JACK'S SCIENTIFIC SERIES

ORGANIC EVOLUTION

1/ NETT

BY C. W. SALEEBY, M.D.

A. R. McFrod

Feb 13/1914.

Toronto

SHILLING
SCIENTIFIC
SERIES

ORGANIC EVOLUTION

BY

C. W. SALEEBY, M.D.

AUTHOR OF

"THE CYCLE OF LIFE," "EVOLUTION THE MASTER KEY," ETC.

LONDON: T. C. & E. C. JACK

16 HENRIETTA STREET, W.C.

AND EDINBURGH

THE

SHILLING SCIENTIFIC SERIES

MOTORS AND MOTORING. By Professor HARRY SPOONER.

RADIUM. By Dr. HAMPSON.

LOCAL GOVERNMENT. By PERCY ASHLEY, M.A.

METEOROLOGY. By J. G. M'PHERSON, Ph.D., F.R.S.E.

BALLOONS, AIRSHIPS, AND FLYING MACHINES. By GERTRUDE BACON.

WIRELESS TELEGRAPHY. By WILLIAM J. WHITE, Engineer-in-Chief's Department, General Post Office.

SPIRITUALISM. By E. T. BENNETT, Assistant-Secretary to the Society for Psychical Research, 1882–1902.

HEREDITY. By C. W. SALEEBY, M.D.

ORGANIC EVOLUTION. By C. W. SALEEBY, M.D.

PSYCHOLOGY. By C. W. SALEEBY, M.D.

SOCIOLOGY. By C. W. SALEEBY, M.D.

ETHICS. By C. W. SALEEBY, M.D.

HERALDRY EXPLAINED. By A. C. FOX-DAVIES, Editor of "Armorial Families."

Others in Preparation.

CONTENTS

ORGANIC EVOLUTION

CHAPTER I

INTRODUCTORY

Until about one hundred years ago, it was all but universally believed that the different kinds of plants and animals as men knew them had existed as such from the beginning. The progeny of cows were always calves, of oaks always acorns. Cows and oaks had long been known; and if they had not changed in two thousand years, they doubtless had not changed in the six thousand years of the earth's history. Not only did animal and vegetable species breed true to their kind, but they did not breed among themselves, or, if they did, the hybrid race was not perpetuated. Doubtless, therefore, cows had always been cows, and oaks oaks.

But indeed men had not been left to draw such an obvious inference, for there was extant a divinely-inspired account of the origin of species, wherein it was authoritatively stated that they had been called into being by "special creation."

To-day, however, there triumphs, after a struggle of several decades, another theory, which goes by the name of *organic evolution*. This theory states that

species of animals and plants, as we know them, are not immutable; that they have been gradually evolved, through many ages, from simpler and simpler forms, and that they are still so evolving. The account given in Genesis has been traced to its Babylonian origin, and is admitted to be untrue and worthless. The history of this change of opinion is so interesting and important that it falls here to be discussed. In a philosophic account of any subject whatever, the history of our knowledge of it must take an indispensable and logically preliminary place.

Many scattered thinkers in the past had questioned the theory of special creation. This theory was not held by the great Greeks. Giordano Bruno, burnt for his beliefs in 1600, had disbelieved it; but none of these had made any permanent impress upon biological thought. Towards the end of the eighteenth century, however, there lived a versatile physician, named Erasmus Darwin, whose interests included poetry and biology. It seemed to him that animal and vegetable species must have undergone modification in the course of ages; but he was not equal to the task of formulating his views in any precise or compelling manner. Then it happened that an elderly Frenchman, Jean Baptiste de Lamarck, was appointed by the Parisian authorities to a post concerned with biology, a study with which he had hitherto had no acquaintance. Merely mentioning the names of Kant and Goethe and Buffon as more or less explicit forerunners of the doctrine of organic evolution, we may devote special attention to the work of Lamarck. In the year 1809, just half a century before the date which was

afterwards to become famous in this connection, Lamarck published his "Philosophie Zoologique," a work in which precise expression was given to the views which Erasmus Darwin and others had merely adumbrated. Lamarck not only declared that animal and vegetable species were cousins, so to speak, but he stated a theory which proposed to explain the manner in which they came to change. His survey of the facts showed him that living things, in the course of their individual history, undergo modifications in response to what he called the "milieu environnant," or, as we now say, the *environment*. To take a simple case, the ancestral giraffe found itself in a land where succulent and palatable leaves grew upon the lowermost branches of tall trees. By an effort the giraffe could just reach the lowest of these leaves. In course of time, then, the giraffe's neck would undergo some elongation, just as the pianist's fingers become capable of unusually wide separation; and the lengthened neck of the giraffe—or rather the ancestor of the giraffe—*would be reproduced in its offspring*. The character acquired by the giraffe in response to the demands of the environment would be perpetuated. Each generation would transmit a slightly longer neck than the last, until finally there appeared the giraffe we know.[1] Such was the theory of Lamarck; but it made little impression or none upon his contemporaries. The theory of organic evolution was to be

[1] Long though the giraffe's neck is, it yet contains only seven vertebræ, the same number as are found in the neck of man and all other mammals save two. The fact obviously points to a common ancestry for all mammals.

established by a man—the grandson of Erasmus Darwin—who was born in the year in which Lamarck's theory saw the light.

Meanwhile, though Lamarckism was found unconvincing, evidence began to accumulate against the special creation theory. There gradually grew up the new-born science of geology, with which Genesis was found to be incompatible. According to geology, there must have been a time when there was no life upon the earth, for the lowest strata which the geologist could recognise contained no fossils, whilst they afforded clear indication of the action of intense heat. In the strata succeeding these were found traces of very simple organisms. Still higher up, there were signs of fishes and reptiles; whilst in strata still more recent were discovered the fossil remains of mammals. It certainly looked as if the higher forms of life must have been developed from the lower.

But this explanation did not satisfy the majority of those days. As against the few who believed that the history of the earth's crust was continuous and uniform — their doctrine was called uniformitarianism—these maintained the "catastrophic theory." Certainly at one time there could only have been lowly ferns and creeping things upon the earth. But some cataclysm had put a term to their existence; and, thereafter, the Creator, "repenting Himself," had called into being higher forms, themselves to be similarly destroyed and similarly succeeded by forms higher still; and so on. Our astonishment at the existence of such ideas may perhaps be qualified by the humiliating thought

that nine out of ten of us would doubtless have subscribed to them; and that most of us doubtless now subscribe to ideas which may seem equally childish to our children's children.

Nevertheless, the advent of the truth was delayed. One independent young thinker, indeed, dared in 1852 to write an essay called the "Development Hypothesis," in which he boldly declared himself against the accepted theory, which still flourished under the protecting names of such distinguished naturalists as Cuvier and Sir Richard Owen. But Herbert Spencer's advocacy did not then effect anything.

Meanwhile, however, Charles Robert Darwin, the greatest biologist of any age, was collecting facts that bore on the question of the origin of species. It was in 1839 that he first began to doubt the current theory and opened his "first note-book" for facts bearing thereon. Spencer's acceptance of the "development hypothesis" was mainly due to his perception that it was the only alternative to the "special creation" hypothesis, which seemed to him unthinkable, "a mere formulation of ignorance into the semblance of knowledge." Darwin's doubt of the orthodox theory had its origin in the facts of animal and vegetable life which he observed during an early voyage to South America. But the "development hypothesis"—it was not until 1857 that Spencer introduced the word evolution—was in need of more support than any one had hitherto afforded it.

Now Darwin, being a thinker, found his recreation in works the reading of which most of us would

regard as work of the most aggravated kind. Thus it chanced that one day he amused himself by reading the "Essay on Population" which an English clergyman named Malthus had published in 1798. Malthus pointed out that the population tends to increase in geometrical progression: whereas the means of subsistence increase, at most, in only arithmetical progression—a nice quandary for the population. This observation of Malthus gave Darwin an idea which, though it is, in essence, as old as Empedocles, will for ever be associated with his name. The argument is very simple. The individuals of any generation vary within wide limits. Some are fleeter, some stronger, some craftier than others. If, then, there is not enough food "to go round," will not the strongest, the fleetest, the craftiest get more than their share, whilst the less favoured starve? And will not the fleetness and strength of those thus selected by nature be transmitted to their progeny; whilst the others will leave few descendants or none to inherit their weakness or dull wits? This is the theory which Darwin called by the unfortunate name of "Natural Selection." When it was submitted to the public in 1859 in the "Origin of Species," Spencer, who was engaged in constructing a philosophic system which should establish his idea of Evolution or Ordered Change, and apply it to all things whatsoever, accepted the Darwinian theory with delight, and happily re-christened it "the survival of the fittest." Darwin, never loth to accept help from any quarter, adopted this phrase in all subsequent editions of his masterpiece.

By a remarkable coincidence, a young surgeon named Alfred Russel Wallace — with Sir Joseph Hooker, one of the two remaining survivors of those epoch-making days — had also read the essay of Malthus; and, one day, as he lay prostrate with malaria in the Malays, there occurred to him the same idea as had occurred to Darwin. He sent home a paper expressing it; and this was shown to Darwin, who was known to be working at the subject. A joint paper was read, in both their names, before the Linnæan Society in 1858.

As in the case of Locke's immortal Essay, which was forbidden to be read in his own University of Oxford, and as in the still more noteworthy case of Newton's great discovery, which was declared to lead to atheism, but in far greater measure than in either of these instances, the publication of Darwin's work aroused an almost unprecedented exhibition of the *odium theologicum*—an exhibition so extreme that any student of the history of thought might almost have been justified in inferring from it the truth, and the magnitude of the truth, of Darwin's discovery.

Darwin himself was possessed of scant literary power, and no taste for controversy. But good fortune brought to his aid two trenchant lieutenants, who more than supplied his deficiencies in this respect. These were Ernst Haeckel of Jena,[1] and Thomas Henry Huxley, whom Darwin addresses in a letter as his "good and admirable agent for the

[1] Haeckel's great work, the "Anthropogenie," has recently been revised by himself, and translated into English under the title of "The Evolution of Man." (Messrs. Watts & Co.)

propagation of damnable heresies." Spencer had hitherto never been able to convince Huxley of the truth of the theory of organic evolution; but, when the "Origin of Species" appeared, Huxley found in it the statement of the factor of evolution for which he was seeking. Many and bitter were the battles between Huxley and the theologians, who were supported by some biological survivors of the old order, such as Owen. The old geologist, Adam Sedgwick, described the theory of Darwin as the "law of higgledy-piggledy." Owen attempted to show—being most signally refuted by Huxley—that the brain of the ape differs profoundly from the brain of man. Bishop Wilberforce asked Huxley, at a memorable meeting of the British Association, whether it was through his grandmother or his grandfather that he claimed the ape-ancestry, thus earning for himself one of the most crushing retorts in the history of controversy; and Alfred Russel Wallace, to Darwin's bitter grief, declared that the theory, however aided or interpreted, could not account for the mental and moral characters of man.

