FISKE JOHN

A CENTURY OF SCIENCE, AND OTHER ESSAYS

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Содержание

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DEDICATORY EPISTLE TO THOMAS SERGEANT PERRY, PROFESSOR OF ENGLISH LITERATURE IN THE KEIO GIJUKU, AT TOKYO

Dear Tom, – It has long been my wish to make you the patron saint or tutelar divinity of some book of mine, and it has lately occurred to me that it ought to be a book of the desultory and chatty sort that would remind you, in your present exile at the world's eastern rim, of the many quiet evenings of old, when, over a tankard of mellow October and pipe of fragrant Virginia, while Yule logs crackled blithely and the music of pattering sleet was upon the window-pane, we used to roam in fancy through the universe and give free utterance to such thoughts, sedate or frivolous, as seemed to us good. I dare say the present volume may serve as an epitome of many such old-time sessions of sweet discourse, which I trust we shall by and by repeat and renew.

But there is one link of association which in my mind especially connects you with the present occasion. My theory of the causes and effects of the prolongation of human infancy, with reference to the evolution of man, was first published in the "North American Review" for October, 1873, when you were the editor of that periodical. The article, which was entitled "The Progress from Brute to Man," was made up of two chapters of my "Outlines of Cosmic Philosophy" (part ii. chaps, xxi., xxii.), which was published a year later, in October, 1874. The value of the theory therein set forth was at once recognized by many leading naturalists. In the address of Vice-President Edward Morse, before the American Association, at its meeting at Buffalo in 1876, my theory receives extended notice as one of the most important contributions yet made to the Doctrine of Evolution; and it is declared that I have given "for the first time a rational explanation of the origin and persistence of family relations, and thence communal [*i. e.*, clan] relations, and, finally, of society."[1]

Uncontrollable circumstances have prevented my giving to the further elaboration of this infancy theory the time and attention which it deserves and demands; but in my little book, "The Destiny of Man," published in 1884, I gave a popular exposition of it which has made it widely known in all English-

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[1] Morse, *What American Zoölogists have done for Evolution*, pp. 37, 39-41, Salem, 1876; *Proc. Amer. Assoc. for Adv. of Sci.*, vol. xxii.

speaking countries and on the continent of Europe, as well as among your worthy Japanese neighbours, Tom, who have done me the honour to translate some of my books into their vernacular. The theory has become still further popularized through having furnished the starting-point for some of the most characteristic speculations of the late Henry Drummond. In these and other ways my infancy theory has so far entered into the current thoughts of the present age that people have (naturally enough) begun to forget with whom it originated. For example, in the recent book, "Through Nature to God," while criticising a remark of Huxley's, I found it desirable to make a restatement of the infancy theory; whereupon a friendly reviewer, referring to that particular part of the book, observes that "of course" it makes no pretensions to originality, but is simply my lucid summary of speculations with which every reader of Darwin, Spencer, Huxley, Romanes, and Drummond is familiar! In point of fact, not the faintest suggestion of this infancy theory can be found in all the writings of Darwin, Huxley, and Romanes. In Spencer's "Sociology," vol. i. p. 630, it is briefly mentioned with approval as an important contribution originating with me; and in Drummond's "Ascent of Man," which is really built upon it, credit is cordially given me.[2]

Indeed, down to the present time, I have been left almost in exclusive possession of that area of speculation which is occupied

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[2] *The Ascent of Man*, pp. 282-291; cf. Tyler, *The Whence and the Whither of Man*, pp. 179, 217, etc.

with the genesis of Man as connected with that prolongation of infancy which first began to become conspicuous in the manlike apes. There are many who assent to what I have put forth, but few who seem inclined to enter that difficult field on the marchland between biology, psychology, and sociology. Doubtless this is because the attention of the scientific world has for forty years been absorbed in the more general questions concerning the competency of natural selection, the causes of variation, the agencies alleged by Lamarck, and in these latter days Weismannism, etc. In course of time, however, the more special problems connected with man's genesis will surely come uppermost, and then we may hope to see the causes of the lengthening of infancy investigated by thinkers duly conversant alike with psychology and embryology.

Questions of priority in originating new theories may not greatly interest the general reader, but you and I feel interested in preventing any misconception in the present case; and it was thus that the careless remark of the friendly reviewer led me to insert in the present volume the shorthand report of some autobiographical remarks on the infancy theory. In reading the proof-sheets I have noticed that the book contains elsewhere many allusions to personal experiences. This feature, which was quite unforeseen, will not fail to commend it all the more strongly to you, my ancient friend and comrade. As for readers in general, I may best conclude in the words of old Aaron Rathbone, whose book entitled "The Surveyor" was dated "from my lodging at the house of M. Roger Bvrgis, against Salisburie-house-gate, in the Strand, this sixt of Nouember, 1616." This wise and placid philosopher saith: "To perswade the courteous were causelesse, for they are naturally kind; and to diswade the captious were bootless, for they will not be diverted. Let the first make true vse of these my labours, and they shall find pleasure and profit therein; let the last (if they like not) leave it, and it shall not offend them."

Wherefore let me, without further ado, subscribe myself,

Ever yours,
JOHN FISKE.
Cambridge, October 25, 1899.

I
A CENTURY OF SCIENCE [3]

In the course of the year 1774 Dr. Priestley found that by heating red precipitate, or what we now call red oxide of mercury, a gas was obtained, which he called "dephlogisticated air," or, in other words, air deprived of phlogiston, and therefore incombustible. This incombustible air was *oxygen*, and such was man's first introduction to the mighty element that makes one fifth of the atmosphere in volume and eight ninths of the ocean by weight, besides forming one half of the earth's solid crust, and supporting all fire and all life. I know of nothing which can reveal to us with such startling vividness the extent of the gulf which the human mind has traversed within little more than a hundred years. It is scarcely possible to put ourselves back into the frame of mind in which oxygen was unknown, and no man could tell what takes place when a log of wood is burned on the hearth. The language employed by Dr. Priestley carries us back to the time when chemistry was beginning to emerge from alchemy. It was Newton's contemporary, Stahl, who invented the doctrine of phlogiston in order to account for combustion. Stahl supposed

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[3] An address delivered in the First Unitarian Church of Philadelphia, May 13, 1896, at the celebration of the one hundredth anniversary of its founding, under the lead of the illustrious Dr. Priestley.

that all combustible substances contain a common element, or fire principle, which he called phlogiston, and which escapes in the process of combustion. Indeed, the act of combustion was supposed to consist in the escape of phlogiston. Whither this mysterious fire principle betook itself, after severing its connection with visible matter, was not too clearly indicated, but of course it was to that limbo far larger than purgatory, the oubliette wherein have perished men's unsuccessful guesses at truth. Stahl's theory, however, marked a great advance upon what had gone before, inasmuch as it stated the case in such a way as to admit of direct refutation. Little use was made of the balance in those days, but when it was observed that zinc and lead and sundry other substances grow heavier in burning, it seemed hardly correct to suppose that anything had escaped from these substances. To this objection the friends of the fire principle replied that phlogiston might weigh less than nothing, or, in other words, might be endowed with a positive attribute of levity, so that to subtract it from a body would increase the weight of the body. This was a truly shifty method of reasoning, in which your phlogiston, with its plus sign to-day and its minus sign to-morrow, exhibited a skill in facing both ways like that of an American candidate for public office.

Into the structure of false science that had been reared upon these misconceptions Dr. Priestley's discovery of oxygen came like a bombshell. As in so many other like cases, the discovery was destined to come at about that time; it was made again three years afterward by the Swedish chemist Scheele, without knowing what Priestley had done. The study of oxygen soon pointed to the conclusion that, whatever may escape during combustion, oxygen is always united with the burning substance. Then came Lavoisier with his balance, and proved that whenever a thing burns it combines with Priestley's oxygen, and the weight of the resulting product is equal to the weight of the substance burned plus the weight of oxygen abstracted from the air. Thus combustion is simply union with oxygen, and nothing escapes. No room was left for phlogiston. Men's thoughts were dephlogisticated from that time forth. The balance became the ruling instrument of chemistry. One further step led to the generalization that in all chemical changes there is no such thing as increase or diminution, but only substitution, and upon this fundamental truth of the indestructibility of matter all modern chemistry rests.

When we look at the stupendous edifice of science that has been reared upon this basis, when we consider the almost limitless sweep of inorganic and organic chemistry, the myriad applications to the arts, the depth to which we have been enabled to penetrate into the innermost proclivities of matter, it seems almost incredible that a single century can have witnessed so much achievement. We must admit the fact, but our minds cannot take it in; we are staggered by it. One thing stands out prominently, as we contrast this rapid and coherent progress with the barrenness of ancient alchemy and the chaotic fumbling of the Stahl period: we see the importance of untrammelled inquiry, and of sound methods of investigation which admit of verification at every step. That humble instrument the balance, working in the service of sovereign law, has been a beneficent Jinni unlocking the portals of many a chamber wherein may be heard the secret harmonies of the world.

It is not only in chemistry, however, that the marvellous advance of science has been exhibited. In all directions the quantity of achievement has been so marked that it is worth our while to take a brief general survey of the whole, to see if haply we may seize upon the fundamental characteristics of this great progress. In the first place, a glance at astronomy will show us how much our knowledge of the world has enlarged in space since the day when Priestley set free his dephlogisticated air.

The known solar system then consisted of sun, moon, earth, and the five planets visible to the naked eye. Since the days of the Chaldæan shepherds there had been no additions except the moons of Jupiter and Saturn. Herschel's telescope was to win its first triumph in the detection of Uranus in 1781. The Newtonian theory, promulgated in 1687, had come to be generally accepted, but there were difficulties remaining, connected with the planetary perturbations and the inequalities in the moon's motion, which the glorious labours of Lagrange and Laplace were presently to explain and remove, – labours which bore their full fruition two generations later, in 1845, when the discovery of the planet Neptune, by purely mathematical reasoning from the observed effects of its gravitation, furnished for the Newtonian theory the grandest confirmation known in the whole history of science. In Priestley's time, sidereal astronomy was little more than the cataloguing of such stars and nebulæ as could be seen with the telescopes then at command. Sixty years after the discovery of oxygen the distance of no star had been measured. In 1836, Auguste Comte assured his readers that such a feat was impossible, that the Newtonian theory could never be proved to extend through the interstellar spaces, and that the matter of which stars are composed may be entirely different in its properties from the matter with which we are familiar. Within three years the first part of this prophecy was disproved when Bessel measured the distance of the star 61 Cygni; since then the study of the movements of double and multiple stars has shown them conforming to Newton's law; and as for the matter of which they are composed, we are introduced to a chapter in science which even the boldest speculator of half a century ago would have derided as a baseless dream. The discovery of spectrum analysis and the invention of the spectroscope, completed in 1861 by Kirchhoff and Bunsen, have supplied data for the creation of a stellar chemistry; showing us, for example, hydrogen in Sirius and the nebula of Orion, sodium and potassium, calcium and iron, in the sun; demonstrating the gaseous character of nebulæ; and revealing chemical elements hitherto unknown, such as helium, a mineral first detected in the sun's atmosphere, and afterward found in Norway. A still more wonderful result of spectrum analysis is our ability to measure the motion of a star through a slight shifting in the wave-lengths of the light which it emits. In this way we can measure, in the absence of all parallax, the direct approach or recession of a star; and in somewhat similar wise has been discovered the cause of the long-observed variations of brilliancy in Algol. That star, which is about the size of our sun, has a dark companion not much smaller, and the twain are moving around a third body, also dark: the result is an irregular series of eclipses of Algol, and the gravitative forces exerted by the two invisible stars are estimated through their effects upon the spectrum of the bright star. In no department of science has a region of inference been reached more remote than this. From such a flight one may come back gently to more familiar regions while remarking upon the manifold results that have begun to be attained from the application of a sensitive photograph plate to the telescope in place of the human eye. It may suffice to observe that we thus catch the fleeting aspects of sun-spots and preserve them for study; we detect the feeble self-luminosity still left in such a slowly cooling planet as Jupiter; and since the metallic plate does not quickly weary, like the human retina, the cumulative effects of its long exposure reveal the existence of countless stars and nebulæ too remote to be otherwise reached by any visual process. By such photographic methods George Darwin has caught an equatorial ring in the act of detachment from its parent nebula, and the successive phases of the slow process may be watched and recorded by generations of mortals yet to come.

To appreciate the philosophic bearings of this vast enlargement of the mental horizon, let us recall just what happened when Newton first took the leap from earth into the celestial spaces by establishing a law of physics to which moon and apple alike conform. It was the first step, and a very long one, toward proving that the terrestrial and celestial worlds are dynamically akin, that the same kind of order prevails through both alike, that both are parts of one cosmic whole. So late as Kepler's time, it was possible to argue that the planets are propelled in their elliptic orbits by forces quite unlike any that are disclosed by purely terrestrial experience, and therefore perhaps inaccessible to any rational interpretation. Such imaginary lines of demarcation between earth and heavens were forever swept away by Newton, and the recent work of spectrum analysis simply completes the demonstration that the remotest bodies which the photographic telescope can disclose are truly part and parcel of the dynamic world in which we live.

