that they have arrived at a new idea when in fact the hypothesis is generally an old idea merely dressed up in a new garb. Even a slight knowledge of the past history of science would in most cases show that an hypothesis does not become true by any amount of verbal changes. As I have shown, Darwin never could see that his doctrine of natural selection was but a new edition of Lamarckism; in essentials both theories depend on an unknown factor of variation in each new generation; it is a mere verbal change to substitute for Lamarck's inherent tendency to vary from the simple to the complex, Darwin's postulate that Nature selects those which are most fit to survive and to propagate. Can men of science tell us what nature and natural law are, or distinguish them from an omniscient and omnipotent Creator?

Darwin uses the hypotheses of Spencer and of Malthus without any real study of their work and he makes sad havoc with their ideas because he never understood them. There is also much in common between the ideas of Buffon and Darwin; yet, in the preface to the *Origin of Species*, he writes that it is not necessary to consider Buffon because "he does not enter on the causes or means of the transformation of species." Darwin can thus dismiss the work of Buffon who states clearly and emphatically what he believes to be the cause of variations. When he essays his hypothesis of pangenesis, some years later, as the cause of hereditary transformation, he asked Huxley to criticise it. When the latter condemns the hypothesis and advises Darwin to read Buffon, he is chagrined to find: "It would have annoyed me extremely to have re-published Buffon's views, which I did not know of, but I will get the book. . . . [When he has read the book, he writes again] . . . I have read Buffon: whole pages are laughably like mine. It is surprising how candid it makes one to see one's views in another man's words. I am rather ashamed of the whole affair, but not converted to a no-belief."[10] As a last instance of this ignorance of the work of others and absorption in his own ideas; in almost the last letter he ever wrote, Darwin says: "From quotations which I had seen, I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere schoolboys to old Aristotle."[11] It is perhaps excusable that the author of an hypothesis should be blind to the work of others, but it is a curious commentary on those who, like Huxley, knew the essential similarity between Darwinism and the theories of other evolutionists and yet would condemn the lat-

[10] *Life and Letters*, vol. II, p. 228.
[11] *Ibid.*, vol. II, p. 427.

ter as untenable, and preach natural selection as a scientific explanation based on the certain foundation of observation and reason.

If Darwinism, or any other theory of the method of evolution, is to serve us as a guide in the broad field of human thought and conduct, it must satisfy us by its soundness as a philosophical system rather than by its apparent agreement with a limited number of biological observations and experiments. As we have seen, natural selection is based on the philosophical systems of Malthus and Spencer and, so far as I can discover, the Darwinians have not denied this assertion. As I intend to discuss the work of Spencer in a later chapter it is necessary now to consider only the ideas of Malthus. They are so manifestly false that it should be necessary merely to state them; but those who teach and preach Darwinism so seldom do more than to echo the phrase, "struggle for existence," that it will be profitable to examine this doctrine of economic philosophy in some detail.

The fallacy of the Malthusian theory may be exhibited in two ways. The one is, that the theory of Malthus is false in itself, and the other is, that even if it were true as an economic theory of the relation of population to available land production, it would fail absolutely when extended, as Darwin assumed, to a general scientific law of nature.

Malthus lays down as a postulate that population tends to increase in a geometrical ratio while its food supply can increase only by an arithmetical ratio; thus the world is bound to become overpopulated and fall a prey to misery and suffering owing to the struggle for existence which must ensue. This postulate is based on what he asserted to be two imperative instincts of the human being,—the desire for food, and to procreate. Thus, it is a mistake to relieve suffering since the only means to reduce population, and so to postpone the *débâcle* of civilization, is to foster vice, misery, and war, the three greatest causes of death.

Since each person has two parents, it must follow that the number of anyone's ancestors doubles with each generation as we go backwards in time, and they form a geometrical series with the number two as a multiplying factor. It is quite another matter when we attempt to estimate the number of posterity anyone will have in successive future generations; that would be a pure guess. All persons have had the same number of ancestors, counting an equal number of preceding generations, and we may apply the law of a geometrical series; but some will have no descendants, others will have a few, and others will have many. And so the population of any country, or even of the whole race, may increase, remain stationary, or decrease in number; there can be no law relating to the future number of a population and no law of future increase or decrease. We accept as a general fact that many species of animals have increased in number for a time and have afterwards decreased until they became extinct. Malthus happened to write when the population of Europe was increasing at a rate which had never before been equalled and when the increase of food supply was not keeping pace with the population. Since then the rate of increase of population has been steadily decreasing and the food supply has been increasing geometrically, until there has arisen the anti-Malthusian cry for more production of children.

A system of thought which classes the desire to procreate and the desire for food as equally imperative is not one to command respect. Even Malthus withdrew from this position and added what he euphemistically called moral restraint as a check to population. The whole subject of fertility and sterility is one of great complexity and about which we know practically nothing. The example of France, where the population actually decreased for years during a time of plentiful food supply and of peace, is evidence enough to prove the fallacy of his argument.[12]

It is also quite apparent that, except for a negligible number of individuals, mankind in civilized

[12] It must be borne in mind that we are discussing merely the total number of the human race and not the relative proportions of advantageous and disadvantageous stocks. It is undoubtedly a most serious menace to the quality of any nation or race when the better classes do not maintain a high proportion in numbers. It is also true that a diminishing birthrate is apparent first in families of the better classes and, in so far, the warnings of the Eugenists are of real value. But one wonders how the Eugenists reconcile their passionate appeal for artificial selection of human stocks with Darwinism. Is it not the fundamental tenet of that doctrine that advantageous stocks will kill out disadvantageous stocks by natural selection, by the struggle for existence, and by the survival of the fittest?

countries is not in a condition to which a struggle for existence can be applied. What man struggles for are the luxuries and not the necessities of life, and it is quite probable that the desire for comforts and luxuries is more potent to reduce population than are vice, misery, and war. Even if his law were true, which cannot be admitted, it would not apply, except in congested localities, to the race as a whole until the land supply has been exhausted. We should give Malthus the excuse that he was specially discussing the condition of Great Britain which offers a condition peculiarly susceptible to overpopulation with respect to its land supply.

When the Malthusian doctrine is applied to all organic beings, as was done by Darwin, it becomes absurd. If we keep in mind the fact that the food of an organic being is other organic beings, then it should be evident that if organic beings increase geometrically their food supply also increases geometrically. It is true that *individuals* perish by the competition of life. Darwin showed quite truly that in certain fields thousands of little trees never came to maturity because they were cropped by cattle, and also that thousands, and even millions, of seeds and eggs perish for one which comes to maturity; but where one kind is eliminated in a certain locality by adverse conditions, in other places conditions are likely to be favourable to multiplication so that, so far as the species is concerned, the struggle for existence does not enter as a determining factor to such an extent that small variations become important. A struggle for existence may affect individuals, but it is not applicable to species, because as soon as destruction is continued to a certain point the pressure is removed and the survivors are free again to multiply. This idea of the struggle for existence, of such a narrow margin between existence and extermination that the least upset in the balance would cause a species either to become dominant or disappear, became an obsession with the Darwinians and during the latter part of the last century the world was pictured as a grim spectacle of blood and conflict. The fact that all conflict is between individuals and not between species was lost sight of, and also the equally strong factor of mutual help and support within the species was not considered. It is safe to say that Lamarck, who doubted whether any species of plants or animals was ever exterminated by conflict or by inability to conform to the slow changes of environment, except the unusual case of those which were pursued and attacked by man, had a keener insight into the powers of nature to protect life than had Darwin. It is, nevertheless, true that many species have appeared and become abundant, and have then disappeared, but the cause of the inability of a species to maintain itself is absolutely unknown. The struggle for existence during those relatively infrequent universal changes of conditions may account for the disappearance of a few species, but the great majority of cases must have been due to the unknown laws which govern fecundity and sterility. Striking examples of great fluctuations in numbers are seen frequently in the sudden appearance of great swarms of insects which reappear for two or three successive years and then cease, although there has been no multiplication of enemies, no lack of food, and no change in environment.

The Darwinian theory of evolution, as it stands today with the modifications which have been made since the time it left Darwin's hands, is a complex doctrine which involves several ideas whose relative importance has not been specified. There are first, the general postulates of heredity common to all theories of evolution; organisms tend to vary; offspring are always different from their parents; and, as a general rule, variation tends to increase the differentiation and complexity of the organism. In addition, there are the specific ideas which distinguish natural selection from other causes for variation.

There has been a vast deal of discussion about the general laws of heredity. Biologists evade the statement that the organism has an *innate* tendency to vary, and attempt to account for variation by physical and chemical forces from a study of the cell and the embryo. But the fact remains, except for a few minor facts of hereditary changes, we are absolutely unable to predict what variations will occur in future generations of animals and plants. The form any variation will take is a mystery revealed at birth, and, as that is exactly the meaning of "innate," why should we not frankly use the word until the biologists can formulate laws which will predict the characteristics of offspring before birth?

Having postulated the general law of variability as the fundamental difference between organic and inorganic bodies, Darwinism next tries to explain how certain variations in a species become fixed by progressive increase to produce new species, which differ morphologically, with pronounced differences in structure, and physiologically, or functionally, so that individuals of the old and new species are mutually sterile.

A cause for the creation of a new species was first proposed by Buffon who believed that an organism changed in order to adapt itself to meet changed conditions of its environment, principally those of temperature, moisture, and food. Thus an animal covers itself with thicker fur to protect itself against the chill of winter, and others have a winter pelt of white fur as a further protection since that colour is the best reflector of heat. The heat of the animal's body is thus more completely reflected back to its body and does not radiate to the colder air, just as a tea-pot is polished and white to maintain its contents hot. Such correspondences between the environment and the organisms are accepted as facts, but they are, evidently, not causes of variation until it can be shown what forces within the organism act to modify it.

The next step in the theory of evolution was taken by Lamarck who proposed his famous doctrine of the inheritance of acquired traits. As I have pointed out, this method rests on the postulate that the use or disuse of any part of the organism during its life tends to modify the part, and the variation is transmitted to the next generation. The cause for increased use or disuse is the desire of the organism to meet new needs brought about by changes in the environment. I have also pointed out that this is a true scientific theory because future events are caused by past actions and that, if the effects of use can be proved to be inherited in all cases, we can predict what will be the general trend of the variation in the offspring, because we may observe the changes which have occurred in the parent. Darwin was reluctantly forced to accept Lamarck's doctrine to a limited extent. At the present time biologists are divided in opinion as to the fact of the inheritance of acquired traits; some hold that only changes in the genetic, or reproductive, cells are transmitted and others that the variations during life may react on the sperm and ovum and thus be transmitted. If Lamarckism can be proved, it would, in my opinion, have the inestimable advantage of opposing the materialistic or mechanical theory of life as it inevitably points to the non-mechanical principle of consciousness or intellect as the distinctive factor of life.

The third contribution to the cause of evolution is Darwin's theory of natural selection and this theory has had so dominating an influence that, to most men, evolution and natural selection are synonymous, even though Darwin, himself, states that the two earlier theories must be accepted as contributory causes. He has stated his theory so clearly that it would be unwise not to quote his own words: "Can it, then, be thought improbable, seeing that variations [in domesticated animals] useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should occur in the course of many successive generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest. Variations neither useful nor injurious would not be affected by natural selection, and would be left either a fluctuating element, as perhaps we see in certain polymorphic species, or would ultimately become fixed, owing to the nature of the organism and the nature of the conditions."[13]

As a corollary to natural selection, Darwin added the element of choice which he calls Sexual Selection. "This form of selection depends, not on a struggle for existence in relation to other organic beings or to external conditions, but on a struggle between the individuals of one sex, generally the males, for the possession of the other sex. The result is not death to the unsuccessful competitor, but few or no offspring. Sexual Selection is, therefore, less rigorous than natural selection. Generally, the most vigorous males, those which are best fitted for their places in nature, will leave most progeny. . . . I can see no good reason to doubt that female birds, by selecting, during thousands of generations, the most melodious or beautiful males, according to their standard of beauty, might produce a marked effect."[14]

Of late years the doctrine of selection has been somewhat modified by de Vries under the name of the Theory of Mutations. Darwin insisted that evolution required that variation must proceed by minute changes, and he maintained this view in spite of the warning of Huxley who wrote: "First, you have loaded yourself with an unnecessary difficulty in adopting *Natura non facit saltum* so unreservedly. . . .

[13] *Origin of Species*, vol. I, p. 98.
[14] *Ibid.*, vol. I, pp. 108 and 109.

And, second, it is not clear to me why, if continual physical conditions are of so little moment as you suppose, variation should occur at all."[15] Evidence has accumulated that offspring frequently differ from their parents by well-marked characteristics. DeVries, on this evidence, assumes that variation of species may thus progress by jumps, or mutations, rather than by the gradual variation which proceeds in the same direction through many generations. The idea is destructive to scientific theory, as it really does away with the whole idea of continuity which should be the basis of an evolution theory; and it certainly, if true, forbids any foretelling of future events since no one knows how great such mutations may be. The thought at once occurs that each of the surprising breaks in the palaeontological record, such an one as separates the reptile from the feathered bird, may have been taken at a single leap during an overstimulated period of Nature. If the theory of jumps is ever accepted, evolution parts company with physics and chemistry and would not differ essentially from the belief in special creation. All other sciences are based on the law, that nature does not proceed by jumps.

We have so far considered the theory of natural selection from the standpoint of its general philosophical adequacy, and have found it to be based on principles which are now discredited and that its weakness is largely due to Darwin's temperamental

[15] Darwin, *Life and Letters*, vol. II, p. 27.

inability to follow abstract thinking. When we turn to the scientific aspects of the theory we should find a different condition of affairs. He was undoubtedly a marvellously keen observer and his powers of scientific generalization were of the best; yet, even from the scientific aspect, Darwin's work to establish natural selection is rapidly crumbling on its biological side. This result is again to be traced indirectly to the same deficiency of his mind; he could generalize correctly so long as he confined himself to a narrow field which lay immediately under his own observation, but he could not sustain himself, because of his lack of imagination, when it was necessary to include so vast a field as the evolution of all organisms.

Darwin based his theory of natural selection on the analogy of the results which man has obtained by selective breeding of domesticated animals; he did an enormous amount of work in this field and collected much curious and valuable information about selective breeding. But he never seems to have once realized that the analogy is purely specious because the variations of domesticated animals and plants have, in man, a directing force which can arrange and alter the animals' habits, instincts, and environment, so as to foster certain variations and eliminate others. The one essential thing for a rational theory of evolution is to discover what directs the, to us, chance variations of undomesticated organisms so that minute changes will accumulate in a continuous increase until a new species is formed. Given a Divine Intelligence to guide organisms, as man directs those in a domesticated state, and the problem is solved, but that is the last admission the scientific evolutionist is prepared to make; he will admit only nature and natural law, whatever those words may mean.

Let us now discuss the arguments for and against the doctrine of natural selection from the biological point of view.[16] Man has by selective breeding produced great diversities in structure and habits of domesticated animals and plants. He has, for example, produced dogs as different as the mastiff and the toy spaniel which have sufficient structural differences to be classed almost as different species. He has even been able to produce characteristics which are detrimental to the comfort of the animal, or dangerous to its life, such as the fan-tail of the pigeon. And, in every case, he has not considered the advantage of the organism but his own desires or whims. These diversities, he has obtained by breeding together individuals which possess some pronounced trait in com-

[16] The literature on the subject is so extensive that only a few of the main points can be touched. I have been careful to verify my statements and have accepted unreservedly the experimental results of competent authorities. The reader may verify them either from his own knowledge or by consultation of the sources. One thing must be kept clearly in mind, the scientific theory of natural selection is subject to the limitations of inductive reasoning; it may be supported by many facts but if other facts are clearly contrary to its acceptance, then it is not an acceptable theory. The reader should also be careful not to depend on popular or even technical works which are specially written in support of the theory; they are almost without exception biased to the extent, at least, of magnifying the facts which support it. It is far safer to refer to biological monographs and to general texts.

mon. Those individuals of their progeny which show this same trait are again selected and bred together, and so on until the desired result is reached. This method is further helped by continued change of diet, climate, or other factors of the environment. Whatever means are adopted, one practice must never be departed from; breeding outside the strain must be rigidly prevented or the organism reverts back to the original stock. To make our ideas more precise let us follow Darwin and consider a particular case in some detail. After deliberation, he selected the pigeon as the best example of directed breeding. He kept every breed he could purchase or obtain; he corresponded with pigeon fanciers; he found that records of breeding extended back into antiquity, and that the diversity of breeds is something astonishing.[17] In addition to all these reasons for his choice, there is the remarkable advantage that: "Great as are the differences between the breeds of the pigeon, I am fully convinced that the common opinion of naturalists is correct, namely, that all are descended from the rock pigeon (*Columba Livia*), including under this term several geographical races or sub-species, which differ from each other in the most trifling respects."[18] He then tells us with the utmost care how man was able to produce such astonishing variations from a single parent stock: "Man can hardly select, or only with much difficulty, any deviation of structure, excepting

[17] *Origin of Species*, vol. I, p. 23.
[18] *Ibid.*, vol. I, p. 26.

such as is externally visible; and indeed he rarely cares for what is internal. He can never act by selection, excepting on variations which are first given to him in some slight degree by nature. No man would ever try to make a fantail till he saw a pigeon with a tail developed in some slight degree in an unusual manner, or a pouter till he saw a pigeon with a crop of some unusual size; and the more abnormal or unusual any character was when it first appeared, the more likely it would be to catch his attention. But to use such an expression as trying to make a fantail is, I have no doubt, in most cases, utterly incorrect. The man who first selected a pigeon with a slightly larger tail never dreamed what the descendants of that pigeon would become through long-continued, partly unconscious and partly methodical, selection."[19] Thus Darwin shows what remarkable results can be obtained when slight, accidental variations are directed by man so as to exclude the crossing of a given strain with other individuals of the same species which do not show the same variation. With his mind fixed on the problem of increasing and fixing variations, he did not see a fatal objection to the theory of evolution when it was applied to organisms not subjected to the control of man's will. The objection is this: in spite of all our breeding of pigeons, which has extended through more than three thousand years, two of the most differentiated varieties can interbreed;

[19] *Origin of Species*, vol. I, p 44.

this fact obviously shows that they are still the same species since their young are not sterile, and, what is even more significant, the pigeons from such cross-breeding, in a few generations, still revert back to the original ancestral type. This tendency to revert to the original stock is so strong that even in pure strains we find "the occasional appearance in all the breeds of slaty-blue birds with two black bars on the wings, white loins, a bar at the end of the tail, with the outer feathers externally edged near their bases with white";[20] these are the characteristics of the rock pigeon (*Columba Livia*). Darwin explains this reversion as follows: "After twelve generations, the proportion of blood, to use a common expression, from one ancestor, is only one in 2048; and yet, as we see, it is generally believed that a tendency to reversion is retained by this remnant of foreign blood. In a breed which has not been crossed, but in which *both* parents have lost some character which their progenitor possessed, the tendency, whether strong or weak, to produce the lost character might, as was formerly remarked, for all that we can see to the contrary, be transmitted for almost any number of generations. When a character which has been lost in a breed, reappears after a great number of generations, the most probable hypothesis is, not that one individual suddenly takes after an ancestor removed by some hundred generations, but that in each successive genera-

[20] *Ibid.*, vol. I, p. 195.

tion the character in question has been lying latent, and at last, under unknown favourable conditions, is developed."[21] This latent tendency to reversion must be very strong. After only one hundred generations, the proportion of blood from one ancestor is only one in 2 with thirty zeroes after it. It is no wonder that the breeder must preserve the purity of a strain with scrupulous care, if so inconceivably small a proportion of foreign blood can still produce an effect. If this latent tendency to revert is as strong in animals and plants in a wild state as it is with them when domesticated, and it would be difficult to deny it, what chance would a variation have to be preserved, when we consider that cross-breeding with others of the species which did not possess the same variation is absolutely certain to occur at all times, unless the variation was so advantageous, and the struggle for existence was so intense, that all the individuals which did not have the variation were killed, and all those which afterwards reverted also died without progeny? In other words, the tendency to revert must be considered as universal a law of nature as the tendency to vary. For example, even in men whose choice in mating has progressed further than in any other species, this reversion to a median line must be very persistent for if it were not, then the race would be, by this time, divided into sharply distinguished characteristics, those growing taller

[21] *Origin of Species,* vcl. I, p. 196.

and those shorter; of mentally strong and weak, etc.

While, at first sight, it seems possible, though hardly probable, that such directed breeding might occur in the natural state, two facts destroy the force of the analogy even with this granted. New varieties and races created by artificial selection revert to the original type as soon as they are left to their own devices; and, in no case, has mutual sterility been produced between different varieties; the most different kinds of dogs, pigeons, and other domesticated animals breed freely together and their offspring is a mongrel; while successive general intercourse soon obliterates all the special traits. It is evident that fixity of traits and sterility are essential to establish a species, and that in some way these must occur in a state of nature. The importance of artificial selection was first criticised by Huxley, and its value as a proof has steadily declined until now many biologists admit that there are fewer features in common between natural and artificial selection than the Darwinians supposed.

Let us now turn to natural selection and let us assume that a useful variation has occurred in some individuals of a certain species; under these favourable conditions we can discuss what the chances are that this variation will continue to increase until the original variants have produced an abundant offspring so different from the original stock that a new species has been formed. Again, to make our argument precise, let us consider the case of the long neck of the giraffe and assume that some offspring of short-necked giraffes have a slightly longer neck, say an additional inch, and that this additional length is of great use in obtaining food. We shall first admit that the struggle for existence is, at that time, so intense that the short-necked giraffes die of starvation and those with this extra inch of length alone survive; then their offspring will have, presumably, the one extra inch and not two extra inches of length. Thus to arrive at the result of the very great length of neck which existing giraffes possess, Darwinians must assume, not a transmission of a real character but the *tendency* of the offspring of giraffes to have a successive increase in the length of the neck. The transmission of a tendency to vary in the same direction is a pure abstraction, and the only alternative of the Darwinians is to accept the transmission of the effects of use and disuse of Lamarck, or the uninterrupted action of the environment working steadily in the same direction of Buffon; both of these admissions are anathema to their theory.

I suspect that many biologists have fallen into a fundamental error, when considering the ultimate effect of a slight variation, which is so common with those who use mathematical formulae without a knowledge of mathematics. Thus, Professor Hugh Elliot discusses the ultimate great effect of a slight change in a germ plasm many million years previously. He says it is similar to the case of a bullet fired directly at London from the star *Alpha Centauri;* if, at a point near the beginning of its journey, a very minute force deflected its path by so small an amount that, after a quarter of a million miles, it is still only an inch out of its original course, yet this minute deflection would ultimately make the bullet miss the Earth altogether. He then concludes that a single minute change in a germ would ultimately make a huge difference in the offspring after countless generations. He adds that "the application is at once obvious."[22] It is obvious, and the conclusion is that he is absolutely wrong and makes an argument which proves just the converse. The original *direction* of the path of the bullet represents the line of offspring which maintains exactly the same characteristics as its ancestor: that is, a fixed species. At a certain time let the species produce an extra inch in length of neck; this corresponds to the point of deflection of the bullet which then continues in a *straight* line in the constant new direction, and this new direction corresponds to a new fixed species with this extra inch in length. The mathematical and graphical representation of the descendants of a fixed species is a straight line; each new change in a species must be shown by a new change of direction of the straight line. To represent continuous small and progressively increasing changes of a species, as are assumed by the Darwinians, we must draw a line which is continually chang-

[22] Trans., *Phil. Zool.*, p. li.

ing in direction, or a curved line. Professor Elliot's example of the bullet, and it is a kind generally used by biologists, is singularly unfortunate; a single disturbance in the path of the bullet may make it miss London, but progressive evolution requires that a force is acting at points all along its path to change it from a straight to a curved line. Thus, even if we accept the postulates, that a favourable variation is transmitted, that the struggle for existence is so intense that all those without a slightly longer neck die, we must assume either that a continuous tendency to vary in the same direction exists, or that these unusual conditions are repeated many times by chance, before the giraffe's neck becomes so conspicuously elongated. The Darwinians can permit neither of these assumptions.

We have, however, gone much too far in our admissions; it is impossible to assume them. Even Darwin, with his attention riveted on the struggle for existence, does not ask us to suppose that an inch difference in length of neck means death or life to a giraffe. Let us follow his own words: "Giraffes which were the highest browsers, and were able during dearths to reach even an inch or two above the others, will *often* have been preserved; for they will have roamed over the whole country in search of food. That the individuals of the same species often differ slightly in the relative lengths of all their parts may be seen in many works of natural history, in which careful measurements are given. These slight proportional differences, due to the laws of growth and variation, are not of the slightest use or importance to most species. But it will have been otherwise with the nascent giraffe, considering its probable habits of life; for those individuals which had some one part or several parts of their bodies rather more elongated than usual, would *generally* have survived. These will have intercrossed and left offspring, either inheriting the same bodily peculiarities, or with a *tendency to vary again in the same manner;* whilst the individuals, less favoured in the same respects, will have been the most liable to perish."[23] It is almost inconceivable that a great man should have rested his case on an argument so easy to tear to pieces. In the first place, he says the giraffe may have a tendency to vary and yet he writes to Hooker: "Heaven forfend me from the Lamarck nonsense of a *tendency to progression*," and he again and again writes to his friends that a "tendency to vary" is fatal to his theory, as it is equivalent to assuming unknown forces which act according to Design.