In a few years Haeckel and Huxley each published volumes on "Man's Place in Nature" (to quote Huxley's title), whilst Haeckel introduced the Germans to what, by a very unfortunate and incorrect use of language, he called *Darwinismus* or Darwinism. Darwin himself had refrained, in the "Origin," from applying his theory to man, lest the excitement aroused should still further prejudice his book; but his honesty compelled him to insert a brief sentence to the effect that "much light" would be thrown by his theory on the origin of man.

In 1871 Darwin published his great work, second only to the "Origin," which he called the "Descent of Man," a book which differs from its predecessor in being easy to read. In it he supplemented the theory of natural selection by the theory of sexual selection, to which the youngest school of biologists has lately afforded signal support. Gradually the scientific world became convinced, whilst Spencer's "Principles of Biology" (1864–67) amplified the theory and included it in the author's conception of universal evolution. In 1880 Huxley lectured at the Royal Institution on the "Coming of Age of the 'Origin of Species,'" and was able to record its scientific triumph. Here and there a theologian yielded to the evidence; but the popular heroes of the time—Disraeli, Gladstone, Salisbury, Manning, Newman, Carlyle, Ruskin—all repudiated the conception, gratuitously assuming their competence to express any opinion upon it.

Now and again some amateur publishes a volume against the theory of organic evolution in general or the Darwinian theory of natural selection in particular, but the time has gone by for the necessity of answering them. And just as the theologians came to withdraw their charge of atheism against Newton, and found in gravitation a new instance of the Divine power and wisdom, so the more liberal theologians of to-day now accept the concluding paragraph of the "Origin," in which Darwin declares that there is some grandeur in the evolutionary conception of the Divine method.

The last prominent attack upon the theory of organic evolution was made in the late Marquis of

Salisbury's Presidential Address to the British Association at its Oxford meeting in 1894. That piece of unprofitable banter may be mercifully forgotten. Ten years later Lord Salisbury's nephew succeeded to his honour, and readers of Mr. Balfour's Address at Cambridge in 1904 will remember that the nephew took for granted, and assumed as the foundation of his argument, that against which the uncle had inveighed ten years before.

At the present day the theory of evolution is the guiding principle to and from which all biological studies are directed. It has led directly to the discovery of many facts, and has suggested countless fruitful lines of research. This principle, and this alone, has imparted meaning and intelligibility to thousands—to tens of thousands—of facts in zoology and botany; and has been the architect of these sciences, taking a collection of unrelated and apparently "arbitrary" facts, unworthy of the name of science, and building them into a stately edifice, which stands four-square to all the winds that blow. About the fact of organic evolution no biologist now disputes; controversy has for many years confined itself to the modes of evolution, and to their relative importance; one school, known as the Neo-Darwinians, following Weismann, but not Darwin, in the belief that natural selection alone accounts for all the facts, whilst another, known as the Neo-Lamarckians, follow Spencer in declaring that the inheritance of acquirements plays a part. Recent physical advances—notably the discovery of radium—have removed the discrepancies between the geological time-table and that of the mathematical

physicists, upon which Lord Salisbury laid so much misdirected stress in its relation to the beginnings of life. The fact of organic evolution is at least as certain a part of knowledge as the law of universal gravitation. Condemned by the ancient beliefs which it has in turn destroyed, misconstrued as the denial of morality, repudiated by the incompetent and the prejudiced, unrecognised in our educational curricula, it is accepted of Truth.

CHAPTER II

THE EVIDENCE IN BRIEF

But it is not consistent either with knowledge or reason or even dignity to hold any dogma because it is loudly proclaimed, or universally accepted, or because disbelief brings penalties or ridicule. It is therefore our duty, before considering the facts of organic evolution, the factors upon which it depends, and the modes of their operation, to make some survey, however general, of the evidence for the theory. In sooth, fully to recount this would entail, amongst other things, a rehearsal of all the facts of biology, so comprehensive is the principle; but here it is proposed merely to set forth in outline the evidence of the chief witnesses at our disposal. Some of them are hardly on nodding terms with one another; but they all tell the same tale.

In the first place, there is the evidence of that central principle of scientific thought, the *law of con-*

tinuity. This vastest of generalisations teaches that all phenomena are inter-related; that the present is the child of the past, the parent of the future; that law rules all; that, if there be a personal Deity, He never finds cause to interfere with His own laws. If the special creation theory were true, this principle must be false. . . . The reader who demands something more tangible is besought to contain himself for but a few lines more.

Secondly, there is that vast generalisation of Universal and Ordered Change which Herbert Spencer discovered and named Evolution. He proved that stars and societies and ideas are subject to this law. The physics of to-day has proved that what is true of species of societies is also true of species of atoms, species which we are only just learning not to call elements. It is more than improbable that the principle which applies elsewhere without exception should not apply to species of animals and plants.

In the next place, there is the evidence of many sciences. We may begin with astronomy, since it is well to hold, as far as possible, to the chronological order.

Some form or other of the nebular theory of the origin of the solar system is now accepted by all astronomers. According to this theory, there was a time when the surface of the earth, ere the birth of the moon, was fluid, whilst all the water of the planet was suspended in gaseous form in its atmosphere. In these conditions life was impossible. That they did once prevail, geology, also, with its knowledge of igneous formations, bears witness. Thus not only have different species of living things been evolved; but

life itself must have been evolved from non-living or inorganic matter.

Geology, again, in virtue of its subsection, palæontology,[1] yields evidence—the "record of the rocks"—in favour of the theory of organic evolution. As we have already seen, the geological record, imperfect though it is, teaches us that there was an "age of reptiles," an age of great ferns, an age when there was no life, and so forth. Furthermore, geologists have long abandoned the catastrophic theory, which, indeed, was hardly more than a survival of the ancient Deluge myths; and compel us to believe that, as the rocks evolved, so did the living things whose imprint they now bear.

If we now pass to the organic sciences, we find evidence still more striking: evidence upon which, even in this little handbook, we must dwell at much greater length.

First let us consider the evidence of anthropology[2]—the science of man. Neglecting the suggestive facts afforded by the comparative study of the extant races of man, let us inquire into the known facts as to the past of the human physique. We have recently become acquainted with some few skulls, undoubtedly human, which are of very great antiquity, dating back to ages beside which the historic period is but a moment. These skulls approximate, far more closely than even the lowest human skull of to-day, to the simian type—to the

1 Cuvier, the founder of palæontology, was the last great opponent of that theory of organic evolution to which palæontology has afforded such conclusive support. Cuvier "built greater than he knew."

2 The term is here used as synonymous with physical anthropology.

skull of the ape. That fact surely means something. Furthermore, a Dutch surgeon, some few years ago, discovered in Java the fossil remains of a skeleton of which it is impossible to say whether it is human or simian. Probably it is neither. As far as the evidence of the skull and the leg bones can be trusted, it would appear that Dr. Dubois was justified in considering that these remains belonged to a creature, neither human nor simian, which may be called the *Pithecanthropus erectus*—the erect ape-man. It may freely be granted that all anatomists are not agreed. The present writer's teacher, Sir William Turner, who is the *doyen* of living anatomists, inclines to the opinion that the remains are partly human, partly simian, bones from two skeletons having chanced to rest together. It is of sufficient significance that no anatomist can afford dogmatically to say of any of these bones, "they are human," or "they are simian."

Of still greater importance is the evidence from embryology, the science which treats of the development of individual organisms. One great service, indeed, this study renders us, apart from the evidence shortly to be recounted. The briefest consideration of the facts of individual development removes what some regard as the incredibleness of the evolutionary theory. If the sceptic is asked to observe a very simple one-celled organism, such as the amœba, through the microscope; or if he is asked to consider the structure of a worm; or the mental equipment of an ape—he declares himself incapable of believing that man can have had such

ancestors. But the difficulty of believing the evolutionary theory which states that man and his capacities have been slowly evolved from these primitive forms through countless ages, extending to at least a hundred millions of years, is as nothing compared with the observed and positive facts of individual development, which no one would believe were any choice allowed him. Any one who can believe that which is daily taking place around him can have no difficulty in believing in organic evolution. For consider the facts.

The greatest of men—your Aristotle or Shakespeare—began his individual career as a unicellular organism just visible in a good light to the naked eye. This minute creature has neither organs nor parts nor passions nor ideas. Yet in nine months it becomes a baby, and twenty-seven years later it may write a "Romeo and Juliet," or be founding a new religion. Had we seen for ourselves the ascent of man from the primitive slime, but never witnessed the relatively instantaneous development of a man from a human germ, we might well account the latter impossible. But having seen the greater marvel, we cannot call the lesser incredible.

So much for the first service of embryology. But its positive evidence in favour of our theory is equally important. For it is found that at a certain stage the human embryo possesses a tail; that at another it has gill slits, for all the world like a fish; that at another it has a hairy coat; that at another no living man could say whether it is the embryo of a man or an ape. To what but one inference can these facts lead?

So striking is the manner in which the individual history of a man recapitulates the history of the race, that many features of the adult anatomy can be explained only on this "recapitulation theory." Man, for instance, has three useless muscles attached to each of his external ears: muscles which few can throw into action and none can utilise. There is only one explanation of their presence. Similarly he has, upon the front of his neck, a sheet of muscle which he never uses. Lower mammals have a continuous sheet of muscle at the same level all over the body, and can use it to displace annoying insects. How does man come to have this useless appanage? Again, man possesses a blind pouch, attached to his alimentary canal, which is far worse than useless. Some ninety thousand operations are performed every year in Great Britain for the relief of inflammation of this pouch—the *appendix vermiformis*—and the portion of bowel from which it springs. Their existence is intelligible only when we find them present, in much larger form, in certain of the lower mammals which are of herbivorous habits. Only on the theory of evolution are these facts explicable.

Lastly, let us consider the evidence of comparative anatomy, the science to which the theory of evolution has given meaning and value. Long before the dawn of the theory, anatomists had observed the similarity of structure between one animal, or one plant, and another. It is to us an enduring instance of the power of preconceived ideas that facts so significant should not have taught them the obvious lesson. Instances of these resemblances are countless. The

typical vertebrate, for instance, always has five fingers and five toes on each limb. This is true of the frog and of man. Nor must you hastily deny that it is true of the bird. True, the adult bird has only three and a half fingers or digits in each wing; but if you examine the developing chick you find that it has five, though of these one and a half are useless and destined to disappear. But these significant resemblances go much deeper. Man has a muscle in his thigh which brings the legs into the tailor's attitude and is so called the *sartorius*. But if you descend in the scale, even to the amphibia, and dissect a frog's thigh, you will find a sartorius muscle there too. It is much older than tailoring. Or take three mammals so diverse as man, the giraffe, and the whale. Their necks do not resemble one another; yet each contains neither more nor less than seven vertebræ. Why? And, since we speak of the whale, how comes it that he, too, has five fingers on each hand, though fingers, hand and all, are buried deep in blubber and serve him no purpose whatever? There is only one theory by which these facts and thousands of thousands more can be explained.