All this enlargement of the mental horizon, from Newton to Kirchhoff, had reference to space. The nineteenth century has witnessed an equally notable enlargement with reference to time. The beginnings of scientific geology were much later than those of astronomy. The phenomena were less striking and far more complicated; it took longer, therefore, to bring men's minds to bear upon them. Antagonism on the part of theologians was also slower in dying out. The complaint against Newton, that he substituted Blind Gravitation for an Intelligent Deity, was nothing compared to the abuse that was afterwards lavished upon geologists for disturbing the accepted Biblical chronology. At the time when Priestley discovered oxygen, educated men were still to be found who could maintain with a sober face that fossils had been created already dead and petrified, just for the fun of the thing. The writings of Buffon were preparing men's minds for the belief that the earth's crust has witnessed many and important changes, but there could be no scientific geology until further progress was made in physics and chemistry. It was only in 1763 that Joseph Black discovered latent heat, and thus gave us a clue to what happens when water freezes and melts, or when it is turned into steam. It was in 1786 that the publication of James Hutton's "Theory of the Earth" ushered in the great battle between Neptunians and Plutonists which prepared the way for scientific geology. When the new science won its first great triumph with Lyell in 1830, the philosophic purport of the event was the same that was being proclaimed by the progress of astronomy. Newton proved that the forces which keep the planets in their orbits are not strange or supernatural forces, but just such as we see in operation upon this earth every moment of our lives. Geologists before Lyell had been led to the conclusion that the general aspect of the earth's surface with which we are familiar is by no means its primitive or its permanent aspect, but that there has been a succession of ages, in which the relations of land and water, of mountain and plain, have varied to a very considerable extent; in which soils and climates have undergone most complicated vicissitudes; and in which the earth's vegetable products and its animal populations have again and again assumed new forms, while the old forms have passed away. In order to account for such wholesale changes, geologists were at first disposed to imagine violent catastrophes brought about by strange agencies, – agencies which were perhaps not exactly supernatural, but were in some vague, unspecified way different from those which are now at work in the visible and familiar order of nature. But Lyell proved that the very same kind of physical processes which are now going on about us would suffice, during a long period of time, to produce the changes in the inorganic world which distinguish one geological period from another. Here, in Lyell's geological investigations, there was for the first time due attention paid to the immense importance of the prolonged and cumulative action of slight and unobtrusive causes. The continual dropping that wears away stones might have served as a text for the whole series of beautiful researches of which he first summed up the results in 1830. As astronomy was steadily advancing toward the proof that in the abysses of space the physical forces at work are the same as our terrestrial forces, so geology, in carrying us back to enormously remote periods of time, began to teach that the forces at work have all along been the same forces that are operative now. Of course, in that early stage when the earth's crust was in process of formation, when the temperature was excessively high, there were phenomena here such as can no longer be witnessed, but for which we must look to big planets like Jupiter; in that intensely hot atmosphere violent disturbances occur, and chemical elements are dissociated which we are accustomed to find in close combination here. But ever since our earth cooled to a point at which its solid crust acquired stability, since the earliest mollusks and vertebrates began to swim in the seas and worms to crawl in the damp ground, if at almost any time we could have come here on a visit, we should doubtless have found things going on at measured pace very much as at present, – here and there earthquake and avalanche, fire and flood, but generally rain falling, sunshine quickening, herbage sprouting, creatures of some sort browsing, all as quiet and peaceful as a daisied field in June, without the slightest visible presage of the continuous series of minute secular changes that were gradually to transform a Carboniferous world into what was by and by to be a Jurassic world, and that again into what was after a while to be an Eocene world, and so on, until the aspect of the world that we know to-day should noiselessly steal upon us.

When once the truth of Lyell's conclusions began to be distinctly realized, their influence upon men's habits of thought and upon the drift of philosophic speculation was profound. The conception of Evolution was irresistibly forced upon men's attention. It was proved beyond question that the world was not created in the form in which we find it to-day, but has gone through many phases, of which the later are very different from the earlier; and it was shown that, so far as the inorganic world is concerned, the changes can be much more satisfactorily explained by a reference to the ceaseless, all-pervading activity of gentle, unobtrusive causes such as we know than by an appeal to imaginary catastrophes such as we have no means of verifying. It began to appear, also, that the facts which form the subject-matter of different departments of science are not detached and independent groups of facts, but that all are intimately related one with another, and that all may be brought under contribution in illustrating the history of cosmic events. It was a sense of this interdependence of different departments that led Auguste Comte to write his "Philosophie Positive," the first volume of which appeared in 1830, in which he sought to point out the methods which each science has at command for discovering truth, and the manner in which each might be made to contribute toward a sound body of philosophic doctrine. The attempt had a charm and a stimulus for many minds, but failed by being enlisted in the service of sundry sociological vagaries upon which the author's mind was completely wrecked. "Positivism," from being the name of a potent scientific method, became the name of one more among the myriad ways of having a church and regulating the details of life.

While the ponderous mechanical intellect of Comte was striving to elicit the truth from themes beyond its grasp, one of the world's supreme poets had already discerned some of the deeper aspects of science presently to be set forth. By temperament and by training, Goethe was one of the first among evolutionists. The belief in an evolution of higher from lower organisms could not fail to be strongly suggested to a mind like his as soon as the classification of plants and animals had begun to be conducted upon scientific principles. It is not for nothing that a table of classes, orders, families, genera, and species, when graphically laid out, resembles a family tree. It was not long after Linnæus that believers in some sort of a development theory, often fantastic enough, began to be met with. The facts of morphology gave further suggestions in the same direction. Such facts were first generalized on a grand scale by Goethe in his beautiful little essay on "The Metamorphoses of Plants," written in 1790, and his "Introduction to Morphology," written in 1795, but not published until 1807. In these profound treatises, which were too far in advance of their age to exert much influence at first, Goethe laid the philosophic foundations of comparative anatomy in both vegetal and animal worlds. The conceptions of metamorphosis and of homology, which were thus brought forward, tended powerfully toward a recognition of the process of evolution. It was shown that what under some circumstances grows into a stem with a whorl of leaves, under other circumstances grows into a flower; it was shown that in the general scheme of the vertebrate skeleton a pectoral fin, a fore leg, and a wing occupy the same positions: thus was strongly suggested the idea that what under some circumstances developed into a fin might under other circumstances develop into a leg or a wing. The revelations of palæontology, showing various extinct adult forms, with corresponding organs in various degrees of development, went far to strengthen this suggestion, until an unanswerable argument was reached with the study of rudimentary organs, which have no meaning except as remnants of a vanished past during which the organism has been changing. The study of comparative embryology pointed in the same direction; for it was soon observed that the embryos and larvæ of the higher forms of each group of animals pass, "in the course of their development, through a series of stages in which they more or less completely resemble the lower forms of the group."[4]

Before the full significance of such facts of embryology and morphology could be felt, it was necessary that the work of classification should be carried far beyond the point at which it had been left by Linnæus. In mapping out the relationships in the animal kingdom, the great Swedish naturalist had relied less than his predecessors upon external or superficial characteristics; the time was arriving when classification should be based upon a thorough study of internal structure, and this was done by a noble company of French anatomists, among whom Cuvier was chief. It was about 1817 that Cuvier's gigantic work reached its climax in bringing palæontology into alliance with systematic zoölogy, and effecting that grand classification of animals in space and time which at once cast into the shade all that had gone before it. During the past fifty years there have been great changes

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[4] Balfour, *Comparative Embryology*, i. 2.

made in Cuvier's classification, especially in the case of the lower forms of animal life. His class of *Radiata* has been broken up, other divisions in his invertebrate world have been modified beyond recognition, his vertebrate scheme has been overhauled in many quarters, his attempt to erect a distinct order for Man has been overthrown. Among the great anatomists concerned in this work the greatest name is that of Huxley. The classification most generally adopted to-day is Huxley's, but it is rather a modification of Cuvier's than a new development. So enduring has been the work of the great Frenchman.

With Cuvier the analysis of the animal organism made some progress in such wise that anatomists began to concentrate their attention upon the study of the development and characteristic functions of organs. Philosophically, this was a long step in advance, but a still longer one was taken at about the same time by that astonishing youth whose career has no parallel in the history of science. When Xavier Bichat died in 1802, in his thirty-first year, he left behind him a treatise on comparative anatomy in which the subject was worked up from the study of the tissues and their properties. The path thus broken by Bichat led to the cell doctrine of Schleiden and Schwann, matured about 1840, which remains, with some modifications, the basis of modern biology. The advance along these lines contributed signally to the advancement of embryology, which reached a startling height in 1829 with the publication of Baer's memorable treatise, in which the development of an ovum is shown to consist in a change from homogeneity to heterogeneity through successive differentiations. But while Baer thus arrived at the very threshold of the law of evolution, he was not in the true sense an evolutionist; he had nothing to say to phylogenetic evolution, or the derivation of the higher forms of life from lower forms through physical descent with modifications. Just so with Cuvier. When he effected his grand classification, he prepared the way most thoroughly for a general theory of evolution, but he always resisted any such inference from his work. He was building better than he knew.

The hesitancy of such men as Cuvier and Baer was no doubt due partly to the apparent absence of any true cause for physical modifications in species, partly to the completeness with which their own great work absorbed their minds. Often in the history of science we witness the spectacle of a brilliant discoverer travelling in triumph along some new path, but stopping just short of the goal which subsequent exploration has revealed. There it stands looming up before his face, but he is blind to its presence through the excess of light which he has already taken in. The intellectual effort already put forth has left no surplus for any further sweep of comprehension, so that further advance requires a fresher mind and a new start with faculties unjaded and unwarped. To discover a great truth usually requires a succession of thinkers. Among the eminent anatomists who in the earlier part of our century were occupied with the classification of animals, there were some who found themselves compelled to believe in phylogenetic evolution, although they could frame no satisfactory theory to account for it. The weight of evidence was already in favour of such evolution, and these men could not fail to see it. Foremost among them was Jean Baptiste Lamarck, whose work was of supreme importance. His views were stated in 1809 in his "Philosophic Zoölogique," and further illustrated in 1815, in his voluminous treatise on invertebrate animals. Lamarck entirely rejected the notion of special creations, and he pointed out some of the important factors in evolution, especially the law that organs and faculties tend to increase with exercise, and to diminish with disuse. His weakest point was the disposition to imagine some inherent and ubiquitous tendency toward evolution, whereas a closer study of nature has taught us that evolution occurs only where there is a concurrence of favourable conditions. Among others who maintained some theory of evolution were the two Geoffroy Saint-Hilaires, father and son, and the two great botanists, Naudin in France and Hooker in England. In 1852 the case of evolution as against special creations was argued by Herbert Spencer with convincing force, and in 1855 appeared "The Principles of Psychology," by the same author, a book which is from beginning to end an elaborate illustration of the process of evolution, and is divided from everything that came before it by a gulf as wide as that which divides the Copernican astronomy from the Ptolemaic.

The followers of Cuvier regarded the methods and results of these evolutionists with strong disapproval. In the excess of such a feeling, they even went so far as to condemn all philosophic thinking on subjects within the scope of natural history as visionary and unscientific. Why seek for any especial significance in the fact that every spider and every lobster is made up of just twenty segments? Is it not enough to know the fact? Children must not ask too many questions. It is the business of science to gather facts, not to seek for hidden implications. Such was the mental attitude into which men of science were quite commonly driven, between 1830 and 1860, by their desire to blink the question of evolution. A feeling grew up that the true glory of a scientific career was to detect for the two hundredth time an asteroid, or to stick a pin through a beetle with a label attached bearing your own latinized name, *Browni*, or *Jonesii*, or *Robinsoniense*. This feeling was especially strong in France, and was not confined to physical science. It was exhibited a few years later in the election of some Swedish or Norwegian naturalist (whose name I forget) to the French Academy of Science instead of Charles Darwin: the former had described some new kind of fly, the latter was only a theorizer! The study of origins in particular was to be frowned upon. In 1863 the Linguistic Society of Paris passed a by-law that no communications bearing upon the origin of language would be received. In the same mood, Sir Henry Maine's treatise on "Ancient Law" was condemned at a leading American university: it was enough for us to know our own laws; those of India might interest British students who might have occasion to go there, but not Americans. Such crude notions, utterly hostile to the spirit of science, were unduly favoured fifty years ago by the persistent unwillingness to submit the phenomena of organic nature to the kind of scientific explanation which facts from all quarters were urging upon us.

During the period from 1830 to 1860, the factor in evolution which had hitherto escaped detection was gradually laid hold of and elaborately studied by Charles Darwin. In the nature of his speculations, and the occasion that called them forth, he was a true disciple of Lyell. The work of that great geologist led directly up to Darwinism. As long as it was supposed that each geologic period was separated from the periods before and after it by Titanic convulsions which revolutionized the face of the globe, it was possible for men to acquiesce in the supposition that these convulsions wrought an abrupt and a wholesale destruction of organic life, and that the lost forms were replaced by an equally abrupt and wholesale supernatural creation of new forms at the beginning of each new period. But, as people ceased to believe in the convulsions, such an explanation began to seem improbable, and it was completely discredited by the fact that many kinds of plants and animals have persisted with little or no change during several successive periods, side by side with other kinds in which there have been extensive variation and extinction.