It is not difficult to make a picture of Darwin's idea. During a period of great scarcity of food all the easily accessible leaves have been used; the margin is so close that individual giraffes which happen to have an extra inch of length in the neck have a great advantage and will more probably survive and produce

[23] *Origin of Species*, vol. I, p. 277.

young which will not only inherit this trait but also have a tendency to have a second additional inch in length. Now we see, at once, that if only a few giraffes have this added length, then almost all the others must die or there will be little chance of longer-necked giraffes finding other longer-necked giraffes as mates: or else we must assume that not only a large proportion suddenly varies in this fashion but also this variation occurs simultaneously with this unusual scarcity of food.

Now the mathematical probability that a great proportion of a species will have the same variation at the same time is a very small fraction, and the probability of a scarcity of food being so great that, at many different times, the leaves of the trees are stripped to a height from the ground so uniform that a difference of an inch in length of neck decides whether giraffes may obtain food or die, is also a very small fraction. And the probability that these two independent events will occur at the same time is the product of the two separate probabilities; that is, it is the product of two very small fractions which is a very, very small fraction. For example, if each probability were one-thousandth, which is manifestly far too great, then the probability of both of them occurring at the same time is only one-millionth.

In the first edition of the *Origin of Species*, Darwin, whose attention was fixed on artificial selection where man forces selected individuals to mate, assumed that in the natural state the same would occur. His attention was soon called to the fact that, if only a few individuals possess an advantageous variation, the effect of chance mating would prevent its continuation, since there would be little probability of these few individuals mating together in the great crowd of others. In the sixth edition, Darwin admits the justice of this criticism and, in doing so, he absolutely abandons his whole theory of natural selection. What else can we conclude from his statement: "There can also be little doubt that the *tendency to vary in the same manner* has often been so strong that all the individuals of the same species have been similarly modified *without the aid of any form of selection*. Or only a third, fifth, or tenth part of the individuals may have been thus affected, of which fact several instances could be given."[24] When we consider the almost infinite variety of forms of life, the enormous amount of variations, and the uncountable number of times variations must have occurred if we suppose all existing organisms are the descendants of a single protoplasmic cell (or of a very few); then the mathematical probability, that these changes have been brought about by the simultaneous variation in the same characteristic of all, or a tenth part of the individuals of a species, is zero. If this is not the doctrine of Design, pure and simple, it is nothing. Darwin plays so fast and loose with the mathematical

[24] *Origin of Species*, vol. I, p. 113.

laws of probability that he is willing to rest the whole multitudinous variation in the world, even granting a "tendency to vary in the same direction," on "several instances which could be given." But even this admission will not help Darwin. Suppose a large proportion of the giraffes to be born and to grow to maturity with an extra inch in length of neck and suppose so severe a scarcity of food to occur that this extra inch is a decisive factor in obtaining food. The necks of mature male giraffes are several inches longer than the necks of all female giraffes, and these, again, are much longer than those of young giraffes of both sexes between the ages of weaning and maturity. Is there any escape from the conclusion that all the females and all the young giraffes of both sexes would die and leave the race of giraffes to be continued by a herd of favoured males, unless these males gallantly pulled down the boughs to the reach of their starving families?

Let us consider a few more cases briefly. Darwin wrote Huxley in 1859: "You have most cleverly hit on one point, which has greatly troubled me; if, as I think, external conditions produce little *direct* effect, what the devil determines each particular variation? What makes a tuft of feathers come on a cock's head, or moss on a moss rose?"[25] What, indeed! We have seen that the appearance of the feather is an enormous advantage as it means the conquest of locomotion in

[25] *Origin of Species*, vol. I, p. 28.

a new environment; it came suddenly so far as our palaeontological records show; it is assumed to have developed from the dermal plates or scales of reptiles. Can anyone imagine any advantage to the reptile during the stages of development between its covering of plates or scales, and that of feathers covering, and arranged on, a bird already adapted for flight? No biologist has found such an advantage, and the theory of natural selection requires that variations, useful at every stage, can alone be preserved. Until we can find such useful qualities during the development of the feather and thousands of other characteristics of plants and animals, why should we accept the doctrine of natural selection or any other hypothesis except the mere belief that organisms have evolved? This is the reason why the doctrine of mutations, or sudden jumps, so unpalatable to evolutionists, is being substituted for natural selection with its slow progression. When we once allow nature to jump, we can no longer ridicule the ingenuous mind which can picture a prehistoric scaly reptile as having been dumfounded when it found that it had suddenly given birth to a feathered bird. The doctrine of mutations does avoid all the difficulties which puzzle us when we attempt to construct a theory of evolution; when we find any variation which cannot be explained, by the theory of mutations we can safely say it was one of the jumps of nature.

The evolutionists gave much importance to the support which is shown by the marvellous protective colouring of animals, and of worms and insects, which counterfeit leaves, twigs, or other organisms. But here again, what is the advantage until the variation has already proceeded so far in mimicry that the owner can elude the keen eyes of its enemies?

As a last example consider for a moment the whole subject of the weird, unaccountable habits of insects. What knowledge we have is largely due to the fascinating pages of Fabre, whom Darwin calls a wonderful observer. Fabre was an unqualified and bitter opponent of natural selection, and challenged anyone to connect the wealth of habits and instincts which he described with that doctrine. As an example, we may cite the case of the wasp which paralyses large insects with a single stab in a definite spot and attaches an egg at another definite place. The insect in this comatose state is devoured by the larva which begins to eat at a certain point and continues in such a direction that no vital nerve centre is severed until the end of the meal. Fabre, by the most thorough and delicate experiments, showed that the sting must be inserted, the egg laid, and the larva work its way exactly as invariably occurs. If there is the least deviation in any of these three factors the paralysed insect always dies and rots before the larva has finished its meal and is ready to spin its cocoon, and the death of the insect is the death of the larva. It is, as Fabre says, impossible to explain this series of events by any progressive evolution. The wasp must have gone through this exact procedure with unerring accuracy the first time or the species would have ended; it cannot be accounted for by chance; it is a complete mystery. The evolutionist who reads Fabre's works with a simple, open mind and not biased by a preconceived idea of natural selection, will rise from his task with the conviction that the instincts and the habits of insects, at least, cannot be explained by any hereditary development of useful traits. Then let him read Maeterlinck's preface and he will humbly admit that the poet has seen more deeply, and more truly than he, into the mysteries of the strange world of insects. We, with our logical brains, are absolutely baffled by this world of little creatures; their seemingly futile actions and rudimentary minds; their intricate apparatus of generation; their extraordinary and weird methods of averting wholesale slaughter; the community life of ants and bees; all these make a picture which must be the despair of the naturalist to explain by any rational process.

It is safe to say that there is scarcely an example cited by a biologist in support of natural selection which another biologist does not contradict either by showing that the example itself is at fault or else by citing a parallel case which opposes the theory. Even the basic principle itself, the struggle for existence as a predominating factor in organic life, is now attacked on all sides. Many naturalists, especially the brilliant school of Russians, hold that mutual aid is as prevalent and as important as destruction; others believe that the struggle against the environment is much more severe than that against other organisms; Kellogg does not believe in severe competition between adult insects. Kropotkin opposes the whole idea that severe competition is beneficial as he finds it not only kills off the weak but jeopardizes the health and vigour of the strong; others, following his lead, state that variations occur most frequently in periods of peace and plenty and that harsh conditions prevent variation.

As it is obvious that many of the habits of animals, especially those connected with mating and breeding, show the characteristics of choice, Darwin assumed that traits, such as ornamentation, were fixed by choice during the breeding season. Sexual selection, as he termed it, is due to the increased likelihood of leaving progeny by those individuals which are the bravest, the most prolific, and have characters which are pleasing to the opposite sex. This theory is, at the present time, harshly criticised and even abandoned by most naturalists. The objections to it may be classed under the following heads. The theory requires a great preponderance in numbers of one sex over the other or else the poorest members of the sex are likely to secure mates, and statistics do not show such to be a general law. If the most ornamented individuals are also the strongest and most prolific, as seems likely, the process would be useless and frequently harmful to the species and this would be counteracted by natural selection. While there are a relatively small number of cases where the females seem to choose mates after a competitive trial of the males, the predominating factor in mating is chance propinquity.

We must endow animals and insects with our highly developed aesthetic and other emotional attributes, and it is altogether improbable that the gorgeous colours of insects can excite such emotions in an organism of so low a mental development. One of the commonest factors in sexual attraction is noise; we can hardly coordinate ability to make the loudest sound with other superior qualities in the cricket, especially as the loudest cricket is the one nearest the female. Mayer and Soule have painted the wings of butterflies different colours and even put male wings on females, and *vice versa*, and found no difference in breeding. The colours in moths, which breed at night, are as lovely as those of butterflies and Fabre has proved that the male moths are attracted, in all probability, to the females by odour; if so, propinquity and the direction of the wind become the determining factors. Lastly, the vivid colouration of male fish at the breeding season is pronounced, and yet the female fish does not even see the particular male, which fertilizes her eggs. Delage sums up the evidence as follows: "Although the theory of sexual selection is to be discarded in its entirety, we must not exaggerate the bearing its passing away will have upon the Darwinian theory in general. Certain naturalists see in it such an important corollary of the theory of natural selection, that if the theory of sexual selection was abandoned, they would consider the theory of natural selection as doomed. We refuse to share this extreme view."[26]

As a scientific problem, natural selection pre-supposes a very narrow margin between life and extinction. The phrase "struggle for existence" certainly implies the will of the individual to live and to transmit its acquired strength. Now Darwin cannot mean that at all, as he applies the term to plants which are passive. Although he protests against Design and tendencies to progress, he is forced to fall back on those ideas when confronted by difficulties; he frequently escapes from a predicament by using those very words, and he thus tacitly assumes a guiding, or directing force. And this directing force, disguised under the esoteric name of nature, or natural law, is, so far as one can see, nothing but the *logoi spermatikoi* of the pantheistic stoics or the Divine Creator of the special creationist. The organic world presents itself to us under the three aspects of intense and persistent slaughter, of enormous power of fertility, and of the most ingenious expedients to avert danger and extinction. We are alternately revolted by the seemingly

[26] Delage and Goldsmith, *The Theories of Evolution*, p. 107.

wanton cruelty and inspired by the delicately adjusted cooperation and mutual assistance which are evident in all forms of life. And in spite of this most intricate web of conflicting actions and passions there persists in us the belief that through all the tangle there runs a thread of continuity and a sort of harmony in the whole of creation. Nature, or God, seems to us to fashion and provide an organism with enormous fertility, abundant food, and a congenial environment and then, at one stage of its life, imposes upon it a freakish impediment which threatens its very existence. Thus, the house-fly has great fertility, many of its larva find abundant food, and yet the change from the larva to the fly is accompanied by such perils that one wonders how any survive. Humanly speaking, we feel that many plans could be devised easily which would make unnecessary such superabundant fertility and such diabolically ingenious methods of destruction. Yet the balance is preserved, the fertility of any species does not make it crowd out other species, and extinction is avoided by marvellous instincts and intricate apparatus of preservation. And the theories of evolution do not explain at all. Darwin certainly exaggerates the narrowness of the margin between existence and extinction. Confined to a small field of observation by his health, he noted the accidents to individuals and failed to note the community help which preserved the species. As a famous example, he describes a whimsical chain of circumstances showing that red clover can be fertilized only by the humble bee; that the bees' nests are destroyed by mice; mice are killed by cats; cats are cherished by spinsters; therefore, an abundance of spinsters and red clover is mutually connected. In all this ingenious chain, it never occurs to him that he is forging evidence against his own theory. Can we not safely argue that, since red clover is an abundant and long-persistent plant, if its existence were dependent on so seemingly small a chance of fertilization as the existence of a single and not very abundant insect, then the margin of its existence must be large; it did not have to struggle for existence, for if it did, its highly specialized apparatus for fertilization would have become a factor for extermination? Can we not state as a fact: since so many plants and animals are dependent on such specialized and intricate operations for propagation, they would not have survived for millions of years if the species had been required to struggle for existence?

The most discouraging feature of the whole problem of biological evolution, to one who has been trained in the exact phraseology and rigorous logic of the physical and mathematical sciences, is the loose language and the still looser reasoning of the evolutionists and of the biologists. Up to a certain point, their language and methods are those of science and then comes a relapse into the methods of the untrained thinker.[27] Professor Bateson carefully knocks down every prop to natural selection, to the inheritance of acquired traits, and to evolution in general; then he concludes by asking us to apply the doctrine of evolution to the thoughts and actions of men because he still has faith in evolution, and some day biologists may find its solution. Delage, who offers enough objections to evolution by natural selection to kill even the most desirable theory, yet concludes with the following extraordinary statement which, taken by itself, would make one believe that he had been unable to find a single valid objection to it: "Darwin's everlasting title to glory will be that he explained the seemingly marvellous adaptation of living things by the mere action of natural factors, without looking for a divine intervention, without resorting to any finalist or metaphysical hypothesis."[28] If it is degrading to man to depend ultimately on divine intervention when no other explanation is attainable, Darwin probably has the glory of avoiding it, but for the rest Delage is writing nonsense.

It is a pleasure to turn to a biologist who is really trying to apply the laws of mechanics to those func-

[27] This conviction that biologists are still groping for a scientific method, accuracy of thought, and intelligible expression is shared in by, at least, some of their own number. W. E. Ritter, Director of the Biological Research Laboratory of the University of California, writes that: "Biology at present needs few things more sorely than a system of reasoning which shall not beget in students the mental habit of allowing recondite concepts and postulates and strange words to cast every-day, familiar facts into outer darkness." And Professor D'Arcy Thompson is very outspoken in his criticism of present biological theories and laxity of thinking.

[28] Delage and Goldsmith, *op. cit.*, p. 45.

tions of life which are clearly mechanical and who does not twist those laws into a pseudo-biological mechanics in which the words are the words of mechanics but the laws are not mechanical. This unusual credit can be given to Professor D'Arcy Thompson who, in his recent work, *Growth and Form*, has worked out many ingenious problems of organisms which are true physical problems; who says frankly that zoologists have scarce begun to dream of defining, in mathematical language, even the simpler organic forms. Unlike Professor Osborn, he does not say, force and energy, when he means something entirely different, and yet he does show that many actions of organisms are due to mechanical forces which the most advanced mechanistic materialists are still "fain to refer to vital instinct or design rather than to the operation of physical forces." Professor Thompson has the rare quality, also, of knowing philosophy as well as zoology, and he has looked outside his narrow laboratory into the wide field of human knowledge; he finds that while zoologists can profitably apply the laws of physics to many problems of life which they have neglected to consider, yet their sweeping assumption that all the functions of life are physical is not in accordance with the facts, for "it is plain that we have no clear rule or guide as to what is 'vital' and what is not."

I am quite willing to rest my argument on the conclusions of Professor Thompson. I am convinced that variation has a wide field, but environment and circumstance do not make a prison wherein the organism must live or else die. The margin of existence is not so narrow. New forms can adapt themselves to new conditions, but, while variation may proceed along directed lines to a great degree, after a time the active and creative energies of growth pass the bounds of physical and physiological equilibrium. Then weakness has set in and the species may not find itself fit to survive either changed or harsh conditions. We are entitled to use the customary *metaphor*, and to see in natural selection an inexorable force, whose function is not to create, but to destroy, individuals. Even after we have so narrowed the scope and sphere of natural selection, it is hard to understand; the causes of extinction are often well-nigh as hard to comprehend as are those of the origin of species. If we consider any exaggerated form which has become extinct, there are kindred forms which survive; and in other cases extinction occurs where we can discover no observable disadvantage.

I am even willing to grant that the struggle for existence and natural selection may be the causes for the extinction of certain species,—and for the very obvious reason that if a species passes out of existence, there must have been either some change in environment very unfavourable to the species, or some powerful and destructive organic enemy must have attacked it in overwhelming numbers, or the species itself must have developed some inherent and fatal weakness. But these are mere *post hoc, propter hoc* statements; if natural selection is a force which can destroy but cannot create species and if the reasons for this destruction are unknown, of what value is the theory to mankind? We can leave to the biologists the hope that some day they may enter the temple of life through the doors of evolution, but the collapse of the theory of natural selection leaves the philosophy of mechanistic materialism in a sorry plight. Those who are trying to use its conclusions as a guide to social polity and ethics will find themselves without any ground on which to stand if they address themselves to a real study of biological evolution.

CHAPTER SEVEN

Life as Mechanism

PERHAPS, the strongest obsession of the mind is the determination to explain whatever attracts its attention. We are so reluctant to confess ignorance that we are quite willing to go round and round in a circle, seemingly satisfied if the argument never ends. We explain the nature of matter by energy, and then explain energy by matter. And, it is only too probable that our absorption in the development of science has increased this tendency to vagueness of thought. Science has so many dazzling achievements to its credit; we have done so many things which seemed to be impossible, that the popular mind is apt to conclude that, if an explanation is given in the name of science, it must be true whether it be understood or not. Although men of science are constantly proposing hypotheses which seem to explain phenomena and are constantly trying to reduce all phenomena to a single principle, they must admit science really teaches that we have no absolute knowledge, because things can be known only by their attributes. Since the time of Newton, we have been sure that no one can state whether a body is at rest, or in motion, and that we can compare merely the relative positions of two bodies. Of late this principle of relativity, or dualism, has been extended to all physical phenomena, largely by the work of Einstein. If we explain all phenomena in terms of one principle, for example, energy, what then is energy? And how shall we explain it except in terms of what we have already declared was explained by energy? Such it seems to me is the hopeless problem of all those who attempt to build a monistic philosophy.

The most extravagant form of this philosophy is for the human mind, which explains all physical phenomena by thought, to attempt to explain thought in terms of physical phenomena; and this is attempted in spite of the fact that our observation and experience teach us there is no causal relation between the two. Beyond affirming that such a relation exists, no biologist has given any proof that matter acted upon by any known physical forces, electrical or mechanical, shows the least similarity to life. We can state categorically that the law of conservation of energy does not apply to thought and that no living attribute except growth can be measured quantitatively.

In our eagerness to get away from the mediaeval idea of man as divine, for whom the universe was created and by whom alone its phenomena can be comprehended, we are now busy in the effort to class him with the amoeba and with the lump of earth from which his body is fashioned. Yet, in spite of the speculations of centuries we have not advanced a step beyond the noble and dignified description of the creation as imagined by the Hebrew Prophet in the Book of Genesis. We can dismiss his story of the Garden of Eden as an allegory, but when he stated that man was created out of the dust and that God breathed into him the Breath of Life, all was said of that supreme mystery, as an eminent philosopher pointed out to me, which can be said. We are asked by astronomers to look upon the earth as a mere insignificant speck, and to be ashamed to consider ourselves important because, forsooth, Betelgeuse is hugely larger and rushes through space with a vast motion. But, if Betelgeuse were a million times larger than it is, of what importance is that fact? So long as this little earth alone contains man with his power of thought, and Betelgeuse does not, then the mystery and value of the earth is incomparably greater; it still remains the dominant factor in the universe, while Betelgeuse is of no more importance than any other bit of matter. The biologists rejoice to mortify us by saying that we are but an aggregation of cells and so is the amoeba; then, they show us by the microscope that our cells and the amoeba's cells are just alike. The psychologist tells us our brain is but a special arrangement of chemical atoms and our thoughts are but the rearrangement of these atoms, so why should we glory in the pride of the intellect?

Those who would explain thought by physical causes must remember, and this they do not, that physical phenomena are limited by time and space while thought is not; to transcend the laws of time and space is the definition of a miracle. The judgement of Sir Thomas Browne is far clearer than theirs, when he says of his own life that: "It is a miracle of thirty years, which to relate, were not a History, but a piece of Poetry, and would sound to common ears like a Fable." Life and thought are the great mysteries of the universe which can be explained only by themselves. To talk of the evolution of thought from sea-slime to the amoeba, and from the amoeba to a self-conscious, thinking man, means nothing; it is the easy solution of the thoughtless mind.

We have already compared the philosophies of monism and dualism and have shown that the earlier Greek thinkers attempted to define all phenomena in terms of a single fundamental principle. Some assumed the *arché* to be the essence of life, and others, that things, animate and inanimate, were reducible to atoms and motion. Then came Plato and Aristotle, who cut the knot by affirming that we cannot do more than to interpret the phenomena of life in terms of life, and those of material things in terms of matter. The organic body is material, but the organic personality is immaterial and the most we can do is to discover the mutual reactions of the one on the other. As Aristotle sums it up: the dead man differs from the living man by something else than chemical changes. The dualism, because of the limitations of our finite minds, is there and we must accept it.

Then the Stoics and the Epicureans reverted to monism and used infinite pains to set a monistic universe in operation. They saw the universe only as a manifestation of matter and force. The nature of matter is its inertia, but it must also act. To avoid this paradox; they, who could themselves be nothing but matter and force, yet saw order in the universe; therefore, there is a God; therefore all things are God; and the mover and the moved are one. There is apparently no use to reason with the monist; for sooner or later he simply jumps over his difficulty and conceals his error with such ingenuity that it still fools us. It is discouraging; even today, men of science are still deceiving themselves, and deceiving others, by pretending, when they say matter is inert and also attracts all other inert matter at a distance or when they say life is mechanical or electrical energy, that the words they use give us any comprehensible idea.

No one can go further towards giving us a monistic cosmic hypothesis than did Kant and Laplace. They assumed, in their nebular hypothesis, that the universe was originally an infinite number of atoms uniformly distributed throughout space. These atoms have no other properties but inertia and Newtonian attraction. By the laws of physics and by experience, this condition is permanent and motion is impossible. Next comes the jump; somewhere in the universe they, arbitrarily and contrary to their own postulate of universal homogeneity, suppose an atom to be displaced in order that the balance of forces may be disturbed, that motion may begin and the accumulation of matter at certain points may occur. What disturbs this balance? Just there is the jump which breaks the argument. Laplace limits himself to questions of mechanical phenomena, but Kant sees that, when the earth is evolved sufficiently far, life must appear and here again a second jump occurs; chemical atoms must unite in a certain way so that the first simple forms of life may appear spontaneously, although spontaneous generation has never been observed and its denial is a postulate of biological experience. It is proper, here, to mention that Kant proposed his nebular hypothesis in his youth and with matured thought he made an unqualified denial of the monistic doctrine of matter and life: "It is certain we cannot learn to know sufficiently organic beings and their inner possibilities by mere mechanical principles of nature; much less can we explain them; and this is so true that we can boldly affirm it is absurd for us either to conceive such an idea, or to hope that some day a Newton will appear who will be able to make even the generation of a blade of grass comprehensible by natural laws without the intervention of Design: we must positively deny that such insight is possible."[1] Modern biologists say he was correct according to the knowledge of his time. But, it is not a question of more or less knowledge, it is still the confession of no knowledge we must make. There is only one way to obtain this knowledge: let the biologist in the laboratory produce a living cell which has not been derived from other living matter; that would convince us that life is a manifestation of physical energy just as the physicist has shown in his laboratory that matter does attract matter and has thus verified Newton's law of gravitation. Until he creates a living cell from dead matter, he is in the same class as was Aristotle who tells us that dust breeds fleas.

The aim of science is to explain phenomena by a single substance, which we may call either matter or electricity, and to endow this substance with a force of attraction which establishes the positions of the atoms of the substance, and gives to them motion. This is undeniably a monistic doctrine since it reduces phenomena to a single principle. From this simple philosophical postulate, the physicist, including the chemist who has also followed this method, has attempted to construct a model of the world such that if we know past actions we can predict with a very considerable accuracy what will occur in the future. While we may thus class the physicist as a monist, he can be so classed only after admitting a funda-

[1] Kant, *Kritik der teleologischen Urtheilskraft*, II Th., § 75.

mental reservation which, in fact, places him in the class of dualists with one field of inquiry suppressed. The physicist rigorously excludes from his field all problems which involve life. For example; if he investigates the motion of a horse drawing a wagon he does so by assuming that the earth pushes the horse forward; in other words, the horse is moved by an external mechanical force. He assumes that a horse cannot by his will bend his legs and push against the earth, and he refuses to consider whether it is alive or whether it is a hobby-horse pushed by a child or by a clock mechanism. If he finds such a mechanical mechanism inside the horse he can investigate that mechanism, but he has found *no mechanical mechanism* inside the living organism which he can describe as physical. The physicist has found no difference between the chemical constitution of matter when it is living and when it is dead; he has found no relation between mechanical energy and what we call life; he has found no way of measuring thought or cell activity; for these reasons he excludes all life, and works with a lifeless world.