To the foregoing there will be added in the chapter on the evolution of man, certain evidences derived from the comparative study of disease, and the comparative study of the blood of different animals—evidence which is almost uncanny in its conclusiveness. But enough has been written in this chapter, it may be hoped, to indicate that the theory of organic evolution is attested by witnesses any one of whom would be credible, and whose united testimony

is irresistible. In the following pages we shall see that there is much more evidence for the theory of organic evolution than may conveniently be set forth at this stage in our study.

CHAPTER III

THE EVOLUTION OF LIFE[1]

In any logical discussion of organic evolution, however brief, one cannot omit consideration of a question with which few evolutionists have concerned themselves, and of which remarkably little is heard in biological controversy at the present time. This is the question of the origin of life, the evolution of living from not-living matter. It was permissible in 1859 for Darwin to postulate a "few simple forms," and then to show their potentialities; but in a present survey of the whole problem we must ask ourselves whence these forms, however few or simple, were derived.

Curiously enough, there is here a difficulty which presents itself only to the man of science. The plain man finds no difficulty in believing that when bread or cheese or old boots are left in a damp, dark spot, living things are developed from them; and, if this be so, there can be no dispute about the evolution of life from the lifeless. But the overwhelming majority of biologists repudiate this belief in "spontaneous generation," declare it to be

[1] In the *Pall Mall Magazine* for June 1905 I have treated this question at greater length than is possible here.

a superstition, and maintain that every living thing must have had a living ancestor—*omne vivum ex vivo.*

Now if we assume that this dogma is true to-day, we find ourselves in a quandary when we come to ask how the first forms of life came to be on our planet. There are only three possibilities. The dogma that life always precedes life may be true to-day, but has not always been true, time having been when life did actually evolve from not-life; or, secondly, the first form or forms of living matter must have been the results of a Creative Act, the law of continuity being interrupted by the intervention of a superhuman Person; or, thirdly, as Lord Kelvin once suggested, the first germs of life may have been borne to this planet by a meteorite derived from the "moss-grown ruins of another world."

With due respect to the most illustrious scientist of the age, we may dismiss Lord Kelvin's theory as, at best, a mere begging of the question. There is evidence of vegetation on Mars, and Professor Pickering maintains that there are traces of its action on the moon; but the problem is not solved by merely shifting its *locale.* Whence the life on Mars, if *omne vivum ex vivo* has always been true?

Then, again, the statement recently made by Lord Kelvin, who speaks without authority on biological matters, that for the origin of life "Science absolutely demands Creative Power," cannot be and is not accepted by biologists. They recognise in it a last survival of the "special creation" myth, and a typical instance of what has well been called the "theology of gaps."

Science would rather have no explanation than a form of words which embodies a proposition that cannot be conceived.

We are forced, then, to the conclusion now generally held by those competent to judge, that *omne vivum ex vivo* has not always been true; that, once upon a time, in conditions which it may now be impossible to reproduce, living matter was evolved from not-living matter on the surface of our planet—in all probability in the waters of the Polar oceans—the first to cool—as Buffon originally suggested. Nor is this by any means inconceivable if we remember that synthetic chemistry can now take the simple elements—carbon, oxygen, hydrogen, nitrogen—and actually build up molecules of albumin from them.

But the philosophic reader will say that he can scarcely stomach the teaching that *omne vivum ex vivo* is true to-day, and has been true for millions of years, but, once on a fateful time, was not true; and such a reader has my sympathy. For myself, I am entirely unconvinced that the evidence supposed to prove this dogma is free from grave fallacy; and, though space does not avail for a discussion of this question here, I would ask the reader to await a book on "The Origin and Nature of Living Matter" which my friend, Dr. Charlton Bastian, F.R.S., will shortly publish. Dr. Bastian is an evolutionist of course, and he sees that the prevailing dogma is improbable, and that its evidential basis is by no means unambiguous. So after a silence of thirty years, the one survivor of the great "spontaneous generation" controversy

in which Tyndall, Pasteur, and Huxley engaged, is to be heard again.

For a philosophic, but somewhat abstract and recondite, consideration of the question of the origin of life, the reader may consult Herbert Spencer's "Principles of Biology," which contains the first serious attempt to grapple with this problem. It did not fall within the province of Darwin, who was a naturalist—to use a term now obsolescent; but it could not be neglected by one who had taken upon himself the demonstration of evolution as a universal principle. Subsequently to Herbert Spencer's discussion of this problem, Professor Ray Lankester has advanced a theory which is based upon his work; and Professor Haeckel has also advanced an unsupported "carbon-theory" of the origin of life.

[Since the writing of the foregoing chapter, and my article in the *Pall Mall Magazine* in criticism of the dogma, *omne vivum ex vivo*, Mr. J. Butler Burke, of the Cavendish Laboratory, Cambridge, has published a preliminary note of experiments with radium and beef-gelatin, both carefully sterilised, which seem to imply the origin of life in the lifeless. Mr. Burke will discuss his work in a volume to be published by Messrs. Chapman and Hall; and I myself hope to publish a volume on the subject in about eighteen months.]

CHAPTER IV

THE CONDITIONS OF ORGANIC EVOLUTION—HEREDITY AND VARIATION

THE proposition that animal and vegetable species change and yet that the changes attain some measure of racial persistence, presupposes two facts which I may call the conditions of evolution —the facts known as heredity and variation.

The fact of heredity, to which I have devoted an entire volume of this series, is beset with a thousand difficulties, and involves a host of problems which interest the man of science not only for themselves but for their practical importance—to which I must allude in considering the teaching of evolution as to human destiny. But for our present purpose heredity is a simple matter—none simpler. When people ask one, "Do you believe in heredity?" they use the term in a sense which is as uncertain as it is unjustifiable. There is no room for disbelief in the assertion that a cat does not give birth to oaks or sheep but always to kittens. This is a fact of heredity, which simply means that *like tends to beget like*; that men "do not gather figs of thistles."

Now it is self-evident that the fact of heredity, if it were not balanced by any other, would be not merely inimical to, but totally exclusive of, the possibility of evolution. If like always begat exactly like, then the present descendants of the primal organisms would be as they were.

This assertion, however, may properly be qualified. For it might be that change or evolution could occur, though heredity were absolute, complete and invariable. For every individual undergoes some change in its own person, in the course of its individual life; not merely the change of normal development from the immature to the mature stage, but change due to its converse with its surroundings. In other words, it undergoes *adaptation to its environment.* If, now, after undergoing a certain change—say the thickening of the skin of the sole of the foot due to walking—the individual reproduced himself, *as changed*, then racial evolution would be possible, even though heredity were invariable and complete.

But, whether or not this power to transmit acquired characters or *acquirements* really exist, and whatever the measure of its action if it do exist, there is also another condition of evolution, to which it is scarcely possible to attach too much importance, and that is variation. A white mouse gives birth to a mouse, and that is an instance of heredity; but the young mouse is sometimes not white but grey, and that is an instance of variation. Hereafter we shall see the essential importance of this condition in the Darwinian explanation of organic evolution.

Now variation, like heredity, is a subject of great complexity: the two must be treated together, and indeed are foremost in the attention of biologists at the present day. It is not necessary or desirable to discuss variation here, for indeed it is a part of the subject of heredity, as we are

now beginning to learn. Variation is not a sort of "bad shot" at heredity, but has laws of its own, and is itself a form of heredity. What is now material for us, however, is merely to appreciate the cardinal fact that heredity and variation are essential conditions of evolution. What Darwin called "natural selection" is the selection of favourable variations: this process could not take place if variations did not occur, and would lead nowhere if such variations were not transmitted and perpetuated by heredity.

There is here a matter of terminology which it is necessary clearly to understand. In the sense in which the word is used by biologists and in this book, variation is an *inborn* change. An individual organism may undergo change by reason of the peculiar conditions of its environment, and thus may come to vary from its fellows; every individual, animal or vegetable, doubtless does so; but such a change is not called a variation, but an acquirement. This definition does not exclude the possibility that a true variation may show itself only late in the individual history, as may quite well be the case even with characters which were truly inborn —latent in the germ. The distinction between a variation and an acquirement is absolutely fundamental, and must never be lost sight of.

Clearly understanding, then, the meaning which attaches to these two words in biology; and clearly recognising that, in all theories of evolution—Lamarckian, Darwinian, Weismannian—these conditions, heredity and variation, are presupposed, we may accept them as facts without here concerning

ourselves with their *causes:* our business in this volume being with their *consequences.* It is worth noting, however, that the fact of variation is that about which the theologico-scientific controversy now rages. In the "Origin of Species" Darwin took the fact of variation for granted, and showed the consequences which may follow from it, without any attempt to explain it. Since the dwindling body of anti-evolutionists have gone so far as actually to study the question before pronouncing an opinion upon it, they have made the signal discovery that Darwin did not explain the origin of variation! Obviously this is a magnificent opportunity for the "theology of gaps." Nowadays the opponents of the law of continuity are compelled to follow the canon of ancient drama, that the intervention of a god must not be employed by the dramatist, save where the occasion really warrants such an extreme measure. Such an occasion is furnished by our present ignorance—which, by the way, has almost disappeared—of the origin of variations; and so it is argued that the Directive and Designing Principle —which has been proved to be inoperative elsewhere—yet really controls the whole process of organic evolution, and thus determines its results by a judicious introduction of those variations upon which the very possibility of evolution, by the admission of the evolutionists themselves, depends. There are some theories which to state is to refute.

CHAPTER V

THE FACTORS OF ORGANIC EVOLUTION— NATURAL SELECTION

Natural selection, or the principle of the survival of the fittest, takes precedence of all the other factors of organic evolution, by reason of its potency. It may therefore be considered first, though its recognition by no means marks the first epoch in evolutionary thought. Exactly *how potent* it is we must later consider.

Centuries before Christ, Empedocles had suggested that, of the atoms conceived by his master Democritus, some would nicely harmonise with their conditions, whilst others would not. The former would persist or "survive," the latter would disappear. The same idea occurred in the early years of the nineteenth century, independently, to Dr. Wells and to Matthew Hay—in their case in reference not to atoms but organisms. In 1851 Spencer expressed the same idea in his "Social Statics"—this time in reference neither to atoms nor organisms but to societies. In spite of the assertions commonly made by interested writers, the idea does not occur in Cardinal Newman's "Essay on the Development of Christian Doctrine," which I have read for the purpose of deciding this point. Thus the reason why "the evolutionists have never had the honesty to acknowledge their indebtedness to Newman" is that there is no debt to acknowledge.

The idea of organic evolution, which Newman never accepted, had been promulgated before his birth.