In connection with this a fact of great significance was elicited. Between the fauna and flora of successive periods in the same geographical region there is apt to be a manifest family likeness, indicating that the later are connected with the earlier through the bonds of physical descent. It was a case of this sort that attracted Darwin's attention in 1835. The plants and animals of the Galapagos Islands are either descended, with specific modifications, from those of the mainland of Ecuador, or else there must have been an enormous number of special creations. The case is one which at a glance presents the notion of special creations in an absurd light. But what could have caused the modification? What was wanted was, to be able to point to some agency, similar to agencies now in operation, and therefore intelligible, which could be proved to be capable of making specific changes in plants and animals. Darwin's solution of the problem was so beautiful, it seems now so natural and inevitable, that we may be in danger of forgetting how complicated and abstruse the problem really was. Starting from the known experiences of breeders of domestic animals and cultivated plants, and duly considering the remarkable and sometimes astonishing changes that are wrought by simple selection, the problem was to detect among the multifarious phenomena of organic nature any agency capable of accomplishing what man thus accomplishes by selection. In detecting the agency of natural selection, working perpetually through the preservation of favoured individuals and races in the struggle for existence, Darwin found the true cause for which men were waiting. With infinite patience and caution, he applied his method of explanation to one group of organic phenomena after another, meeting in every quarter with fresh and often unexpected verification. After more than twenty years, a singular circumstance led him to publish an account of his researches. The same group of facts had set a younger naturalist to work upon the same problem, and a similar process of thought had led to the same solution. Without knowing what Darwin had done, Alfred Russel Wallace made the same discovery, and sent from the East Indies, in 1858, his statement of it to Darwin as to the man whose judgment upon it he should most highly prize. This made publication necessary for Darwin. The vast treasures of theory and example which he had accumulated were given to the world, the notion of special creations was exploded, and the facts of phylogenetic evolution won general acceptance.

Under the influence of this great achievement, men in every department of science began to work in a more philosophical spirit. Naturalists, abandoning the mood of the stamp collectors, saw in every nook and corner some fresh illustration of Darwin's views. One serious obstacle to any general statement of the doctrine of evolution was removed. It was in 1861 that Herbert Spencer began to publish such a general systematic statement. His point of departure was the point reached by Baer in 1829, the change from homogeneity to heterogeneity. The theory of evolution had already received in Spencer's hands a far more complete and philosophical treatment than ever before, when the discovery of natural selection came to supply the one feature which it lacked. Spencer's thought is often more profound than

Darwin's, but he would be the first to admit the indispensableness of natural selection to the successful working-out of his own theory.

The work of Spencer is beyond precedent for comprehensiveness and depth. He began by showing that as a generalization of embryology Baer's law needs important emendations, and he went on to prove that, as thus rectified, the law of the development of an ovum is the law which covers the evolution of our planetary system, and of life upon the earth's surface in all its myriad manifestations. In Spencer's hands, the time-honoured Nebular Theory propounded by Immanuel Kant in 1755, the earliest of all scientific theories of evolution, took on fresh life and meaning; and at the same time the theories of Lamarck and Darwin as to organic evolution were worked up along with his own profound generalization of the evolution of mind into one coherent and majestic whole. Mankind have reason to be grateful that the promise of that daring prospectus which so charmed and dazzled us in 1860 is at last fulfilled; that after six-and-thirty years, despite all obstacles and discouragements, the Master's work is virtually done.

Such a synthesis could not have been achieved, nor even attempted, without the extraordinary expansion of molecular physics that marked the first half of the nineteenth century. When Priestley discovered oxygen, the undulatory theory of light, the basis of all modern physics, had not been established. It had indeed been propounded as long ago as 1678 by the illustrious Christian Huyghens, whom we should also remember as the discoverer of Saturn's rings and the inventor of the pendulum clock. But Huyghens was in advance of his age, and the overshadowing authority of Newton, who maintained a rival hypothesis, prevented due attention being paid to the undulatory theory until the beginning of the present century, when it was again taken up and demonstrated by Fresnel and Thomas Young. About the same time, our fellow countryman, Count Rumford, was taking the lead in that series of researches which culminated in the discovery of the mechanical equivalent of heat by Dr. Joule in 1843. One of Priestley's earliest books, the one which made him a doctor of laws and a fellow of the Royal Society, was a treatise on electricity, published in 1767. It was a long step from that book to the one in which the Danish physicist Oersted, in 1820, demonstrated the intimate correlation between electricity and magnetism, thus preparing the way for Faraday's great discovery of magneto-electric induction in 1831. By the middle of our century the work in these various departments of physics had led to the detection of the deepest truth in science, – the law of correlation and conservation, which we owe chiefly to Helmholtz, Mayer, and Grove. It was proved that light and heat, and the manifestations of force which we group together under the name of electricity, are various modes of undulatory motion transformable one into another; and that, in the operations of nature, energy is never annihilated, but only changed from one form into another. This generalization includes the indestructibility of matter, and thus lies at the bottom of all chemistry and physics and of all science.

Returning to that chemistry with which we started, we may recall two laws that were propounded early in the century, one of which was instantly adopted, while the other had to wait for its day. Dalton's law of definite and multiple proportions has been ever since 1808 the corner stone of chemical science, and the atomic theory by which he sought to explain the law has exercised a profound influence upon all modern speculation. The other law, announced by Avogadro in 1811, that, "under the same conditions of pressure and temperature, equal volumes of all gaseous substances, whether elementary or compound, contain the same number of molecules," was neglected for nearly fifty years, and then, when it was taken up and applied, it remodelled the whole science of chemistry, and threw a flood of light upon the internal constitution of matter. In this direction a new world of speculation is opening up before us, full of wondrous charm. The amazing progress made since Priestley's day may be summed up in a single contrast. In 1781 Cavendish ascertained the bare fact that water is made up of oxygen and hydrogen; within ninety years from that time Sir William Thomson was able to tell us that "if the drop of water were magnified to the size of the earth, the constituent atoms would be larger than peas, but not so large as billiard balls." Such a statement is confessedly provisional, but, allowing for this, the contrast is no less striking.

Concerning the various and complicated applications of physical science to the arts, by which human life has been so profoundly affected in the present century, a mere catalogue of them would tax our attention to little purpose. As my object in the present sketch is simply to trace the broad outlines of advance in pure science, I pass over these applications, merely observing that the perpetual interaction between theory and practice is such that each new invention is liable to modify the science in which it originated, either by encountering fresh questions or by suggesting new methods, or in both these ways. The work of men like Pasteur and Koch cannot fail to influence biological theory as much as medical practice. The practical uses of electricity are introducing new features into the whole subject of molecular physics, and in this region, I suspect, we are to look for some of the most striking disclosures of the immediate future.

A word must be said of the historical sciences, which have witnessed as great changes as any others, mainly through the introduction of the comparative method of inquiry. The first two great triumphs of the comparative method were achieved contemporaneously in two fields of inquiry very remote from one another: the one was the work of Cuvier, above mentioned; the other was the founding of the comparative philology of the Aryan languages by Franz Bopp, in 1816. The work of Bopp exerted as powerful an influence throughout all the historical fields of study as Cuvier exerted in biology. The young men whose minds were receiving their formative impulses between 1825 and 1840, under the various influences of Cuvier and Saint-Hilaire, Lyell, Goethe, Bopp, and other such great leaders, began themselves to come to the foreground as leaders of thought about 1860: on the one hand, such men as Darwin, Gray, Huxley, and Wallace; on the other hand, such as Kuhn and Schleicher, Maine, Maurer, Mommsen, Freeman, and Tylor. The point of the comparative method, in whatever field it may be applied, is that it brings before us a great number of objects so nearly alike that we are bound to assume for them an origin and general history in common, while at the same time they present such differences in detail as to suggest that some have advanced further than others in the direction in which all are travelling; some, again, have been abruptly arrested, others perhaps even turned aside from the path. In the attempt to classify such phenomena, whether in the historical or in the physical sciences, the conception of development is presented to the student with irresistible force. In the case of the Aryan languages, no one would think of doubting their descent from a common original: just side by side is the parallel case of one sub-group of the Aryan languages, namely, the seven Romance languages which we know to have been developed out of Latin since the Christian era. In these cases we can study the process of change resulting in forms that are more or less divergent from their originals. In one quarter a form is retained with little modification; in another it is completely blurred, as the Latin *metipsissimus* becomes *medesimo* in Italian, but *mismo* in Spanish, while in modern French there is nothing left of it but *même*. So in Sanskrit and in Lithuanian we find a most ingenious and elaborate system of conjugation and declension, which in such languages as Greek and Latin is more or less curtailed and altered, and which in English is almost completely lost. Yet in Old English there are quite enough vestiges of the system to enable us to identify it with the Lithuanian and Sanskrit.

So the student who applies the comparative method to the study of human customs and institutions is continually finding usages, beliefs, or laws existing in one part of the world that have long since ceased to exist in another part; yet where they have ceased to exist they have often left unmistakable traces of their former existence. In Australasia we find types of savagery ignorant of the bow and arrow; in aboriginal North America, a type of barbarism familiar with the art of pottery, but ignorant of domestic animals or of the use of metals; among the earliest Romans, a higher type of barbarism, familiar with iron and cattle, but ignorant of the alphabet. Along with such gradations in material culture we find associated gradations in ideas, in social structure, and in deep-seated customs. Thus, some kind of fetishism is apt to prevail in the lower stages of barbarism, and some form of polytheism in the higher stages. The units of composition in savage and barbarous societies are always the clan, the phratry, and the tribe. In the lower stages of barbarism we see such confederacies as those of the Iroquois; in the highest stage, at the dawn of civilization, we begin to find nations imperfectly formed by conquest without incorporation, like aboriginal Peru or ancient Assyria. In the lower stages we see captives tortured to death, then at a later stage sacrificed to the tutelar deities, then later on enslaved and compelled to till the soil. Through the earlier stages of culture, as in Australasia and aboriginal America, we find the marriage tie so loose and paternity so uncertain that kinship is reckoned only through the mother; but in the highest stage of barbarism, as among the earliest Greeks, Romans, and Jews, the more definite patriarchal family is developed, and kinship begins to be reckoned through the father. It is only after that stage is reached that inheritance of property becomes fully developed, with the substitution of individual ownership for clan ownership, and so on to the development of testamentary succession, individual responsibility for delict and crime, and the substitution of contract for status. In all such instances – and countless others might be cited – we see the marks of an intelligible progression, a line of development which human ideas and institutions have followed. But in the most advanced societies we find numerous traces of such states of things as now exist only among savage or barbarous societies. Our own ancestors were once polytheists, with plenty of traces of fetishism. They were organized in clans, phratries, and tribes. There was a time when they used none but stone tools and weapons; when there was no private property in land, and no political structure higher than the tribe. Among the forefathers of the present civilized inhabitants of Europe are unmistakable traces of human sacrifices, and of the reckoning of kinship through the mother only. When we have come to survey large groups of facts of this sort, the conclusion is irresistibly driven home to us that the more advanced societies have gone through various stages now represented here and there by less advanced societies; that there is a general path of social development, along which, owing to special circumstances, some peoples have advanced a great way, some a less way, some but a very little way; and that by studying existing savages and barbarians we get a valuable clue to the interpretation of prehistoric times. All these things are to-day commonplaces among students of history and archæology; sixty years ago they would have been scouted as idle vagaries. It is the introduction of such methods of study that is making history scientific. It is enabling us to digest the huge masses of facts that are daily poured in upon us by decipherers of the past, – monuments, inscriptions, pottery, weapons, ethnological reports, and all that sort of thing, – and to make all contribute toward a coherent theory of the career of mankind upon the earth.

In the course of the foregoing survey one fact stands out with especial prominence: it appears that about half a century ago the foremost minds of the world, with whatever group of phenomena they were occupied, had fallen, and were more and more falling, into a habit of regarding things, not as having originated in the shape in which we now find them, but as having been slowly metamorphosed from some other shape through the agency of forces similar in nature to forces now at work. Whether planets, or mountains, or mollusks, or subjunctive moods, or tribal confederacies were the things studied, the scholars who studied them most deeply and most fruitfully were those who studied them as phases in a process of development. The work of such scholars has formed the strong current of thought in our time, while the work of those who did not catch these new methods has been dropped by the way and forgotten; and as we look back to Newton's time we can see that ever since then the drift of scientific thought has been setting in this direction, and with increasing steadiness and force.

Now, what does all this drift of scientific opinion during more than two centuries mean? It can, of course, have but one meaning. It means that the world *is* in a process of development, and that gradually, as advancing knowledge has enabled us to take a sufficiently wide view of the world, we have come to see that it is so. The old statical conception of a world created all at once in its present shape was the result of very narrow experience; it was entertained when we knew only an extremely small segment of the world. Now that our experience has widened, it is outgrown and set aside forever; it is replaced by the dynamical conception of a world in a perpetual process of evolution from one state into another state. This dynamical conception has come to stay with us. Our theories as to what the process of evolution is may be more or less wrong and are confessedly tentative, as scientific theories should be. But the dynamical conception, which is not the work of any one man, be he Darwin or Spencer or any one else, but the result of the cumulative experience of the last two centuries, – this is a permanent acquisition. We can no more revert to the statical conception than we can turn back the sun in his course. Whatever else the philosophy of future generations may be, it must be some kind of a philosophy of evolution.

Such is the scientific conquest achieved by the nineteenth century, a marvellous story without any parallel in the history of human achievement. The swiftness of the advance has been due partly to the removal of the ancient legal and social trammels that beset free thinking in every conceivable direction. It is largely due also to the use of correct methods of research. The waste of intellectual effort has been less than in former ages. The substitution of Lavoisier's balance for Stahl's *a priori* reasoning is one among countless instances of this. Sound scientific method is a slow acquisition of the human mind, and for its more rapid introduction, in Priestley's time and since, we have largely to thank the example set by those giants of a former age, Galileo and Kepler, Descartes and Newton.