Now the biologists have invaded the world of the physicist. They have invented a family tree, connecting themselves genealogically with the physicist. They call themselves biophysicists and biochemists and claim a blood relationship. But they are not so related; when they are studying living phenomena, they are biologists; and when they are studying the same bodies from which life has been killed they may be physicists; but they cannot be both. The burden they are trying to put on physics and chemistry is too heavy to be borne. The physicists use the word energy, and they mean just one thing, the combination of matter and motion, and they measure it in foot-pounds; the biologist has violently, and against their protest, seized on the word, energy, and it sounds the same in our ears, but it is not matter in motion, and it is not measured in foot-pounds or in any other physical units; it is not conservative and it cannot be predicted. No biophysicist can examine a horse and tell us when it will move, how fast it will move, or where it will move; but a physicist can answer these questions about a hobby-horse containing a clock-work mechanism. And to make matters worse, the vicious use of the word, energy, by the biologists has encouraged the psychologists to go a step further and to use energy as an explanation of thought and emotion; and in this connection the word loses every particle of its original significance. I have never met the physicist who would admit the least connection between "physical" and "psychological" energy. It is time physicists should demand that energy be restricted to its established use when it is applied to scientific problems or permit the biologists to have the word and coin another for their own use, just as law-abiding citizens often permit the transfer of their property to the pockets of robbers who use force rather than reason. It is, at least, worth while to say that physicists are not a party to this extension of their field to include the phenomena of life.

The physicist deals with a fairly definite problem; he deals with this problem in a definite way and, in order to be definite, he abstracts from his problem all phenomena which he cannot measure in terms of mass, length, and time. For example: when he studies light and sound, he expresses both phenomena by a single equation which involves only the energy of motion and ignores the fact that to us, by our sense perception, they are fundamentally different. Thus the world is reduced to substance, matter or electricity, whose only properties are inertia and a mutual force of attraction. Force has but one property, that of producing motion, thus force accounts for the form of bodies and is measured by the change of motion it produces. When a portion of matter is displaced by force, we express that phenomenon by the term, energy. The energy of a body is thus measured as the product of a force and the distance the body moves under the action of the force or, what amounts to the same quantity, by one-half the mass times the square of its velocity. And energy in physics means nothing else.

It may well be objected that the physicist has no right to limit the words, force and energy, to such a special meaning; because, when we speak of force of character or of an energetic mind, we convey a definite idea. So we do. But, when the biologists or psychologists use these words, they should state that they are using them in a different way. On the contrary, they insist that they are expressing life actions in terms of physics, and that force and energy are to be measured as they are by the physicist. In other words, they will treat life and its actions as a physical phenomenon, they will use the terms of physics, but they will give to them a different and hidden significance. In physics, a certain amount of heat energy and mechanical energy are mutually convertible one into the other, but the energy of thought is not convertible into any form of physical energy, nor is physical energy convertible into thought. That I am not exaggerating this constant and flagrant misuse of terms, let me quote from Professor Osborn, who is trying to prove that the failure to find the causes of the evolution of life arises from the fact that the chief explorers in the subject have been trained in the school of the naturalists, who have studied external forms and have observed the end results of long processes of evolution and have then attempted to reason backwards to their cause. He proposes that we find the cause of evolution in terms of energy and he divides energy into four categories: *inorganic environment*: the energy content in the sun, the earth, the water, and the air;—*organism*: the energy of the individual, developing and changing the cells and tissues of the body;—*heredity-germ*: the energies of the heredity substance;—*life environment*: beginning with monads and algae and ascending in a developing scale of plants and animals.[2] Of these four categories, the first comprises all that is included by the physicist in the word, energy; the others mean nothing to him nor to Professor Osborn. Could any better way of muddling thought be devised than to give four different and incongruous definitions to his fundamental term? In what units of measure will he express the energy of the heredity substance, in what units of measure will he express thought? When we analyse the conclusions of biological monism we shall find that the biologists speak of matter and force and energy, and they say life is one of their manifestations, but they are using words which convey no meaning.

We may define the unqualified mechanistic theory of life as follows: if we could arrange atoms of the chemical elements in the numerical quantities and in the space relations to each other which they occupy in the fertilized ovum of a man and place this body in a proper physical environment, it would develop into a man.

As an example of a believer, without reservations, in this mechanistic theory of life we can cite Haeckel. In spite of the fact that he is rather a bug-bear to those biologists and sociologists who, while advancing the scientific and mechanistic doctrine of life, wish to

[2] *Origin and Evolution of Life*, p. xvi.

maintain a shadowy image of a Deity in the background, we must accept Professor Ray Lankester's opinion that Haeckel is "one of the most learned, experienced, and honourable naturalists of modern times." Now Haeckel explains the mechanistic theory clearly and forcibly: "I have here spoken somewhat fully of the phenomena of rudimentary organs, because they are of the utmost general importance, and because they lead us to the great, general, and fundamental questions in philosophy and natural science, for the solution of which the Theory of Descent has now become the indispensable guide. As soon, in fact, as, according to this theory, we acknowledge the exclusive activity of physico-chemical causes in living (organic) bodies, as well as in so-called inanimate (inorganic) nature, we concede exclusive dominion to that view of the universe, which we designate as the *mechanical*, and which is opposed to the *teleological* conception. If we compare all the ideas of the universe prevalent among different nations at different times, we can divide them all into two sharply contrasted groups—a *causal* or *mechanical*, and a *teleological* or *vitalistic*. The latter has prevailed generally in Biology until now, and accordingly the animal and vegetable kingdoms have been considered as the products of a creative power, acting for a definite purpose."[3] Again he says: "We must decidedly adopt that view of the universe which is called the *mechan-*

[3] Haeckel, *History of Creation*, vol. I, p. 17.

ical or *causal*. It may also be called the *monistic*, or *single-principle* theory, as opposed to the *two-fold principle*, or *dualistic* theory, which is necessarily implied in the teleological conception of the universe. The mechanical view of nature has for many years been so firmly established in certain domains of natural science, that it is here unnecessary to say much about it. It no longer occurs to physicists, chemists, mineralogists, or astronomers, to seek to find in the phenomena which continually appear before them in their scientific domain the action of a Creator acting for a definite purpose. They universally, and without hesitation, look upon the phenomena which appear in their different departments of study as the necessary and invariable effects of physical and chemical forces which are inherent in matter. Thus far their view is purely *materialistic*, in a certain sense of that 'word of many meanings.' "[4] While we might wonder why it is so remarkable that physicists should rely on matter and mechanical forces as adequate to explain mechanical phenomena, and that it would be quite as logical for biologists to add a *biotic* force in order to explain the additional phenomena of life, we must conclude that Haeckel and his class of biologists insist upon bridging the gap between the organic and inorganic because of the obsession of the human mind to explain all phenomena by one principle, even when it can find no real bridge connecting the two

[4] *History of Creation*, vol. I, p. 20.

regions. But, passing over the exaggerated statements and illogical deductions of Haeckel, we may accept this mechanistic monism as the end towards which the Theory of Descent by natural selection tends.

It is surprising how few biologists see that the philosophical conclusion of Darwin's hypothesis of natural selection is a mechanistic monism. The reason is: too many men of science are unwarrantably self-satisfied with the superiority and certainty of their scientific method and are but superficially trained in either philosophy or humanistic thought. As a consequence, they rather affect to despise the logical conclusions of their scientific hypotheses when they are carried beyond their purely technical significance by what they call "paper philosophers." Or else they content themselves with the excuse that their hypotheses serve well enough for their own immediate purposes; if their effect on social and religious problems is unfortunate, the remedy should be proposed by others. Professor Vernon Kellogg is not indifferent to the results of Darwinism. He recognizes, while he laments the fact, that it is discredited as much by its philosophical vulnerability as by the adverse character of recent biological discoveries. He says: "The name Darwinism has been pretty consistently applied by biologists only to those theories practically original with Darwin which offer a mechanic explanation of the accepted fact of descent."[5]

[5] Kellogg, *Darwinism To-Day*, p. 2.

Not many of the biologists carry through to its logical conclusion the monistic doctrine as did Haeckel. Most of them take refuge behind that convenient term, agnosticism, which was so happily coined by Huxley.

This middle ground, between those who are unreservedly monistic in thought and those who hold that there is an unbridgeable gap between the organic and inorganic worlds, includes, I think, the majority of biologists and of those who are trying to base philosophy and religion on science. The great champion of scientific agnosticism is Huxley, and it is to his *Essays* that we should turn for our discussion of this class of thinkers.

Each time I read the *Essays* of Huxley, I find myself more baffled. His apparently simple ideas and his exquisite style make each separate statement seem convincing; his constant appeal to truth as his only guide, and his contempt for the subterfuges of others who dress up loose logic with high-sounding terms, impress one with the feeling that here is, at least, clear and honest thinking. And yet Huxley's own thought is complicated and obscure. With much care I have taken passages from his *Essays* which bear on the question at issue and will let the reader judge for himself.

Huxley adopts an attitude of proud humility; he sees himself as a mere soldier in the army of those who seek for truth. He treats equally with scorn the clergy who accept the literal interpretation of the Bible and the atheist who denies God; he rejects both the materialism and the idealism of the philosopher. He tells us, emphatically, that it is useless to discuss the nature of God, of life, of matter, of energy, or of anything because, by his nature, man can have no absolute knowledge and is limited to the acquisition of knowledge by comparing phenomena. The wise man will maintain an agnostic mind: "It is wrong for a man to say that he is certain of the objective truth of any proposition unless he can produce evidence which logically justifies that certainty. This is what Agnosticism asserts; and, in my opinion, it is all that is essential to Agnosticism. That which Agnostics deny and repudiate, as immoral, is the contrary doctrine, that there are propositions which men ought to believe, without logically satisfactory evidence."[6] In this fashion only, can we avoid the *-isms* which arise out of the schools of philosophy as the Truth. This definition sounds admirably clear and it would seem that the Agnostic could never be convicted of error, although he might not be able to add any positive knowledge to the world. But what are these "objective truths" and what is the "evidence which logically justifies that certainty"? I am sure Huxley would have agreed that objective knowledge is derived by our sense perceptions and he, with all of us, knew how easily deceived our senses are; he also would

[6] *Science and Christian Tradition*, p. 310.

have agreed that evidence, which logically justifies, is dependent on the fallibility of human reason. It would seem, then, that the Agnostic in his definition of Agnosticism departs from his unbiased critical attitude and *assumes* positive knowledge just as is the habit in all other schools of philosophy.

Huxley, himself, is as emphatic in his belief in the certainty of natural law, as he is in his scorn of the preacher who holds that he knows God. He says: "Fact I know; and Law I know; but what is this Necessity, save an empty shadow of my own mind's throwing?"[7] In the same volume, he states very emphatically that what he is considering is the superiority of science over metaphysics. He thus defines, on page 60, the method of science: "All physical science starts from certain postulates"; and on the next page: "Physical science therefore rests on verified or uncontradicted hypotheses." Now physical science may rest on one of these bases, but it obviously cannot on both, as even the most unlearned knows that a postulate and an hypothesis are very different things. Let us pass by this objection, and glance at merely one or two Facts and Laws of physics.

As a Fact or postulate, let us take the simple one, that the straight line is the shortest distance between two points. This is generally assumed to be a necessary postulate, which cannot be proved logically or

[7] *Method and Results*, p. 161.

by observation; and yet it is categorically denied by modern geometry to be a fact. As an example of Law, let us take Newton's law of universal gravitation. What does Huxley *know* about it? Our experiments in the laboratory show that it is approximately true and that we do not *know* the law of attraction. Furthermore, beyond the limits of the solar system, we have not a single observation or fact to show that Newton's law has any agreement with fact; the motions of all fixed stars appear to be independent of this generalization as their paths, to us, are straight lines. Lastly, the essential postulate of the conservation of matter is contradicted by the quantitative results of every experiment made by us in the chemical laboratory, and no one knows anything about the quantity of matter in any body not on the earth. Every so-called fact and every so-called law in the physical sciences is accepted in spite of the inaccuracy of our observations and measurements, and is extended to regions beyond our reach by that very Necessity which Huxley repudiates. We must accept facts and laws because we see law and order; the man of science calls this Necessity by the name of Nature and the religious man calls it, God.

Huxley was very frequently accused of materialism and of atheism. These he indignantly repudiates, and he is quite explicit in his denial. He says: "I, individually, am no materialist, but, on the contrary, believe materialism to involve grave philosophical error."[8] Again: "The phaenomena of life are dependent neither on physical nor on chemical, but on *vital* forces, yet they result in all sorts of physical and chemical changes."[9] And, in fact, no criticism arouses Huxley and Spencer to greater wrath than to couple their ideas with Comte's Positive Philosophy. As for his belief in God, it is asserted freely: "I take it that all will admit there is definite Government of this universe—that its pleasures and pains are not scattered at random, but are distributed in accordance with orderly and fixed laws."[10] You may believe in God, but you must affirm none of His qualities except that He instituted Nature and Natural Law.

Huxley, in spite of his agnosticism, accepts the existence of God and the reality of an inorganic world of matter governed by vital forces. How can we reconcile these beliefs with his other statement that we know only the facts and laws of the physical world? Can he mean that the facts of the spiritual world—of thought, of virtue, etc.—are not as certain as the facts of the physical world? If they are not, through what medium do we know the facts of the physical world, except by thought and the spirit? To Descartes, whom Huxley eulogizes, thought was the one fact in the universe. Those who believe in the objective reality of matter tell us that each person who

[8] *Method and Results*, p. 155.
[9] *Science and Education*, p. 64.
[10] *Ibid.*, p. 62.

observes a book obtains a different idea of it, and that the real book is different from all our observations of it because our sense perceptions always differ. But, if men can come to no agreement on the nature of spiritual phenomena; if, for example, we cannot agree on the properties of virtue or of redness, these same men cry out that we have no right to postulate their existence and character at all.

Now what Huxley does, is merely to affirm that we can explain the material world in terms of the spiritual world or we can explain spiritual things in terms of the material. Thus, although he acknowledges they are different, he asks us for convenience's sake to assume that they are alike. This juggling with words by the scientist, the sworn apostle of the truth as he calls himself, may excite surprise, but we can give his own words: "It is of little moment whether we express the phaenomena of matter in terms of spirit; or the phaenomena of spirit in terms of matter: matter may be regarded as a form of thought, thought may be regarded as a property of matter—each statement has a certain relative truth. But with a view to the progress of science, the materialistic terminology is in every way to be preferred."[11] It may seem bizarre to accuse Huxley and his school of being Jesuitical in their methods, but it is difficult to avoid it in the light of this advice: "This union of materialistic terminology with the repudiation of materialistic phi-

[11] *Method and Results*, p. 164.

losophy I share with some of the most thoughtful men with whom I am acquainted."[12] He is here contrasting his ideas with those of the Archbishop of York, whom he classes as one of the clergy who shut their eyes to the truth, and yet if Huxley, that master of forceful English, means anything, he is advising us to use words and to mean something else, to pretend to knowledge which we have not got. It is not a pleasant picture to think of Huxley as denying materialism and then spending his whole life to exalt its value, as proclaiming himself to be the apostle of truth and at the same time preaching expediency in order that he might proselytize for the doctrine of Evolution.

Let us follow Huxley a little further to see if he is consistent in his belief that material things are directed by physical forces and that living things are subject to vital forces. It is not difficult to show that he is a monist and a materialist (although it is difficult to know a man's honest belief who uses materialistic terminology and denies materialistic ideas). He writes: "There is a wider Teleology, which is not touched by the doctrine of Evolution, but is actually based upon the fundamental proposition of Evolution. That proposition is, that the whole world, living and not living, is the result of the mutual interaction, according to definite laws, of the forces possessed by the molecules of which the primitive nebulosity

[12] *Method and Results*, p. 155.

of the universe was composed. If this be true, it is no less certain that the existing world lay, potentially, in the cosmic vapour; and that a sufficient intelligence could, from a knowledge of the properties of the molecules of that vapour, have predicted, say the state of the Fauna of Britain in 1869, with as much certainty as one can say what will happen to the vapour of the breath in a cold winter's day."[13] There is not much Agnosticism in that statement nor does it leave a possibility of explaining material phenomena by spiritual causes. Comte could certainly subscribe to it as a foundation for his Positive Philosophy.

The above quotation is perhaps metaphysical in its nature, it goes back to a time of cosmic nebulosity when one can imagine many things which the man of science has no chance to verify. But we can give a quotation of a different nature where Huxley touches the field of physics and where a physicist has some authority of criticism. Huxley declares: "I hold, with the Materialist, that the human body, like all living bodies, is a machine, all the operations of which will, sooner or later, be explained on physical principles. I believe that we shall, sooner or later, arrive at a mechanical equivalent of consciousness, just as we arrived at a mechanical equivalent of heat. If a pound weight falling through a distance of a foot gives rise to a definite amount of heat, which may

[13] *Darwiniana*, p. 110.

properly be said to be its equivalent; the same pound weight falling through a foot on a man's hand gives rise to a definite amount of feeling, which might with equal propriety be said to be its equivalent in consciousness."[14] At the memorable occasion when the Bishop of Oxford wished to know whether it was through Huxley's grandfather or grandmother that he claimed descent from a monkey, Huxley is reported, before he made his famous and crushing reply to the Bishop, to have murmured, "The Lord hath delivered him into mine hands." Into whose hands has the good Lord delivered Huxley?

The equivalence of energy, as proposed by Huxley, is explicit; it is an equivalence between mechanical energy and feeling, or consciousness, and does not involve those actions of the human body which are readily seen to be associated with physical forces. I grant that there is a mechanical equivalent of heat. If a pound weight falls through a distance of 778 feet it will give rise to one unit of heat; that is, it will give rise to enough heat to raise the temperature of one pound of water one degree Fahrenheit. I also know that if it falls twice as far it will give rise to twice as much heat, and I know that I can measure both quantities. But, as I accept the law of conservation of energy, I know also that one unit of heat can

[14] *Method and Results*, p. 191. The reader should refresh his memory with the quotation previously given where Huxley says: "I, individually, am no Materialist, but, on the contrary, believe materialism to involve grave philosophical error."

be changed back into mechanical work and that when so doing, it will lift a pound weight just a distance of 778 feet.

Now, Huxley says that a pound weight falling through a foot on a man's hand gives rise to a definite amount of feeling, or consciousness. By a definite amount of feeling he must mean that it can be measured and that a knowledge of the amount of feeling experienced can be communicated to others. I do not know what Huxley could do, but no psychologist at the present time has a quantitative measure of feeling, or knows of any units in which to express it. Again, if Huxley's analogy be true, if the weight falls two feet, the man must experience twice the feeling, and we can easily figure that if it fell through a great distance and struck the man's hand (I wish he had used the head as an example) there should be a great deal of feeling and intense consciousness. This may be a scientific truth, but, to the ordinary mind, the man would be dead. If we adhere to the belief in the conservation of energy we must find that a falling weight would not heat a live man's hand as much as a dead one's because part of the mechanical energy must be used in the one case to produce feeling and consciousness and not in the other. And lastly, since we are dealing with physical law, the energy must be mutually convertible; mechanical motion produces heat, and heat can be changed to mechanical motion; every one knows that from experience. Therefore, in

Huxley's ingenious mechanism, if a falling weight produces feeling and is equivalent to consciousness, it must be true that a man by feeling and by consciousness can raise the weight. One would never expect Huxley to have stated as scientific truth what to most of us would be classed as a miracle. Is he of those who by faith can move mountains?[15]

How is one to argue with the materialistic monist or rather with the materialistic terminologist? When one thinks he has him cornered, like Proteus he assumes a new form and slips from the grasp. I thought, for once, Huxley had been so definite in his statement that consciousness—and the term carries with it the functions of life—was a phenomenon of mechanical energy that I had finally cornered a monist and shown him to be unescapably in error. But what was my surprise to find Huxley was merely using materialistic *terminology;* his meaning was something quite different as one can see from this passage: "I have already hinted, it seems to me pretty plainly, that there is a third thing in the universe, to-wit, con-

[15] Huxley, of course, wrote this before the discovery of Fechner's law; that sensation is proportional to the logarithm of the stimulus. This law is frequently cited as an example that we are able to express psychological phenomena in terms of mathematical formulae. But, as Poincaré points out, Fechner's law violates a fundamental law of quantity. No one will deny that, in mathematics, if A = B, and B = C, then A = C. But by Fechner's law: if a weight A of 10 grams and a weight B of 11 grams produce identical sensations, and if the weight B of 11 grams and a weight C of 12 grams also produce identical sensations, then we must say mathematically; A = B, and B = C. But we also find that the weight A of 10 grams and the weight C of 12 grams produce easily distinguishable sensations, then we must, contrary to mathematical law, hold that A is *not* equal to C.

sciousness, which, in the hardness of my heart or head, I cannot see to be matter, or force, or any conceivable modification of either, however intimately the manifestations of the phaenomena of consciousness may be connected with the phaenomena known as matter and force."[16] All through my study for this *Essay* I have been seeking for an expression of the methods of the evolutionary or materialistic monist, and now I can thank Huxley for supplying me with just the sentence I need. They employ the materialistic terminology, but they do not honestly believe in materialistic philosophy, and, as I am simple minded, I can take this only to mean that they use words which say that life and matter are one but they do not really believe that they are one, because they can find no real connection between them; they are talking in a Pickwickian sense and laughing in their sleeves at our gullibility.

It is probably better to select a restricted function of the mind rather than such general ideas as consciousness or feeling when we try to find a physical explanation of life. For this purpose memory seems to be one of the most promising. The faculty of memory is aroused by an external stimulus; something seems to be stored up and then given out again at a subsequent time. We use practically the same words in connection with physical energy. We say a body is given potential energy if it is raised from the

[16] *Evolution and Ethics*, p. 130.

earth by an external impulse, or it is given kinetic energy if its velocity is increased; the body maintains this energy and may, later, give it back to other bodies. Let us see if the analogy is one of words only, or whether memory can be expressed in terms of energy. Suppose, for example, I see a pencil and that a chemical change of the retina occurs. As a result, a definite portion of the brain may be physically changed. If memory be a physical phenomenon I can imagine no other physical change in the brain than such a rearrangement in space of molecules or atoms as will increase the potential energy of the portion of the brain just as would be effected in it by an increase of heat. That is, the sight of the pencil causes a molecular change in a portion of the brain and increases its potential energy. If, tomorrow, circumstances arise such that the appearance of the pencil is recalled in my mind, I can think of no other explanation but that I have used some of the potential energy which was stored up by the original stimulus of seeing the pencil. Each time, then, that I remember the pencil I use a portion of this potential energy until, if the process were repeated often enough, the portion of the brain would return to its original state. As a physical process memory would grow fainter the oftener the faculty is used, whereas psychologically memory increases with use. It really seems as if not only our mental actions were not measurable in physical units but also that there is no real correspondence between mental and physical states.

It is a serious charge to make, but after reading and weighing the evidence which biologists present to prove that biological and psychological phenomena are not irreconcilable with physical phenomena, I can, after a life spent in investigating the phenomena and laws of physics, find no meaning in their statements. The biologist who sins least in his reckless treatment of physics is Professor D'Arcy Thompson. I agree with him that there is an immense field of inquiry connecting physical energy with the functions of the body which biologists have not touched. It is possible that the cleavage of cells as they grow larger is due to surface tension and not to a vital action, just as a falling stream of water is broken into drops, but this action does not touch the true problem of the growth of the cell nor of the selective differentiation of the cell. The cause which directs the primitive cells so that they, in one case, grow into the organism, man, and in another case into a tree, is not physical. At the other end of the scale in the reckless disregard of physical law is Professor Osborn, who, either wilfully or through inability to comprehend the elementary laws of physics, invents his own physics. I have called attention to his weird definition of energy. His idea of force is equally wonderful. He amends Newton's third law of motion, that the actions and reactions of force are equal and simultaneous, by saying that they "are chiefly simultaneous"; then he naively adds to the universe a new force which he calls "interaction," and illustrates this pretty fiction of his imagination by the fact that when "one pulls on the reins, the horse feels it a little later than the moment at which the reins are pulled." The first thing which the materialistic monists should do is to learn physics, and next find some quantitative relations between physical and biological phenomena.