Despite these names, and that of Mr. Wallace, there is one man, and one alone, to whom belongs the enduring honour of establishing this principle as part of recognised Truth, and that man is Charles Darwin. The "Darwinian theory" is not that animal and vegetable species have evolved; it is not that man is descended from a monkey; it is that *an important factor in such evolution is natural selection.*

If we observe the progeny of any generation of animals or plants we find that they vary somewhat, on the average, from their parents. Some of these variations are favourable, others unfavourable, to the life of the possessor. If, then, there be not room for all, the fittest will survive, the word fittest having no moral connotation, not meaning the *best*, but the *best-adapted* to the environment. The reverse of this proposition—that the unfittest should survive—is inconceivable, as Spencer observes: so that the survival of the fittest, being a proposition the negation of which is inconceivable, is a "truth of the highest certainty."

Now let us most clearly understand that the Darwinian theory has nothing of the inevitable about it: since the conditions that make it possible may not be satisfied. If, for instance, the environment be so favourable, enemies so few, food so abundant, that *all* variations not absolutely disabling can survive and propagate their like, then natural selection is abrogated: universal survival replaces survival of the fittest. It is, perhaps, if we knew

it, the leading practical question of the present age whether or no this abrogation of the law of natural selection is not disastrously occurring amongst ourselves.

Natural selection, then, need not always be at work. But even when it is at work, it need by no means necessarily make for what *we* call progress. Natural selection selects those variations which tend to promote life. Now these may be good or bad, according to our standards—of which Nature takes no cognisance. If, for example, there occurs a variation in the direction of greater intelligence, that variation makes for survival; and, as it happens, we call it good. But there may occur such a variation in the digestive apparatus as adapts the new organism to a parasitic life, otiose, degraded, but safe. Again the fittest survives, but in this case the fittest is what we should call the worst.

Natural selection, then, is not always operative; and, when operative, has no concern with higher or lower, better or worse, but merely with fitter or less fit.

But if this be so, rightly observes the critic, how do you explain the observed *fact of progress?* If natural selection is morally blind, how comes it that, solely under its sway, as some assert, there have been evolved morality and intelligence—all that stands to us for progress? Must there not be some *final cause*[1] which directs the evolutionary process. In other words, though the evolutionists have disproved the teaching as to Creative Design in the wing of the bird, or the shape of the flower.

[1] A design towards a purpose or end: (final = end-al).

must it not yet be said that there is Design in Evolution?[1]

The answer to this, as we shall see in another volume, is that morality is itself a factor that makes for survival (union being strength), and that therefore morality finds in biological facts a natural and perdurable sanction which antedates all the churches by tens of millions of years.

Then, again, it is said that natural selection is a cruel law. Alfred Tennyson, the first poet to recognise and to appraise the moral and philosophic significance of organic evolution, speaks of Nature as "red in tooth and claw"; "so careful of the type she seems, so careless of the single life;" and we are often told that Nature cares nothing for the individual, but only for the race—as if a race were not a collection of individuals.

But these phrases of Tennyson's cannot be allowed to pass unchallenged. On the contrary, it must be asserted that natural selection is a benign and merciful law: contrasting, in this regard, with the human laws which allow the criminal, the drunkard, the insane, the tuberculous, to propagate their kind. By destroying the unfit, or refusing to allow them opportunity to reproduce themselves, Nature increases the amount of organic fitness in the world; and no competent person now disputes that Spencer has proved the relation, now and in the past, between fitness and happiness. Natural selection, therefore, constantly works for greater happiness, and if there exist any other

[1] See, for instance, the Rev. Professor George Henslow, in "Modern Rationalism Critically Examined."

method so well adapted to this end, it has not yet been conceived by the mind of man.

But the critic may reply, with the late Lord Salisbury, that, in point of fact, "no one has seen natural selection at work." What positive experimental evidence is there that this thing exists outside the pages of modern treatises? It is not sufficient to show that, if it existed, it could do many things; it is necessary to show that it does exist. This challenge had to be met. We could not be content even with showing, from *à priori* considerations, that natural selection must be and must have been at work. If others could be content with *à priori* argument—that is, argument that, since so-and-so is so-and-so, then something else must follow — men of science could not, for they have been fighting, since the dawn of science, against the countless lies which the *à priori* method has asserted as true. If possible, we must certainly establish the fact of natural selection by the *à posteriori* or specifically scientific method, which begins by recording facts and facts and more facts, and then proceeds to base general conclusions upon them. And already, even within the few years since Lord Salisbury issued his challenge, we have been able to adduce actual observations of what no one can doubt to be "natural selection at work."

In 1893, 1895, and 1898 careful measurements were made of the shells of a certain kind of crab (*Carcinus mœnas*) which lives in Plymouth Sound. It was found—one need not give all the details here[1]—

[1] See Report of British Association, 1898, p. 887.

that the average breadth of these crabs had rapidly diminished. Now Professor Weldon observed that, during this period, a huge breakwater was being built in Plymouth Sound, which affected the movement of the water, and permitted the large quantities of china clay which the rivers carry from Dartmoor to the Sound, to be deposited in hitherto unprecedented amount in the Sound itself. Other foreign matter also found its way into the Sound in increasing degree, owing to the increase in population on its banks. The suggestion was that a relative narrowness of the shell became an advantage—a survival-factor—to the crabs placed in this changing environment. Therefore Professor Weldon made a simple experiment. He placed a number of crabs in a vessel filled with sea-water, and suspended some fine china clay therein. When he came to measure the living and the dead crabs, he found that the former had, on the average, much narrower shells. He further showed that the crabs with narrower shells are able, more efficiently than the others, to filter the water which passes through their gills. The evidence is not absolutely conclusive, and it will be necessary to make further measurements of these crabs every few years; but, at any rate, these studies may be regarded as very nearly tantamount to experimental proof of the theory of natural selection.

This I have selected as one representative instance of the kind of evidence which is now being accumulated. Other instances deal with mice and sparrows and man and other creatures. For more detail than I have space to recount I would refer

the reader to the chapter of Dr. Vernon's "Variation in Animals and Plants,"[1] which he entitles "The Action of Natural Selection on Variations."

It has already been noted that Darwin's original term, "Natural Selection," was hardly satisfactory. It was not self-explanatory, and it seemed to point to some conscious agency which selects. We may, therefore, ask how it was that Darwin came to employ this term. The answer is that he desired to express the parallel between natural selection and artificial selection. His study of animals and plants under domestication taught him, not merely that species are capable of profound modifications (the pouter pigeon, the race-horse), but also the lesson which it remained for an open-minded thinker to learn therefrom—that what conscious agency accomplishes in such cases other agencies may be conceived to accomplish in the case of animals and plants that live in natural conditions. The phrase *natural selection*, and the idea it embodies, offer a conspicuous instance of the really fruitful and scientific use of the argument from analogy, which has been misleading men ever since they started to think. The difference between the Darwinian and, say, the Socratic employment of analogical reasoning—to instance the name of its first conspicuous advocate—is that Darwin, led to a possible inference by analogy, was not content to accept it without question, but spent decades in applying his unsurpassed powers of observation and his impeccable fidelity in confirming it by that right

[1] Kegan Paul, Trench, Trübner & Co.

interrogation of Nature which Bacon advocated. By such means alone can the analogical method yield any valuable conclusions whatsoever. But whereas the poets' and metaphysicians' employment of analogy entails little mental effort, and occupies only a few seconds, the method that leads to Truth demands infinite patience, perseverance, and fidelity, superadded to rare powers of observation. There is no royal road to knowledge.

CHAPTER VI

THE FACTORS OF ORGANIC EVOLUTION—SEXUAL SELECTION

THE "Origin of Species" was the fruit of some twenty years of observation and thought. Thereafter, whilst others bore the brunt of controversy, Darwin resumed his work in happy and untroubled personal obscurity. Twelve years later he published his "Descent of Man," in which is stated another factor in organic evolution which he named "sexual selection." Whilst the action of this factor is by no means confined to man, Darwin considered that it had been of especial importance in his evolution. Concerning this factor there has been, and still is, much biological controversy. In his article "Evolution"[1] in the tenth edition of the *Encyclopædia Britannica*, Dr. Chalmers Mitchell expresses the opinion that sexual selection is of considerably

[1] This article is, of course, quite incorrectly named. It deals merely with organic evolution.

less importance than Darwin thought; but we shall see that very recent work done by the newest school of biologists—the biometricians, followers of Darwin's distinguished first cousin, Mr. Francis Galton—affords evidence which goes to show that Darwin by no means overestimated the importance of this factor.

Of all the individuals of any species, living at any given date, some will leave many descendants —more or less like unto themselves—others will leave few, and others none. It is a question of the first importance to determine the factors which decide whether a given individual is to belong to one group or another: for if these be persistent in their operation, the type of the race must necessarily change. Now we have already seen that as man, by artificial selection, chooses certain types of domestic animals and puts them into the first group, whilst relegating others to the last, so "Nature," by the analogous process of "natural selection," similarly allocates the individuals of any generation to one or another category. In the process of artificial selection, man chooses certain characters—now one, now another—which please him; in the process of natural selection, "Nature" chooses always one character and one only, that pleases her: which character is *fitness*. It is now, further, to be found that the individuals themselves exert a selective action, the character which they choose as their criterion being *sexual attractiveness*. That and that alone is the concern of the chooser of a mate;[1] but

[1] "Marrying for money" is a pathological phenomenon which does not concern us here.

it is evident that the ultimate consequences will be far wider than the mere consideration of the immediate criterion would suggest, for sexual attractiveness may be *correlated*—to use the technical term—with various other characters, such as strength and intelligence; which thus tend to be perpetuated.

This conscious and, so to speak, æsthetic aspect of sexual selection may first be briefly considered, ere we ask whether sexual selection may not work in other ways as well. It is evident, of course, that this mode of sexual selection can act only where there is some measure of æsthetic perception. The animal that has but a feeble colour-sense, and likes no one colour better than another, is as likely to choose a sober- as a gay-suited fellow. Therefore it may be argued that this form of sexual selection is of relatively recent development; and, indeed, must tend to increase in importance as the æsthetic faculty comes to be more widely disseminated and more cogent in its demands.

In human society of the present day, sexual selection is perhaps more especially exercised on the part of the male. In most civilised communities of our time, there are, for instance, more women than men, and, given the observance of monogamy, it is self-evident that the women whom men regard as preferable will, on the average, be preferred. But even though marriage is usually "more important" for a woman than a man in these days, there is, of course, a measure of sexual selection exercised by women. Here and there is a man who has never been able to find a woman who will "take pity on him"; and his particular type therefore tends, in

virtue of sexual selection, towards extinction. But in the case of the lower animals—and therefore throughout the greater part of the history of this form of sexual selection—it would appear that the taste of the female has been more important than that of the male. Hence the results of sexual selection are more conspicuous in the male than in the female. Characters produced by sexual selection are called "secondary sexual characters," and it is chiefly to the male that we look for examples of them. Amongst such are, in all probability, the beard of man (though, as it happens in our particular generation and society, this happens to be rather a sexual disadvantage, in the majority of cases, than the reverse); the mane of the lion; the voice of the cock and the lark; the magnificent plumage and colouring of the peacock; and so forth—examples being innumerable.