The lessons that might be derived from our story are many. But one that we may especially emphasize is the dignity of Man whose persistent seeking for truth is rewarded by such fruits. We may be sure that the creature whose intelligence measures the pulsations of molecules and unravels the secret of the whirling nebula is no creature of a day, but the child of the universe, the heir of all the ages, in whose making and perfecting is to be found the consummation of God's creative work.

May, 1896.

II
THE DOCTRINE OF EVOLUTION: ITS SCOPE AND PURPORT [5]

It was not strange that among the younger men whose opinions were moulded between 1830 and 1840 there should have been one of organizing genius, with a mind inexhaustibly fertile in suggestions, who should undertake to elaborate a general doctrine of evolution, to embrace in one grand coherent system of generalizations all the minor generalizations which workers in different departments of science were establishing. It is this prodigious work of construction that we owe to Herbert Spencer. He is the originator and author of what we know to-day as the doctrine of evolution, the doctrine which undertakes to formulate and put into scientific shape the conception of evolution toward which scientific investigation had so long been tending. In the mind of the general public there seems to be dire confusion with regard to Mr. Spencer and his relations to evolution and to Darwinism. Sometimes, I believe, he is even supposed to be chiefly a follower and expounder of Mr. Darwin! No doubt this is because so many people mix up Darwinism with the doctrine of evolution, and have but the vaguest and haziest notions as to what

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[5] Part of an address before the Brooklyn Ethical Association, May 31, 1891.

it is all about. As I explained above, Mr. Darwin's great work was the discovery of natural selection, and the demonstration of its agency in effecting specific changes in plants and animals; and in that work he was completely original. But plants and animals are only a part of the universe, though an important part, and with regard to universal evolution or any universal formula for evolution Darwinism had nothing to say. Such problems were beyond its scope.

The discovery of a universal formula for evolution, and the application of this formula to many diverse groups of phenomena, have been the great work of Mr. Spencer, and in this he has had no predecessor. His wealth of originality is immense, and it is unquestionable. But as the most original thinker must take his start from the general stock of ideas accumulated at his epoch, and more often than not begins by following a clue given him by somebody else, so it was with Mr. Spencer when, about forty years ago, he was working out his doctrine of evolution. The clue was not given by Mr. Darwin. Darwinism was not yet born. Mr. Spencer's theory was worked out in all its parts, and many parts of it had been expounded in various published volumes and essays before the publication of the "Origin of Species."

The clue which Mr. Spencer followed was given him by the great embryologist, Karl Ernst von Baer, and an adumbration of it may perhaps be traced back through Kaspar Friedrich Wolf to Linnæus. Hints of it may be found, too, in Goethe and in Schelling. The advance from simplicity to complexity in the development of an egg is too obvious to be overlooked by any one, and was remarked upon, I believe, by Harvey; but the analysis of what that advance consists in was a wonderfully suggestive piece of work. Baer's great book was published in 1829, just at the time when so many stimulating ideas were being enunciated, and its significant title was *Entwickelungsgeschichte*, or "History of Evolution." It was well known that, so far as the senses can tell us, one ovum is indistinguishable from another, whether it be that of a man, a fish, or a parrot. The ovum is a structureless bit of organic matter, and, in acquiring structure along with its growth in volume and mass, it proceeds through a series of differentiations, and the result is a change from homogeneity to heterogeneity. Such was Baer's conclusion, to which scanty justice is done by such a brief statement. As all know, his work marked an epoch in the study of embryology; for to mark the successive differentiations in the embryos of a thousand animals was to write a thousand life histories upon correct principles.

Here it was that Mr. Spencer started. As a young man, he was chiefly interested in the study of political government and in history so far as it helps the study of politics. A philosophical student of such subjects must naturally seek for a theory of evolution. If I may cite my own experience, it was largely the absorbing and overmastering passion for the study of history that first led me to study evolution in order to obtain a correct method. When one has frequent occasion to refer to the political and social *progress* of the human race, one likes to know what one is talking about. Mr. Spencer needed a theory of progress. He could see that the civilized part of mankind has undergone some change from a bestial, unsocial, perpetually fighting stage of savagery into a partially peaceful and comparatively humane and social stage, and that we may reasonably hope that the change in this direction will go on. He could see, too, that along with this change there has been a building-up of tribes into nations, a division of labour, a differentiation of governmental functions, a series of changes in the relations of the individual to the community. To see so much as this is to whet one's craving for enlarged resources wherewith to study human progress. Mr. Spencer had a wide, accurate, and often profound acquaintance with botany, zoölogy, and allied studies. The question naturally occurred to him, Where do we find the process of development most completely exemplified from beginning to end, so that we can follow and exhaustively describe its consecutive phases? Obviously in the development of the ovum. There, and only there, do we get the whole process under our eyes from the first segmentation of the yolk to the death of the matured individual. In other groups of phenomena we can only see a small part of what is going on; they are too vast for us, as in astronomy, or too complicated, as in sociology. Elsewhere our evidences of development are more or less piecemeal and scattered, but in embryology we do get, at any rate, a connected story.

So Mr. Spencer took up Baer's problem, and carried the solution of it much further than the great Esthonian naturalist. He showed that in the development of the ovum the change from homogeneity to heterogeneity is accompanied by a change from indefiniteness to definiteness; there are segregations of similarly differentiated units resulting in the formation of definite organs. He further showed that there is a parallel and equally important change from incoherence to coherence; along with the division of labour among the units there is an organization of labour: at first, among the homogeneous units there is no subordination, – to subtract one would not alter the general aspect; but at last, among the heterogeneous organs there is such subordination and interdependence that to subtract any one is liable to undo the whole process and destroy the organism. In other words, integration is as much a feature of development as differentiation; the change is not simply from a structureless whole into parts, but it is from a structureless whole into an organized whole with a consensus of different functions, and that is what we call an organism. So while Baer said that the evolution of the chick is a change from homogeneity to heterogeneity through successive differentiations, Mr. Spencer said that the evolution of the chick is a continuous change from indefinite incoherent homogeneity to definite coherent heterogeneity through successive differentiations and integrations.

But Mr. Spencer had now done something more than describe exhaustively the evolution of an individual organism. He had got a standard of high and low degrees of organization; and the next thing in order was to apply this standard to the whole hierarchy of animals and plants according to their classified relationships and their succession in geological time. This was done with most brilliant success. From the earliest records in the rocks, the general advance in types of organization has been an advance in definiteness, coherence, and heterogeneity. The method of evolution in the life history of the animal and vegetal kingdoms has been like the method of evolution in the life history of the individual.

To go into the inorganic world with such a formula might seem rash. But as the growth of organization is essentially a particular kind of redistribution of matter and motion, and as redistribution of matter and motion is going on universally in the inorganic world, it is interesting to inquire whether, in such simple approaches toward organization as we find, there is any approach toward the characteristics of organic evolution as above described. It was easy for Mr. Spencer to show that the change from a nebula into a planetary system conforms to the definition of evolution in a way that is most striking and suggestive. But in studying the inorganic world Mr. Spencer was led to modify his formula in a way that vastly increased its scope. He came to see that the primary feature of evolution is an integration of matter and concomitant dissipation of motion. According to circumstances, this process may or not be attended with extensive internal rearrangements and development of organization. The continuous internal rearrangement implied in the development of organization is possible only where there is a medium degree of mobility among the particles, a plasticity such as is secured only by those peculiar chemical combinations which make up what we call organic matter. In the inorganic world, where there is an approach to organization there is an adumbration of the law as realized in the organic world. But in the former, what strikes us most is the concentration of the mass with the retention of but little internal mobility; in the latter, what strikes us most is the wonderful complication of the transformations wrought by the immense amount of internal mobility retained. These transformations are to us the mark, the distinguishing feature, of life.

Having thus got the nature of the differences between the organic and inorganic worlds into a series of suggestive formulas, the next thing to be done was to inquire into the applicability of the law of evolution to the higher manifestations of vital activity, – in other words, to psychical and social life. Here it was easy to point out analogies between the development of society and the development of an organism. Between a savage state of society and a civilized state, it is easy to see the contrasts in complexity of life, in division of labour, in interdependence and coherence of operations and of interests. The difference resembles that between a vertebrate animal and a worm.

Such analogies are instructive, because at the bottom of the phenomena there is a certain amount of real identity. But Mr. Spencer did not stop with analogies; he pursued his problem into much deeper regions. There is one manifest distinction between a society and an organism. In the organism, the conscious life, the psychical life, is not in the parts, but in the whole; but in a society, there is no such thing as corporate consciousness: the psychical life is all in the individual men and women. The highest development of this psychical life is the end for which the world exists. The object of social life is the highest spiritual welfare of the individual members of society. The individual human soul thus comes to be as much the centre of the Spencerian world as it was the centre of the world of mediæval theology; and the history of the evolution of conscious intelligence becomes a theme of surpassing interest.

This is the part of his subject which Mr. Spencer has handled in the most masterly manner. Nothing in the literature of psychology is more remarkable than the long-sustained analysis in which he starts with complicated acts of quantitative reasoning and resolves them into their elementary processes, and then goes on to simpler acts of judgment and perception, and then down to sensation, and so on resolving and resolving, until he gets down to the simple homogeneous psychical shocks or pulses in the manifold compounding and recompounding of which all mental action consists. Then, starting afresh from that conception of life as the continuous adjustment of inner relations within the organism to outer relations in the environment, – a conception of which he made such brilliant use in his "Principles of Biology," – he shows how the psychical life gradually becomes specialized in certain classes of adjustments or correspondences, and how the development of psychical life consists in a progressive differentiation and integration of such correspondences. Intellectual life is shown to have arisen by slow gradations, and the special interpretations of reflex action, instinct, memory, reason, emotion, and will are such as to make the "Principles of Psychology" indubitably the most suggestive book upon mental phenomena that was ever written.

Toward the end of the first edition of the "Origin of Species," published in 1859, Mr. Darwin looked forward to a distant future when the conception of gradual development might be applied to the phenomena of intelligence. But the first edition of the "Principles of Psychology," in which this was so successfully done, had already been published four years before, – in 1855, – so that Mr. Darwin in later editions was obliged to modify his statement, and confess that, instead of looking so far forward, he had better have looked about him. I remember hearing Mr. Darwin laugh merrily over this at his own expense.

This extension of the doctrine of evolution to psychical phenomena was what made it a universal doctrine, an account of the way in which the world, as we know it, has been evolved. There is no subject, great or small, that has not come to be affected by the doctrine, and, whether men realize it or not, there is no nook or corner in speculative science where they can get away from the sweep of Mr. Spencer's thought.

This extension of the doctrine to psychical phenomena is by many people misunderstood. The "Principles of Psychology" is a marvel of straightforward and lucid statement; but, from its immense reach and from the abstruseness of the subject, it is not easy reading. It requires a sustained attention such as few people can command, except on subjects with which they are already familiar. Hence few people read it in comparison with the number who have somehow got it into their heads that Mr. Spencer tries to explain mind as evolved out of matter, and is therefore a materialist. How many worthy critics have been heard to object to the doctrine of evolution that you cannot deduce mind from the primeval nebula, unless the germs of mind were present already! But that is just what Mr. Spencer says himself. I have heard him say it more than once, and his books contain many passages of equivalent import.[6] He never misses an opportunity for attacking the doctrine that mind can be explained as evolved from matter. But, in spite of this, a great many people suppose that the gradual evolution of mind *must* mean its evolution out of matter, and are deaf to arguments of which they do not perceive the bearing. Hence Mr. Spencer is so commonly accredited with the doctrine which he so earnestly repudiates.

But there is another reason why people are apt to suppose the doctrine of evolution to be materialistic in its implications. There are able writers who have done good service in illustrating

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[6] See, for example, *Principles of Psychology*, second edition, 1870-72, vol. ii. pp. 145-162.

portions of the general doctrine, and are at the same time avowed materialists. One may be a materialist, whatever his scientific theory of things; and to such a person the materialism naturally seems to be a logical consequence from the scientific theory. We have received this evening a communication from Professor Ernst Haeckel, of Jena, in which he lays down five theses regarding the doctrine of evolution: —

1. "The general doctrine appears to be already unassailably founded;

2. "Thereby every supernatural creation is completely excluded;

3. "Transformism and the theory of descent are inseparable constituent parts of the doctrine of evolution;

4. "The necessary consequence of this last conclusion is the descent of man from a series of vertebrates."

So far, very good; we are within the limits of scientific competence, where Professor Haeckel is strong. But now, in his fifth thesis, he enters the region of metaphysics, – the transcendental region, which science has no competent methods of exploring, – and commits himself to a dogmatic assertion:

5. "The beliefs in an 'immortal soul' and in 'a personal God' are therewith" (*i. e.*, with the four preceding statements) "completely ununitable (*völlig unvereinbar*)."

Now, if Professor Haeckel had contented himself with asserting that these two beliefs are not susceptible of scientific demonstration; if he had simply said that they are beliefs concerning which a scientific man, in his scientific capacity, ought to refrain from making assertions, because Science knows nothing whatever about the subject, he would have occupied an impregnable position. His fifth thesis would have been as indisputable as his first four. But Professor Haeckel does not stop here. He declares virtually that if an evolutionist is found entertaining the beliefs in a personal God and an immortal soul, nevertheless these beliefs are not philosophically reconcilable with his scientific theory of things, but are mere remnants of an old-fashioned superstition from which he has not succeeded in freeing himself.