But for an "explanation" of life in terms of physics I think nothing could exceed the attempt of Professor W. P. Montague.[17] One feels that he must be concealing somewhere a colossal joke and yet he gives his opinions with the solemnity of a profound discovery. He assures us that if we conceive of the germ of life as a hierarchical system of *super-forces* it will be possible to explain heredity and life in terms of mechanistic categories. He gives us no idea what *super-forces* are or how we are to recognize them. But they do the most extraordinary things, such as giving many degrees of rest or modes of existence on the other side of mere rest. Somehow, they produce a negative velocity which is less than rest and they give

[17] W. P. Montague, *Proceedings of the Aristotelian Society*, vol. XXI, 1921, pp. 13-50. My brother, Mr. P. E More, has discussed this same article from the stand-point of its bearing on religion in a recent volume. For the benefit of mathematicians, I must add that Mr. Montague does as extraordinary things with the laws of mathematics as with those of physics. For example, he integrates a function which contains no infinitesimal quantity.

rise to *anergy*. Energy is the tendency to change position and is the result of forces; *anergy* is its negative and is the tendency to cling to or endure in one position. A world of *anergetic* things all holding on tightly to positions of mere space would be, indeed, a world where anything might occur. When these esoteric definitions are clearly understood and accepted, anyone will agree that the problem of life is solved. It would be stupid not to understand this lucid explanation of sensory perception: "When a vibration-wave proceeding over a sensory nerve is gradually brought to a stop by the resistance of the synapse, its energy is transformed from a visible and kinetic form to an invisible and potential form. As its velocity passes through the zero phase, its slowness passes through an infinity phase. I ask you to entertain the suggestion that this *infinity phase of slowness* is the common stuff of all sensations."[18]

The reader should not imagine he is reading the abracadabra or spells of a mediaeval necromancer. This is a supposedly scientific explanation from a mechanistic stand-point of the mystery of life and, so far as I can discover, was listened to by the members of the Aristotelian Society with respect. It is a relief to turn from this phantasmagoria of a disordered imagination to the simple faith of a man of preeminent scientific achievement. Pasteur wrote to Sainte-Beuve: "Je m'abandonne, par exemple, à celle

[18] *Ibid.*, p. 41.

qu'inspirent ces sentiments si naturellement éternels que l'on éprouve au chevet de l'enfant dont on voit s'échapper le dernier souffle. A ce moment suprême, il y a quelque chose au fond de l'âme qui nous dit que le monde pourrait bien ne pas être un pur ensemble de phénomènes propres à un équilibre mécanique sorti de chaos des éléments par le simple effet du jeu graduel des forces de la matière."

The biologist has put an equally heavy burden on chemistry for, by the very nature of his methods, the chemist must deal with lifeless material. He can analyse the substance of many bodies and he can often synthesize a given product from its elements, but his laboratory methods are not those fitted to deal with the living cell or living organism. When it was found that the elements, carbon, hydrogen, oxygen, and nitrogen, were the elements essential to the physical substance of living bodies, their importance was emphasized by the name of organic chemistry. The impression was then given that chemists were studying life, whereas they were merely studying inorganic compounds which were also used by living cells to build the physical structure of the body. The chemist has analysed many of the products of life. He may know the composition of muscles and bones, but he cannot make a muscle or bone that has the properties of the living bone or muscle. He has made synthetic urea, but he does it by an entirely different process from the organism. It was an ingenious thing to do, as the method was complicated, but the chemist certainly never considered urea as alive. The chemist can also create water from hydrogen and oxygen, and why do not biologists include this amongst the organic processes; it is as much a waste product of the organism as is urea; so, also, is carbon dioxide. Is it so surprising that the living chemist by means of his brains and hands can make compound substances which are the same as those made in the laboratory of the living cell? But where, and what, are the chemists of that laboratory?

As a rather simple example, let us study the properties of the growing plant. The leaves of a plant contain a substance called chlorophyll whose chemical composition is said to be known. When light falls on the living leaf, chlorophyll in some way can break up the carbon dioxide of the air which comes into contact with it into free oxygen and free carbon; the oxygen is given back to the air but the carbon is retained in the living plant to form its bulk. But when light falls on chlorophyll in a dead leaf, or extracted from a plant, no such action occurs. And curiously enough, at a definite season of the year, the chlorophyll decomposes and the leaf turns yellow. Botanists say they understand these processes and that they are chemical, as the following anecdote proves. An eminent botanist gave this lucid explanation to the question, why green leaves turned yellow in the autumn. His answer was that, in the spring, leaves contain chlorophyll, and, in the autumn they contain xanthophyll. Such, I take it, is a classic explanation of life by biologists.[19]

With time, organic chemistry has lost its connection with biology and has become simply the study of the compounds of the chemical element, carbon. With the rise of physiology and other branches of biology which are classed under the group name of the medical sciences, a new attempt has been made to fuse biology and chemistry. We now have the border science of biochemistry which is said to include the chemistry of the living organism. The subject is a most important one and much has been discovered in regard to such functions as digestion, nerve actions, etc. But biochemistry does not touch what we call the chemistry of life.

When a nerve action occurs, we find accompanying changes in temperature, electrical charges, mechanical and chemical properties of the substance of the nerve tissue, and we can provoke nerve action by physical and chemical stimuli. But is this not totally different from claiming that nerve action *is* a chemical or physical phenomenon? To show that fatigue is accompanied by an excess of acid in the muscular tissue or to show that if a muscle is alternately placed in an alkaline and in an acid fluid, it will alternately contract and lengthen does not touch the problem why or how our muscles lengthen and shorten. We

[19] In the present neglect of the study of Greek it may aid the appreciation of this scientific explanation to point out that *phyllon* means a leaf, *chloros* means green, and *xanthos* means yellow.

have always known that the organic and inorganic worlds are mutually reactive. Substances taken into the stomach affect the mind and the nerves and, on the other hand, the state of the mind and nerves affects the digestion. But this is not equivalent to saying that the mind and nerves and digestion *are* physical. What we are concerned with is, what initiates and what directs these mutual actions, and these questions, so far as I can see, the biochemists do not touch.

The chief reason why biologists have transferred their interest from the study of the organism as a living thing to an attempt to construct it as a mechanism is that work in the biological laboratory is mostly confined to the properties of dead bodies and to the cell.

From the organism, after life is gone, the biologist can learn many valuable things about its physical and chemical structure. The dead body is a machine and we can learn the same things from it that we can learn from a contemplation of any other machine —its form and materials, its levers, wheels, and links. But such a study ignores the operation and the purpose of machines, and those functions are, after all, the real ones worth the labour of investigation. And from the biological laboratory of dead bodies we can learn but little about the habits, the instincts, or the manifold differences of the living world. No study of the physical brain will show or even indicate that it could think; no study of the physical nerves can connect their actions with sensation; no study of the physical cell could predict that it could grow.

Thus young students of biology have had imposed upon them a wrong impression; they are taught to look upon the physical body as the chief part of the organism; they subordinate the great mystery of the universe, life, and fondly hope to explore its problems in their little laboratories. For those who go further into the study of biology and make it their life-work such serious harm is probably not done, as there are most important problems to be worked out in the laboratory. Such workers lead a full and satisfied life, more or less detached from the issues their discoveries arouse; they are inclined to feel that all this bother about human evolution is more or less of a distraction. But the great majority of students take only an elementary course in biology; they listen to lectures and dissect a few of the simpler organisms under the microscope. They leave the course imbued with the idea that the problems of life have been solved or will be solved when knowledge has increased. They have been taught to be receptive to a philosophy of materialism, and they confidently spread its doctrines. Because they have learned something of the mechanism of the body, they think they have included an apperception of life and thought, that they can base their conduct on the sure foundation of science rather than on the deep wisdom of Plato or Jesus. It is to such people that the present doctrines of biology do infinite harm, for they do not see that the thoughts of man must be learned in other ways than by dissecting the brain under the microscope.

What the course of biological study would have been if Schleiden and Schwann had not developed the cell theory as the point of attack and explanation of the phenomena of life, we do not know. But, it is evident that its course would have been quite different if biologists had continued to study the organism as a living unit instead of transferring the dead organism to the laboratory, there to investigate it as if it were a mere aggregate of elementary cells whose living structure and functions could be fully determined by first killing the cell with stains and then examining its corpus under the microscope. It is difficult to estimate the value of the cell theory because, by its means, we have learned much about the physical and chemical laws of the dead bodies of the organic world. From the point of view of this discussion, however, we can surely point to it as leading directly to the theory of mechanistic evolution. The complex living organism becomes but an addition of simple and modified cells; and the cell itself, seemingly lifeless or merely an adumbration of life, can be *assumed* to be merely a complex form of physical matter. If one considers only a complex organism alive and performing the manifold functions of life, especially if the organism be a man, it would be a bold person who would jump to the conclusion that such an organism is merely material. The jump of the imagination to consider a single microscopic and rudimentary cell of the monad, or of the plant, or of man, all of which can barely be distinguished from each other, as a complex aggregation of chemical elements is neither great, nor seemingly difficult, nor does it shock our sensibilities. If we once grant this assumption, then we must accept the same idea for two cells and, by simple addition, for the enormous number of cells comprised within the corpus of a man. The error we have admitted for the single cells seems insignificant and our lazy minds refuse to add up small errors as many times as the biologist tells us to add cells.

Professor D'Arcy Thompson is quite clear on this point. When Darwin was discussing the leading facts of embryology and, in particular, Von Baer's law of embryonic resemblances [the law from which, because the foetus of a man has at one stage a gill-like structure and a tail, etc., evolutionists have proposed the theory that embryos trace in their growth the past evolutionary stages of their species] he was puzzled because adults show greater differences than embryos. Darwin says: "But there is no reason why, for instance, the wing of a bat, or the fin of a porpoise, should not have been sketched out with all their parts in proper proportion, as soon as any part became visible."[20] Thompson comments: "It would seem to me

[20] *Origin of Species*, vol. II, p. 244.

that even the most elementary attention to form in its relation to growth would have removed most of Darwin's difficulties in regard to the particular phenomena which he is here considering. For these phenomena are phenomena of form, and therefore of relative magnitude; and the magnitudes in question are attained by growth, proceeding with certain specific velocities and lasting for certain long periods of time. And it is accordingly obvious that in any two related individuals (whether specifically identical or not) the differences between them must manifest themselves gradually, and be but little apparent in the young. It is for the same simple reason that animals which are of very different sizes when adult, differ less and less in size (as well as in form) as we trace them backwards through the foetal stages."[21] This statement would point to the uselessness of embryological similarities as a proof of evolution, and Thompson, himself, is very sceptical about all our theories of its proof. But, as I pointed out previously, there is no use in depending on biologists to advise us to give up evolution as a scientific law and gospel, for note Thompson's subsequent attitude. His reasoning should be, if embryos must be more and more alike the earlier the stage of their development, then their first appearance, that of the ovum, should be quite indistinguishable amongst all the forms of living organisms, which is an observed fact. Is there any escape

[21] *On Growth and Form*, 1917, p. 59.

from the argument that also all the varied mental and psychical attributes of man, those less varied of the dog, the apparent absence of them in plants and simple forms of animals, all this wide psychological diversity should also shrink to apparent similarity in the protoplasmic cells of all of them? But Professor Thompson does escape the dilemma, and he does it by accepting one premise and denying the other. He is not a psychologist so he is willing to let God put souls in man and not in plants or in matter; but he is, on the other hand, a biologist and a profound student of the cell, and he desires to explain the cell in terms of physics. So he admits no break between the living and the dead cell, but he does recognize a break between the living and the dead man; in the former there was a soul, in the latter there is none.

In a most interesting symposium on this very subject, Dr. Haldane proposes and defends the thesis: "That, for the three several sciences, or disciplines, of physics, biology, and psychology, the general conceptions with which we should approach them, the categories by which it behoves us to interpret them, are essentially different, incompatible, irreconcilable, irreducible."[22] Dr. Thompson replies to this thesis: "At once and willingly, I grant the point as regards psychology. That matter and mind are incommensur-

[22] *Life and Finite Individuality. Two Symposia.* Edited by H. Wildon Carr, Williams and Norgate, London, 1918, p. 30. Those who are interested in this subject are strongly advised to read this most important discussion.

ables seems to my judgement so obvious that it needs no argument and risks no serious denial. It involves, doubtless, an uncomfortable dualism, an awkward breach in the continuity of our thinking. I must leave it at that; and be content to state rather than to defend my dualistic attitude. Biology, then, for the present, I take to mean the study of the forms, whether gross or molecular, *assumed* by matter in the fabric of living things, and all the changes, processes, activities associated therewith, so far (and it seems to me a long, long way) as we can study them apart from consciousness, or 'conscious reactions.' "[23] Now Dr. Thompson must either assume that plant life as well as the higher forms of animals have consciousness which he means us to take as synonymous with life or else that consciousness is an added attribute to biological life. He admits a miraculous[24] break between psychology and physics but not between biology and physics. If it is the province of biology to study only the mechanical corpus of the body, then, of course, there is no break between the two sciences. But he does not mean that, and his fallacy, just as always happens, lies in his ambiguous use of the phrase "the forms, whether gross or molecular, *as-*

[23] *Ibid.*, p. 30.

[24] The definition of *miraculous* is to be thought of as signifying a supernatural event which is beyond or exceeding the powers or laws (*i.e.*, observed sequences) of nature. Since Professor Thompson admits such a break when the self-consciousness of man appears in the biological world, he also admits that natural evolution is not a sufficient scientific law, and he must admit that the first appearance of organic life may have been another such supernatural, or miraculous, event.

sumed by matter in the fabric of living things." What causes matter in the simple cells to *assume* the form of the future complex adult? If it is a physical force, can he show any counterpart of such a force in the material world which *assumes* motion, or can he show any reciprocal relations of action and reaction between the cell and dead matter? He can cause the living cell to change to dead matter but he cannot change dead matter into the living cell. Until he can do so, it is he who has made the assumption. Like most men of science he is quite willing to admit ignorance and a dualistic attitude in matters pertaining to other sciences, but he clings to rationalistic monism in his own.

The cell, to the biologist, is a microscopic body, consisting of a jelly-like mass, called protoplasm, which is insoluble in water. Plant cells have a boundary surface of starch, but animal cells have no apparent distinguishing surface. Within the protoplasm are a few minute granules which become visible when certain stains are applied to the cell. According to the biologists it is these little granules which determine the growth and hereditary characteristics of the future organism. A vast literature has grown up about the cell, and it would seem that all possible speculations have been proposed to account for the growth, the splitting of cells, their differentiation, and the change from the primal cell to the adult organism. It is true that many curious things have been discovered, many extraordinary processes have been followed, but so far as one can see, after unravelling the confused ideas and technical language of the biologists, we can say hardly anything more than that the cell increases in size and divides into two parts, and that the chromosomes within the cell also grow and split. The dividing continues until after a while we notice that some of the aggregates of cells differ from other aggregates, and from the various different aggregates, the different parts and organs begin to show their characteristic attributes. At this stage the mass is called an embryo; it is followed by birth, growth to maturity, decay, and death. As the fundamental axiom of biology, we shall accept the belief that no cell occurs except from the growth and division of a former cell; in spite of this we are also asked to accept the axiom of evolution that the cell has evolved ultimately from purely material elements.

It would hardly be an exaggeration to say that the study of the cell is the science of biology. Schleiden started the domination of the cell by the dictum that: "In the strictest sense of the word, only the separate cell deserves to be called an individual."[25] And most biologists would probably subscribe to this doctrine. A man, a dog, or a tree, is not an individual, an organism, but each is an aggregation of cells, and to know what we call the individual it is necessary to

[25] Schleiden, *Contribution to Phytogenesis.*

study only the separate cells, for each has its separate individuality. Could there be a more inadequate or futile idea than to suppose an adult man is contained in the single cell from which he originates or that the multitude of cells of his body has each a separate identity? The cell is a relatively simple physical body, composed of a number of chemical elementary substances combined together in, to us, a complex fashion. But it has one distinguishing feature which, to one who does not believe in a mechanistic or materialistic philosophy, makes it distinct from the physical world; it is alive; it contains potentially the power of developing into an adult organism which carries on, in the main, the distinguishing characteristics of the ancestral bodies of which it was once a part. This governing principle, call it spirit, hyperphysical force, biotic force, or what you will, governs and regulates the cell's growth and is so certain in its action that the development to an organism similar to its ancestor never fails; the cell of the oak tree must become an oak tree or nothing. It divides the cell into new ones and arranges them in definite order so as to produce a predetermined form and to carry on predetermined functions. From the confused welter of substances which makes the environment of the cell, it selects just those kinds in proper proportions which the cell needs and combines them with unerring accuracy. It provides and maintains a nexus between the cells, so that they react on one another, developing differently to form the various parts and to give the aggregation a homogeneous entity which we call the organism.

It is no casual separation of our ideas into the physical, biological, and psychological realms. The physical world is a combination of substances acting according to a certain set of laws of force and energy, the biological world is composed of the same substances, but the laws of action are not the same. They have, however, this great principle in common; they, both, are limited by time and space. Then, somehow to the biological world an added principle is given that we can call consciousness which is not material but is associated with matter and which is not limited by time and space. To the present time, at least, these three realms are to us incommensurable and we have made no progress in measuring or explaining one by the other.

When growth, physical and hyperphysical, has been attained there invariably comes a time when this governing principle, or biotic force, loses its control, the organism dies and the cells return to their physical state. The discussion whether the biotic and psychological actions persist or are inseparable from the body is, in my opinion, academic as we have found no rational or observational method by which to attack the problem.

There are some symptoms that the biologists, themselves, are waking up to the fact that they have submitted too long to the incubus of the cell, and that the attempt to explain the whole organism as an aggregation of separate cells can lead to no useful end. They are even beginning to doubt that life can be subjected to the microscope. Professor William Ritter has recently given us an elaborate discussion for and against the cell theory and concludes that life must be studied from the aspect of the organism as a unit.[26] Of all the biologists whom Professor Ritter quotes, no one seems to me to have seen so clearly and to have expressed so simply the evidence against the theory of the cell as has Professor Whitman. Even the biologists should heed such of his opinions as these: "May we not go further, and say that an organism is an organism from the egg onward, quite independently of the number of cells present? In that case, continuity of organization would be the essential thing, while division into cell-territories might be a matter of quite secondary importance. . . . The more carefully we compare the cleavage in different eggs, the more clear it becomes that the test of organization in the egg does not lie in its mode of cleavage, but in subtile formative processes. The plastic forces heed no cell-boundaries, but mould the germ-mass regardless of the way it is cut up into cells. . . . The essence of organization can no more lie in the number of nuclei [of the cells] than in the number of cells. The structure which we see in a cell-mo-

[26] W. E. Ritter, *The Unity of the Organism*, Gorham Press, 2 vols.

saic is something superadded to organization, not itself the foundation of organization. . . . Comparative embryology reminds us at every turn that the organism dominates cell formation, using for the same purpose one, several, or many cells, massing its material and directing its movements, and shaping its organs, as if cells did not exist, or as if they existed only in complete subordination to its will, if I may so speak."[27] These passages strike one as the clear expression of a man who sees that an unknown cause cannot be explained by an hypothesis merely because we do not desire to consider it as beyond our grasp, and that we do not aid matters by wrapping up our vagueness of ideas in technical words and abstruse phrases which seem to mean what we cannot express. Such simplicity of thought is rare amongst men of science who are only too prone to deceive themselves by their mere observation and by their technical language. To show that it is no exaggeration to say that while biologists may condemn the cell-theory, yet they will always return to it as an explanation of those things which we do not and cannot understand, I may quote from Professor E. B. Wilson, and no one will question his authority on the cell. He says: "The only unity is that of the entire organism, and as long as its cells remain in continuity they are to be regarded not as morphological individuals, but as specialized centres of action into which the living body

[27] *Ibid.*, vol. I, pp. 159-60.

resolves itself, and by means of which the physiological division of labour is effected."[28] It would seem clear from the above that he is certain that the life and habits of an adult organism cannot be deciphered or predicted by any study of the primitive cell of the ovum. But not at all: when a specific case of heredity is brought to his attention, he immediately returns confidently to "them there bags of mysteree," the cells. To explain why certain flies develop certain future characteristics, he says: "This case, and many others of similar type, may be *completely explained* through our knowledge of the relation of the chromosomes to sex. . . . All the facts revealed by experiment are very simply and completely accounted for by the *simple assumption* that the X-chromosome is responsible not only for sex, but also for the short-winged character."[29] And all Professor Wilson really knows about the X-chromosome is that it is a minute speck in the cell which can be seen under a microscope when an ovum has been stained. But if Professor Wilson and other biologists sin by saying that they understand what they do not, the most unpardonable case is that of Professor Ritter, himself, who writes a long and difficult treatise to overthrow the cell-theory and with it the materialistic theory of life, and then, in the end, proposes a new and crude materialistic theory in these words: "All the manifestations which in the aggregate we call life, from those presented by the

28 *The Unity of the Organism*, vol. I, p. 161.
29 *Ibid.*, vol. I, p. 163.

simplest plants to those of a consciously psychical nature presented by man and numerous other animals, result from the chemical reaction between the organism and the respiratory gases they take, oxygen being almost certainly the effective gas for nearly all animals. An essential implication of this proposition is that every living individual organism has the value, chemically speaking, of an elementary chemical substance."[30] If anything could add to the complexities of the chemist it would be to consider a living man as an elementary chemical substance. So far the chemist has had to destroy life before he can experiment with organic substances and if he kills the living man he loses this new elementary life-substance and his experimental object changes into the known inorganic elements.

This discussion of the cell has gone into too great a length, but it should be remembered that the link of biology to physics and chemistry is supposed to be the cell. And if the cell-theory falls, then the chief support of the mechanistic philosophy of life and evolution is destroyed. We may sum up our argument by referring to Huxley's illustration of life by this theory, for no one has given it in more vivid form.

Huxley gives the following picturesque account of the development of the adult from the ovum. He says each being passes from a rudimentary to its perfect condition, through a series of changes which are called

[30] *Ibid.*, vol. II, p. 286.

its Development. In the higher animals these changes are extremely complicated but they have been *almost completely unravelled* by Von Baer and others. The organism commences its existence as an egg, or ovum; under the *proper conditions* this apparently insignificant particle of matter becomes animated by a new and mysterious activity. It grows and then splits into two parts; by the repetition of this process the whole yelk of the egg is converted into a mass of granules, each of which consists of a minute spheroid of yelk-substance, inclosing a central nucleus: "Nature, by this process, has attained *much the same result* as that which a human artificer arrives at by his operations in a brick-field. She takes the rough plastic material of the yelk and breaks it up into well-shaped, tolerably even-sized masses—handy for building up into any part of the living edifice. Next, the mass of organic bricks, or *cells*, as they are technically called, thus formed, *acquires an orderly arrangement*";[31] until one after another the organs and parts of the adult are formed.

If we analyse this description, and it is a typical one for the cell theory, we immediately note how specious it really is. The emphasis is first placed on the apparent simplicity of the ovum which prepares our mind for the admission that the drop of protoplasm is very like to a drop of water or other material substance. It also seems simple to say that it grows

[31] Huxley, *Man's Place in Nature*, pp. 82-5.

and then splits into two similar cells and continues in this same simple process until very many cells are formed. Then, it is casually stated that the aggregation of simple cells is differentiated into all the complex physical and mental characteristics of the adult. The little doubt about such an argument which we may have is soothed by saying that Von Baer and others have almost completely unravelled these processes. If so, why does the incessant labour of the biologists continue as they try to find how the cell grows and how from seeming simplicity it becomes complex? If the reader were not hypnotized by the reiteration that cells are almost like bricks of inorganic matter, he would at once ask himself whether the addition of many simple things changes them into a complex unit, and he would also be sure that the adult existed potentially in the ovum or that there must be some intelligent being who has made a plan and carried it out just as an architect builds a house. Who is this artificer, Nature, which makes these extraordinary cell-bricks and gives them the power to acquire an orderly arrangement? Nature has here the characteristics we used to assign to an intelligent God.

And this simile of an artificer constructing according to the design of an architect is the picture or metaphor which the biologist employs, although, at other times, he denies anything but matter and physical force. After comparing the cells to bricks, he jumps over the whole difficulty by innocently remarking that the cells, or bricks, *acquire* an orderly arrangement. He pays absolutely no attention to the meaning of the word, *acquire*, and apparently most readers accept it without question. Just imagine a mass of bricks *acquiring* an orderly arrangement and becoming a house! It is this extraordinary fact that the cellular organism does act independently of its environment and arranges its order from within which makes it absolutely different from bricks and all other inanimate matter. This is the sort of language and these are the loose ideas of men of science when they wander out of their own field and try to vivify matter. And the astounding thing is that they have "put it over" and confused the simple knowledge of men by technical words which mean no more than the common ideas of the Greek and Latin words from which they are derived. They sneer at the looseness of thought of the clergy whose chief fault is, they do not see this fallacy and have adopted also a materialistic philosophy veneered with a thin disguise of humanitarianism.

When we strip from the mechanistic cell theory its wrappings of mysticism and technical verbiage no more inadequate proposition was ever imagined. The idea of inorganic matter being an aggregation of molecules has been seized upon, but the one restriction which makes the molecular hypothesis in physics reasonable has been quite overlooked. Molecules of water, for example, when added together make only water; cells when added together make such different things as hearts, brains, and muscles. A molecule of water can be, and is, endowed with all the properties of a gallon of water except mere size and mass. A germ cell of a man has not the properties of a man. The physicist who examines a tiny crystal of ice the size of an ovum can detail to you all the properties of a pound of ice or else physics would be futile as a science; the biologist studies the cell and says, add cells together and all the properties change.