But this is only one mode of sexual selection—perhaps the least important. Consider the case of half-a-dozen males of any species, each of whom desires sole possession of the one available female. In the ensuing battle victory will commonly go to the superior strength, intelligence or cunning, fleetness, perseverance. If these characters are transmissible—a fact of which there is no question—the next generation of this species will tend to possess them in greater degree than the last. There is neither space nor occasion to elaborate this argument here;[1] but it is still necessary—fallacies having many more lives than the proverbial cat—to consider

[1] Mr. Murray has lately issued a complete edition of the "Descent of Man" for half-a-crown.

the relation of the theory of sexual selection to certain statistical facts of human marriage.

Married men live longer on the average than bachelors. The wholly unjustifiable inference still continues to be drawn, despite Spencer's exposure of it in the "Study of Sociology," in 1873, that marriage is conducive to longevity. The truth is that married men are selected; and, as they are the fathers of nearly all of the younger generation, it is well that they should be selected. In some degree they are selected by their mates, who tend to prefer energy, health, and the good looks bred of health. Furthermore, it is the robust man who, in greater degree than the weakling, has the inclination towards that which marriage satisfies; and it is the healthy man who is more able, on the average, to earn the means which permit him to marry. In these various ways, then, marriage tends to health; and the superior longevity of married men is thus a consequence of a certain mode of sexual selection, not a consequence of the married state.

Lastly, we must consider an aspect of sexual selection which has recently been emphasised by the work of the biometricians—the new school of biologists who employ the methods of mathematics in studying the problems of life. Professor Karl Pearson and his co-worker, Professor Weldon, have recently made a most comprehensive research into the facts of human marriage, by studying, for instance, the tombstones of rural Oxfordshire, the dales of Yorkshire, and the London cemeteries, and by inquiries into pedigrees, such as those furnished by the records of the Society of Friends. They

have thus been able to prove that, on the average, *like tends to mate with like.* This fact is, of course, in a measure obvious. The individuals of any species are, as a rule, unattracted by the individuals of any other species. But these researches, so far as they have gone, appear to show that this principle, which Professor Pearson calls *assortative mating*—as distinguished from the *preferential mating* which we have already discussed—holds good within the species also. For instance, despite a popular impression that extremes meet in marriage, it has been shown by examination of thousands of the living, that a blue-eyed man is more likely than a brown-eyed to marry a blue-eyed wife. People with a "strong constitution" (of which longevity is taken as the criterion) tend to marry their like; short men tend to marry shorter women than do tall men, and so forth over a whole host of characters. Further, Professor Raymond Pearl, of the University of Michigan, has found that the same is true of certain animalcules—unicellular creatures about one-hundredth of an inch in length—known as the *paramœcia.* In all probability the same holds good throughout the animal world generally, though no inquiries have yet been made. This principle, the mating of like with like, Professor Pearson calls *homogamy;* and he regards it as having been a most important factor in the isolation and perpetuation —indeed, in the "origin"—of animal species. This is a mode of sexual selection which furnishes, it would appear, a most important addendum to Darwin's "Descent of Man." It occurred to me that, if homogamic unions could be shown to be more

fertile than those between individuals markedly unlike, the principle might be regarded as applicable to plants as well as to animals; but Professor Pearson tells me that, as yet, there have been made practically no investigations into this aspect of the question.

CHAPTER VII

THE FACTORS OF ORGANIC EVOLUTION— TRANSMISSION OF ACQUIREMENTS

Concerning the action of natural selection and sexual selection no one now doubts, but concerning the action of the factor now to be discussed there still rages much controversy, and the more accepted opinion is that this factor is entirely inoperative.

It is plain that if acquired characters or acquirements are transmitted, such transmission must be a factor in organic evolution—and a most potent one. But the question first to be answered is, Are they transmitted? Until not so long ago every one would have answered this question in the affirmative. Lamarck, who founded the belief in this factor, would have been seconded by Darwin himself, who even invented a theory to explain the manner of its occurrence. Spencer also would have rendered an affirmative, and so does Haeckel today.

The question here at issue is plainly a problem of heredity, and I have discussed it at no greater length than its importance demands in a companion volume to this. Here, therefore, the matter may

be most briefly considered: ignored in a discussion of the possible factors of organic evolution it cannot be.

In the first place, it must be noted that the importance of this factor—assuming it to have any importance at all—is very much smaller than it was formerly thought to be. A very large number of facts which it was once invoked to explain can be more completely and convincingly explained on the theory of natural selection. Furthermore, it is evident that, at any rate, this factor is far less important than it might be. If there be transmission of acquirements it is far from complete. Were it complete the facts of human life would to-day be almost infinitely different from the facts as they are: the child of the scientist would inherit all his father's knowledge; the child of the linguist would enter, by right of birth, into mastery of all the tongues his father had learnt by dint of arduous effort; the child of the cricketer would not require to learn the art of playing with a straight bat; each generation would begin where the last "left off." This, we know, is not so: plainly, therefore, if the transmission of acquirements be possible, its scope is very limited, and the question arises whether if, as we certainly know, many acquirements are not transmissible—whether any are transmissible. May not the circumstances which veto the transmission of so many veto the transmission of all?

Secondly and lastly—for one can fortunately save much precious space in this matter—let us briefly note the chief objection of the Weismannians to the belief in the inheritance of acquirements as a

factor in organic evolution. It is really this: that, on their master's theory of reproduction, *it is impossible to conceive how such transmission can occur.* Here I would merely enter a demurrer against this objection, on the grounds that it is unphilosophic. There are countless observed and admitted facts, in all the sciences, which it is as yet impossible to explain. But facts being "chiels that winna ding," they must be accepted nevertheless. Similarly it does not matter one straw whether the Weismannians are unable to conceive the manner in which certain facts may be brought about, *if they are brought about.* When I say it does not matter I do not mean that it is immaterial whether or not the facts are explained; but that the lack of an explanation cannot for one moment be held to affect or prejudice the fact-ness—if I may coin a word—of any fact. If, then, observation and experiment reveal any instance or instances where, in point of fact, acquired characters *are* transmitted, the controversy must, *ipso facto*, be regarded as at an end. Such facts, I believe, have been recorded, and elsewhere I detail them. If this belief be well founded, we are not bound by our further acceptance of Weismann's brilliant theory of the continuity of the germ plasm, to deny that the transmission of acquired characters is, within certain limits and in certain conditions, a factor in organic evolution.

CHAPTER VIII

THE FACTORS OF ORGANIC EVOLUTION—ARE THERE ANY STILL UNKNOWN?

Formidable though the evidence for organic evolution be, and finally though the belief in it has been established by the work of the past half-century, it would be idle to deny that there is yet difficulty enough in explaining many of the facts of animal and vegetable life. Darwin himself said that he could never think of the eye without something like a shiver—for indeed there does appear to be something worse than presumption in the attempt to explain the evolution of an organ so complex by the action of such a principle as natural selection. Needless to say, the evolutionist's difficulty is his opponents' opportunity. Whilst he attempts, by thought and observation and experiment, to show how this and that structure may have been evolved, they seek to insist upon the presence of the difficulties—which is unnecessary, since no one denies it—and to declare that they are insoluble—which is to indulge in that "most gratuitous form of human error" called prophecy. Indeed, more and more difficulties are yearly solved, but many yet remain. At this point there begins the latest phase in the struggle between the scientific student of life and those who seek to reconcile his novel conclusions with others which have antiquity, if nothing else, to commend them.

The belief in organic evolution is now, as we have

already observed, accepted by many outsiders whose predecessors denounced it as impious and blasphemous. But this is the usual manner of acceptance: Yes, certainly evolution is true, but your explanation of its *modus operandi* is imperfect, and must ever remain so. We say it is imperfect because it does not explain all the facts: we say it must ever remain so, because there is one essential factor in organic evolution which you are not capable of recognising until you are convinced that your own explanations are inadequate. This factor is a Directive or Designing Principle which controls the whole process from outside, producing those favourable variations the origin of which you are admittedly unable to explain; and ever exercising a subtle but indispensable influence upon the course of the whole process. This is the "unknown factor" in organic evolution.

Let us carefully consider the real meaning of this contention. The evolutionists have shown that, for instance, the shape of the plant which catches and imprisons the insects that serve for its food is not, as was supposed, an instance of Creative Design, but has been produced by natural selection. The contention of the new school of "reconcilers" is, when examined, found to entail nothing other than the reinstatement of the idea of design in a shape somewhat less crude than that which satisfied Paley. But the position of our friends is really untenable; for it amounts to nothing less unphilosophic than the admission of the natural explanation whenever it is feasible, and the assertion of the supernatural explanation

elsewhere. But if they postulate a conscious directive agency which merely happens to prefer this very roundabout and relatively inhumane method of gaining its ends, why need they accept *any* of the explanations we offer? Granted that evolution has occurred, and is occurring, why trouble to recognise the action of natural law at any point if a Divine Will is to be postulated elsewhere? Why not allow the Divine Will to have the whole field to itself? Or if, on the other hand, they will maintain the truly philosophic view that natural selection, for instance, being a law of Nature, is a law of Nature's God, why not admit that other laws of Nature may acccount for the facts unaccounted for by the particular law which they do recognise? If natural selection be a law of Nature's God, why should He require to supplement its action by His own immediate volition? Why should He not have promulgated enough laws to do all the work?[1]

In point of fact, there is not to be found any biologist of note who is concerned to discover any hitherto "unknown" factor in organic evolution. On the contrary, it is more apparent every day that the factors with which we are already acquainted will prove amply sufficient for the explanation of all the facts. So far are those competent to judge from seeking any factor hitherto unrecognised, that the only outstanding question is whether certain of the alleged factors are not superfluously invoked to explain facts which are more easily explained without their assistance.

[1] The above must not be taken as implying any assent of mine to certain of its assumptions. My business has merely been to show the unphilosophic character of the position stated.

CHAPTER IX

THE EVOLUTION OF PLANTS

Our chief concern in this book is with organic evolution as a doctrine indispensable to the serious and systematic student of human life: for the nonce we are "men in a world of men," rather than biologists. Hence the vegetable kingdom (without which we could not be) interests us rather in its relation to animal life than for the many characters which fascinate the botanist. But, even in such a work as this, it is impossible wholly to ignore the history of evolving life as manifested in fungus, fern, and flowering-plant.

Adequately to discuss this subject would entail numerous digressions and footnotes concerned with botanical nomenclature; would demand the services of an expert in fossil botany; and would also necessitate the writing of a chapter on geology, for which it is impossible to spare any space here. We must therefore content ourselves with a broad and general survey of the subject, whilst fully recognising that its scientific importance is far greater than such a survey might suggest.

If we take a "bird's-eye view" of the vegetable world of to-day, we find, as the general doctrine of evolution would lead us to expect, that it presents certain parallels to the animal world. We see simple one-celled organisms, such as the bacteria, in great abundance, at one extreme; and complex

forms, such as the oak or the rose, at the other. Similarly we find that, as in the case of the animal kingdom, the highest forms of vegetable life reproduce themselves by single cells, as does man himself. Thus, in accordance with the recapitulation theory, the individuals of even the highest vegetable and animal species begin their career as single cells, as did the age-long race from which they are descended. Also we find that in the economy of the higher plants as in that of the higher animals, a great part is played by that vastly important differentiation which we call sex.