Here one must pause to inquire what Professor Haeckel means by "a personal God." If he refers to the Latin conception of a God remote from the world of phenomena, and manifested only through occasional interference, – the conception that has until lately prevailed in the Western world since the time of St. Augustine, – then we may agree with him; the practical effect of the doctrine of evolution is to abolish such a conception. But with regard to the Greek conception entertained by St. Athanasius; the conception of God as immanent in the world of phenomena and manifested in every throb of its mighty rhythmical life; the deity that Richard Hooker, prince of English churchmen, had in mind when he wrote of Natural Law that "her seat is the bosom of God, and her voice the harmony of the world," – with regard to this conception the practical effect of the doctrine of evolution is not to abolish, but to strengthen and confirm it. For, into whatever province of Nature we carry our researches, the more deeply we penetrate into its laws and methods of action, the more clearly do we see that all provinces of Nature are parts of an organic whole animated by a single principle of life that is infinite and eternal. I have no doubt Professor Haeckel would not only admit this, but would scout any other view as inconsistent with the monism which he professes. But he would say that this infinite and eternal principle of life is not psychical, and therefore cannot be called in any sense "a personal God." In an ultimate analysis, I suspect Professor Haeckel's ubiquitous monistic principle would turn out to be neither more nor less than Dr. Büchner's mechanical force (*Kraft*). On the other hand, I have sought to show – in my little book "The Idea of God" – that the Infinite and Eternal Power that animates the universe must be psychical in its nature, that any attempt to reduce it to mechanical force must end in absurdity, and that the only kind of monism which will stand the test of an ultimate analysis is monotheism. While in the chapter on Anthropomorphic Theism, in my "Cosmic Philosophy," I have taken great pains to point out the difficulties in which (as finite thinkers) we are involved when we try to conceive the Infinite and Eternal Power as psychical in his nature, I have in the chapter on Matter and Spirit, in that same book, taken equal pains to show that we are logically compelled thus to conceive Him.

One's attitude toward such problems is likely to be determined by one's fundamental conception of psychical life. To a materialist the ultimate power is mechanical force, and psychical life is nothing but the temporary and local result of fleeting collocations of material elements in the shape of nervous systems. Into the endless circuit of transformations of molecular motion, says the materialist, there enter certain phases which we call feelings and thoughts; they are part of the circuit; they arise out of motions of material molecules, and disappear by being retransformed into such motions: hence, with the death of the organism in which such motions have been temporarily gathered into a kind of unity, all psychical activity and all personality are *ipso facto* abolished. Such is the materialistic doctrine, and such, I presume, is what Professor Haeckel has in mind when he asserts that the belief in an immortal soul is incompatible with the doctrine of evolution. The theory commonly called that of the correlation of forces, and which might equally well or better be called the theory of the metamorphosis of motions, is indispensable to the doctrine of evolution. But for the theory that light, heat, electricity, and nerve-action are different modes of undulatory motion transformable one into another, and that similar modes of motion are liberated by the chemical processes going on within the animal or vegetal organism, Mr. Spencer's work could never have been done. That theory of correlation and transformation is now generally accepted, and is often appealed to by materialists. A century ago Cabanis said that the brain secretes thought as the liver secretes bile. If he were alive to-day, he would doubtless smile at this old form of expression as crude, and would adopt a more subtle phrase; he would say that "thought is transformed motion."

Against this interpretation I have maintained that the theory of correlation not only fails to support it, but actually overthrows it. The arguments may be found in the chapter on Matter and Spirit, in my "Cosmic Philosophy," published in 1874, and in the essay entitled "A Crumb for the Modern Symposium," written in 1877, and reprinted in "Darwinism and Other Essays."[7] Their purport is, that in tracing the correlation of motions into the organism through the nervous system and out again, we are bound to get an account of each step in terms of motion. Unless we can show that every unit of motion that disappears is transformed into an exact quantitative equivalent, our theory of correlation breaks down; but when we have shown this we shall have given a complete account of the whole affair without taking any heed whatever of thought, feeling, or consciousness. In other words, these psychical activities do not enter into the circuit, but stand outside of it, as a segment of a circle may stand outside a portion of an entire circumference with which it is concentric. Motion is never transformed into thought, but only into some other form of measurable (in fact, or at any rate in theory, measurable) motion that takes place in nerve-threads and ganglia. *It is not the thought, but the nerve-action that accompanies the thought, that is really "transformed motion."* I say that if we are going to verify the theory of correlation, it must be done (actually or theoretically) by measurement; quantitative equivalence must be

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[7] See also *Excursions of an Evolutionist*, 1883, pp. 274-282.

proved at every step; and hence we must not change our unit of measurement; from first to last it must be a unit of motion: if we change it for a moment, our theory of correlation that moment collapses. I say, therefore, that the theory of correlation and equivalence of forces lends no support whatever to materialism. On the contrary, its manifest implication is that psychical life cannot be a mere product of temporary collocations of matter.

The argument here set forth is my own. When I first used it, I had never met with it anywhere in books or conversation. Whether it has since been employed by other writers I do not know, for during the past fifteen years I have read very few books on such subjects. At all events, it is an argument for which I am ready to bear the full responsibility. Some doubt has recently been expressed whether Mr. Spencer would admit the force of this argument. It has been urged by Mr. S. H. Wilder, in two able papers published in the "New York Daily Tribune," June 13 and July 4, 1890, that the use of this argument marks a radical divergence on my part from Mr. Spencer's own position.

It is true that in several passages of "First Principles" there are statements which either imply or distinctly assert that motion can be transformed into feeling and thought, —*e. g.*: "Those modes of the Unknowable which we call heat, light, chemical affinity, etc., are alike transformable into each other, and into those modes of the Unknowable which we distinguish as sensation, emotion, thought; these, in their turns, being directly or indirectly retransformable into the original shapes;"[8] and again, it is said "to be a necessary deduction from the law of correlation that what exists in consciousness under the form of feeling is transformable into an equivalent of mechanical motion," etc.[9] Now, if this, as literally interpreted, be Mr. Spencer's deliberate opinion, I entirely dissent from it. To speak of quantitative equivalence between a unit of feeling and a unit of motion seems to me to be talking nonsense, – to be combining terms which severally possess a meaning into a phrase which has no meaning. I am therefore inclined to think that the above sentences, literally interpreted, do not really convey Mr. Spencer's opinion. They appear manifestly inconsistent, moreover, with other passages in which he has taken much more pains to explain his position.[10] In the sentence from page 558 of "First Principles," Mr. Spencer appears to me to mean that the nerve-action, which is the objective concomitant of what is subjectively known as feeling, is transformable into an equivalent of mechanical motion. When he wrote that sentence perhaps he had not shaped the case quite so distinctly in his own mind as he had a few years later, when he made the more elaborate statements in the second edition of the Psychology. Though in these more elaborate statements he does not assert the doctrine I have here maintained, yet they seem consistent with it. When I was finishing the chapter on Matter

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[8] *First Principles*, second edition, 1867, p. 217.

[9] *Id.* p. 558.

[10] See, e. g., *Principles of Psychology*, second edition, vol. i. pp. 158-161, 616-627.

and Spirit, in my room in London, one afternoon in February, 1874, Mr. Spencer came in, and I read to him nearly the whole chapter, including my argument from correlation above mentioned. He expressed warm approval of the chapter, without making any specific qualifications. In the course of the chapter I had occasion to quote a passage from the Psychology,[11] in which Mr. Spencer twice inadvertently used the phrase "nervous shock" where he meant "psychical shock." As his object was to keep the psychical phenomena and their cerebral concomitants distinct in his argument, this colloquial use of the word "nervous" was liable to puzzle the reader, and give querulous critics a chance to charge Mr. Spencer with the materialistic implications which it was his express purpose to avoid. Accordingly, in my quotation I changed the word "nervous" to "psychical," using brackets and explaining my reasons. On showing all this to Mr. Spencer, he desired me to add in a footnote that he thoroughly approved the emendation.

I mention this incident because our common, every-day speech abounds in expressions that have a materialistic flavour; and sometimes in serious writing an author's sheer intentness upon his main argument may lead him to overlook some familiar form of expression which, when thrown into a precise and formal context, will strike the reader in a very different way from what the author intended. I am inclined to explain in this way the passages in "First Principles" which are perhaps chiefly responsible for the charge of materialism that has so often and

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[11] Vol. i. p. 158. Cf. my *Cosmic Philosophy*, vol. ii. p. 444.

so wrongly been brought up against the doctrine of evolution.

As regards the theological implications of the doctrine of evolution, I have never undertaken to speak for Mr. Spencer; on such transcendental subjects it is quite enough if one speaks for one's self. It is told of Diogenes that, on listening one day to a sophistical argument against the possibility of motion, he grimly got up out of his tub and walked across the street. Whether his adversaries were convinced or not, we are not told. Probably not; it is but seldom that adversaries are convinced. So, when Professor Haeckel declares that belief in a "personal God" and an "immortal soul" is incompatible with acceptance of the doctrine of evolution, I can only say, for myself – however much or little the personal experience may be worth – I find that the beliefs in the psychical nature of God and in the immortality of the human soul seem to harmonize infinitely better with my general system of cosmic philosophy than the negation of these beliefs. If Professor Haeckel, or any other writer, prefers a materialistic interpretation, very well. I neither quarrel with him nor seek to convert him; but I do not agree with him. I do not pretend that my opinion on these matters is susceptible of scientific demonstration. Neither is his. I say, then, that his fifth thesis has no business in a series of scientific generalizations about the doctrine of evolution.

Far beyond the limits of what scientific methods, based upon our brief terrestrial experience, can demonstrate, there lies on every side a region with regard to which Science can only suggest questions. As Goethe so profoundly says: —

> "Willst du ins Unendliche streiten,
> Geh' nur im Endlichen nach allen Seiten."[12]

It is of surpassing interest that the particular generalization which has been extended into a universal formula of evolution should have been the generalization of the development of an ovum. In enlarging the sphere of life in such wise as to make the whole universe seem actuated by a single principle of life, we are introduced to regions of sublime speculation. The doctrine of evolution, which affects our thought about all things, brings before us with vividness the conception of an ever present God, – not an absentee God who once manufactured a cosmic machine capable of running itself, except for a little jog or poke here and there in the shape of a special providence. The doctrine of evolution destroys the conception of the world as a machine. It makes God our constant refuge and support, and Nature his true revelation; and when all its religious implications shall have been set forth, it will be seen to be the most potent ally that Christianity has ever had in elevating mankind.

March, 1890.

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[12] "If thou wouldst press into the infinite, go but to all parts of the finite."

III
EDWARD LIVINGSTON YOUMANS [13]

In one of the most beautiful of all the shining pages of his "History of the Spanish Conquest in America," Sir Arthur Helps describes the way in which, through "some fitness of the season, whether in great scientific discoveries or in the breaking into light of some great moral cause, the same processes are going on in many minds, and it seems as if they communicated with each other invisibly. We may imagine that all good powers aid the 'new light,' and brave and wise thoughts about it float aloft in the atmosphere of thought as downy seeds are borne over the fruitful face of the earth."[14] The thinker who elaborates a new system of philosophy, deeper and more comprehensive than any yet known to mankind, though he may work in solitude, nevertheless does not work alone. The very fact which makes his great scheme of thought a success, and not a failure, is the fact that it puts into definite and coherent shape the ideas which many people are more or less vaguely and loosely entertaining, and that it carries to a grand and triumphant conclusion processes of reasoning

[13] An address before the Brooklyn Ethical Association, March 23, 1890.

[14] Vol. iii. p. 113.

in which many persons have already begun taking the earlier steps. This community in mental trend between the immortal discoverer and many of the brightest contemporary minds, far from diminishing the originality of his work, constitutes the feature of it which makes it a permanent acquisition for mankind, and distinguishes it from the eccentric philosophies which now and then come up to startle the world for a while, and are presently discarded and forgotten. The history of modern physics – as in the case of the correlation of forces and the undulatory theory of light – furnishes us with many instances of wise thoughts floating like downy seeds in the atmosphere until the moment has come for them to take root. And so it has been with the greatest achievement of modern thinking, – the doctrine of evolution. Students and investigators in all departments, alike in the physical and in the historical sciences, were fairly driven by the nature of the phenomena before them into some hypothesis, more or less vague, of gradual and orderly change or development. The world was ready and waiting for Herbert Spencer's mighty work when it came, and it was for that reason that it was so quickly triumphant over the old order of thought. The victory has been so thorough, swift, and decisive that it will take another generation to narrate the story of it so as to do it full justice. Meanwhile, people's minds are apt to be somewhat dazed with the rapidity and wholesale character of the change; and nothing is more common than to see them adopting Mr. Spencer's ideas without recognizing them as his or knowing whence they got them. As fast as Mr. Spencer could set forth his generalizations they were taken hold of here and there by special workers, each in his own department, and utilized therein. His general system was at once seized, assimilated, and set forth with new illustrations by serious thinkers who were already groping in the regions of abstruse thought which the master's vision pierced so clearly. And thus the doctrine of evolution has come to be inseparably interfused with the whole mass of thinking in our day and generation. I do not mean to imply that people commonly entertain very clear ideas about it, for clear ideas are not altogether common. I suspect that a good many people would hesitate if asked to state exactly what Newton's law of gravitation is.