It seems almost self-evident that, if the biologist is to derive useful conclusions, he must start from the assumption that the cell is materially simple and its substance is governed by the forces and energies known to physics. Many properties of the adult body can be learned from such a study of the cell. But the growth of the cell and its life functions are due to some predisposing cause which is not physical force and energy, because it displays none of the laws of such force and energy. In our total ignorance of this cause we may just as well name it hyperphysical, psychic, or vital energy. This cause calls into action and controls the physical forces which select and arrange the material elements of the body to produce growth.

There are some signs, as I have said, that the attempt to explain our life with its conscious thoughts and emotions as a form of materialism is rapidly losing ground. The blighting effect of this doctrine which grew out of the evolution theory of the last century and which led to a philosophy and religion of naturalism was first dimly seen by thoughtful people who were themselves neither philosophers nor men of science. But so long as the biologists held to the belief that by their study of the cell they could find the link between life and chemistry, progress out of this unbreathable atmosphere would be slow, because of the submission of thought to the dictates of scientific men. But even the biologists are beginning to admit that the cell is not the basis of life and life is not explainable by the cell; so that there is now hope that progress may be more rapid.

The most significant and the most interesting proof of the uneasiness of the biological mind is the symposium on *Life and Finite Individuality* from which I have already quoted. Held in England and engaged in by the foremost biologists and philosophers of that country, it forms the clearest discussion of this most fundamental problem which has been published. The thesis of the symposium was given by Professor J. S. Haldane who had previously startled the biologists by a series of experiments to show that the vital operations of the organism do not conform to the laws of chemistry and physics. His thesis is that: "Our ordinary working conceptions [in science] of what we regard as physical, biological and psychological phenomena are not only different, but irreducible to one another."[32] After a very masterly argument, and he is a biologist whose work carries conviction, he summarizes his position as follows: "When we make use of physical categories, we are employing simplified maxims or principles which, on account of their simplicity, are very convenient for purposes of prediction, but which can only be used over a limited extent of our experience without gross error. When we attempt to apply them to biological or psychological phenomena, the error becomes apparent; we cannot express biological or psychological experience in terms of physical conceptions."[33]

The principal reply to this thesis is given by Professor D'Arcy Thompson; with the natural reluctance of the biologist, and especially of one who has advanced most interesting physical explanations of many phenomena connected with cell action, to abandon a cherished theory, he is not willing to give up hope that in some future time biology may become a branch of physics. But even he is willing to admit that the biologists can apply physical laws only to those actions of the organism which are physical, and he furthermore makes an unbridgeable gulf between consciousness, or psychology, and physics; that is, he partially connects biology and physics and separates psychology as a science from both of them. His conclusion is: "The physicist is, *ipso facto*, a mechanist,

[32] *Life and Finite Individuality*, p. 11.
[33] *Ibid.*, p. 27.

but he is not by implication a materialist; nor is the biologist of necessity a materialist, even though he may study nothing but mechanism in the material fabric and the bodily activities of the organism. It is not merely that in dust we had our first beginnings, and that to dust we shall at last return. Our bodies are dust all the while, as is the grass that withers and the flower that fades; and the laws by which our bodies are governed are the laws by which earth and dust are ruled. . . . But there is a something that is not dust at all, though as in all things else it is found therein; something that is the Order of the Cosmos and the Beauty of the World; that lives in all things living, and dwells in the mind and soul of man; something not fulfilled in physics, which vivifies the dust and makes the dry bones live. You may call it what you please, but it is always the same. You may call it Entelechy, you may call it the Harmony of the World; you may call it the *Élan vital*, you may call it the Breath of Life. Or, you may call it, as it is called in the Story-book of Creation and in the hearts of men—you may call it the Spirit of God."[34]

This discussion of life as mechanism has been extended to a great length, probably to the point of weariness to the reader, but it is the goal to which biological theories of evolution inevitably tend and it is only by proving that there is no scientific proof for this doctrine that evolution as a basis for a science

[34] *Life and Finite Individuality*, p. 54.

of life and thought can be successfully attacked. It seems to me that there has been given sufficient evidence to show the flimsiness of the claims of the mechanists, and that the evidence has been given in the words of Dr. Haldane and Dr. Thompson.

CHAPTER EIGHT

Evolution and Society

If it is a correct idea that the Renaissance of the fifteenth century really divided the Christian era into two periods which are separated not only by great differences in the conditions and customs of life but also by a fundamental change in the concepts and motives of life itself; then there is little wonder that we, in these modern times, comprehend neither what men and women did during the Middle Ages nor even why they attempted to do the surprising things which history records. This break in the continuity of history is comprehensible if it is true that religious thoughts and ideals really dominated society before the Renaissance, and that since then we have replaced this domination by that of science; a society which looks to God for immediate direction in its ordinary affairs of life is essentially different from one which relies on its own ability to mark out its path. We must expect to find also in each of the two periods a time of maximum sway of its dominating influence, preceded by a hopeful period during which the idea of this new power gains strength, and followed, unfortunately, by the discouragement which seems inevitably to accompany our inability to realize our ideals. The maximum sway of the religious domination culminated in the twelfth and thirteenth centuries; while during the latter half of the nineteenth century science obtained its greatest mastery over society. Many of us, still living, can remember with what supreme assurance the new gospel of reason was preached; it was confidently believed that man had found, at last, a new philosophy which was not subject to the vagaries of the emotions and the will, or to the incomprehensible interference of God. We had, of course, much to learn, the book of life was not understood; it was not even read as yet, but we owned the book and we had manufactured the key of the puzzling language in which it was written. And we hoped and expected, having finally had our eyes opened to the universal and natural law of evolution and progress, that we were laying the foundations of a new civilization which should go on growing and expanding in order and efficiency until the past haphazard history of the world would seem to be a merely unpleasant dream. What ingenious, and unfortunately also dreary, pictures were given of life and society in a thousand or more years hence! Many tried these essays but of them all only Mr. H. G. Wells still persists in the attempt to outline specifically the evolution of mankind in the distant future, or to show that the habits of the pterodactyl were the tentative but indispensable forerunners of social democracy built on the sure foundations of biological evolution.

We are well acquainted with the spectacle of a person who is dominated by a single idea which colours all his thoughts and acts; we find in such an one a certain power of achievement, but with this power there is apt to be rashness of opinion and intolerance to opposition; such a person is called a fanatic, because he is governed rather by imagination than by judgement. So, too, a society living under such a state of domination is likely to make a great change in conditions, to make what we are now apt to call progress, although it is better to class it merely as a change; it is also true that such a change is characterized by a certain lack of balance; qualities are neglected which should be cultivated to maintain good civilization. When the religious impulse with its emphasis on the cultivation of the supernatural is too strong, ignorance and superstition prevail amongst the common people; and when science, which seeks knowledge and power, is not kept within bounds, society drifts into industrialism and moral confusion. It may be, the chief cause of the Renaissance was that it came at a period when the emotions and the reason were closer to a state of balance than before or after.

It is easy for us to see the misery, the injustice, the gross ignorance and superstition, which prevailed during the Middle Ages. But the flower of that civilization, such a man as St. Francis of Assisi, who truly sought and even found a mystical communion with God, inspires us with a feeling of reverential wonder. In comparison with such a religious life as he and his sincere followers led, that of our humanitarian social workers seems trivial and barren.

It is more difficult to find so typical a leader of the age of reason with its self-assurance, its efficiency, and lack of reverence. But, as I am contrasting these two periods principally from the standpoint of reason as opposed to mysticism, Herbert Spencer may be taken as the best type of the nineteenth century. No other leader showed quite such self-assurance in his conviction that past knowledge was futile in comparison with his own ability to formulate definitions of the truth and to derive from them truly logical conclusions; no one showed a greater impatience towards the commands of authority; no one was more quickly wearied by those things which depend on the imagination. He, himself, the leading philosopher of the time, is quite unconcerned with the work of his predecessors. He can nonchalantly remain ignorant of such men as Aristotle and Plato, who are not even cited in the index of his *First Principles* or of his *Autobiography*. Kant is mentioned once; he tells us he tried to read the *Critique of Pure Reason* which he believed had been at that time recently published. The task was too great for him: "Being then, as always, an impatient reader, even of things which in large measure interest me and meet with a general acceptance, it has always been out of the question for me to go on reading a book the fundamental principles of which I entirely dissent from. Tacitly giving an author credit for consistency, I, without thinking much about the matter, take it for granted that if the fundamental principles are wrong the rest cannot be right; and thereupon cease reading—being, I suspect, rather glad of an excuse for doing so."[1] Both religion and poetry bored him because of their appeal to the imagination. Homer and Dante inspired in him only disgust because of their triviality and monotony. The most striking instance of this aridity of character is shown by the action of his intimate friend E. A. B—— who wrote him that painful as it was they must break their friendship and become as strangers to each other; for "I should feel that I was bound to leave no means untried to endeavour to bring you to a true view of the truths of religion, but I know so well that no *argument* on such a subject ever yet convinced one who has closed his ears to everything but *human reason*."[2]

To Spencer, the philosopher, should be added Darwin on account of his dominance in the biological sciences, and Buckle, who first attempted to reduce the history of the genus *homo* to the laws of a science. Before discussing the effect of the doctrine of evolution, by means of natural selection, on social and religious life let us briefly recapitulate the conclusions of the previous chapters. The doctrine has been presented to us under four different aspects.

[1] *Autobiography*, Appleton and Co., vol. I, p. 289.
[2] *Ibid.*, vol. I, p. 316.

The first of these is the general statement of scientific evolution. From the facts which have been accumulated by biologists relative to organic species and heredity, a general law of evolution has been accepted as a part of biological science. According to this law, species are mutually related in such a way that those forms now in existence are modified forms of previous species. Since this law is capable of statement as a scientific generalization which can be supported by observation and experimentation it is a thoroughly justifiable assumption and one with which we have no quarrel.

Secondly, the attempt has been made to determine the cause of evolution and the method by which species vary. From this attempt have arisen the hypotheses of natural selection, inheritance of acquired traits, mutations, etc. I have contended that these hypotheses are not proved and are really metaphysical and unverifiable in character.

Thirdly, the hypotheses of the cause and method of evolution inevitably lead to a mechanistic philosophy in which the phenomena of life are to be explained by physical and chemical processes. Biology is thus linked with physics. The facts are against this mechanistic view of life and the hypotheses are unjustifiable assumptions.

Fourthly, the hypotheses of biological evolution have been expanded to include the psychological realm of consciousness and the social and ethical life of man. This aspect of evolution is based, not on the scientific foundations of biology, but on the metaphysical attempts included in the second and third categories. It is this phase of evolution which has created confusion and disaster.

Our faith in the idea of evolution depends on our reluctance to accept the antagonistic doctrine of special creation, because this view of creation is foreign to our belief in the continuity of law and order. The first inquiries into the question of genetic evolution came from the inability to classify satisfactorily living species. Evolution is thus a modern belief growing out of the accumulation of knowledge about organic forms; it became inevitable only when biologists found prehistoric fossils of species now extinct and were able to classify them in a series agreeing roughly with the chronological tables of geology. These fossil forms show changes of structure and, in a general way, the more differentiated and complex types occur in the more recent strata of rocks. But our palaeontological record is perhaps even more remarkable in showing the persistence of types and the ability of simple organisms to withstand great epochs of time and great change in environment. It is also sadly defective and, especially, at times when radically new types have suddenly appeared in great abundance, so defective that we cannot determine definite lines of ancestry. However interesting the classification of past occurrences may be, the chief value of science is the ability to generalize observations in laws which will permit us to predict future events. In this respect evolution has absolutely failed. We know nothing about the method of evolution; we know nothing about the cause of variation; we cannot even guess the characteristics of future species.

For nearly a century and a quarter, attention has been focused on the causes and methods of variation, yet we have made no progress towards a solution. Lamarck's hypothesis of the inheritance of acquired traits may prove to be a fact, but it is bound up inseparably with the ontological theory of design and with the hyperphysical element of desire. Spencer's philosophical dictum that homogeneity passes to heterogeneity is applicable to any theory of evolution, as it specifies no method and is directly contradicted by the pronounced persistence of undifferentiated or homogeneous forms of life; his famous phrase, the survival of the fittest, is but reasoning in a circle for, if the fittest alone do survive, then all existing individuals are necessarily fit to survive and the eugenists' worry about Jukes and imbeciles is futile; they are alive and therefore fit. Malthus's struggle for existence and Darwin's natural selection may explain the death of individuals and the disappearance of some species, but biologists now agree that they are ineffective as a means of producing species.

At the present time, biologists are in the position of having disproved all former hypotheses of evolution and of having accepted some form of what they call the mutative hypothesis. As a scientific theory it is purely nugatory as, at bottom, it merely holds that some individuals in a species may and do differ to an unknown extent from the typical form. If these individuals breed true to their new characters, and if these characters are capable of fitting in with the environment, we then have a new species or the potentiality of a new species. It is evident that if the variation into new species depends on what are to us unknown and freakish variations in individuals, there is no such thing in mutations as a scientific law of continuity or order. As I extravagantly remarked, a reptile might give birth to a feathered bird, or a giraffe with his great length of neck might be produced in a generation or two.

As time passes, separating us further and further from the innumerable cross-currents of the nineteenth century, we realize more and more clearly that the supreme effort of the Victorian age, as the English are accustomed to call it, was to establish a rational monistic philosophy which would embrace the whole universe in a single science. What Newton accomplished, by finding the universal force of gravitation, towards unifying the physical sciences and preparing for the nebular hypothesis, had been extended by Spencer and Darwin until a universal evolutionary hypothesis embraced all phenomena, both of the organic and the inorganic worlds. In such a grandiose system, the spirit of man, with its element of free-will or choice, shrivelled to insignificance in comparison with the inexorable majesty of natural law.

In brief, we are asked to begin with a picture of the universe as an undifferentiated and homogeneous aggregation of atoms subject only to Newton's law of attraction. In sequence of time homogeneity changed to heterogeneity, how or why we cannot even guess, and the universal mass became located in definite parts of space until there came to be the various stellar and solar systems. The earth, as an insignificant speck of matter, molten and containing its chemical substances in an undifferentiated mass, gradually cooled and, slowly by chemical processes, formed its present heterogeneous geological structure. When time was ripe, a certain aggregate, or aggregates, of physical molecules occurred which possessed the elements of what we call life,—the organic molecules. Again, by that meaningless law of the homogeneous passing to heterogeneity the organic molecules by aggregation and differentiation changed to organized life. By continuing this process the earliest organisms evolved into all the flora and fauna of later times. Somewhere along the line, the chemical molecules found themselves in such a combination that the organism possessed what we call the rudiments of thought or self-consciousness; at the end, we have the universe as it is now. What is to be the future? Only

Natural Law, the Absolute Unknowable, and the Biologist may know. Such is, as I understand it, in bare outline the philosophy of evolution. While it may be true that each proponent of this doctrine may modify it in particulars with that curious reluctance of all of us to accept unreservedly the logical conclusions of our postulates, yet we should recognize that this monistic philosophy, dependent on natural law, is the governing idea of the world today. Those, and they are the majority, who still wish to reconcile what is commonly designated as Religion,—that is, a Principle directing and guiding man's conduct outside the principle of natural law—and what is commonly called Science,—the belief in the absolute dominion of natural law—should heed the warning of Spencer who introduces this philosophy with the statement: "Of all antagonisms of belief, the oldest, the widest, the most profound and the most important, is that between Religion and Science."[3] If this controversy ever ends it will be when Science has conquered Religion, for their essential aims are antagonistic.

If such a system as this monistic philosophy of naturalism is to be accepted, then the history of man must be studied from an entirely different standpoint. New sciences are necessary; and we have the attempt to create the sciences of history, psychology, and sociology by the evolutionists. No longer shall we chronicle the deeds of the individual as a mys-

[3] *First Principles,* Appleton and Co., p. 11.

terious power of the free-will, set apart from the natural laws of his environment, with his own little subjective world cutting through the objective universe, now using the forces of nature and again opposing them; the objective and subjective worlds become one. His body is a machine subject to biologico-physical laws and his mind is another machine whose laws can be derived objectively by psychologico-physical laws. Thus, Fiske devotes one of the most important chapters in his *Cosmic Philosophy* to demolishing the idea of free-will or volition. Human beings, as individuals or as grouped in societies, conform to fixed and ascertainable laws and "the fundamental law to which they conform is the Law of Evolution, which has now been proved to hold sway among inorganic and organic phenomena, as well as among those superorganic phenomena which we distinguish as psychical."[4] So it is the custom for psychologists and sociologists, who hope to formulate rigorous laws for the human machine, to tell physicists that it is extremely necessary for their students to study physics. It is easy to agree with them, because it would undoubtedly be good for them to exercise their minds on, at least, one subject which requires a rather large element of exact and rigorous thinking. But experience teaches me, at least, that these new theorists are content with a very small dose of the exact sciences; this half-knowledge merely adds to their confusion of

[4] *Cosmic Philosophy*, vol. III, p. 241.

thought. They will certainly not learn from any physicist how to correlate atoms of matter and thought.

The first explicit attempt to treat history as a science began with Buckle's *History of Civilization in England* and, although his conclusions have mostly been proved to be inadequate, his method of treatment is still accepted as the basis of the science of history. He is also the ancestor of Mr. H. G. Wells's *Outline of History* in which the governments, the habits, the customs of modern times are not only traced back to the earliest records of human history but are linked to the vast and dim life of our bestial ancestry. Buckle introduces his subject by saying that historians have collected much material, but they have not combined it into a homogeneous science. This narrow standard has been very prejudicial to the progress of our knowledge, and history has not followed other fields of inquiry in which the necessity of generalization is universally admitted. The historian should first acquire a broad knowledge of political economy, of statistics, of ecclesiastical affairs, and of the physical sciences. This is a large programme of preparation in addition to the historical records which must also be mastered. That he took this idea seriously is shown by the fact that he lists some five hundred and ninety-eight titles from which he quoted, and of these comparatively few refer to works other than purely historical. It is no wonder that he reluctantly turned from the discussion of the civilization of the world to the limited field of England. And even in this narrower field he staggered about in such a way as to give point to the anecdote which Spencer tells in his *Autobiography*. He and Huxley met and walked with Buckle, and Huxley, struck by the historian's feeble, undecided gait, remarked: "Ah, I see the kind of man. He is top-heavy." Spencer notes: "I have never done more than dip in the *History of Civilization in England;* but I suspect that the analogy suggested was not without truth. Buckle had taken in a much larger quantity of matter than he could organize; and he staggered under the mass of it."[5] One may add that the reader also staggers under the burden and, if his comprehensive method were followed, history would be less written and still less read.

As a science, history asks the question whether the actions of men and of societies are governed by fixed laws. Buckle, of course, answers that they are governed by the laws of nature: "Thus the whole world forms a necessary chain, in which indeed each man may play his part, but can by no means determine what that part shall be."[6] Or as a later and more indoctrinated scientific historian, Fiske, defines history: "Civilization runs in a definite path, that the sum total of ideas and feelings dominant in the next generation will be the offspring of the sum total of ideas

[5] *Autobiography*, vol. II, p. 4.
[6] *History of Civilization*, Appleton, 1891, vol. I, p. 7.

and feelings dominant in this."[7] This may be true, but to me it is mere words, and it leaves history forever as the great unattainable science. What is the sum total of ideas and feelings of a generation? If I examine myself, I am bewildered by the complexity and fugitiveness of my own ideas and feelings; those of my own generation are beyond my apprehension; and those of past generations fade into vacuity. Would it not be utter folly to predict what the next generation will attempt to do in any one field of thought? If such is to be the basis of history, it may be a science, but if so, science is not the rational and exact guide we fondly hoped it might be.

Buckle next finds that there are two classes of laws which govern society; the laws of mind, and the laws of matter: history is therefore the result of the actions of external phenomena upon the mind and of mind on external phenomena. This is a maxim tremendous but trite if the two are believed to be separate; it becomes even more tremendous since we now are asked to combine mind and external phenomena into a single category. His proof of the utility of this law is seen in the fact that statistics show that the number of suicides, murders, missent letters, and other phenomena, are not subject to chance or to what would seem to be individual idiosyncrasies. The discovery of such regularity in the averages of human actions is undoubtedly interesting and has value. In any

[7] *Cosmic Philosophy*, vol. III, p. 348.

country, it is approximately certain that, let us say, a given number will die during a given year, and from this fact we can draw some useful information, but this knowledge, historically, is far overshadowed by the importance of knowing when a certain few individuals will die; and this specific datum is just exactly that which the mathematics of probability, or statistics, does and must ignore. For example, we should be safe in saying that the assassination of Lincoln had far more effect on the history of the United States than had the deaths of all the other men who died during that year. Or, again, it is now quite customary to figure the financial profit to a community which results from the lowering of the number of deaths caused by a given disease; but statisticians neglect the fact that if the life of a great creator of wealth were saved the gain would rise enormously, or that if an incendiary's life should be saved, he might burn the property of the whole community. Since Buckle's time the activities of statisticians have been unceasing and we are swaddled in sheets of figures; it would be a comfort to us harassed beings if it were better known that the majority of the statistics were futile, because their collectors and interpreters do not know enough physics to understand the Law of the Virial which proves that a generalization from statistics can be valid only in so far as the activities of the individuals forming the collection are negligible.

After Buckle has proposed the general laws which govern the science of history, he next attempts to find the specific causes for the diversities of civilization. He assumes that, in primitive conditions, the physical environment is the dominating force. The environment affects man by climate, food, soil, and those general aspects of nature which excite the imagination. If the first three are favourable, they produce wealth or the accumulation of property; wealth permits leisure; leisure is responsible for taste and knowledge, without which there can be no progress towards civilization. He, in accordance with this sequence, finds that the first civilizations arose in hot countries with superabundant food; in India because of rice, in Egypt from dates, in Peru and Mexico from potatoes, bananas, and maize. Unfortunately, cheap food induces laziness and low wages, and these in turn make for despotism; so that, in the end, this type of civilization could not advance far. Europe owes its more permanent and advanced civilization to the opposite causes. It had neither fertile soil nor a superabundant food, therefore wages were high and the government tended toward democracy because of industry and competition. All seems logical and convincing, but there remain certain difficulties; other parts of the world had a warm climate and abundant food, Australia, parts of Africa, of North and South America and the Pacific Islands, and yet no primitive civilization started in them. The same is true when we consider regions similar to Europe, and there are many of them, yet the American Indians in the best parts of North America remained savages and would still be in the same state if they had not been overwhelmed by Europeans.

Nor does Buckle hesitate to apply his laws to the explanation of the existing national characteristics of the European societies. Where the aspects of nature are the more majestic, there, he finds, man becomes painfully aware of his insignificance and does not struggle; where nature is feeble, man gains confidence in his powers. Mountains, earthquakes, and volcanoes are certainly prevalent in Italy, Spain, and Portugal; accordingly ignorance and superstition are the characteristics of those people. So we must not look to them for superiority in scientific and rational achievement but, in the imaginative life, they are the leaders as nearly all the greatest sculptors and artists have been produced in those peninsulas. This explanation is too simple. Buckle forgot the music of Germany; the art of France; the stubborn resistance to superstitions and ignorance in Switzerland; and worst of all, the Romans, strikingly deficient in art and imagination, created a great empire in Italy although its mountains and volcanoes were presumably as majestic then as they are now.