If, now, with a well-founded prepossession in favour of the theory of organic evolution, we study the comparative anatomy of the vegetable kingdom, we find every fact in favour of the theory. Confining ourselves solely to the study of the vegetable forms which people the earth and the sea to-day, we find it possible to arrange them in what, but for the fact of their simultaneous existence, might well be called a more or less complete genealogical order. We find, also, that the conditions of evolution—heredity and variation—are conspicuously illustrated by the vegetable kingdom; and that the factors of evolution may similarly be observed. Even the most striking examples cited by our grandfathers as evidence of Creative Design, are found to be susceptible of a rational explanation in terms of such a theory as natural selection. Everywhere we find the most striking illustrations of the principle of adaptation to environment. In short, every kind of evidence which the vegetable kingdom might be

expected to afford, were the theory of organic evolution true, is afforded us without stint.

Having reached these conclusions—for which I would ask the reader not to take my word, but rather to study the classical and compendious pages of Darwin—we naturally turn our eyes to the past, and ask whether there is any positive evidence as to the history of vegetable life; and whether such evidence lends support to the theory of creation (if a legendary statement of the inconceivable may be called a theory) or to the doctrine of evolution. Dig as deep as we may, do we find evidence of the past existence of more complex forms in as great abundance as to-day, or is the geological record a record of ordered change?

The great principle which biology has established is indeed found to be abundantly supported by the record of the rocks, in regard to botanical as well as zoological facts. And it has given meaning and profound interest to a new study, now being prosecuted by many ardent students, which is known as *palæobotany*. The science of palæontology is naturally divisible into the study of animal and the study of vegetable fossils. The latter we now dignify—the honour has been earned—by the special title of palæobotany. The amateur reader may not inexactly gauge the suddenness with which—in virtue of the universal acceptance of the doctrine of organic evolution—this study has leapt into prominence, by noting the closely printed thirty pages devoted to it in the tenth edition of the *Encyclopædia Britannica*, and then rummaging through the old volumes in the hope—all but vain—that he may somewhere,

under some remote heading, find some allusion to it.

Such evidence as is afforded by the fossilised remains of plants—those preserved by petrification have been of chief value—teaches us most unequivocally the truth of the doctrine of organic evolution. In amazing measure—if we consider the conditions under which the evidence has been preserved—does the actual historical record coincide with that hypothetical table of genealogy which the botanist might amuse himself in reconstructing from the facts of the vegetable life now extant. Arguing from the known facts of comparative anatomy he would regard it as probable, let us say, that the ferns are older than the flowering-plants, the algæ or bacteria older than the ferns. And when the proposition is put to the rocks, they affirm it by yielding evidence of ferns, but none of flowering-plants, in strata older than those which yield fossilised remains of both; and so forth.

If we make an ideal section of the earth's crust, we find that, above a certain level, there begin to appear remains of living things. It is, of course, of great interest in relation to the origin of life, to determine the characters that differentiate the strata above this level from those below it; but here we will simply accept the fact that, at a certain level, there appear signs of past life. The many strata above this level may conveniently be divided into three successive lots, which are called primary, secondary, and tertiary; or palæozoic, mesozoic, and cainozoic, to indicate that they contain *ancient*, *intermediate*, and *recent* animal remains. Lately we

have learnt that the remains are vegetable as well as animal: so that the terms should properly be palæobiotic instead of palæozoic, and so forth. What, then, is "time's abstract and brief chronicle" thus furnished us?

In palæozoic times there certainly existed many kinds of *algæ*, the simplest known order of green or chlorophyll-containing plants. Here, at the outset, is a fact of far more than botanical or palæobotanical importance: for we know that the animal kingdom, in general, ultimately depends for its food entirely upon the chemical powers which the possession of chlorophyll confers upon the green plant. It was therefore to be expected that the advent of the green plant should prove to be as early as the early stages of animal life; and so it was. . . . We also find remains which show that the fungi—those lowly plants which contain no chlorophyll — already existed in the primary or palæozoic period; whilst students competent to judge accept as proved the existence of bacteria—the lowest order of fungi—in those times. Many plants which correspond to our present mosses and ferns also existed; *but there is no trace whatever of the flowering-plants*, a term which properly includes what we call trees, all of which bear unmistakable though usually very inconspicuous flowers.

The remains of the giant ferns of the later ages of the primary period now serve mankind in a thousand ways under the name of coal.

In the later stages of the mesozoic period we find the first signs of the higher kinds of plants which rapidly carried all before them, almost put an end

to the history of many of their predecessors, have persisted and more than persisted through the subsequent epochs, and now reign in the vegetable kingdom as effectively as the vertebrates in the animal kingdom.

Meanwhile a vast number of species have succeeded in persisting from palæozoic and mesozoic times; many of them, so far as can be judged, without having undergone any change through all these ages. To this fact of the *persistence of types*, which is exemplified in both the vegetable and the animal kingdom, we shall revert in a later chapter,[1] since upon it has been founded a specious objection to the theory of organic evolution, and since it is incompatible with that popular misreading of the theory which regards it as expressing a principle of *necessary* "progress," or ascent from lower to higher forms.

CHAPTER X

A CONCLUSIVE INSTANCE

We have now considered, in brief, the main lines of evidence in favour of organic evolution; we have noted the conditions upon which it depends, and the factors of its course; but sceptical readers—of whom I would rather have ten than ten times ten of the credulous—may yet be inclined to exclaim that "all this is very well, hangs nicely together, is plausible and interesting; *but* is there, or is there not, any conclusive instance of the

[1] See Chapter XII.

evolution of any species. The thing may well have happened; it is difficult to understand, indeed, what else could have happened — but, has it happened?"

The reader who adopts this position is in company no less distinguished than that of Thomas Henry Huxley. This redoubtable champion of the "New Reformation" was never tired of insisting upon the immorality of belief without sufficient evidence, as against the contention of all churches, that it is immoral to refuse belief without evidence; and Huxley was not the man to confound precept by practice. Thus for many years he declined to admit that the fact of evolution was proved. It was probable, and more than probable, but it was not proved. In this chapter I propose briefly to recount an instance of evolution which even the sceptical Huxley—who did not live to see it in the perfect form it presents to-day—was prepared to quote as "demonstrative evidence" of organic evolution. This great service, the affording of unquestionable proof of this momentous theory mankind owes to its trusty servant the horse.[1] Let us now look at this familiar beast from a new point of view.

The modern horse is a very specialised animal. There is no mistaking him, nor any mistaking the fossil remains of his immediate ancestors. Notably is he distinguished by his limbs and his teeth. Let

[1] The horse always stands to me for three things. First, its obsolescent use as a beast of burden. Second, its proof of the truth of organic evolution. Third, its priceless services—irreplaceable by any machine—in giving its blood to save our children's lives when they are in the clutches of diphtheria.

us consider, in especial, his fore-legs. It is the characteristic of vertebrated animals—all of whom, on the evolutionary theory, have a common origin—to possess two pairs of limbs. The anatomical parallelism between such limbs, wherever met, is technically known as *homology*.[1] Thus the fore-limb of a horse is the homologue of the fore-limb of man or the frog or the bat. Now there is a well-marked type to which the vertebrate fore-limb—the case of the hind-limb is quite parallel—in general conforms. In the upper segment of the limb there is one bone, the *humerus;* in the next segment there are two bones, the *radius* and *ulna,* to which is attached the wrist, usually consisting approximately of two rows of four small bones each; and to the wrist is attached the hand, which is a *five-fold* structure. The vertebrate hand (and foot) is typically five-fingered, or, to use the exact Greek equivalent, *pentadigitate.* The hand with which you are holding this book, and the hand of a frog, are the first instances that occur to me.

But there are exceptions, you will say; to which I retort that, for once in a way, we can attach a real meaning to the proverb, usually quoted without any meaning, that the "exception proves the rule." The exceptions to this rule really do prove it; which is indeed to say that they conform to it, appearances notwithstanding. Let us consider the case of the birds (I have not forgotten the horse, though I

[1] The term analogy is applied to organs which serve the same *function* in different species, though their place in the structure of the animal may be dissimilar. Thus the wing of a bird and the arm of a man are homologous, but not analogous. The skeleton of a man and that of a lobster are analogous, but not homologous.

appear to wander). The hen, for instance, does not have five fingers in her wings, vertebrate though she be. In point of fact, she has three and a half fingers in each wing, as a simple dissection demonstrates. What, then, becomes of our theory that the typical vertebrate hand is pentadigitate, and our inference that this is presumptive proof of the evolution of all vertebrates from a common stock? We answer by asking you now to dissect the embryonic form of the hen. When we examine the embryo chick, *it is found to have a five-fingered hand.* Later, one and a half fingers, which are found to be superfluous for the due efficiency of the wing in its new *rôle* as an organ of flight, undergo atrophy, and disappear. You are tempted to suggest that this formation of more fingers than are to persist is somewhat pointless and lacking in economy. That may be, but it at least serves this purpose: that it is an instance of a fact which, on the theory of organic evolution alone, is capable of a rational interpretation.

Turn we now to another apparent exception—the modern horse. Comparative anatomy affords us some very interesting information concerning the fore-limb of the horse. It teaches us—as no one who has looked into the matter disputes—that what we call the knee of the horse is really its wrist. Its "cannon-bone" corresponds to the middle one of the five bones (called metacarpals) which constitute the skeleton of the palm of the human hand. The three bones which the veterinary surgeon knows as the "pastern," the "coronary," and the "coffin" bones, are strictly homologous with

the three bones of the human middle finger; and the horse's fore-hoof is the nail of that finger; whilst the hoof of each of its hind-legs is similarly the nail of the third or middle toe. In point of fact, the horse walks upon the extremities of the nails of its middle (and, as we shall see, only remaining) fingers and toes. Place your two middle fingers upright on this page, with only the nails touching the paper, imagine the thumbs and remaining fingers, together with the bones that support them, to be absent; bend the wrists forward, as the horse's so-called knees are bent, and you will obtain some idea of the highly specialised manner in which the horse walks. Lastly, let us note that the horse's cannon-bone is supported on each side by two small and useless bones, to which no fingers are attached, but which must be regarded as corresponding to the second and fourth metacarpal bones of the human or any other vertebrate hand. Occasionally there is born a foal whose hands and feet contain further rudimentary bones which obviously approximate them still further to the general vertebrate pattern.