Among the men in America whose minds, between thirty and forty years ago, were feeling their way toward some such unified conception of nature as Mr. Spencer was about to set forth in all its dazzling glory, – among the men who were thus prepared to grasp the doctrine of evolution at once and expound it with fresh illustrations, – the first in the field was the man to whose memory we have met here this evening to pay a brief word of tribute. It is but a little while since that noble face was here with us, and the tones of that kindly voice were fraught with good cheer for us. To most of you, I presume, the man Edward Livingston Youmans is still a familiar presence. There must be many here this evening who listened to the tidings of his death three years ago with a sense of personal bereavement. No one who knew him is likely ever to forget him. But for those who remember distinctly the man it may not be superfluous to recount the principal incidents of his life and work. It is desirable that the story should be set forth concisely, so as to be remembered; for the work was like the man, unselfish and unobtrusive, and in the hurry and complication of modern life such work is liable to be lost from sight, so that people profit by it without knowing that it was ever done. So genuinely modest, so utterly destitute of self-regarding impulses, was our friend, that I believe it would be quite like him to chide us for thus drawing public attention to him, as he would think, with too much emphasis. But such mild reproof it is right that we should disregard; for the memory of a life so beautiful and useful is a precious possession of which mankind ought not to be deprived.

Edward Livingston Youmans was born in the town of Coeymans, Albany County, N.Y., on the 3d of June, 1821. From his father and mother, both of whom survived him, he inherited strong traits of character as well as an immense fund of vital energy, such that the failure of health a few years ago seemed (to me, at least) surprising. His father, Vincent Youmans, was a man of independent character, strong convictions, and perfect moral courage, with a quick and ready tongue, in the use of which earnestness and frankness perhaps sometimes prevailed over prudence. The mother, Catherine Scofield, was notable for balance of judgment, prudence, and tact. The mother's grandfather was Irish; and while I very much doubt the soundness of the generalizations we are so prone to make about race characteristics, I cannot but feel that for the impulsive – one had almost said explosive – warmth of sympathy, the enchanting grace and vivacity of manner, in Edward Youmans, this strain of Irish blood may have been to some extent accountable. Both father and mother belonged to the old Puritan stock of New England, and the father's ancestry was doubtless purely English. Nothing could be more honourably or characteristically English than the name. In the old feudal society, the *yeoman*, like the *franklin*, was the small freeholder, owning a modest estate, yet holding it by no servile tenure; a man of the common people, yet no churl; a member of the state who "knew his rights, and knowing dared maintain." Few indeed were the nooks and corners outside of merry England where such men flourished as the yeomen and franklins who founded democratic New England. It has often been remarked how the most illustrious of Franklins exemplified the typical virtues of his class. There was much that was similar in the temperament and disposition of Edward Youmans, – the sagacity and penetration, the broad common sense, the earnest purpose veiled but not hidden by the blithe humour, the devotion to ends of wide practical value, the habit of making in the best sense the most out of life.

When Edward was but six months old, his parents moved to Greenfield, near Saratoga Springs. With a comfortable house and three acres of land, his father kept a wagon shop and smithy. In those days, while it was hard work to wring a subsistence out of the soil or to prosper upon any of the vocations which rural life permitted, there was doubtless more independence of character and real thriftiness than in our time, when cities and tariffs have so sapped the strength of the farming country. In the family of Vincent Youmans, though rigid economy was practised, books were reckoned to a certain extent among the necessaries of life, and the house was one in which neighbours were fond of gathering to discuss questions of politics or theology, social reform or improvements in agriculture. On all such questions Vincent Youmans was apt to have ideas of his own; he talked with enthusiasm, and was also ready to listen; and he evidently supplied an intellectual stimulus to the whole community. For a boy of bright and inquisitive mind, listening to such talk is no mean source of education. It often goes much further than the reading of books. From an early age Edward Youmans seems to have appropriated all such means of instruction. He had that insatiable thirst for knowledge which is one of God's best gifts to man; for he who is born with this appetite must needs be grievously ill made in other respects if it does not constrain him to lead a happy and useful life.

After ten years at Greenfield the family moved to a farm at Milton, some two miles distant. Until his sixteenth year Edward helped his father at farm work in the summer, and attended the district school in winter. It was his good fortune at that time to fall into the hands of a teacher who had a genius for teaching, – a man who in those days of rote-learning did not care to have things learned by heart, but sought to stimulate the thinking powers of his pupils, and who in that age of canes and ferules never found it necessary to use such means of discipline, because the fear of displeasing him was of itself all-sufficient. Experience of the methods of such a man was enough to sharpen one's disgust for the excessive mechanism, the rigid and stupid manner of teaching, which characterize the ordinary school. In after years Youmans used to say that "Uncle Good" – as this admirable pedagogue was called – first taught him what his mind was for. Through intercourse and training of this sort he learned to doubt, to test the soundness of opinions, to make original inquiries, and to find and follow clues.

But even the best of teachers can effect but little unless he finds a mind ready of itself to take the initiative. It is doubtful if men of eminent ability are ever made so by schooling. The school offers opportunities, but in such men the tendency to the initiative is so strong that if opportunities are not offered they will somehow contrive to create them. When Edward Youmans was about thirteen years old he persuaded his father to buy him a copy of Comstock's Natural Philosophy. This book he studied at home by himself, and repeated many of the experiments with apparatus of his own contriving. When he made a centrifugal water wheel, and explained to the men and boys of the neighbourhood the principle of its revolution in a direction opposite to that of the stream which moved it, we may regard it as his earliest attempt at giving scientific lectures. It was natural that one who had become interested in physics should wish to study chemistry. The teacher (who was not "Uncle Good") had never so much as laid eyes on a textbook of chemistry; but Edward was not to be daunted by such trifles. A copy of Comstock's manual was procured, another pupil was found willing to join in the study, and this class of two proceeded to learn what they could from reading the book, while the teacher asked them the printed questions, – those questions the mere existence of which in textbooks is apt to show what a low view publishers take of the average intelligence of teachers! It was not a very hopeful way of studying such a subject as chemistry; but doubtless the time was not wasted, and the foundations for a future knowledge of chemistry were laid. The experience of farm work which accompanied these studies explains the interest which in later years Mr. Youmans felt in agricultural chemistry. He came to realize how crude and primitive are our methods of making the earth yield its produce, and it was his opinion that when men have once learned how to conduct agriculture upon sound scientific principles, farming will become at once the most wholesome and the most attractive form of human industry.

Along with the elementary studies in science there went a great deal of miscellaneous reading, mostly, it would appear, of good solid books. Apparently there was at that time no study of languages, ancient or modern. At the age of seventeen the young man had shown so much promise that it was decided he should study law, and he had already entered upon a more extensive course of preparation in an academy in Saratoga County when the event occurred which changed the whole course of his life. He had been naturally gifted with keen and accurate vision, was a good sports-man and an excellent shot with a rifle; but at about the age of thirteen there had come an attack of ophthalmia, which left the eyes weak and sensitive. Perpetual reading probably increased the difficulty and hindered complete recovery. At the age of seventeen violent inflammation set in; the sight in one eye was completely lost, while in the other it grew so dim as to be of little avail. Sometimes he would be just able to find his way about the streets, at other times the blindness was almost total; and this state of things lasted for nearly thirteen years.

This dreadful calamity seemed to make it impossible to continue any systematic course of study, and the outlook for satisfactory work of any sort was extremely discouraging. The first necessity was medical assistance, and in quest of this Mr. Youmans came in the autumn of 1839 to New York, where for the most part he spent the remainder of his life. Until 1851 he was under the care of an oculist. Under such circumstances, if a man of eager energy and boundless intellectual craving were to be overwhelmed with despondency, we could not call it strange. If he were to become dependent upon friends for the means of support, it would be ungracious, if not unjust, to blame him. But Edward Youmans was not made of the stuff that acquiesces in defeat. He rose superior to calamity; he won the means of livelihood, and in darkness entered upon the path to an enviable fame. At first he had to resign himself to spending weary weeks over tasks that with sound eyesight could have been dispatched in as many days. He invented some kind of writing machine, which held his paper firmly, and enabled his pen to follow straight lines at proper distances apart. Long practice of this sort gave his handwriting a peculiar character which it retained in later years. When I first saw it in 1863 it seemed almost undecipherable; but that was far from being the case, and after I had grown used to it I found it but little less legible than the most beautiful chirography. The strokes, gnarled and jagged as they were, had a method in their madness, and every pithy sentence went straight as an arrow to its mark.

While conquering these physical obstacles Mr. Youmans began writing for the press, and gradually entered into relations with leading newspapers which became more and more important and useful as years went on. He became acquainted with Horace Greeley, William Henry Charming, and other gentlemen who were interested in social reforms. His sympathies were strongly enlisted with the little party of abolitionists, then held in such scornful disfavour by all other parties. He was also interested in the party of temperance, which, as he and others were afterward to learn, compounded for its essential uprightness of purpose by indulging in very gross intemperance of speech and action. The disinterestedness which always characterized him was illustrated by his writing many articles for a temperance paper which could not afford to pay its contributors, although he was struggling with such disadvantages in earning his own livelihood and carrying on his scientific studies. Those were days when leading reformers believed that by some cunningly contrived alteration of social arrangements our human nature, with all its inheritance from countless ages of brutality, can somehow be made over all in a moment, just as one would go to work with masons and carpenters and revamp a house. There are many good people who still labour under such a delusion.

Though Mr. Youmans was brought into frequent contact with reformers of this sort, it does not seem to me that his mind was ever deeply impressed with such ways of thinking. Science is teaching us that the method of evolution is that mill of God, of which we have heard, which, while it grinds with infinite efficacy, yet grinds with wearisome slowness. It was Mr. Darwin's discovery of natural selection which first brought this truth home to us; but Sir Charles Lyell had in 1830 shown how enormous effects are wrought by the cumulative action of slight and unobtrusive causes, and this had much to do with turning men's minds toward some conception of evolution. It was about 1847 that Mr. Youmans was deeply interested in the work of geologists, as well as in the Nebular Theory, to which recent discoveries were adding fresh confirmation. Some time before this he had read that famous book "Vestiges of Creation," and although Professor Agassiz truly declared that it was an unscientific book, crammed with antiquated and exploded fancies, I suspect that Mr. Youmans felt that amid all the chaff there was a very sound and sturdy kernel of truth.

Among the books which Mr. Youmans projected at this time, the first was a compendious history of progress in discovery and invention; but, after he had made extensive preparations, a book was published so similar in scope and treatment that he abandoned the undertaking. Another work was a treatise on arithmetic, on a new and philosophical plan; but, when this was approaching completion, he again found himself anticipated, this time by the book of Horace Mann. This was discouraging enough, but a third venture resulted in a brilliant success. We have observed the eagerness with which, as a schoolboy, Mr. Youmans entered upon the study of chemistry. His interest in this science grew with years, and he devoted himself to it so far as was practicable. For a blind man to carry on the study of a science which is preëminently one of observation and experiment might seem hopeless. It was at any rate absolutely necessary to see with the eyes of others, if not with his own. Here the assistance rendered by his sister was invaluable. During most of this period she served as amanuensis and reader for him. But, more than this, she kept up for some time a course of laboratory work, the results of which were minutely described to her brother and discussed with him in the evenings. The lectures of Dr. John William Draper on chemistry were also thoroughly discussed and pondered.

The conditions under which Mr. Youmans worked made it necessary for him to consider every point with the extreme deliberation involved in framing distinct mental images of things and processes which he could not watch with the eye. It was hard discipline, but he doubtless profited from it. Nature had endowed him with an unusually clear head, but this enforced method must have made it still clearer. One of the most notable qualities of his mind was the absolute luminousness with which he saw things and the relations among things. It was this quality that made him so successful as an expounder of scientific truths. In the course of his pondering over chemical facts which he was obliged to take at second hand, it occurred to him that most of the pupils in common schools who studied chemistry were practically no better off. It was easy enough for schools to buy textbooks, but difficult for them to provide laboratories and apparatus; and it was much easier withal to find teachers who could ask questions out of a book than those who could use apparatus if provided. It was customary, therefore, to learn chemistry by rote; or, in other words, pupils' heads were crammed with unintelligible statements about things with queer names, – such as manganese or tellurium, – which they had never seen, and would not know if they were to see them. It occurred to Mr. Youmans that if visible processes could not be brought before pupils, at any rate the fundamental conceptions of chemistry might be made clear by means of diagrams. He began devising diagrams in different colours, to illustrate the diversity in the atomic weights of the principal elements, and the composition of the more familiar compounds. At length, by uniting his diagrams, he obtained a comprehensive chart exhibiting the outlines of the whole scheme of chemical combination according to the binary or dualist theory then in vogue. This chart, when published, was a great success. It not only facilitated the acquirement of clear ideas, but it was suggestive of new ideas. It proved very popular, and kept the field until the binary theory was overthrown by the modern doctrine of substitution, which does not lend itself so readily to graphic treatment.

The success of the chemical chart led to the writing of a textbook of chemistry. This laborious work was completed in 1851, when Mr. Youmans was thirty years old. Professor Silliman was then regarded as one of our foremost authorities in chemistry, but it was at once remarked of the new book that it showed quite as thorough a mastery of the whole subject of chemical combination as Silliman's. It was a textbook of a kind far less common then than now. There was nothing dry about it. The subject was presented with beautiful clearness, in a most attractive style. There was a firm grasp of the philosophical principles underlying chemical phenomena, and the meaning and functions of the science were set forth in such a way as to charm the student and make him wish for more. The book had an immediate and signal success; in after years it was twice rewritten by the author, to accommodate it to the rapid advances made by the science, and it is still one of our best textbooks of chemistry. It has had a sale of about one hundred and fifty thousand copies.