Buckle was not more fortunate when he discussed the mental laws of civilization. He divides them into moral feeling and intellectual knowledge. Progress, he says, does not depend on differences or growth of natural capacity but on the increasing ability to withstand the pressure of external circumstances. The child born in a civilized community is not superior to one born among barbarians. From the mental laws, he draws his final conclusion that civilization is due solely to intellectual progress by which man has increasingly dominated his external environment. "Applying this test to moral motives, or to the dictates of what is called moral instinct, we shall at once see how extremely small is the influence those motives have exercised over the progress of civilization. For there is, unquestionably, nothing to be found in the world which has undergone so little change as those great dogmas of which moral systems are composed. To do good to others; to sacrifice for their benefit your own wishes; to love your neighbour as yourself; to forgive your enemies; to restrain your passions; to honour your parents; to respect those who are set over you: these, and a few others, are the sole essentials of morals; but they have been known for thousands of years, and not one jot or tittle has been added to them by all the sermons, homilies, and text-books which moralists and theologians have been able to produce."[8]

It was this opinion, that civilization was ultimately to be judged by its material achievements rather than by its spiritual excellence, so boldly and une-

[8] *History of Civilization*, vol. I, p. 129.

quivocally stated as the conclusion of scientific history, which aroused the persistent opposition of the Evolutionists to Buckle. They would have approved of his scientific method. But he damaged the cause of evolution far more than he aided it: they could readily excuse the errors of fact of a pioneer, but they could not forgive his separation of mental and natural laws. Still worse was his division of the agencies of morality and intellectuality and the complete subordination of the former. They knew it would be a rash thing to expect success for a philosophy which openly denied morality to be the supreme goal of progress; on the other hand, if our moral attributes were known and practised thousands of years ago in a period of barbarism, how could they compel acceptance of the doctrine of a continuous evolution of the mind from physical phenomena, and of moral self-consciousness from the mind? How could Spencer's evolution of altruism from egotism be a steady progress from the ape to man as he is today, if the highest forms of altruism were taught thousands of years ago and we have never improved them? Buckle may have originated the science of history, but he dealt a horrid blow to progress and evolution. The great lesson to us should be that he told the truth about our attainment of morals and was a far better prophet of the consequences of scientific evolution than were the Evolutionists. Unfortunately we have subscribed to the doctrine of evolution and we are its products;

our civilization is today an altar to the god of material progress.[9]

If the Evolutionists disliked Buckle, they hated Comte; and their constant effort was to disentangle themselves from the accusation of being his followers in positivism. They accused him of not seeing how science would develop, and they accused him of stating that scientific thought tended towards atheism and materialism; whereas, in their opinion, it merely stopped with agnosticism and the Absolute Unknown. Yet in both of these respects they foresaw less clearly than did Comte and Buckle what would be the results of their own philosophy of science.

The Evolutionists had so many general traits in common and they formed such a compact and homogeneous group, that it is possible to discuss their common idea of social organization, and then point out briefly how their individual opinions differed. These men, Spencer, Darwin, Huxley, Haeckel, and Fiske, have received their share of praise and commendation; they have moulded our thought; the condition of the world today is largely the result of their teaching; they established biology as a great science; they started the sciences of psychology and sociology, and fostered the science of history, which attract large and enthusiastic, if somewhat vague, groups of followers;

[9] Can we say that Buckle's opinion is discarded? Will not very many agree with this writer? "Human civilization goes hand in hand with the degree of successful interference which man exerts on the natural forces around him."

they have smashed the authority of the humanities and have changed our universities into technical schools, where results can be determined by material achievement and where scholars seek to uplift humanity by the process of levelling down all inequalities: their works and ideas are chronicled in innumerable books. They accomplished all these things and to them belongs the great credit of having, by ridicule, convinced us that the Christian Religion had encrusted itself with a mass of superstitious beliefs in God and the Bible which could not withstand the facts brought to light by science. By exalting the dignity of human observation and reason, they undoubtedly diminished bigotry and idolatry. Thus, it is true that in a very real sense they might have prepared the way for a better and more spiritual religion, if only they could have taken the next step and have shown us what to believe as well as what not to believe. In this nobler endeavour they failed; try as they and their followers of today will, they cannot escape the taint of materialism: the stimulus to live so as to advance the future race leaves the individual unaffected; smothered by the feeling that he is subject to an impersonal general law of nature, his personal will and personal responsibility for his conduct are relaxed in the unbreathable atmosphere of natural selection; the worship of the Absolute Unknown may have exalted the poet, but it leaves the less imaginative person untouched, and he turns to the gratification of his senses by material comforts and conveniences.

The predominating trait of the leaders of evolution was an intense egotism and self-confidence that in them lay the truth. They brushed aside the work of earlier philosophers and teachers of ethics, or rather they made hardly any reference to them. How could it be otherwise when they had newly found the scientific key to the law of the universe, that human civilization was a steady progress? Why should we stoop to learn from a Socrates, a Jesus, or a Çakya-Mouni who shone merely by contrast in a community of early barbarism unacquainted with the most elementary laws of physics and biology? Darwin had a naïve ignorance of the work of even his immediate predecessors; Spencer read no book whose fundamental ideas differed from his own; and Huxley was the strenuous opponent of classical education.[10]

With this egotism, there naturally followed an unlimited admiration for each other. Jealous of the supreme influence of Newton over the physical sciences, Huxley proclaims Darwin to be a second Newton of the life-sciences; and Fiske, not to be outdone, goes

[10] The philosopher of this group was Spencer. Do not the following quotations support my opinion that they were convinced the Truth dwelt in them and in them alone? Spencer puts in words what his contemporaries and Evolutionists believe. He writes: "I am never puzzled. . . . The conclusions at which I have from time to time arrived, have not been arrived at as solutions of questions raised: but have been arrived at unawares." (*Autobiography*, vol. I, p. 462.) "Very rarely, if ever, did I cite an authority for any opinion expressed." (*Ibid.*, vol. II, p. 6.) Is not our emphasis on modern opinion and neglect of the Bible and the classics indicative of the same spirit?

a step further in order to place Spencer above Newton. It does not seem to have occurred to them that Newton attained the reputation of being the master mind of science only after a long and serious critique of his work; it would have been better taste to let the acid test of time determine what was the value of the achievement of their new and untried heroes.

But the most irritating and exasperating characteristic of this group was the assumption that in their doctrines only was the truth to be found since they, alone, were seekers after the truth. Day in and day out they proclaimed that they wished only to bring truth to light and that all the rest of the world were guided by expediency and ulterior motives. In this respect Huxley was the leader, and this complacency drew caustic rebuke from the tolerant William James: "It must be delightful, only I can't agree to what seems to be becoming the conventionally accepted view of him [Huxley], that he possessed the exclusive specialty of living for the truth. A good deal of humbug about that!—at least when it becomes a professional and heroic attitude."[11] They all, like mediaeval knights, rode out to battle carrying a banner on which was displayed the motto, *Veritas praevalebit*. They attacked bitterly the beliefs of their enemies, shouting their battle cry of "Facts we know and Law we know but what you know is false." And when

[11] James, *Life and Letters*, vol. II, p. 148.

questioned to learn what were these facts and these laws, then, to the surprise of their adversaries, the Evolutionists were found to be safely entrenched in their fortress of Agnosticism from which came the murmur that the Truth was, "Nothing can be known." Sensitive to the accusation that they were atheists and materialists, they adopted, as Huxley acknowledged, the terminology of materialism and denied its reality. To them the great religions, and especially Christianity, were solely the worship of an anthropomorphic god and the superstitious submission to miraculous events contrary to scientific facts. They failed utterly to see that these are but the outer garments by which were symbolized the highest and holiest aspirations and convictions of man.

Nor did it ever occur to them that the "anthropomorphization" of God—the phrase is due to Fiske—was exactly on the same footing as their own idolatry of the materialization of the aether; if God is inexpressible by human qualities so, also, the aether is equally inexpressible by material qualities. Both are abstractions and both have been endowed with concrete qualities. Perhaps it is unavoidable that ardent adherents to a new gospel will not appreciate the fundamental fallacies of their faith. So we may excuse the Evolutionists their failure to see that science is, at bottom, based on the same kind of postulates and deductive reasoning as are all other kinds of knowledge. But, what is an entirely different and inexcusable matter, is the fact that the Evolutionists based their doctrine on the laws of physics, yet, as I have shown, they were pathetically ignorant of the facts and laws of physics. To the long and disastrous list of errors to be found in Huxley and modern biologists we may add Spencer's categorical statement that the forces which we class as vital and mental are transformable and equivalent to the physical forces.[12] In the first place, Spencer cannot distinguish between the ideas of force and energy; and in the second place, every physicist will deny this transformation and equivalence, on the ground that it is contrary to the law of the conservation of energy, since, until someone can show that thought is due to the positions of atoms, mental force is not in any sense a mechanical force. Even his ardent pupil, Fiske, could not subscribe to this statement, but Fiske himself is as lacking in a knowledge of physics as was Spencer.

Fiske was keen to show that the facts of physics fitted into the doctrine of evolution. He gives as an important evidence: "Galileo proved, by reasoning upon direct observations, that all motion is naturally rectilinear and not circular."[13] The slightest acquaintance with the history of physics should have convinced him that Galileo was engaged in destroying the Aristotelian notion of any natural motion, and that his reasoning was contrary to observation since there are no bodies which move uniformly in a straight

[12] *First Principles*, pp. 203-21.
[13] *Cosmic Philosophy*, vol. I, p. 157.

line unless they are constrained to do so by force. The conclusion, which Fiske attributes to Galileo, was really due to Newton and is an acknowledged deduction. Again Fiske contrasts the theory of light with metaphysical disputes, "which, conducted upon the subjective method, and dealing with unverifiable hypotheses, have never led, and never can lead, to anything but an endless renewal of dispute."[14] The theories of light are based on the unverifiable hypotheses of the aether or of light corpuscles and their history has been an endless dispute between the two ideas.

Like Buckle, top-heavy with a vast mass of facts which he could not coordinate, the Evolutionists staggered under the same burden. In the end, they adopted the method of choosing those things which agreed with their preconceived ideas and of shutting their eyes to those which opposed them. There is something almost tragic in the vehemence with which they struggled with their overpowering obstacles, convinced that salvation dwelt with them, until the lives of Darwin, Huxley, and Spencer became one long lament over ill-health; their days troubled by nervous dyspepsia and their nights tortured with insomnia.

As they had devoted their lives to the cultivation of science, it was natural that they should have felt themselves able to prophesy what would be the result of an age of reason. Science was to create a well-disciplined mind conquering one difficulty after another

[14] *Cosmic Philosophy*, vol. I, p. 192.

and gradually weaving its accumulating knowledge into a single homogeneous garment. The history of science has been just the reverse. After a brief period of synthesis, during which both in physics and biology it seemed as if universal laws were being established which covered all the known facts, we have passed into a period marked by extreme disintegration of ideas and by metaphysical hypotheses. The accepted generalizations of the last century lie shattered and discredited.

They taught that pure science should be the focus of our educational system. The study of the humanities has steadily decreased but with it there is an equal neglect of pure science; the emphasis in teaching is now directed almost entirely towards vocational and practical courses. Great laboratories have arisen everywhere, in which men of science should be able to devote themselves unhampered to the cultivation of pure science; but these buildings are thronged with professional students who care only for the material and industrial applications of science, and the lonely cultivators of pure knowledge spend their time teaching those who look upon science only as a laborious and unavoidable prerequisite to their real business of life. Imagine Huxley's disgust if he had realized that our scientific educators would cite him as a proof that the study of hat-making and manual training was as effective for an educational descipline as biology or physics.

They preached that the trend of society would be towards freedom. Under a *laissez-faire* government would result the highest development and freedom of the individual. The world promptly turned towards socialism and collectivism, and drifted into a war which was a horrible example of the absolute negation of the individual. And today the individual, supposedly exercising the right of the suffrage, is helplessly giving up his personal rights because of the dictation of militant and clamorous minorities. They preached that to protect the weak and unfit was to court disaster to the race and, behold, society answers by creating a vast machine of organized charity which aims not to prepare the unfit for happiness in a future life, but to make their existence in this world as comfortable and luxurious as possible. Their fundamental idea of government was the sovereignty of both social and natural law under which the individual who broke the law was justly and severely punished; the idea of law is now that prohibitions should be enacted to penalize those who can restrain their appetites and passions in order to protect the weak and vicious.

The consequences of exalting mechanical law at the expense of the mystery of human thought and personal responsibility were so rapid and so disconcerting that Fiske towards the end of his life sadly clothed the Absolute Unknown with qualities which he designated as quasi-human. And Spencer, after a life spent in developing a grandiose cosmogony in which a belief in free-will had no share, ends his *Autobiography* with the discouraged admission: "That the control exercised over men's conduct by theological beliefs and priestly agency, has been indispensable." In the light of the collapse of the scientific foundations of evolution could anything be more desolate than his concluding estimate of his life's work: "Then behind these mysteries lies the all-embracing mystery —whence this universal transformation which has gone on unceasingly throughout a past eternity and will go on unceasingly throughout a future eternity? And along with this rises the paralysing thought—what if, of all that is thus incomprehensible to us, there exists no comprehension anywhere? No wonder that men take refuge in authoritative dogma! . . . Thus religious creeds, which in one way or other occupy the sphere that rational interpretation seeks to occupy and fails, and fails the more the more it seeks, I have come to regard with a sympathy based on community of need: feeling that dissent from them results from inability to accept the solutions offered, joined with the wish that solutions could be found."[15]

Herbert Spencer can certainly be regarded as the founder of the philosophy of monistic evolution. Although his ideas have been modified and many of his

[15] *Autobiography*, vol. II, Conclusion.

conclusions have been changed or ignored, he is still the leader of the thought of today. He pictures two evolutions; one of the universe agreeing with the nebular hypothesis and another of the society of the genus *homo* which is a kind of microcosm immeshed in the macrocosm. Just as the corpus of man evolved from material elements through the simplest forms of organic matter to its present state by the actions of physical laws and by adaptation to its environment, so man has also evolved his instincts, his habits, his self-consciousness, and his moral nature from the so-called chemical irritability of the protoplasm. "Every lesson learnt, every fact picked up, every observation made, implies some molecular re-arrangement in certain nervous centres."[16] These forces of the mind, as he erroneously uses the word force, are equivalent and mutually transformable to mechanical forces, so that the mind since it has been actually built up by mechanical forces can be, if not actually, yet theoretically resolved back into matter and mechanical force.[17] As the complex animal, or plant, is an aggregate of cells, so society is a complex aggregate of individual persons.[18] According to immutable natural laws society has progressed, or evolved, from a bestial herd, or pack, to its present state. Because our apparent wilfulness and waywardness can amount to

16 *Autobiography*, vol. I, p. 507.
17 *Ibid.*, vol. I, p. 549.
18 *Ibid.*, vol. I, p. 590.

nothing in the steady sway of the universal law of physical force: "There is a gradual advance towards harmony between man's mental nature and the conditions of his existence. After finding that from it are deducible the various characteristics of Evolution, we finally draw from it a warrant for the belief, that Evolution can end only in the establishment of the greatest perfection and the most complete happiness."[19] As the doctrine of evolution by natural selection is founded on the extinction of species in order that new ones more fit to struggle may appear, we must conclude that the goal of evolution lies in our extinction and the appearance of the species of superman. At any rate, this is the doctrine of progress and of eugenics; if we can find solace for the sorrows and failures of our own lives in the contemplation of the complete happiness of this far remote superman, thousands of years hence, the world should bless its author. Fiske, in a glow of sentimental enthusiasm, describes this blessed state as one which: "Must eventually go far to realize the dream of the philosophic poet—of a Parliament of Man, a Federation of the World,

> When the kindly earth shall slumber, lapt in
> universal law,

and when the desires of each individual shall be in proximate equilibrium with the means of satisfying

[19] *First Principles,* p. 517.

them and with the simultaneous desires of all surrounding individuals."[20] It is no wonder that Tennyson, the poet of evolution, describes this seemingly impossible state of the satisfactory reconciliation of egotism and altruism as: "The far distant goal to which creation moves." We can testify that it is not yet proximate.

If progress, or evolution, is thus a universal law, we should have an expression of its character. Spencer gives this law as follows: "Evolution is an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation."[21] These are brave words, but as a law, I confess, they carry no meaning to me. I find motion and matter in the objective world but when they are applied to explain my thoughts and the actions of society I can neither discover nor measure any matter or motion. If the Evolutionists can master this law and use it to describe any of my past thoughts or any past state of society or predict my future thought or the future state of society, they are closer to the character of supermen than we had supposed. One wonders what has permitted the homogeneity of the atom and of the monad to be the only persistent things in the uni-

[20] *Cosmic Philosophy*, vol. III, p. 334.
[21] *First Principles*, p. 396.

verse. But specific criticism is not worth the effort of making.[22]

There is a definite and fundamental difference of opinion among Evolutionists as to whether there is continuity of development of the psychical nature of man. Spencer and Haeckel see no break, and insist on the transformation and equivalence of physical energy and mental and spiritual processes. Huxley, on the other hand, believes in a break in the law of evolution by natural selection when man attained self-consciousness, and Fiske is careful to avoid the assumption that physical energy is transformed into mental processes. They thus believe in two lines of evolution, or that there is a discontinuity between biology and psychology.

If we omit the evolution of man from the lower animals, which is purely a matter of guess, and begin the study of society at the point where, however primitive his state may have been, the individual can be clearly recognized as a man, we can proceed with some sureness, as we have records which give us a con-

[22] It might be well to emphasize the fact that this law applies to physical phenomena as well as those connected with life. It should, since it is a law of matter and motion, be more easily criticised by a physicist than by a biologist because as a law of life it would involve first the question whether life is a function of matter and motion. It would not be rash to say that no physicist could ever agree that it in any sense can be coordinated to any known laws or phenomena of physics. A fundamental law of physics is that *matter is always definite, is always coherent, and is always heterogeneous.* If Spencer's statement about motion means anything it is an erroneous reference to Lord Kelvin's law of the dissipation of energy.

ception of his nature and habits. That man has slowly developed his mental powers and by gradually learning the laws of his environment has been able to modify and adapt them to his use, is the natural and, indeed, unavoidable belief of historians and philosophers. And this view is now amply supported by tradition, by documents, and by observation of existing primitive peoples.

The differences of belief do not arise from the fact of a change of society from barbarism to civilization but from the causes which produced it and the method of change.

We may broadly classify the two opposing ideas as the humanistic and the scientific. While these two views are radically different it is not easy to contrast them because between the two extremes of belief lie all shades merging from one to the other. Briefly then, we may say that according to the humanistic idea society is a collection of individuals, each of whom is animated by his own personality. When man attained, or was endowed with, self-consciousness and inhibition he became, to a degree, independent of his environment. This belief in free-will is the touchstone of the non-scientific idea, because it frees man from the laws of the machine and makes him responsible to himself for good or evil. Thus, the intrusion of free-will or inhibition destroys or, at least, produces variations in any scientific law of social organism. Nor does it make any difference whether free-will is a development from the lower animals or whether it be a special faculty added to man by a supernatural being. No scientific law can be imagined to control a system of bodies where the separate parts may *will* to act or to refrain from acting.

According to the scientific doctrine of society, the race of man is an organism subject to general laws which conform to the mechanical, or material, laws of nature. These laws, which, if known, would permit us to unravel the past and predict the future course of history, can be found only by studying society as a whole. The individual sinks to insignificance; he may seem to act as he desires or wills, and he may seem to affect results; his actions, in reality, are included in the general scheme of affairs. What each does, and what all do, is predetermined by what was done in the past generations or by the unvarying law of society. Fiske gives us this social law: "The fact remains that civilization runs in a definite path, that the sum total of ideas and feelings dominant in the next generation will be the offspring of the sum total of ideas and feelings dominant in this."[23] For example, the course of the French Revolution is independent of the fact that the Corsicans failed in their attempt to assassinate Napoleon in 1792. Or rather, the failure was neither chance nor due to the ingenuity of Napoleon. The Corsicans failed in their attempt because the actions of previous people were such that

[23] *Cosmic Philosophy*, vol. III, p. 348.

what happened then was the natural result of these previous actions. Going a step further (it is well at times to be uncompromisingly logical) in this fatalistic chain all these previous actions were the phenomena due to the positions and motions of material particles. The whole course of the revolution was determined by the ideas and feelings of preceding ancestors and ancestral atoms. No one can prove that it was not, but, also, no one can hope to know these ideas and feelings, and atoms. To us, the failure of the Corsicans has all the characteristics of chance, and we shall continue to ascribe to the clever wit of Napoleon the chief influence in the later course of the revolution. Scientific sociologists point to the laws of physics as a proof that individual chance can be subordinated to general laws. And they argue that they, too, can follow the same methods when their science will have arrived at maturity. The question actually is, has their science ever been born? They make this parallel out of their abysmal ignorance of physics. Suppose we accept the law of physics that the pressure of a gas is due to the impact of an indefinitely large number of swiftly moving molecules against the walls of the containing vessel. The necessary assumptions, according to Clerk Maxwell, that this law may hold are: the number of individuals must be indefinitely large; they must be all alike; they must be so far apart that the action of any one will not affect the actions of any others; if any individual were with-drawn from, or added to, the vessel the pressure would not be changed. These assumptions are necessary parts of the mathematical law of probability and chance. They cannot now, and never can, be made about the individual members of society. The number of the individuals is not indefinitely large; the personality of any individual cannot be predicted from the characteristics of his ancestors and the opinion of the public is moulded, or at least greatly influenced, by the character of a few individuals. Even the most ardent sociologist must admit that the birth or death of a great man affects profoundly the course of history. Thus, the aim of the physicist is directed solely to the formulation of laws which eliminate the acts of individual molecules; the aim of history and sociology is fundamentally concerned with the mutual relations between individuals and society.

We may then take the doctrine of free-will, or the ability of each individual to choose between two lines of thought or conduct and to be held responsible for his choice, as the fundamental difference between the humanistic and scientific attitude towards society. It is quite clear that an unreserved acceptance of evolution according to natural law precludes the belief in free-will. Fiske, following the example of Spencer, devotes a chapter in his *Cosmic Philosophy* to the discussion of free-will and, as he believes that all social phenomena are subject to law, he makes short work of the doctrine; expressing the conviction that belief in free-will is an obstacle to the progress of sociology and historical science. He attacks this profound and subtle question which has baffled the greatest thinkers of all the ages in a light-hearted fashion and finds it an easy one to answer. Every one who has disagreed with him he accuses of having been entangled by "metaphysical jargon." But, when he tries to avoid the doctrine of scientific fatalism he, himself, flounders in a sea of confused words and, in fact, never discusses the real philosophical problem.

So far as I can discover, Haeckel is the only one of the Evolutionists who is thorough-going in his conviction that free-will in any form is a delusion. From the standpoint of this biologist: All natural bodies which are known to us are equally animated, and the distinction which has been made between animate and inanimate bodies does not exist.[24] The thoughts and actions of men are the results of atomic motions and forces and no more can deviate from their prescribed course than can the bullet depart from its path when fired from a gun. On the psychological side he concludes that purposiveness no more exists than the much talked of beneficence of the Creator. "The dominion of the 'moral' popes, and their pious inquisition, in the mediaeval times, is not less significant of this than the prevailing militarism with its 'moral' apparatus of needleguns and other refined instruments of murder, or the pauperism which is the in-

[24] *History of Creation*, vol. I, pp. 17-24.

separable accompaniment of our refined civilization."[25] Thus physics and the existence of sin in the world, both preclude belief in free-will and in a beneficent Creator.

The simple fact is, that the question of free-will is one which cannot be solved logically for the reason that we have not the data for postulates from which to derive logical and satisfactory conclusions. On the one side, the man of science can find no connection between thought and physical law; and on the other, the fatalistic argument of the Calvinist for predestination and foreordination is founded on the postulate of an omniscient and omnipotent God, whose purpose is outside human experience. Our lives, as a whole, may be the result of circumstance; we may be caught and swept along in the current of physical law and heredity: but each of us is convinced that every individual action is the result of his own choice and volition. And no man of any character or self-esteem will excuse his conduct on the grounds of fatalism but will accept the punishment or reward of his act as the result of his personal decision.

Our whole social system is based on the common belief in free-will and on the accountability of the individual for his acts; in the unqualified denial of personal responsibility, true or not, lies despair or madness for the individual, and anarchy and disintegration of society.

[25] *Ibid.*, vol. I, p. 19.

Even Spencer, who founds his philosophy on agnosticism, is forced to pass from the negation of knowledge to the *a priori* postulation of universal truths. He denies a God and postulates an Inscrutable Power or Absolute Unknowable as a positive creator of law and order; he denies absolute knowledge and proposes a Universal Postulate of truth.

The only criterion of the Truth which this advocate of observation and reason can give us is: "The test by which, in the last resort, I determine whether a belief is one I must perforce accept, is that of trying whether it is possible to reject it—whether it is possible to conceive its negation. In other words, the inconceivability of its negation is my ultimate criterion of a certainty."[26] On this standard of certainty we may easily base the certainty of free-will, for on the inconceivability of its negation has been judged the life of every man and the history of human society both by the humanists and by the Evolutionists themselves.