Here I omit any description of the horse's teeth, and will proceed to quote a paragraph from Huxley,[1] which serves fitly to introduce the next part of this chapter:—

> Hence the general principles of the hypothesis of evolution lead to the conclusion that the horse must have been derived from some quadruped which possessed five complete digits on each foot; which had the bones of the forearm

[1] "Lectures on Evolution."

and of the leg complete and separate, and which possessed forty-four teeth, among which the crowns of the incisors and grinders had a simple structure; while the latter gradually increased in size from before backwards, at any rate in the anterior part of the series, and had short crowns. And if the horse has been thus evolved, and the remains of the different stages of its evolution have been preserved, they ought to present us with a series of forms in which the number of the digits becomes reduced; the bones of the forearm and leg gradually take on the equine condition; and the form and arrangement of the teeth successively approximate to those which obtain in existing horses.

Surely any unprejudiced student will be prepared to regard as a conclusive instance the actual demonstration of these intermediate forms. This, and no less, has actually been accomplished.

The remains of the horse found in European cave deposits and gravels give us no help. Their characters are indistinguishable from those of the horse we know. In earlier deposits, in Europe and India, we come upon remains which cannot be denied equine rank, but in which there are two small digits, one on each side of the central digit. These lateral digits do not touch the ground. This extinct horse, or ancestor of the horse, is known as *Hipparion*. Before him there was another animal, now known as *Anchitherium*, which possessed three complete toes, all of which touched the ground, and were doubtless of actual use. This European sequence, Anchitherium, Hipparion, Equus, is very suggestive indeed, especially when we take into account various other skeletal and dental characters which I cannot detail here. It seemed suggestive to Huxley, and

he regarded himself as justified in quoting it as demonstrative evidence of organic evolution.

But indeed this European evidence sinks into something like insignificance when compared with the evidence which has subsequently been afforded us by the researches of Marsh and others in America. When the New World was discovered, the horse was totally unknown to its inhabitants. There was to be found no sign of its existence. But the American palæontologists have discovered, one after another, the remains of various horse-like animals, now in more superficial strata, now lower down. The lower the stratum the closer the approximation of the remains to the ordinary vertebrate type. Thus, at the present day, you may walk beside the walls of an American Museum, and may be defied to indicate any break or gap in the collection of fossil remains which continuously connect the horse of to-day with a five-toed animal, hardly bigger than a large pig, which once flourished on the continent of America. Even since Huxley welcomed these American discoveries as confirming the opinion he had formed of the meaning to be attached to the work already done by the European workers, fresh remains have been unearthed, and now the series is absolutely complete. The evidence of the limbs and teeth is conclusive. Whatever the factors of evolution—whatever the forces, personal or impersonal, that may or may not preside over it—whatever its implications as regards man and his most cherished dogmas—the history of the horse conclusively proves that, in the case of one extant species at any rate, *evolution has occurred.*

The only other conceivable explanation is, as was suggested to Huxley, that these fossil remains are special creations intended to test our faith in Holy Writ. Between this inference and that already drawn, the reader will judge.

This chapter must not conclude without the recording of an event which I regard as not without historic interest. At the Royal Institution of Great Britain there have been delivered, during the Christmas holidays of many past decades, a series of lectures "adapted to a juvenile auditory." The lecturer for the Christmas of 1903 was Professor Ray Lankester, and his subject "Extinct Animals." In point of fact, these lectures consisted of a most complete marshalling of all the evidence afforded by palæontology in favour of the theory of organic evolution. But the title sounded innocent enough, and the famous theatre was daily filled with children. Professor Lankester naturally devoted a large measure of his time to a discussion of the history of the horse. I was struck by the consideration that many of the little boys who listened to and honoured with their applause the distinguished lecturer, will, in a few years, qualify themselves for entrance to the University of Cambridge by reading the works of Dr. Paley, who died four years before the publication of Lamarck's great work. The question one asks is as to the consequences which may ensue in these young minds, many of which are doubtless destined to take a large share in the direction of this people in coming years, when the arguments of the learned exponent of Creative Design are met by the memories of Professor Ray Lankester's

disquisitions. I took the trouble to count the little boys and girls at each lecture, expecting to find indications that their parents saw the "drift" of these pleasant chats on "Extinct Animals." But the numbers did not diminish. I will do Professor Lankester the justice to say that, as far as the substance of the lectures was concerned, their title might have been "Palæontology versus the Creation Myth," instead of this simple-seeming "Extinct Animals." Plainly we have travelled since 1859. *E pur si muove.*

CHAPTER XI

THE PAST EVOLUTION OF MAN

It is one thing to accept the assertion that some one or other of the tens of thousands of species of beetles was originally derived from some other species which closely resembles it; and another thing to accept the assertion that man is a highly-developed "kind of monkey." Hopes and fears which cause many to deny the truth of the latter assertion are not concerned with the acceptance of the former. But, from the impartial point of view of the biologist, the lord of creation is one species, "homo sapiens," and the malaria-bearing mosquito is another, "anopheles claviger." The biologist is not primarily concerned with the import or the significance of this or any other biological proposition, but only with its *truth*. And from this standpoint the two propositions I have instanced are seen to be strictly parallel; nor is their asso-

ciation in one sentence more improper or lacking in a sense of proportion than the assertion that a falling apple and a flying star—a pippin and an Arcturus—both move in virtue of the one law of gravitation.

Nevertheless, the question of man's origin is too grave and too instant for us to expect that it can be approached in the truly philosophic temper, save by dint of some mental preparation. This Darwin, as we have seen, was not above recognising; and so he refrained from discussing the question of man's origin in that first treatise which was startling enough without any chapters that concerned themselves with this matter. To-day, however, our mental environment permits most of us—if not, indeed, all of the younger generation—to face this question in a spirit worthy of our own assertions as to man's dignity. We are coming to see that no rehearsal of the base degrees by which we did ascend can in any way lessen the worth of what is truly worthy in man and human life.

It is now admitted by all biologists and, indeed, by all fair-minded and competent thinkers, whether specially qualified to deal with such questions or no, that the human *body*, at any rate, is a product of "æonian evolution." Here and there a biologist, such as Dr. Alfred Russel Wallace, denies that the same may be said of the non-material part of man; and this denial is necessarily echoed by the theologians, and also by the adherents of that metaphysical theory which is known as idealism—the theory which maintains that the human consciousness is antecedent, in order of causation, to

all other things whatsoever. This profoundly important question, as to the history of the human consciousness, falls to be discussed in the volume that treats of our knowledge of the laws and nature of mind. Here we shall confine ourselves exclusively to the evolution of the man's body.

The anatomical resemblances between the body of man and other vertebrates are, in some measure, obvious. The superficial resemblances need not be insisted upon. He has the same number of eyes and fingers and toes as the ape. The results of dissection are even more striking. His skeleton is, bone for bone, identical save in minute points with the skeleton of the ape. His muscles are similarly arranged, so that it would be absurd to employ different names in the description of the human and the simian musculature. The "milk-teeth" and so-called "permanent teeth" of man agree, in number and in arrangement and in structure, with those of the anthropoid ape, but not with those of the monkeys of the New World. The internal organs show similar resemblances: every well-marked convolution and fissure of the human brain can be detected at sight in the brain of the higher apes. Some practical indication of the completeness of the anatomical resemblance between man and the anthropoid ape may be gathered from the fact that surgeons nowadays spend much time and labour in performing novel operations upon these animals in preparation for the performance of the same operations in man. The surgeon who has frequently removed the

appendix of an ape need not fear his first attempt to perform this operation upon a human being. There are the same strata to incise, the same muscles to divide, the same landmarks to be sought, the same structures to avoid. Surgeons, be assured, do not undergo this discipline for a theory. It is only the anthropoid ape that possesses an appendix similar to that of man. This structure is not found in the lower apes.

It therefore becomes highly desirable to ascertain the cardinal distinctions—if such there be—that obtain between the anatomical configuration of man and, say, the chimpanzee.[1] When we come to consider the realm of mind, we shall see that one human character may fairly be regarded as absolutely distinct from any character of sub-human minds. That character is self-consciousness: the recognition of the distinction between the self and all that is not the self. But in the physical realm, no such cardinal distinction is to be found. Nevertheless, we can discern a character which distinguishes man from the ape and indeed from all mammals save himself, but does not distinguish him from *all* sub-human animals, for he has it in common with the bird. This character is the *erect attitude.* We may remind ourselves of the abandoned classification of Blumenbach, followed by Cuvier, who called men two-handed *Bimana,* as contrasted with the four-

[1] The four species of anthropoid apes are the chimpanzee, the orang-outang, the gibbon, and the gorilla. Of these perhaps the first is the most nearly allied to man, who possesses some two hundred anatomical characters in common with the anthropoid apes as distinguished from lower species.

handed animals, the *Quadrumana;* or, to use the more familiar terms, man is a biped, not a quadruped.

Every one has seen pictures of the gorilla, striding along on its hind-legs, but balancing its body on the knuckles of its hands. Only by a muscular effort, not long to be sustained, can any mammal other than man dispense with the aid of the fore-limbs in standing and in progression.

So profoundly important has been the liberation of man's fore-limbs from the performance of any balancing or locomotory function, that we must inquire into the anatomical circumstances which permit of this liberation. Consider the hip-joint of a dog or an ape, *or a human baby.* In each case, a vertical line dropped from the centre of gravity of the animal's body will reach the ground at a point in front of the point reached by a vertical line dropped from the hip-joints. This being so, none of these animals, save by a great muscular effort, can stand upright. As the baby grows, however, the curvature of its spinal column—which at birth and for some months thereafter is a simple curve concave forwards—undergoes an important series of modifications, the result of which is so to alter the relation of the centre of gravity to the hip-joint that the vertical from the former falls behind the vertical from the latter. Thus the adult human body tends to roll backwards at the hip-joints, whilst the body of the infant (true to the history of the race) tends to fall, and indeed does fall, forwards. This is why a baby crawls ere it can stand or walk. In consequence of the change in equili-

brium conditioned by the characteristic curvature of the adult human spine, there has been developed, on the front aspect of each hip-joint, an exceedingly powerful ligament—by far the strongest in the body—whose function it is to prevent the whole of the body above that level from rolling backwards in obedience to the law of gravitation. Hence the exceptional development of these "Y-shaped ligaments" comes to be a characteristic of the human anatomy.

"Man the erect" is thus, as Stevenson calls him, "Man the erected." Let us observe some consequences of this attainment of the erect attitude. The hands being freed for grasping, it becomes no longer necessary that the feet should retain this power. It is much better that they should concentrate their attention—so to speak—on the completest possible adaptation of the sole function of support and progression. Hence we find that the great toe of the human foot cannot be *opposed* to the other digits as can the thumb, and as can the great toes of certain of the apes. Not even in the tell-tale baby can the great toe be opposed. but no one who has observed a baby can have failed to notice the facility and frequency with which it bends all the toes together towards the sole of the foot. And though it soon loses this tendency as it learns to use the foot for its special purpose, no one can doubt that the human foot is descended from a prehensile organ. Various "armless men" have shown its latent possibilities in this direction. Furthermore, there exists in every human foot—though civilised man never employs them—a com-

plete series of muscles for separating the toes from one another, and for drawing them towards one another. The sole of the human foot—with its bewildering four layers of muscles—is indeed the bugbear of the student of anatomy. Its complexity —its quite useless complexity — if it is to be interpreted in accordance with the theory that the human foot was specially created for its present purpose, must be regarded as gravely reflecting upon the intelligence of Creative Design. Interpreted in the light of evolutionary theory, the sole of the foot affords pleasure to the dissector. The student of human anatomy will admit that that is a considerable statement.