The publication of this book at once established its author's reputation as a scientific writer, and in another way it marked an era in his life. The long, distressing period of darkness now came to an end. Sight was so far recovered in one eye that it became possible to go about freely, to read, to recognize friends, to travel, and make much of life. I am told that his face had acquired an expression characteristic of the blind, but that expression was afterward completely lost. When I knew him it would never have occurred to me that his sight was imperfect, except perhaps as regards length of range.

Youmans' career as a scientific lecturer now began. His first lecture was the beginning of a series on the relations of organic life to the atmosphere. It was illustrated with chemical apparatus, and was given in a private room in New York to an audience which filled the room. Probably no lecturer ever faced his first audience without some trepidation, and Youmans had not the mainstay and refuge afforded by a manuscript, for his sight was never good enough to make such an aid available for his lectures. At first the right words were slow in finding their way to those ready lips, and his friends were beginning to grow anxious, when all at once a happy accident broke the spell. He was remarking upon the characteristic inertness of nitrogen, and pointing to a jar of that gas on the table before him, when some fidgety movement of his knocked the jar off the table. He improved the occasion with one of his quaint *bons mots*, and, as there is nothing that greases the wheels of life like a laugh, the lecture went on to a successful close.

This was the beginning of a busy career of seventeen years of lecturing, ending in 1868; and I believe it is safe to say that few things were done in all those years of more vital and lasting benefit to the American people than this broadcast sowing of the seeds of scientific thought in the lectures of Edward Youmans. They came just at the time when the world was ripe for the doctrine of evolution, when all the wondrous significance of the trend of scientific discovery since Newton's time was beginning to burst upon men's minds. The work of Lyell in geology, followed at length in 1859 by the Darwinian theory; the doctrine of the correlation of forces and the consequent unity of nature; the extension and reformation of chemical theory; the simultaneous advance made in sociological inquiry, and in the conception of the true aims and proper methods of education, – all this made the period a most fruitful one for the peculiar work of such a teacher as Youmans. The intellectual atmosphere was charged with conceptions of evolution. Youmans had arrived at such conceptions in the course of his study of the separate lines of scientific speculation which were now about to be summed up and organized by Herbert Spencer into that system of philosophy which marks the highest point to which the progressive intelligence of mankind has yet attained. In the field of scientific generalization upon this great scale, Youmans was not an originator; but his broadly sympathetic and luminous mind moved on a plane so near to that of the originators that he seized at once upon the grand scheme of thought as it was developed, made it his own, and brought to its interpretation and diffusion such a happy combination of qualities as one seldom meets with. The ordinary popularizer of great and novel truths is a man who comprehends them but partially, and illustrates them in a lame and fragmentary way. But it was the peculiarity of Youmans that while on the one hand he could grasp the newest scientific thought so surely and firmly that he seemed to have entered into the innermost mind of its author, on the other hand he could speak to the general public in an extremely convincing and stimulating way. This was the secret of his power, and there can be no question that his influence in educating the American people to receive the doctrine of evolution was great and widespread.

The years when Youmans was travelling and lecturing were the years when the old lyceum system of popular lectures was still in its vigour. The kind of life led by the energetic lecturer in those days was not that of a Sybarite, as may be seen from a passage in one of his letters: "I lectured in Sandusky, and had to get up at five o'clock to reach Elyria; I had had but very little sleep. To get from Elyria to Pittsburg I must take the five o'clock morning train, and the hotel darky said he would *try* to waken me. I knew what that meant, and so did not get a single wink of sleep that night. Rode all day to Pittsburg, and had to lecture in the great Academy of Music over footlights… The train that left for Zanesville departed at two in the morning. I had been assured a hundred times (for I asked everybody I met) that I could get a sleeping-car to Zanesville, and when I was all ready to start I was informed that *this* morning there was no sleeping-car. By the time I reached here I was pretty completely used up."

Such a fatiguing life, however, has its compensations. It brings the lecturer into friendly contact with the brightest minds among his fellow countrymen in many and many places, and enlarges his sphere of influence in a way that is not easy to estimate. Clearly, an earnest lecturer, of commanding intelligence and charming manner, with a great subject to teach, must have an opportunity for sowing seeds that will presently ripen in a change of opinion or sentiment, in an altered way of looking at things on the part of whole communities. No lecturer has ever had a better opportunity of this sort than Edward Youmans, and none ever made a better use of his opportunity. His gifts as a talker were of the highest order. The commonest and plainest story, as told by Edward Youmans, had all the breathless interest of the most thrilling romance. Absolutely unconscious of himself, simple, straightforward, and vehement, wrapped up in his subject, the very embodiment of faith and enthusiasm, of heartiness and good cheer, it was delightful to hear him. And when we join with all this his unfailing common sense, his broad and kindly view of men and things, and the delicious humour that kept flashing out in quaint, pithy phrases such as no other man would have thought of, and such as are the despair of any one trying to remember and quote them, we can seem to imagine what a power he must have been with his lectures.

When such a man goes about for seventeen years, teaching scientific truths for which the world is ripe, we may be sure that his work is great, albeit we have no standard whereby we can exactly measure it. In hundreds of little towns with queer names did this strong personality appear and make its way and leave its effects in the shape of new thoughts, new questions, and enlarged hospitality of mind, among the inhabitants. The results of all this are surely visible to-day. In no part of the English world has Herbert Spencer's philosophy met with such a general and cordial reception as in the United States. This may no doubt be largely explained by a reference to general causes; but as it is almost always necessary, along with our general causes, to take into the account some personal influence, so it is in this case. It is safe to say that among the agencies which during the past fifty years have so remarkably broadened the mind of the American people, very few have been more potent than the gentle and subtle but pervasive work done by Edward Youmans with his lectures, and to this has been largely due the hospitable reception of Herbert Spencer's ideas.

It was in 1856 that Youmans fell in with a review of "Spencer's Principles of Psychology," by Dr. Morell, in "The Medico-Chirurgical Review." This paper impressed him so deeply that he at once sent to London for a copy of the book, which had been published in the preceding year. It will be observed that this was four years before the Darwinian theory was announced in the first edition of the "Origin of Species."[15]

After struggling for a while with the weighty problems of this book, Youmans saw that the theory expounded in it was a long stride in the direction of a general theory of evolution. His interest in this subject received a new and fresh stimulus. He read "Social Statics," and began to recognize Spencer's hand in the anonymous articles in the quarterlies in which he was then announcing and illustrating various portions or segments of his newly discovered law of evolution. One evening in February, 1860, as Youmans was calling at a friend's house in Brooklyn, the Rev. Samuel Johnson, of Salem, handed him the famous prospectus of the great series of philosophical works which Spencer proposed to issue by subscription. Mr. Johnson had obtained this from Edward Silsbee, who was one of the very first Americans to become interested in Spencer. The very next day Youmans wrote a letter to Spencer, offering his aid in procuring American subscriptions and otherwise facilitating the enterprise by every means in his power. With this letter and Spencer's cordial reply began the lifelong friendship between the two men. It was in that same month that I first became aware of Spencer's existence, through a single paragraph quoted from him by Lewes, and in that paragraph there was immense fascination. I had been steeping myself in the literature of modern philosophy, starting with Bacon and Descartes, and was then studying Comte's "Philosophie Positive," which interested me as suggesting that

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[15] See above, p. 49.

the special doctrines of the several sciences might be organized into a general body of doctrine of universal significance. Comte's work was crude and often wildly absurd, but there was much in it that was very suggestive. In May, 1860, in the Old Corner Bookstore in Boston, I fell upon a copy of that same prospectus of Spencer's works, and read it with exulting delight; for clearly there was to be such an organization of scientific doctrine as the world was waiting for. It appeared that there was some talk of Ticknor & Fields undertaking to conduct the series in case subscriptions enough should be received. Spencer preferred to have his works appear in Boston; but when in the course of 1860 his book on "Education" was offered to Ticknor & Fields, they declined to publish it, – which was, of course, a grave mistake from the business point of view. Youmans, however, was not sorry for this, for it gave him the opportunity to place Spencer's books where he could do most to forward their success.

Some years before, during his blindness, his sister had led him one day into the store of Messrs. D. Appleton & Co. in quest of a book, and Mr. William Appleton had become warmly interested in him. I believe the firm now look back to this chance visit as one of the most auspicious events in their annals. Youmans became by degrees a kind of adviser as regarded matters of publication, and it was largely through his far-sighted advice that the Appletons entered upon the publication of such books as those of Buckle, Darwin, Huxley, Tyndall, Haeckel, and others of like character; always paying a royalty to the authors, the same as to American authors, in spite of the absence of an international copyright law. As publishers of books of this sort the Appletons have come to be preëminent. It is obvious enough nowadays that such books are profitable from a business point of view; but thirty years and more ago this was by no means obvious. We Americans were terribly provincial. Reprints of English books and translations from French and German were sadly behind the times. In the Connecticut town where I lived, people would begin to wake up to the existence of some great European book or system of thought after it had been before the world anywhere from a dozen to fifty years. In those days, therefore, it required some boldness to undertake the reprinting of new scientific books; and none have recognized more freely than the Appletons the importance of the part played by Youmans in this matter. His work as adviser to a great publishing house and his work as lecturer reinforced each other, and thus his capacity for usefulness was much increased.

When Spencer's book on "Education" failed to find favour in Boston the Appletons took it, and thus presently secured the management of the philosophical series. This brought Youmans into permanent relations with Spencer and his work. In 1861 Youmans was married, and in the course of the following year made a journey in Europe with his wife. It was now that he became personally acquainted with Spencer, and found him quite as interesting and admirable as his books. Friendships were also begun with Huxley and other foremost men of science. From more than one of these men I have heard the warmest expressions of personal affection for Youmans, and of keen appreciation of the aid that they have obtained in innumerable ways from his intelligent and enthusiastic sympathy. But no one else got so large a measure of this support as Spencer. As fast as his books were republished Youmans wrote reviews of them, and by no means in the usual perfunctory way; his reviews and notices were turned out by the score, and scattered about in the magazines and newspapers where they would do the most good. Whenever he found another writer who could be pressed into the service, he would give him Spencer's books, kindle him with a spark from his own magnificent enthusiasm, and set him to writing for the press. The most indefatigable vender of wares was never more ruthlessly persistent in advertising for lucre's sake than Edward Youmans in preaching in a spirit of the purest disinterestedness the gospel of evolution. As long as he lived, Spencer had upon this side of the Atlantic an *alter ego* ever on the alert with vision like that of a hawk for the slightest chance to promote his interests and those of his system of thought.

Among the allies thus enlisted at that early time were Mr. George Ripley and the Rev. Henry Ward Beecher, both of whom did good service, in their different ways, in awakening public interest in the doctrine of evolution. In those days of the Civil War it was especially hard to keep up the list of subscribers in an abstruse philosophical publication of apparently interminable length. Youmans now and then found it needful to make a journey in the interests of the work, and it was on one of these occasions, in November, 1863, that I made his acquaintance. I had already published, in 1861, an article in one of the quarterly reviews, in which Spencer's work was referred to; and another in 1863, in which the law of evolution was illustrated in connection with certain problems of the science of language. The articles were anonymous, as was then the fashion, and Youmans' curiosity was aroused. There were so few people then who had any conception of what Spencer's work meant that they could have been counted on one's fingers. At that time I knew of only three: the late Professor Gurney, of Harvard; Mr. George Litch Roberts, now an eminent patent lawyer in Boston; and Mr. John Spencer Clark, now of the Prang Educational Company. I have since known that there were at least two or three others about Boston, among them my learned friend the Rev. William Rounseville Alger, besides several in other parts of the country. When we sometimes ventured to observe that Spencer's work was as great as Newton's, and that his theory of evolution was going to remodel human thinking upon all subjects whatever, people used to stare at us and take us for idiots. Any one member of such a small community was easy to find; and I have always dated a new era in my life from the Sunday afternoon when Youmans came to my room in Cambridge. It was the beginning of a friendship such as hardly comes but once to a man. At that first meeting I knew nothing of him except that he was the author of a textbook of chemistry which I had found interesting, in spite of its having been crammed down my throat by an old-fashioned memorizing teacher who, I am convinced, never really knew so much as the difference between oxygen and antimony. At first it was a matter of breathless interest to talk with a man who had seen Herbert Spencer. But one of the immediate results of this interview was the beginning of my own correspondence and intimate friendship with Spencer. And from that time forth it always seemed as if, whenever any of the good or lovely things of life came to my lot, somehow or other Edward Youmans was either the cause of it, or at any rate intimately concerned with it. The sphere of his unselfish goodness was so wide and its quality so potent that one could not come into near relations with him without becoming in all manner of unsuspected ways strengthened and enriched.

In the autumn of 1865 we were dismayed by the announcement that Spencer would no longer be able to go on issuing his works. In London they were published at his own expense and risk, and those books which now yield a handsome profit did not then pay the cost of making them. By the summer of 1865 there was a balance of £1100 against Spencer, and his property was too small to admit of his going on and losing at such a rate. As soon as this was known, John Stuart Mill begged to be allowed to assume the entire pecuniary responsibility of continuing the publication; but this, Mr. Spencer, while deeply affected by such noble sympathy, would not hear of. He consented, however, with great reluctance, to the attempt of Huxley and Lubbock, and other friends, to increase artificially the list of subscribers by inducing people to take the work just in order to help support it. But after several months the sudden death of Spencer's father added something to his means of support, and he thereupon withdrew his consent to this arrangement, and determined to go on publishing as before, and bearing the loss.