I confess to a sly pleasure in the idea that even Haeckel, Huxley, and mechanistic monists of all shades of that stupefying doctrine unconsciously preserve in their subliminal minds a modicum of belief, or rather an unalterable faith, that the machine of the universe is under the control of an inscrutable Engineer who controls its actions and guides the world perhaps beneficently or perhaps ruthlessly, and who

[26] *Autobiography*, vol. I, p. 484.

still, in some unknown way, leaves us freedom of choice. For how else can we account for Huxley's bitter condemnation of us for not accepting his doctrines? How else can we account for Haeckel's rage against the popes and the Christian inquisition which burnt the "great Dominican friar, Giordano Bruno" who was himself a monist, or account for his contempt of the early Christian and mediaeval eras because they neglected science although they were changing the civilization of the world and preparing, after the *débâcle* of the Roman Empire, for the Renaissance; a contempt so great that he dismisses this whole period of history with only a curt notice of St. Augustine and St. Thomas Aquinas? If man is but an aggregation of material atoms subject to mechanical forces he is surely but a part of an inexorable machine; his actions and his thoughts are but the consequence of former actions of molecules, such a power as free-will or the ability to choose what we shall do has no place in this scheme. One might as well expect a stone to rise up suddenly from the earth as to suppose that those atoms, called St. Simon Stylites, could get down from their pillar and begin the study of evolution, or that the pope and the inquisition could consecrate Bruno instead of burning him. If the pope who condemned Bruno and the fire which burned him; if the "distinction which has been made between animate and inanimate bodies does *not* exist" as Haeckel states, then why is the pope different from the fire—they both acted; and they both obeyed law? One might as well blame a river because, in part of its course, it flowed through a dingy and dirty morass instead of on the high ground lying near its channel as to curse the mediaeval ages because they turned to the contemplation of a future life instead of investigating the laws of matter. Somehow one cannot feel that the task of St. Augustine while deliberating on the *De Civitate Dei* or St. Francis when meditating on the holy life was altogether inferior to the delicate task of the biologist in dissecting a grasshopper even if his results might add to the Theory of Descent. It is a curious example of the wilfulness of the human mind, thus to rage against the doctrine of free-will of man, to endeavour to make of him merely a cog in a machine, and at the same time to curse him for not doing otherwise than he does.

Sociology was designed to be the science of sciences. Supported on one side by the physical sciences and on the other by biology, it would reach backwards to tell us the entire past history of men and looking forwards it would unerringly point out the future path of society until we reached that perfect state so exuberantly described by Fiske. From the legends and myths of our early ancestors we should find those primitive ideas from which have developed our religion and our social customs; and from the customs of existing backward peoples we would interpolate all the intermediate steps of development. Sociology, however, has not followed this course. It has broken away absolutely from physics and biology; the path of human progress cannot be determined; and no reason can be advanced why different stocks develop different types of society. As for the future, we cannot decide on a goal to work towards nor devise any methods to constrain society to move in any direction. As Huxley once wisely said, the points of a short-horn cow are easier to determine than are the points of a good citizen, and by the time evil traits show themselves the evil has been done and the unfit have produced their progeny. Nor do I see any prospect of a goal of perfection, admitting we know what that means; so far as we can see from history the essentials of human character have not changed since man attained self-consciousness and, unless they do change, it is difficult to understand how we can accomplish more than to make more generally followed the precepts for right living which have been abundantly given us by men of the past.

The doctrine of progress and eugenics was begun by biological evolutionists; from the principles of their own science how can we draw any assurance that society, from laws of its own nature, will or can tend to a future perfection? Spencer often writes as if the law of progress is merely to pass further and further from homogeneity to heterogeneity. If such be the goal of the human species, merely to create a greater complexity of social life, we have all the warning necessary from palaeontology that complexity generally ends in weakness and extinction. Biology certainly with its axiom of the struggle for existence does not even foster the idea of permanence. On the side of physics, the Evolutionist makes progress the adaptation of the organism to its environment, but what the future of our environment is to be is a question which it is impossible even to guess.

In spite of all the resources of our machinery and of our financial system not more than five or ten per cent of the population in the most advanced communities can, or will, accumulate enough in their active years to support themselves when old age approaches. Of the millions, who use mechanical appliances for almost all their daily needs, only a very few have any knowledge of the machines, their construction, or their scientific principles. Before a scientific apparatus can be transformed into a machine it must be changed into one significantly known as "fool-proof." It is no exaggeration to say that if a few thousands of superior men were eliminated for two or three generations, or if the incentive for the rewards of invention were abolished as the socialists advocate, our industrial and mechanical civilization would crumble like a dream; the common intellect during that time, unguided by the specialist, could neither create new machines nor renew the old ones. The vast difference between operating a machine and adjusting it when some part goes wrong or creating a new one is readily understood when we remember that negroes operate our most complex and delicate machinery and that they were unable by their own initiative to progress beyond a rudimentary state of civilization. They were flung into our complex society and have been in a condition of independence less than a century; they conform to the customs of an industrial world and an intricate social life without understanding its motives or its meaning and cannot add a tittle to its ideas. Is such an example not a proof that native ability has not advanced appreciably during historical times? How long would it have taken the Greek or Egyptian population to perform the simple operation of levers and buttons, labelled to pull or push, if one of our machines could have been presented to them and its manipulation explained? Does anyone suppose that they could not have run a Ford automobile or a motor boat as well as thousands are doing today under the supervision of the expert?

What the Evolutionists expected of sociology was that it would become a true science which would formulate laws, derived from the study and observation of past times, applicable to guide the course of future society. What has happened is, that sociologists have accumulated a mass of statistics relating to human affairs which they are not able to digest; for theory, they have compiled text-books whose real information consists of excerpts from philosophers and historians, and to these has been added a set of vague doctrines inapplicable to the actual problems of life. What is worse, the subject has attracted but very few men of real ability. It would have caused deep chagrin to the biological Evolutionists if they had foreseen that the chief solicitude and work of the sociologists were to be for the unfit. The earlier thinkers were convinced that progress rested on the greater opportunities which could be given to the fittest, or best endowed individuals, by a science which would eliminate the unfit and not attempt the impossible task, in their opinion, of purifying an undesirable strain until it was no longer a demoralizing element. On the contrary, the efforts of the sociologists have been confined to ameliorating the physical condition of the slums. They have united themselves with the professional uplifters and humanitarians and have created organized charities and social agencies. In their councils of social agency they have brought about an alliance of the Church and industrial management. In this alliance it is only too evident that the clergy have forgotten their Master's warning about the aims of the rich man. In the mind of the skeptical, the suspicion will remain that the motives of the managers of great industrial plants, who lend their efficient aid to organized charity, are a strange mixture of sentimentality which the trials of poverty must exert on any one accustomed to luxury, and of the business sense which feels that the weight of a whole community directed towards alleviating the discomforts of life does much to counteract the exhortations of the radicals and contributes much to business and the efficiency of the employee.

If this is a correct summary of the results of the doctrine of social progress, when the laws of biological evolution have been tempered with mercy and pity for the weak and unfortunate, what has the hard humanitarianism, which is the logical conclusion from the thesis of the struggle for existence, done for the world? This is the familiar, and until recently popular, doctrine of the superman. The Germans, in their schools, in their pulpits, in their government, and in their philosophy of Nietzsche, adopted it more unreservedly than any other nation. Unfortunately, they did what no other people were willing to do; they put this fallacious doctrine into practice. They plunged the world into a war which was in every sense a struggle for existence.

CHAPTER NINE

Evolution and Religion

THE most unfortunate result of the spread of the doctrine of evolution in the nineteenth century was the outbreak of a bitter conflict between science and religion which was the most virulent since the trial of Galileo. While we may agree with Spencer that there is always a deep and lasting antagonism between them, yet it is one which becomes acute only at rare intervals;—at those times when the issue spreads so as to enlist the attention of the general public. To-day, it is light-heartedly assumed that there is no need for such bitterness; both sides are honestly working for the good of humanity and both should become reconciled and encouraged to live at peace. Is it not probable, that this opinion is due to loss of intensity of convictions and weariness from a conflict we seem unable to settle? Beneath this apparent indifference lies the real reason for the truce; science, for the time being at least, is the victor. The world is dominated by the scientific method; we may have discarded many of the specific conclusions of the great Evolutionists, but their method of thought still governs Church and State. Sociologists may agree that Spencer's specific ideas of the State are not correct; the clergy may admit that Fiske's humanitarian religion does not hold together the congregations; the biologists have found that Darwin, great genius that he was, could not foretell the facts which have since been discovered and which destroy the foundations of his hypothesis, they may claim that Spencer was weak in his knowledge of biology and Huxley too prone to pass from the calm discussion of scientific truth to the passionate methods of the propagandist: all still accept their philosophy of evolution and all use their method to search for the truth in both the material and spiritual realms. If the doctrine of evolution has added confusion to social questions which are closely involved with material affairs, it must be even more dangerous as a guide to religion, whose cultivation and discipline are the furthest removed from our animal characteristics.

If science were concerned only with our relations to our environment and religion with our spiritual affairs, there would be no cause for antagonism. Such a separation does not and cannot exist; just as the body and the spirit of a man are inextricably woven together, so the fields of science and religion overlap and mingle. The conflict between them is not due to rivalry because of their achievements but to the far deeper cause of their essentially different conceptions of the aim of life. As I have elsewhere said, science seeks for power and control of our environment, and religion places character, or the judgement of good and evil, as the end or purpose of life.

There can be no harmony between two such opposite aspects of life so long as the man of science, consciously or unconsciously, agrees with Buckle that civilization is a progress due to the accumulation of facts and the rational interpretation of our environment, and the religious assume that our civilization is to be judged by its morality and otherworldliness whose precepts were known and practised thousands of years ago. Can it be denied that those who subscribe to the dogma of power are sympathetically in agreement with Spencer? He tells us that religious worship yielded him no pleasure and he saw in religion only: "The notion of a deity who is pleased with the singing of his praises, and angry with the infinitesimal beings he has made when they fail to tell him perpetually of his greatness."[1] How can there be peace, except the peace of exhaustion or the *pax Romana*, between such an attitude and that of St. Thomas Aquinas who declared the acquisition of knowledge to be a sin except in so far as it displayed the power of God, or of St. Augustine who would limit all his knowledge to that of God and his soul? These are the extremes of the two attitudes towards life and between them lie all degrees of opinion. The captains of science will, however, always accuse the religious of thwarting the activities of the reason, and the leaders of the other side will condemn the men

[1] *Autobiography*, vol. I, p. 171.

of science because they place the material life above the spiritual.

When either of these ruling passions becomes dominant society suffers, for it is not wholesome to be governed exclusively by the reason or by the spirit. How hard it is to preserve a just balance is shown by the few periods when man has been able to prevent the encroachment of the one or the other. Such may well be called golden eras. No thoughtful person but will admit that today we are basing our hopes of civilization on the ability to devise a more rational scheme of life which will obviate the inequalities of circumstançes rather than on the submission of our desires to a moral code whose only reward is indifference to material success.

Before any standards of criticism can be set, we must have a fairly clear agreement as to what religion and science are. All the Evolutionists are conspicuous for their tendency to confuse religion with idolatry. Spencer may say: "Religion, everywhere present as a weft running through the warp of human history, expresses some eternal fact."[2] But his criticism of religion is not on the basis of its being an essential and eternal verity. His presentation of religion is always under the aspect that this fundamental verity is degraded by error and superstition in practice. This is pernicious, because he judges the benefits

[2] *First Principles*, p. 20.

of religion by the practice of the masses instead of by the lives of the better few. It is not the criticism of a philosopher who should consider principles and not practice. And it is not honest criticism, because he estimates the practice of principles of all sorts by the people in the following cynical fashion: "While character remains unchanged, institutions cannot be fundamentally changed. . . . The masses can appreciate nothing but immediate and material boons. . . . They fall under one kind of dominance after another."[3]

When the Evolutionists discuss the qualities of science and its cultivation, they do so *con amore*. It is easy to prove this by passages from any of their writings. They define science as an organized body of facts and of laws and ignore the vast body of hypothesis and speculation which, as any student knows, fills the major portion of any treatise on science; they discuss religion as if it were only hypothetical and speculative and overlook the equally great accumulation of facts and laws about the spiritual life or, rather, they class these as science and leave to religion only the attributes of emotionalism. Thus Spencer writes that men of science are impatient of the pretension of religion because they are "occupied with established truths, and accustomed to regard things not already known as things to be hereafter discovered."[4] And Fiske constantly condemns the doctrines

[3] *Autobiography*, vol. II, p. 434.
[4] *First Principles*, p. 16.

of the Christian Church because of the superstition and idolatry with which the masses are prone to personify God, and in the next breath, with childish credulity, accepts on faith the superstition and idolatry of science which portray the form and qualities of atoms and aethers, and narrates the history of an infinite universe from its inception to modern times. Spencer and Fiske speak reverently of the Absolute Unknown and of religion, but they are equally emphatic that all religions, except the submission to natural law, are degraded by their errors; but they do not dwell on the errors and absurdities of science. Thus, the impression one gets is that science seeks the truth; religion cultivates deception. Men of science are critical, while men of religion are gullible. The one is judged under its best aspects and the other by its worst. Can we truthfully say that the masses have degraded religion more than they have science? What is the attitude towards medicine, or any of the laws of nature, but the same superstition and idolatry as towards religion?

If we are to compare science and religion we must consider the best of each and decide whether rational or moral aspirations and practice have been the more efficacious in promoting civilization. I cannot see that the scientific "de-anthropomorphization of God" into the Absolute Unknowable which institutes natural law is any more exact than, or in fact different from, the idea of God as the essence of spirit and truth which is the belief of the best teachers of religion. Nor do I think that the materialism of the ordinary convert to evolutionary science is any more critical or any sounder in its blind acceptance of scientific hypothesis than is the idealism of the ignorant and credulous Christian.

Those, who would have us believe that science moves forward steadily after each step has been subjected to rigorous criticism, and that men of science are inspired only by so pure a love of truth as to welcome the overthrow of an erroneous theory on which their reputation depends, do not present a just picture of science or of any human activity. As I review the history of science on the one hand and of philosophy and religion on the other, nothing seems more certain than that scientific men do carefully sift the accuracy of observations and measurements, while they are at the same time singularly indifferent towards the manifest absurdity of many of the scientific hypotheses. Do Spencer and Fiske show a critical spirit when they say categorically that their whole vast scheme of evolution is an established fact? Do the physicists realize the impossibility of the situation when they announce comprehensible laws of a universe each of whose almost infinitesimal parts is more complicated than our solar systems? Or do men of science recognize that they are living in glass houses and that it is dangerous to throw stones? When they scoff at philosophy and religion because of seventyodd jarring sects which cannot agree, they forget their own inability to solve the nature of matter and energy and that the pathway of science is strewn with the wrecks of cherished hypotheses. We, who were brought up on the stress theory of electricity, now find that it is all wrong and that the truth lies in the old discarded theory of electrical substance. In comparison with the severe and exhaustive criticism which a new principle of philosophy or a new dogma of religion must meet, opposition to a new theory of science is singularly mild. The incredible cell theory of the biologists, the topsy-turvy world of Einstein, the Langmuir atoms which break all the law of mechanics, the ridiculous assumptions of the behaviouristic school of psychologists, awaken no acerbity and excite no surprise, although if they are true the whole structure of rational science falls to pieces. If the religious, only, are stifled by the weight of authority, and if in science truth prevails, why is it that Spencer refused an honorary degree from the University of St. Andrews? He gives as his reason that the ideas of younger men have so little chance to receive attention because of the weight of authority and that "this unavoidable difficulty is made artificially greater when, bearing no stamp of value, they have for competitors those who, to the advantages of known achievements, add the advantage of officially stamped values."[5] It is not that I am trying to diminish the achievements

[5] *Autobiography*, vol. II, p. 273.

of science but am pointing out that the history of science is the same wayward chronicle of human effort and human mistakes as is that of philosophy and religion.

What most distinguishes our attitude towards religion from that of the Middle Ages is our disbelief in miracles and our unquestioning reliance on the scientific postulates that all phenomena are continuous in time and space, and are the effects of natural causes. As I have used the words spirit and spiritual in this book, not in the vulgar sense of disembodied personalities, but rather as synonyms for the psychic or hyperphysical element as defined by Plato and Aristotle, so I shall not use the word miracle as descriptive of the legendary stories of early peoples or as indicative of the supernatural events used to strengthen the faith of the credulous; these for the most part are insignificant and puerile. I mean by miracles those events in the natural world which transcend any known physical or biological law and especially most of the events in the hyperphysical or psychic world. These, I shall claim, are neither confirmed nor disproved by scientific methods, since they lie outside the realm of the rational, and science has discovered no methods of measuring them, or of dealing with them.

Science does not embrace all phenomena and it has not, for its use, all the criteria of truth. For example, when Professor Haldane says there is a break between physics and biology and another between biology and psychology, he is admitting two miracles, one of life and the other of the spirit. During the time when the earth was too hot to permit life to exist on it, the laws of the physical sciences could alone account for its history. When life began, there began with it the laws of biology. If Professor Haldane is correct that the laws of the two sciences are not convertible, the appearance of life is a break, or miracle; it cannot be explained by physical law and there evidently could not have been a pre-existent biological cause. The same is true when self-consciousness appeared in man; we cannot obviously account for what we may call the spirit by any preceding phenomena of biology or physics. The desire to link the three categories of the material, the vital, and the spiritual into a single monistic philosophy is naturally strongest amongst those psychologists who are endeavouring to find a biological and physical support for their science and to develop the mind as a progress from the beginning of time. The biologists are quite willing to escape from the psychologists but they cling to physics because they, too, are embarrassed by the admission that life began in a miraculous way. The physicists persist in excluding both life and spirit as phenomena of matter and energy and show no desire to complicate further their already intricate problems. Thus the sciences of physics, biology, and psychology are valid for certain classes of phenomena and within restricted periods of time. Again, as another example, if a man is standing still, he will remain in that position forever according to the laws of physics unless he be constrained to move by some *external* force. But, it is common experience, that the man may, by thought, *will* to bend his knees; his muscles contract, and he moves. The physicist can find no external cause for this motion and it is, so far as he is concerned, a miracle, transcending the laws of physics. As for biology and psychology, they cannot tell whether the man will move, why he moves, when he will move, or where he will move. Not to be able to predict any of these actions removes the action from the laws of science. For the solution of this problem of simple motion, no objective observations or experiments will find a cause; it is locked up in the subjective mind of the man who moves.

It is said that Cardinal Newman was once reproached because of his acceptance, under authority, of the many miracles of the Catholic Church. To this reproach, he answered that the belief in God was so supreme and so awful a miracle that, when he had compelled himself to admit that on faith, all others seemed trivial. Yet the belief in God is the most general belief of all times. Most evolutionists indignantly deny atheism. And faith in God, whether it be the idol of the barbarian, the Inscrutable Power of Spencer and Fiske, or the Divine Spirit of the Christian or

Jew, carries with it the conviction of a power which instituted natural law and the self-consciousness of the human spirit. To admit the existence of God in any sense of the word is to admit the possibility of the miraculous.

To say that natural law was instituted by a Power and to deny that natural law may be suspended or changed is to accept the greater mystery and to deny a less. If God instituted the laws by which the solar system moves then I see no reason, so far as physics is concerned, why the sun may not have stood still at the command of God through Joshua. To say that it would have deranged the solar system is an argument which should have no more weight than to say that a man who had made a machine could not stop it and start it again without deranging its mechanism. The disbelief in such miracles comes from the conviction of so steadfast a reign of law that the purpose ascribed to the miracles is not commensurate with the infraction of the law. But believing, as I do, in free-will, which is contrary to scientific law, and that man can comprehend imperfectly the laws of the universe, it seems reasonable to assume that he also to the same extent comprehends the creator of the laws. The service which science has rendered to religion is to show that the less religion depends on material phenomena and on material laws for its support the purer and nobler it becomes, and less subject to an *idolatry* of the miraculous.

Man's position in nature may truly be classed as unique; his existence is miraculous. So far as we can observe, his body is composed of the common inorganic materials, he is subject to the same biological laws which apply to a vast number of other organic bodies; but he possesses a third nature, self-consciousness which he has found nowhere else in the universe. By self-consciousness, I mean the actions which we class as moral. We are convinced that *our* actions alone can be judged by the attributes of good or evil. Many attempts have been made to prove that we are constrained by law, that our acts and thoughts are as unconscious as those of automata; such attempts have failed to convince. We seem to be in a world of facts and laws which are not subject to any change but we also seem able to rearrange the objective world so long as we respect certain rules of the game. We have also discovered many facts and laws of our subjective world as certain as those of the objective world: while we can never be sure that our interpretation of the objective world is true because its data are known to us through our sensations, we can be certain that our subjective world is in itself real. So Descartes was willing to group all animals as automata but in man he placed a soul, and Huxley saw in man the end of natural selection because his self-consciousness permitted him to create an artificial world of good and evil.

We have discovered a body of facts and laws for our subjective world. They are fully as certain as, but they are not commensurate with, the facts and laws of the objective world. We have learned to judge conduct and to trace the effects of right and wrong so that we believe in order in this spiritual realm as we do in our environment, but we find also here startling and inexplicable breaks which we are forced to class with the miraculous. There are numerous cases of men whose character and motives are a matter of authentic record and who have changed suddenly the whole course of their lives; as conspicuous examples of this we may cite the conversion of St. Paul, of St. Francis of Assisi, and of Pascal. We can find no sufficient cause for such abrupt changes of life; they appeal to me as of the nature of the miraculous. I am quite aware that physiologists point to the influence of mental hallucination and to bodily derangement, but these men are conspicuous as examples of mental and bodily sanity and of keen critical judgement. Others will say that the mystery is merely a seeming one because we do not understand the scientific laws of the mind as we do of matter. I know, too, that there is a school of psychologists who call themselves behaviourists. They hold that thought in all its phases is but a physical phenomenon; that, if we could know the positions and motions of the atoms of our brain we should know all there is in what we erroneously call life and self-consciousness. They discuss the mind by first denying its existence, and they have never produced the slightest evidence that thought has any connection with the positions of atoms in the brain nor have they shown the slightest similarity between purpose and physical energy. The beliefs of this school of psychologists are as naïve and as incredible as are the crudest miracles of the age of mythology.

The social evolutionists place much emphasis on what their doctrine means for civilization. They picture a steady progress of society from a herd of brutes to our present society and foretell a future perfect state when a reign of law shall control the conflicting aims of egoism and altruism. It is rather difficult to see what progress the cultivation of the physical and biological sciences can accomplish except to extend our knowledge of our environment and to increase our material welfare. In this respect, our civilization has been a great and signal expansion. The goal of this scientific achievement is industrialism. We are not ready to say that industrialism in even its best aspects is the most desirable aim of life, and we certainly do not find that it has brought peace to the world, or that it has reconciled the egoism and altruism of the human race.

What are we to think of this doctrine of progress when we are not able to include in it an equal progress in morals? Can we deny what Buckle affirmed, that the highest moral truths were known and practised thousands of years ago and that we have been able to add nothing to them since, in spite of constant and persistent effort? To me, and I think to most others, the highest civilization is one in which the highest moral characteristics are displayed by the greatest number of individuals. Would any one venture to say that a community which was eager to enjoy and capable of criticising the artistic and moral exposition of the Greek tragedies or the plays of Shakespeare was not as near the goal of refined civilization as are our own communities? Were not those citizens at least comparable to ours whose recreations lie rather in the automobile, the movies, and the magazines, although these three are cited as marvels of science? I should consider little Athens, or little Florence, with its record of eminent men, whose achievements were the common property of its citizens, on a par with our greatest industrial cities. Nor would the life and aspirations of the little band of early Christians compare unfavourably with the Council of the League of Nations.

The Evolutionists may point to progress in many things but none of them ventures to claim that the standards of individual ability have been advanced. Aristotle, Hipparchus, and Archimedes still rank with Darwin, Galileo, and Newton in scientific acumen; Socrates and Jesus still stand unchallenged in moral character. Professor Conklin and others who have tried to reconcile biological evolution with social and moral progress admit that such progress cannot be claimed for the few of superior ability who have appeared throughout historical times. They admit that the best amongst the Greeks have not been surpassed by the best today, but contend that progress lies in the wider diffusion of ability and culture. Even such a progress cannot be admitted: the common people are as ready to seize on immediate benefits and material boons as they ever were, and they still fall as foolishly under one kind of dominance after another. Can Professor Conklin be so shortsighted as not to see that he has advanced an argument which is, if true, convincing proof against the idea of progress of society by biological evolution? For society, as a whole, to progress there must be a continuous growth in the standards of civilization and in the ability of its leaders as well as in the diffusion of ability and character. Unless the fittest individuals constantly advance in succeeding generations, progress will cease when society attains to their stationary standards. This is merely the fundamental idea of natural selection. Let us suppose that a few individuals of a species are possessed of a slightly advantageous trait and that, by extermination or by the spread of the trait, all the individuals come to possess it to the same degree, there will be no evolution of a new species unless there is also a continuous increase of the trait amongst a few favoured individuals in succeeding generations. To say that society may ultimately attain the level of the best individuals of the past ages is a different thing from the claim that society will progress indefinitely. Knowing the best characteristics of the past we would know the goal towards which man moves even though the goal towards which all creation moves is still shrouded in mystery.

Let us examine this idea of evolutionary progress by natural causes a little more closely. We have seen that Buckle tried to explain why a certain few primitive stocks developed an early civilization and why European culture was late in beginning but was not so soon exhausted. It was shown, I think, conclusively that the natural causes he advanced were quite inadequate to tell us why some stocks advanced and others did not. We might add to the illustrations already given, that the Athenians became so superior a people that their influence is still woven into all our modern thought and yet the peoples just north of them remained almost stagnant; or we could cite the Romans who created one of the great empires of the world while none of their immediate neighbors were capable of showing this initiative. How can we lay such inequalities to environmental causes? No, the best we can say is that certain of these primitive stocks possessed the innate ability to grow and could adapt themselves to favourable conditions on the one hand and overcome unfavourable conditions on the other hand.