But as soon as the first evil tidings reached America Youmans made up his mind that $5500 must be forthwith raised by subscription, in order to make good the loss already incurred. It is delightful to remember the vigour with which he took hold of this work. The sum of $7000 was raised and invested in American securities in Spencer's name. If he did not see fit to accept these securities, they would go without an owner. The best of Waltham watches was procured for Spencer by his American friends; a letter, worded with rare delicacy and tact, was written by the late Robert Minturn; and Youmans sailed for England to convey the letter and the watch to Spencer. It was a charming scene on a summer day in an English garden when the great philosopher was apprised of what had been done. It was so skilfully managed that he could not refuse the tribute without seeming churlish. He therefore accepted it, and applied it to extending his researches in descriptive sociology.

Of the many visits which Youmans made to England, now and then extending them to the Continent, one of the most important was in 1871, for the purpose of establishing the International

Scientific Series. This was a favourite scheme of Youmans. He realized that popular scientific books, adapted to the general reader, are apt to be written by third-rate men who do not well understand their subject; they are apt to be dry or superficial, or both. No one can write so good a popular book as the master of a subject, if he only has a fair gift of expressing himself and keeps in mind the public for which he is writing. The master knows what to tell and what to omit, and can thus tell much in a short compass and still make it interesting; moreover, he avoids the inaccuracies which are sure to occur in second-hand work. Masters of subjects are apt, however, to be too much occupied with original research to write popular books. It was Youmans' plan to induce the leading men of science in Europe and America to contribute small volumes on their special subjects to a series to be published simultaneously in several countries and languages. Furthermore, by special contract with publishing houses of high reputation, the author was to receive the ordinary royalty on every copy of his book sold in every one of the countries in question; thus anticipating international copyright upon a very wide scale, and giving the author a much more adequate compensation for his labour. To put this scheme into operation was a task of great difficulty, so many conflicting interests had to be considered. Youmans' brilliant success is attested by that noble series of more than fifty volumes, on all sorts of scientific subjects, written by men of real eminence, and published in England, France, Italy, Germany, and Russia, as well as in the United States.

A word is all that can be spared for other parts of our friend's work, which deserve many words, and those carefully considered. His book on "Household Science" is not the usual collection of scrappy comment, recipe, and apothegm, but a valuable scientific treatise on heat, light, air, and food in their relations to every-day life. In his "Correlation of Physical Forces" he brings together the epoch-making essays of the men who have successively established that doctrine, introducing them with an essay of his own, in which its history and its philosophical implications are set forth in a masterly manner. In his book on the "Culture demanded by Modern Life" we have a similar collection of essays with a similar excellent original discussion, showing the need for wider and later training in science, and protesting against the excess of time and energy that is spent in classical education where it is merely the following of an old tradition.

As a crown to all this useful work, Youmans established, in 1872, "The Popular Science Monthly," which has unquestionably been of high educational value to the general public. It was not the aim of this magazine to give an account of every theory expounded, every fact observed, every discovery made, from year to year, whether significant or insignificant. The mind of the people is not educated by dumping a great unshapely mass of facts into it. It needs to be stimulated rather than crammed. Education in science should lead one to think for one's self. The scientific magazine, therefore, should present articles from all quarters that deal with the essential conceptions of science or discuss problems of real theoretical or practical interest, no matter whether every particular asteroid or the last new species of barnacle receives full attention or not. "The Popular Science Monthly" has now been with us eighteen years; its character has always been of the highest, and it must have exerted an excellent influence not only as a diffuser of valuable knowledge, but in training its readers to scientific habits of thought in so far as mere reading can contribute to such a result.

In concluding our survey of this useful and noble life, what impresses us most, I think, is the broad democratic spirit and the absolute unselfishness which it reveals at every moment and in every act. To Edward Youmans the imperative need for educating the great mass of the people so as to use their mental powers to the best advantage came home as a living, ever present fact. He saw all that it meant and means in the raising of mankind to a higher level of thought and action than that upon which they now live. To this end he consecrated himself with unalloyed devotion; and we who mourn his loss look back upon his noble career with a sense of victory, knowing how the good that such a man does lives after him and can never die.

March, 1890.

IV
THE PART PLAYED BY INFANCY IN THE EVOLUTION OF MAN [16]

The remarks which my friend Mr. Clark has made with reference to the reconciling of science and religion seem to carry me back to the days when I first became acquainted with the fact that there were such things afloat in the world as speculations about the origin of man from lower forms of life; and I can recall step by step various stages in which that old question has come to have a different look from what it had thirty years ago. One of the commonest objections we used to hear, from the mouths of persons who could not very well give voice to any other objection, was that anybody, whether he knows much or little about evolution, must have the feeling that there is something degrading about being allied with lower forms of life. That was, I suppose, owing to the survival of the old feeling that a dignified product of creation ought to have been produced in some exceptional way. That which was done in the ordinary way, that which was done through ordinary processes of causation, seemed to be cheapened and to lose its value. It was a remnant of the old state of feeling which took pleasure in miracles, which

[16] Short-hand report of my speech at a dinner given for me by Mr. John Spencer Clark, at the Aldine Club, New York, May 13, 1895.

seemed to think that the object of thought was more dignified if you could connect it with something supernatural; that state of culture in which there was an altogether inadequate appreciation of the amount of grandeur that there might be in the slow creative work that goes on noiselessly by little minute increments, even as the dropping of the water that wears away the stone. The general progress of familiarity with the conception of evolution has done a great deal to change that state of mind. Even persons who have not much acquaintance with science have at length caught something of its lesson, – that the infinitely cumulative action of small causes like those which we know is capable of producing results of the grandest and most thrilling importance, and that the disposition to recur to the cataclysmic and miraculous is only a tendency of the childish mind which we are outgrowing with wider experience.

The whole doctrine of evolution, and in fact the whole advance of modern science from the days of Copernicus down to the present day, have consisted in the substitution of processes which are familiar and the application of those processes, showing how they produce great results.

When Darwin's "Origin of Species" was first published, when it gave us that wonderful explanation of the origin of forms of life from allied forms through the operation of natural selection, it must have been like a mental illumination to every person who comprehended it. But after all it left a great many questions unexplained, as was natural. It accounted for the phenomena of organic development in general with wonderful success, but it must have left a great many minds with the feeling: If man has been produced in this way, if the mere operation of natural selection has produced the human race, wherein is the human race anyway essentially different from lower races? Is not man really dethroned, taken down from that exceptional position in which we have been accustomed to place him, and might it not be possible, in the course of the future, for other beings to come upon the earth as far superior to man as man is superior to the fossilized dragons of Jurassic antiquity?

Such questions used to be asked, and when they were asked, although one might have a very strong feeling that it was not so, at the same time one could not exactly say why. One could not then find any scientific argument for objections to that point of view. But with the further development of the question the whole subject began gradually to wear a different appearance; and I am going to give you a little bit of autobiography, because I think it may be of some interest in this connection. I am going to mention two or three of the successive stages which the whole question took in my own mind as one thing came up after another, and how from time to time it began to dawn upon me that I had up to that point been looking at the problem from not exactly the right point of view.

When Darwin's "Descent of Man" was published in 1871, it was of course a book characterized by all his immense learning, his wonderful fairness of spirit and fertility of suggestion. Still, one could not but feel that it did not solve the question of the origin of man. There was one great contrast between that book and his "Origin of Species." In the earlier treatise he undertook to point out a *vera causa* of the origin of species, and he did it. In his "Descent of Man" he brought together a great many minor generalizations which facilitated the understanding of man's origin. But he did not come at all near to solving the central problem, nor did he anywhere show clearly why natural selection might not have gone on forever producing one set of beings after another distinguishable chiefly by physical differences. But Darwin's co-discoverer, Alfred Russel Wallace, at an early stage in his researches, struck out a most brilliant and pregnant suggestion. In that one respect Wallace went further than ever Darwin did. It was a point of which, indeed, Darwin admitted the importance. It was a point of which nobody could fail to understand the importance, that in the course of the evolution of a very highly organized animal, if there came a point at which it was of more advantage to that animal to have variations in his intelligence seized upon and improved by natural selection than to have physical changes seized upon, then natural selection would begin working almost exclusively upon that creature's intelligence, and he would develop in intelligence to a great extent, while his physical organism would change but slightly. Now, that of course applied to the case of man, who is changed physically but very slightly from the apes, while he has traversed intellectually such a stupendous chasm.

As soon as this statement was made by Wallace, it seemed to me to open up an entirely new world of speculation. There was this enormous antiquity of man, during the greater part of which he did not know enough to make history. We see man existing here on the earth, no one can say how long, but surely many hundreds of thousands of years, yet only during just the last little fringe of four or five thousand years has he arrived at the point where he makes history. Before that, something was going on, a great many things were going on, while his ancestors were slowly growing up to that point of intelligence where it began to make itself felt in the recording of events. This agrees with Wallace's suggestion of a long period of psychical change, accompanied by slight physical change.

Well, in the spring of 1871, when Darwin's "Descent of Man" came out, just about the same time I happened to be reading Wallace's account of his experiences in the Malay Archipelago, and how at one time he caught a female orang-outang with a new-born baby, and the mother died, and Wallace brought up the baby orang-outang by hand; and this baby orang-outang had a kind of infancy which was a great deal longer than that of a cow or a sheep, but it was nothing compared to human infancy in length. This little orang-outang could not get up and march around, as mammals of less intelligence do, when he was first born, or within three or four days; but after three or four weeks or so he would get up, and begin taking hold of something and pushing it around, just as children push a chair; and he went through a period of staring at his hands, as human babies do, and altogether was a good deal slower in getting to the point where he could take care of himself. And while I was reading of that I thought, Dear me! if there is any one thing in which the human race is signally distinguished from other mammals, it is in the enormous duration of their infancy; but it is a point that I do not recollect ever seeing any naturalist so much as allude to.

It happened at just that time that I was making researches in psychology about the organization of experiences, the way in which conscious intelligent action can pass down into quasi-automatic action, the generation of instincts, and various allied questions; and I thought, Can it be that the increase of intelligence in an animal, if carried beyond a certain point, must necessarily result in prolongation of the period of infancy, – must necessarily result in the birth of the mammal at a less developed stage, leaving something to be done, leaving a good deal to be done, after birth? And then the argument seemed to come along very naturally, that for every action of life, every adjustment which a creature makes in life, whether a muscular adjustment or an intelligent adjustment, there has got to be some registration effected in the nervous system, some line of transit worn for nervous force to follow; there has got to be a connection between certain nerve-centres before the thing can be done, whether it is the acts of the viscera or the acts of the limbs, or anything of that sort; and of course it is obvious that if the creature has not many things to register in his nervous system, if he has a life which is very simple, consisting of few actions that are performed with great frequency, that animal becomes almost automatic in his whole life; and all the nervous connections that need to be made to enable him to carry on life get made during the fœtal period or during the egg period, and when he comes to be born, he comes all ready to go to work. As one result of this, he does not learn from individual experience, but one generation is like the preceding generations, with here and there some slight modifications. But when you get the creature that has arrived at the point where his experience has become varied, he has got to do a good many things, and there is more or less individuality about them; and many of them are not performed with the same minuteness and regularity, so that there does not begin to be that automatism within the period during which he is being developed and his form is taking on its outlines. During prenatal life there is not time enough for all these nervous registrations, and so by degrees it comes about that he is born with his nervous system perfectly capable only of making him breathe and digest food, – of making him do the things absolutely requisite for supporting life; instead of being born with a certain number of definite developed capacities, he has a number of potentialities which have got to be roused according to his own individual experience. Pursuing that line of thought, it began after a while to seem clear to me that the infancy of the animal in a very undeveloped condition, with the larger part of his faculties in potentiality rather than in actuality, was a direct result of the increase of intelligence, and I began to see that now we have two steps: first, natural selection goes on increasing the intelligence; and secondly, when the intelligence goes far enough, it makes a longer infancy, a creature is born less developed, and therefore there comes this plastic period during which he is more teachable. The capacity for progress begins to come in, and you begin to get at one of the great points in which man is distinguished from the lower animals, for one of those points is undoubtedly his progressiveness; and I think that any one will say, with very little hesitation, that if it were not for our period of infancy we should not be progressive. If we came into the world with our capacities all cut and dried, one generation would be very much like another.

Then, looking round to see what are the other points which are most important in which man differs from the lower animals, there comes that matter of the family. The family has adumbrations and foreshadowings among the lower animal, but in general it may be said that while mammals lower than man are gregarious, in man have become established those peculiar relationships which constitute what we know as the family; and it is easy to see how the existence of helpless infants would bring about just that state of things. The necessity of caring for the infants would prolong the period of maternal affection, and would tend to keep the father and mother and children together, but it would tend especially to keep the mother and children together. This business of the marital relations was not really a thing that became adjusted in the primitive ages of man, but it has become adjusted in the course of civilization. Real monogamy, real faithfulness of the male parent, belongs to a comparatively advanced stage; but in the early stages the knitting together of permanent relations between mother and infant, and the approximation toward steady relations on the part of the male parent, came to bring the family, and gradually to knit those organizations which we know as clans.

Конец ознакомительного фрагмента.