We owe the next attempt to make a science of history and sociology to Spencer. He tried to find a universal law which would express the general evolution of the human race. He proposed the idea that society is an organism following the general, but quite vague, law that homogeneity always progresses into heterogeneity. As the biologist is apt to classify organisms according to the complexity of their functions and structures, so the sociologist assumes that society is the most advanced towards perfection which is the most complex in its functions and construction.

This analogy is quite a specious one. The biologist does loosely classify species of animals and plants in a series from lower to higher according to the complexity of their organization. He may say the oyster is a lower form than the dog, but he does not attribute to the words higher and lower any moral significance or perfection of character. In a biological sense the most perfect organism is that which is constituted to preserve and maintain itself, and complexity very often carries with it weakness and extinction. When evolution is applied to social changes we introduce the new idea of ethics and use the words higher and lower with an ethical interpretation. We cannot say that the most heterogeneous society is the most progressive or the most perfect, as a simple society may have the very highest ideals. From a biological conception the Greeks were not as fit as the Hottentots for they could not maintain themselves, largely on account of the complexity of their organization, and the Hottentots still persist; sociologically, there is no doubt which was the more perfect type.

Again, if it were a general law that homogeneity changes to heterogeneity, then all primitive stocks should progress if sufficient time be given. The contrary is the rule. Only a few primitive stocks have shown the power to advance to a high civilization and the rule for such peoples is, with few exceptions, that they reach a maximum and then decay. In the great majority of cases, progress continues only so far as to produce simple tribal communities which are able to withstand the adversities of their environment. They develop a language, use fire and a few simple tools, and live under a primitive government and religion. This condition once attained they remain stationary. Unless they fall under the constraint of a foreign dominating stock we see no signs that they would ever advance to a complex or heterogeneous social state. Such was the history of the American Indians and of the Negroes and such would have been, possibly, the history of the Gauls if the Romans had not constrained them to adopt the progressive civilization of Rome.

Fiske also tried to trace the changes of society by the law of natural selection. Here, again, we have the attempt to apply a general law to fit the history of the few peoples which were able to develop themselves by their own innate power. We shall not press the point that the biologists are pretty well agreed that natural selection is an effective agent to exterminate a species but that it is not an adequate cause of continuous variation. If it is not accepted in this field it is still less likely to apply to human society. Fiske finds that perhaps half of the primitive stocks were able to progress beyond savagery and of these almost all have stayed arrested in an immobile type of civilization. Continuous progress, he says, is limited to the European Aryans and a very few other stocks. He thus restricts the operation of natural selection to what he calls the rare cases where there is a concurrence of exceptionally favourable environmental factors. This is a vague and ineffective hypothesis. His argument amounts to this: We, looking backwards, see that progressive civilization occurs only in a certain few peoples; natural selection is the cause of this progress; therefore, circumstances must in these cases only have been favourable. He cannot tell us what these circumstances were nor can he predict what people will continue to advance or when they will retrograde.

Those who still follow the example of the pioneers in the doctrine of sociological evolution invariably run against that mystery, or miracle, of the unknown and unexpected variation of individuals, the fact that blood ties give certain common characteristics of power or weakness and that at the same time each individual is unaccountably different from his ancestors and his contemporaries. The historians and sociologists have not proved to us that the course of society is not principally the result of the ability and effort of individuals.

The attempt to find a path of progress from a primitive to an advanced civilization or to find the causes of change has not been successful. It must be true that knowledge, from the accumulation of experience, must grow with time in an organism such as man. He has the faculty of adding to, as well as of remembering, the accomplishments of the past, and he has developed speech and writing in which past records are transmitted and preserved; he has thus escaped from the bondage of the merely repetitive acts of plants and other animals. But we still find that the most pronounced characteristic of the generality of people is to hold obstinately to past customs and past ideals. Just as in palaeontology, where the striking fact is the persistence of types rather than a tendency towards variation, so the striking fact in mental development is the obstinate persistence of the common people of all races.

In all parts of the world today, except where the civilization of the few dominant races has intruded and compelled the natives to adopt new customs and new ideas, the mental ability of the people has shown no change for thousands of years. Even in Europe and North America, the common people have progressed but little, if at all, in the essentials of thought and character beyond those which were possessed by the more vigorous people of the earliest historical times. A certain mechanical civilization has been imposed upon them much as it has been imposed upon the Negroes in the United States. But if we consider real mental ability which consists in judging what are the true and lasting benefits of life we must agree with Spencer; the average person cares only for immediate and personal boons and cannot restrain his appetites or know whether what he seeks is really for the benefit of himself and of his race.

As for the facts and laws of morality, it is conceded that they have been known for thousands of years. It is also true that the very highest communities have not been able to attain to these standards or to make them operative. These laws were given to us by men who, so far as scientific power and knowledge are concerned, were unenlightened barbarians. They have been reiterated from time to time since the days of Hammurabi and yet the best of our contemporaries would be content to have lived according to their precepts. Europe is even now plunged in a state of fear, hatred, and envy which could not be surpassed at any time in its history however far backwards it might be traced. Thus moral progress is not coincident with scientific achievement or even causally related to it. If morals were merely an adaptation to our environment as some have believed, or if they were conventions of society, then they should rise and fall with the rhythm of rational and scientific progress. Instead of such variation, the standards of morality remain fixed and eternal truths. They are seen clearly by a comparatively few gifted individuals who appear from time to time in the most different social environments. And we can safely say that all of us who attempt to break these laws, do so not from a lack of knowledge of what is right but because we have not the will to restrain our desires. From what I have observed, many have been able to evade the physical laws but I have found no one who has broken the moral laws and escaped the punishment which leaves an indelible stain on the character, and mars the peace of mind which belongs only to a righteous life.

From all the discussion evoked by the study of history, one fact, and it seems to be one of supreme importance, stands out clearly and unchallenged. What we believe to be the higher forms of civilization have arisen from a very few primitive stocks. If we neglect the more or less questionable surmises which have been made by anthropologists and start from a period when our records are considered reliable we can locate these influential stocks. We find that the peoples found on the African and American continents produced no important civilized states with the exception of the Egyptians, Mexicans, and Peruvians whose influence has been slight if not negligible. In Asia we find the stationary states of the Chinese and the Hindus and the vanished societies of Mesopotamia. The Malaysian peoples of the Pacific Islands give no contribution. Lastly, in Europe, the Greeks showed certainly that they possessed the almost unique power of continued self-development. There have been various attempts to show from what stock they descended; they undoubtedly sucked inspiration from their neighbours but they so quickly surpassed all others that it was their ideas which prevailed and spread. The rest of the European peoples, from whatever stocks they may have arisen, owe their civilization to the Greeks. The one possible exception is the Romans; yet their power is so bound up with Greek culture that, although they became the dominating power of Europe, we may say they were rather the instrument for the spread of civilization than its originator. There is an analogy between the later civilization of the Gauls, Teutons, Celts, and others, and that of the Greeks similar to Darwin's classification of the evolution of domesticated animals by artificial selection and of those, in the wild state, by natural selection. In the one case, variation is directed and constrained to follow certain lines by a superior directing power; in the other case we can find no cause directing the fluctuating variations due to hereditary changes.

The most we can say of the European stocks is that they had the ability to receive, and perhaps to improve, the Greek culture which the Romans impressed upon them in their early and plastic state. But we have no proof that any of the human stocks has not the innate ability to become more or less civilized under constraint. Even the African Negroes have quickly assumed the external forms of our most complex civilization and no one can predict how far they may be able to go while directed and aided by the initiative of others.

While we have not been able to discover any general laws of evolution, either of environment or of a subjective nature, which will explain why some stocks become civilized and others do not, yet there is an almost startling fact to be noticed from which we can draw an important conclusion. The legends and history of the stagnant peoples have brought down to us hardly the name of a single individual, of such a race, who was distinguished by creative ability in art, literature, religion, science, or government. We can recall but a few names, and these not for work of great distinction, of all those millions of people during thousands of years, except it be for personal bravery or leadership in war.

On the other hand those stocks which developed a true social civilization have preserved for us the names and accomplishments of a long line of especially gifted individuals. These became the leaders and teachers of their contemporaries and descendants. And the advance of any people which has continued to progress has been accompanied by the frequency of the appearance of such gifted individuals. The appearance of these superior men is startlingly sudden and unexpected: we cannot predict when or in what field of endeavour they will appear; we cannot find in their ancestry the qualities which would make it probable that it would produce a genius; we cannot tell whether the ideas of the genius will bear fruit or will prove to be sterile.

The influence of the individual on the progress of society is closely analogous to the present "mutation" theory of biological evolution. The biologists have been compelled to give up general laws and general causes for the variation of species, and are pretty well convinced that it is due to the sudden and unexpected variations in individuals. For example, if a large number of seeds from a single plant are grown, each will have certain characteristic differences from the others, and a new species is due to the true breeding of such individual abrupt changes. Such a cause cannot evidently be classed as a general law since it depends on individual idiosyncrasies rather than on common qualities. We can admit the fact of variation by such a cause; as I before remarked, a reptile may have laid and hatched an egg which turned out to be a feathered bird. But such an admission, while it may close the palaeontological gap between reptiles and birds, is quite contrary to the purpose of a scientific hypothesis. So, too, if sociological variations are due to the sudden and unexpected variations in a few individuals instead of the onward sweep of variations of a social organism, there is not much hope that we can find general laws for a science of history or of sociology.

We have had at least three attempts to construct elaborate cosmogonies which have fascinated the imagination; Plato conceived a universe of the ideal, Descartes pictured it as a machine obedient only to mechanical law, and Spencer as an evolution from homogeneity to heterogeneity in which matter, motion, and life are woven together in an incomprehensible verbal scheme. These structures have no correspondence with reality; they are illusion without substance and give neither shelter nor security to the spirit. Is it still not the truth that our real course of life should be to adapt ourselves as best we can to the Philosophy of the Unexpected, guided so far as possible by the few facts in the objective and in the subjective world which we have been able to discover and use? We continue to pass our lives in a world of mystery and of the miraculous in which the Unexpected constantly intrudes.

How can we speak of a science of history or of sociology when a Moses unexpectedly appears in a nation of bondsmen and leads them to independence or when Jesus is born in an obscure carpenter's family and institutes a new ideal and a new life in the world? In Greece, during a state of society hardly to be distinguished from barbarism, the poems of Homer which have never been surpassed flash out; as unexpectedly Thales, whose ancestry is unknown, creates philosophy by finding a principle of order in what seems to be chaos. In our own times, Napoleon escapes from assassins and profoundly changes the course of history. A Newton springs from an humble farmer's family; a St. Francis from the nobility; a Darwin from a line of intellectual ancestry. The history of all nations, which have played a part in civilization, is a chronicle of the deeds and thoughts of the few superior individuals who have issued from all kinds of ancestry and in the most different surroundings.

Sometimes the common people vaguely appreciate the superlative benefits given to them by such richly endowed individuals. Most often they learn reluctantly new ideas, and then they are apt to choose what seems to offer them immediate but transitory boons and are led by powerful but untrustworthy guides. That a nation may continue to progress we must have not only a steady supply of gifted individuals but they must come at the proper time when their ideas can be carried out effectively. Is it probable, if Hero of Alexandria, with his knowledge of the motive power of steam, had lived in a community and at a time prepared to apply his discovery, that we should have had to wait for Watt to perfect the steam engine? Again, if Roger Bacon had been understood, the age of science might have begun much earlier. There is no trait more pronounced in average men than a reluctance to accept new ideas or to conform to new habits. We prefer to follow the example of the past with its known conditions rather than to experiment with new possibilities, and this inherent conservatism has often served as a safeguard as well as a danger.

At rare intervals, an extraordinarily large number of gifted individuals appear almost simultaneously, and this event produces a temporary moral and intellectual exaltation in the whole community. This seems to be the explanation of the Golden Age of Greece and of the Renaissance in Italy, if that can be called an explanation which gives no cause for such a production of genius. Every little town could point to its illustrious citizens, and the whole community absorbed and shared the honour of their achievements. The progress of civilization, on the other hand, ceases at those times when mediocrity alone prevails or when circumstances stifle the work of genius. I am thus proposing the opposite philosophy to that introduced by the Evolutionists of the last century. They believed the appearance of gifted individuals to be due to the general progress of society; whereas I base the upward and downward movements of society on the unexpected appearance of the few who slowly impart beneficial ideas and invention to a usually reluctant commonalty.

Is it merely unreasoning pessimism to look upon the present state of society with apprehension or to think the present lack of eminent men ominous for the near future at least? We are passing through a severe convulsion of society. Our philosophy and religion have been shocked to their foundations, and the Evolutionists have given us no new positive beliefs or any spiritual check to control our wayward fancies and desires. Our rapid extension of power over our environment has brought with it an industrialism whose social effects we have not been able to understand or to guide into safe channels. Other social revolutions, such as that which began towards the end of the eighteenth century, were productive of great men of thought and action, but we cannot point to such an effect in our own times; we stand distracted and alarmed because of the lack of leaders.

In our crisis, we do not turn to great individuals, and in fact we should have difficulty in finding them, to teach us new laws and a new religion. We are placing our hopes on groups of mediocrity,—on Covenants of a League of Peace, on social agencies, on organized charities, on coöperation and on committees, on plans of relief and on plans of organization. We forget Huxley's stinging aphorism that, if wisdom lies in a multitude of counselors, it is to be found in only a few of them.

There are faint signs of restiveness which may be the beginning of our realization that we need great men rather than great organizations to show us the way of salvation. We are beginning to see that the plans for a permanent settlement of our troubles formulated by however large and complex an association of mediocre men and women, fortified by any amount of statistics and diagrammatic curves of averages, will necessarily be cursed by mediocrity. We need a Moses to lead us out of the bondage of the machine. A recent writer forcibly pictures our bewildered state: "There has never been a time, and pray Heaven there never will come a time, when a great man cannot do more than a great machine, when it will not be worth more to humanity to breed up able, true men than to build up organizations. A machine can have great force; a crowd is very powerful, but machines and crowds do no miracles. A man who has a touch of genius in him can do what passes sight and reason; it is men who are taken up to Valhalla to live with gods, not nations or courts or leagues. 'The more I see of mankind,' wrote Addison sincerely to Halifax, 'the more I learn to value extraordinary men.' "[6]

The system of ethics founded by Spencer is merely the endeavour to know physical law in order that we may conform to our environment. Its result was to be a society which would give the greatest possible freedom for the self-expression of the individual and the most equable fulfilment of temporal desires. Such a system of ethics was too vague to become a religion,

[6] *The Villager*, 1923.

it failed to touch the imagination. For the source of our present humanitarian religion we must turn to Fiske and the other popularisers of Spencer's philosophy. With Fiske begins the introduction of sentimentality into the doctrine of evolution which is now the creed of eugenics and of humanitarian righteousness. He started the doctrine that religion is an adjustment to a larger and larger environment. According to him, humanity is to be saved by removing the inequalities of material fortune rather than by acting on the faith that righteousness is the highest reward of life, whatever may be its temporal misfortunes. He wished to promote by every method the "deanthropomorphization" of God and he succeeded only in promoting the "anthropomorphization" of religion so that what used to be called the house of God is better characterized as an institutional church.

Fiske softens the Absolute Unknowable of Spencer into what he calls a quasi-human God. We are to be permitted to say that God is Spirit but not that God is Force, and we must avoid scrupulously the use of the words, Intelligence and Volition, with regard to the Deity. He finds that we feel a sense of dependence upon the Unknowable which gives to our search for the fulness of life in conforming to a larger and larger environment a certain association with a feeling for reverence for the Absolute,—and this is religion. This would indeed be a religion for the few. He recognized, what Spencer failed to understand until towards the end of his life, that religion is not known or proved by the reason. And having no other guide for truth, he turns to crass emotionalism as its source. He degrades the austere sense of human righteousness, which compels us to obey our conscience in spite of human and natural obstacles, to the mere state of physical and mental well-being which soothes those who contemplate nature in her smiling and benign moods. Religion lies in the sensuous delight of great music which appeals to him like voices from an unseen world, and in the solace from care which the innocent playing of children and the singing of birds afford. He looks for sermons in brooks and stones and butter-cups rather than in the experience of wise men who have suffered and sinned, but who have attained that inner serenity of the soul which passes understanding. All Fiske's sources of religion are but a childish hedonism; at best they are merely refined sensual pleasures and a shrinking from physical and mental pain.

We must give to Fiske the credit that, when he traces the evolution of religion from the customs of our early ancestors, he logically derives his religion as an evolution of pain and pleasure. He begins with the idea of pleasure and pain which are the nervous reactions to physical causes. With this false idea of a physical or natural cause for religion planted in our minds, he first subtilizes the sensual effects of pain and pleasure into intellectual attributes and finally identifies them with our moral sense of right and wrong. It is but another example of Huxley's use of materialistic words and disavowal of materialistic ideas. Fiske explicitly denies that our spiritual qualities can be derived from material forces, yet because he can use the same words, pain and pleasure, to express two different ideas he jumps to the conclusion that physical sensations and moral feelings are connected causally as well as verbally. The higher forms of pleasure which Fiske identifies with religion are undoubtedly to be eagerly cultivated, but they are not religion; a man may be a wicked villain and still love nature and music and children.

It is sometimes cited as a proof of the efficacy of the gospel of natural evolution that its founders were men of high morals and pure motives, and of keen intellectual ability. So they were, but they were also moulded in their youth by the gospel of another religion. To find the effect of their preaching we must look to the coming generation whose early training has been in their hands. The youth of today are replying in no uncertain tones, that their teachers have failed to show them a standard other than to obtain out of life what pleasure and success can be snatched. Our moral standards are certainly changed; whether the new freedom of speech and the new freedom from sex restraint are blessings or not, must be left for time to decide. But it is not to be denied that the gospel founded on reason has been followed by a generation whose interest in intellectual matters is more languid and whose absorption in material amusements and whose restless activity are greater than they were a century ago.

So far the Christian Church, or at least an influential portion of it, has accepted evolution, but it has failed to find in the doctrine any strong incentive to lead the religious life. The clergy have made the profound mistake of not realising that they are not concerned with the scientific doctrine of biological evolution. It should make no difference to them whether corporeal man was created by a special act of God or whether he is linked to the rest of organic beings. Their business is not with man as an animal but with man as an immortal spirit. If the spirit or soul is merely an evolution of life then I can see no need for a separation of religion from the other customs and habits of social life nor, in fact, from the social life of any other animal. The doctrine of evolution is a rational doctrine and it cannot be made to include the spirit, which is essentially irrational and miraculous. The attributes of God and of the soul are solely matters of faith and intuition and can be neither proved nor disproved by science.

Shaken in their belief, the clergy are not profoundly convinced of the truth of their religion. They may teach that there is a personal God and that He has broken the chain of evolution by giving to man an immortal soul, but the weight of their argument is based on the reason rather than on the miraculous. They may teach that God has revealed the higher law to a few individuals, now and then, and that Jesus was, in a manner, divine. But they sedulously minimize the elements of the miraculous in the lives of the prophets who are to the average person the living symbols of God and religion. They repeat the creeds of the Church, but they place upon them their own interpretation which is quite contrary to the simple meaning of the words they use. And their interpretation is acceptable neither to faith nor to reason; it is neither frankly spiritualistic nor materialistic.

Distracted by the impossible attempt to reconcile rational progress and moral stability, very many have given up the search for spirituality altogether. Their sole aim is to get from life what pleasure and what success they may. The majority have turned rather to humanitarianism and are hoping to save society by a more equitable distribution of the comforts and ease of life. They fail to see that the prevailing unrest and dissatisfaction do not come from a lack of the necessities which permit a righteous life, but that they are due to the envy of the luxuries of others. The inevitable inequalities of fortune are increased by the emphasis placed on material welfare and the attempts to increase it. Even the poor are today so surrounded with mechanical contrivances and social aids that their material life compares favourably with that of the rich of former times. Yet we see no contentment of mind. Unless the righteous life can be shown to be the inestimable reward of existence and unless its attainment is accompanied with a certain indifference to success and comfort there is little value in religion. And I can find in the doctrine of evolution no guide to such a standard of life. In spite of the degradation by superstition and idolatry of which they are accused, the great religions have held faith in things unseen steadily before us; they have given an incentive for piety and the spiritual life which has held and satisfied the best minds of the past. I can find no symbol and no law to satisfy our spiritual nature in the quasi-Christianity of the humanitarian applications of evolution. The real tendency of evolution is to be found in the philosophy of Nietzsche and not in the life of Christ.

In the past, society turned to the precepts and example of a few gifted individuals for a standard of conduct. These teachers were so endowed with the wisdom of analysing human hearts and motives, and they set an example in the practice of their lives so unattainable by others, that they were called prophets and were considered to be divine.

However the religions instituted by these men may differ, they were all singularly united in the fact that their fundamental commandments were few in number and simple in precept. And they had this most essential quality in common; they were almost exclusively commands not of what may be done but of what may *not* be done; they were, in psychological terms, inhibitions. These canons of religious conduct were based on the assumption that moral facts and laws are even more certain and unchangeable than natural law. They are not a code of convenience shifting with the conventions of society as they are believed to be by humanitarians and pragmatists. They tacitly assumed that one may do all those many things which appeal to him, excepting the few which harm either himself or others spiritually. With all the failures of the older religions, no one who reflects on the history of society can fail to do homage to the results which have followed from obedience to the precepts of these individual teachers. These precepts are bound up with the belief in free-will and that the individual is personally responsible for his acts to a Divine Power whose plan he is capable of understanding. According to this doctrine of inhibition, society is dependent on the individual, and reform is due to the conviction of the individual that he, himself, must order his own life aright.

Now, unfortunately, the reform and progress of society are being undertaken by doctrinaire sociologists and pseudo-biologists who imagine a system of government and of ethics to be derived from a scientific formula based on the laws of biological evolution. The method of this evolution is to be found, to the present time at least, in Darwin's doctrine of natural selection. So far as one can judge, these new arbiters of thought and conduct are not, themselves, persons who command either the respect or the adoration of their fellow-men on account of their rational superiority or their moral sublimity. They make no appeal which compels us to conform our lives to their precepts or to their practice. Their claim to authority is based on the assumption that natural law is supreme and unique; the man of science is the lawgiver and the laws for humanity are to be obtained in the laboratory. We are to seek for a social law. When it is found, all will obey it for the advantage of the race; all will follow the path of the common good, like well-aimed bullets fired from a gun which, directed by the law of gravitation, must necessarily hit the target.

No one could have a greater respect for the character of the great men of science than have I. But it has always seemed to me, when such men are removed from their proper sphere of work and attempt to solve problems where both the conditions of work and the conclusions to be derived are lacking in the definiteness necessary to the solution of a laboratory problem, that then they are singularly unfit to be followed as guides. Success in science requires a certain aloofness from the complex currents of human endeavour and concentration on restricted phenomena which tend to narrow the mind. As a rule, the creative man of science is content to leave to others the applications of his discoveries. The interpretation of biology and the application of evolution to social laws have spread to the public principally through the medium of the popularisers of science. The descent from scientific accuracy to the vague use of scientific terms by the humanitarians and sociologists has been rapid and fatal.

Our command over our environment has increased enormously during the past century, owing to the applications of scientific discovery, and with it has come a correspondingly large increase in the complexity of social life. It is a question whether this added power has been accompanied by a corresponding growth of judgement to use it rightly. In other words, has man the ability to use this additional power to direct himself in a democratic state without some ethical and personal guide? We certainly shall encounter grave difficulties and go through much anguish of mind unless we can strengthen our inhibitions to use this power for good rather than for harm. The scientific law of evolution, as deduced from natural selection, is concerned with the preservation of the race and seems to have but little bearing on the morals and actions of the individual. At bottom, it declares that what is, is right, or, at least, is unavoidable; and conclusions can be deduced from it which will favour any line of conduct, as I have pointed out previously.

The passion for unity which lies at the root of scientific inquiry is responsible for the attempt to construct a monistic philosophy of the universe by which all phenomena are referred to a single law of the conservation of physical energy. And this passion for unity is but another name for the wilfulness of the intellect which tries to satisfy itself by giving a name to whatever is not comprehended. A monistic philosophy may be a great feat of the mind, but it must remain barren because it ignores or smoothes out all the manifold differences between spirit and matter, between the living and the dead.

Unless it can be indisputably proved that man, with his infinite variety of thoughts and emotions, is but an aggregation of mechanical atoms held together and moved by physical forces—an hypothesis for which there is not the slightest proof—, there seems to be no necessity to deny the existence of a spiritual world not subject to the laws of mechanical energy or circumscribed by the space limitations of material or electrical substances.

THE END