But of far greater interest is the new importance which the assumption of the erect attitude has given to the human hand. The hand of the ape is a wonderful and nervous instrument—"far too good" for even intermittent use as a balancing organ. But when the ancestor of man assumed the erect attitude, at last the hand had a chance worthy of its potentialities. Many distinguished anatomists—chief of whom is Professor Cunningham of Edinburgh—consider that the numberless possibilities offered to man's hand, and especially to his thumb, by the assumption of the erect attitude, must be regarded as one of the most important factors—perhaps *the* most important factor—in the education of the human brain. However this may be, the educationists are beginning to learn the importance of the hand in mental training; and nowadays we hear on all sides of the importance of manual work in education This opinion certainly seems to be

vindicated by the results; and the evolutionist may be permitted to quote the educative value of the hand in the individual as corroboration of his theory that it has played an important part in the education of the race.

This naturally leads us to the consideration of the last anatomical difference between man and the anthropoid that need be discussed. Others there are, such as that distinctively human structure known as the chin, but they are of scant significance. This last anatomical difference is a difference—or rather, a series of differences—in *brain-proportion.*

We have already observed that there is scarcely any difference in brain-structure between man and his cousins.[1] The human and the anthropoid brain correspond, convolution for convolution, fissure for fissure. But the correspondence is very far from being merely anatomical. It is also physiological —a fact of much profounder significance. As every one knows, recent study has enabled us to allocate various functions to various areas of the brain. One part of a certain convolution controls the muscles of the arm; another area is concerned with the sight; another with hearing, and so forth. The correspondence between the human and the anthropoid brain in these respects is simply amazing. Indeed the greater part of our knowledge of what is called "cerebral localisation" in man has necessarily been derived from study of the ape. Since we can experiment upon the ape but not

[1] His *cousins*, not his ancestors. This most important distinction will later be discussed.

upon man, the "new phrenology" is far more complete as regards the simian than as regards the human brain. But whenever Nature, by means of disease, makes an experiment upon the human brain, and whenever the surgeon has occasion to open the cranium, and whenever an accident, such as fracture of the skull, causes pressure upon an area of the brain, it is found that the physiological correspondence between the brain of man and that of the anthropoid is as complete as is the anatomical correspondence. This fact has a practical as well as a theoretical bearing, for it repeatedly enables the surgeon, by making the safe assumption that what has been observed in the simian is true of the human brain, to perform operations which save life or relieve pain. Such and such facts having been experimentally observed as true of the brain of the chimpanzee, the cranial surgeon knows where to open the human skull and in which direction to incise the brain so as to reach a tumour, let us say, which, *when found*, it is no very difficult matter to remove.

Having observed, then, these facts of correspondence, we are now prepared to consider the facts of difference between the brain of man and the brain of the anthropoid. It has already been stated that the difference is essentially one of brain-proportion. This is true in three senses.

In the first place, it is true as regards the proportion of brain-weight to body-weight. This proportion is much higher in man—and also in woman, though the difference is less—than in the ape. Students have naturally sought to explain this

difference. It is known that many cases of human idiocy are associated with a small size of the head (*microcephaly*). It is further found that in such cases the sutures or joints between the various cranial bones close unusually early; and, since the cranial bones grow in area by addition of new bone tissue along their edges, this premature fusion of the edges arrests further growth. The inference naturally suggests itself that it is this premature closure of the cranial sutures which must be held to account for the small size of the brain; which is, as it were, thus clamped down in an inextensible box. Hence it has been suggested that the immediate cause of the greater size of the human, as compared with the simian, brain is to be sought in the later closure of the cranial sutures in the case of man.

When, however, we come to examine this widely-accepted hypothesis more closely, we find it to lack the truly scientific character.[1] *Why* should the cranial sutures close later in man? The hypothesis which professes to explain the facts offers no explanation of the cardinal fact. Further, it is to be remembered that the brain—as we know beyond dispute—controls the growth and functions and activities of all parts of the body, the skull included, in virtue of what we call its trophic power. Hence we must amend our hypothesis and declare that the brain is the author of that late or early closure of the cranial sutures which reacts upon its own

[1] Operations for relief of microcephalic idiocy by excising strips of cranial bone and so "allowing the brain to grow" have been uniformly unsuccessful.

development. Thus stated, the hypothesis is seen to be reduced to an absurdity. The prime author of the chain of events is not the initiative of the cranial sutures, but the initiative of the brain itself. In other words, the cranial sutures close later in man, because the brain of man undergoes a longer and greater development than does that of the ape. I do not here outline any of the highly speculative ideas that are advanced in explanation of this more prolonged development of the human brain. The subject is fascinating, but our knowledge of it too unsure for discussion here. We merely assert that the hypothesis which alleges the all-controlling brain to be at the mercy of the cranial sutures is radically unsound, essentially absurd, and must be incontinently rejected.

The second difference in brain-proportion between man and the anthropoid ape has regard to the superficial grey matter which contains the nerve-cells and is the essential part of the brain. In man we find this layer of grey matter to be thicker; we find that the fissures, into which the grey matter always dips, are deeper and much more subdivided. Thus the brain of man contains a far larger number of nerve-cells than the brain of the ape.

The third difference in brain-proportion between man and the ape has regard to the mutual proportions of different parts of the brain. There is some truth in the popular notion that a *high* forehead is connected with high intelligence. There is probably still more truth in the notion—expressed by Tennyson when he speaks of "the straitened forehead of the fool"—that a *broad* forehead is

likely to be associated with high intelligence. The chief characteristic of the human as distinguished from the simian brain, and of the brain of higher races of men as distinguished from savages, is the exceptional development of the *frontal region*. The relation of this region to the intelligence may now be fairly regarded as indisputable.

Here I may be permitted parenthetically to meet a possible objection. It may be said that I contrast the relatively vertical human forehead with the receding forehead of the ape. But how comes it that woman, who is, on the average, intellectually [1] the inferior of man, has a forehead more vertical than his? Does not this directly contravene the theory? This objection may be very easily answered. It involves the cardinal error of the old phrenology that the external contour of the skull may uncritically be accepted as indicative of the contour of the brain. In consequence probably of sexual selection, man has developed a more resonant voice than woman. Its resonance is largely due to the presence of actual resonating chambers connected with the air-passages. Amongst such air-chambers—formed by the separation of the two dense layers which form the inner and outer surfaces of the cranial bones—are the *frontal sinuses*, which appear prominently above the nose and eyes of most men. It is their presence which renders the frontal outline of man less vertical than that of woman; and not any greater development in woman of the frontal lobes of the subjacent brain.

In another volume I must deal with the im-

[1] I beseech the reader to observe that I do not say *morally*.

measurable psychological differences between man and his nearest relatives. Here I have been concerned merely with the comparative anatomy of the brain. We shall see that the psychological differences are much more marked than the anatomical, but we shall completely fail to discover the reasons of this apparent disparity between comparative function and comparative structure.

In considering the relationships of the human body—relationships which are of such profound interest when regarded as facts from which its origin may be inferred—the contemporary writer upon organic evolution is able to avail himself of certain recently discovered facts which were entirely unknown to the founders of this theory: facts some of which are no less than bizarre.

In order to justify my use of this word, I will begin with the most striking and the most recently discovered of these facts. It is of immediate interest alike to the juryman and the biologist.

It occasionally becomes a matter of medico-legal importance to determine whether a suspicious blood-stain on a garment or a weapon is of human origin. This determination offers serious difficulties even to the expert. In the case of fresh blood it is possible to isolate a few of the red corpuscles on a minutely graduated stage, and, by examining them with a rather high power of the microscope, to determine their size. Their shape is identical[1] in all the mammalia, with the single exception of the camel, but their size varies within small limits in different

[1] They are biconcave circular discs.

species. Even in the case of quite fresh stains this method is, however, somewhat uncertain; and it is inapplicable to those stains—constituting the large majority—in which the corpuscles are no longer recognisable.

Recently, however, students of the blood have been enabled to elaborate a method of identification which is based upon a quite different set of facts. If a few drops of blood obtained from any species of animal be injected, with due antiseptic or aseptic precautions, into the veins of another animal of the same species—as from man to man, or from cat to cat—no results of any kind are to be observed. The injected drops find themselves at home, and their corpuscles mingle with those of the second animal's own blood, without any ill results to either. It is found, however, that very striking results follow the injection of blood from an animal of one species into the veins of an animal belonging to another species: as from a cat to a dog. If the species are distinct, the result is obtained, even though they be so closely allied as are cat and dog. The red blood-corpuscles of the second animal's blood are found to undergo a rapid disintegration and dissolution. On analysis it is discovered that this result is due to the presence in the fluid of the blood of any animal, of certain substances which have received the appropriate name of cytolysins: a term accurately to be translated as meaning cell-dissolvers. These cytolysins exert no deleterious action upon the cells of the blood in which they naturally occur, nor upon the cells of the blood of any animal that belongs to the same species. It does not matter

whether the varieties of the two animals are different. The blood of any kind of dog will not affect the blood of any other kind of dog. Directly, however, there is introduced the specific difference — the difference of species—this cell-dissolving action is found to occur. We thus have a new and subtle specific test for blood. A given blood-stain upon the clothes of a suspect may be human, as the police allege, or canine, as the accused alleges. The truth can be ascertained without reference to circumstantial evidence. If a solution of this blood-stain is found to exercise no action upon a few drops of canine blood, but is found to dissolve the cells of human blood, the accused is vindicated. The blood is canine, as he states, else canine blood would not consort with it; not human, else human blood would be unaffected by admixture with it.

What, now, if we apply this test to the blood of man as compared with the blood of the ape?[1] The astonishing fact, to which I think the word bizarre may fairly be applied, is that this specific test fails when thus applied. I have said, "the blood of the ape," but I must correct myself. Hans Friedenthal of Berlin has shown that human blood, when mixed with the blood of the *lower* apes, has a poisonous effect on the latter: the serum of the one destroys the blood-cells of the other. But this does not happen when human blood is mixed with that of the *anthropoid* ape. Regarded in the light of the facts we have already detailed, we cannot but

[1] The whole subject is so new that I must not be regarded as speaking with any air of finality. These tests may also be performed in a much more roundabout but much more accurate fashion. (For a brief account of this see Metchnikoff's "Nature of Man.")

regard this fact as a new "proof of the close blood-relationship, in the literal sense of the word," between man and the anthropoid ape.[1]

This most remarkable series of researches may be supplemented by certain recent observations in comparative pathology. It is as yet very far from being precisely known why certain species or individuals are immune from certain diseases—*i.e.* from the attacks of certain microbes—whilst others are susceptible. One kind of sheep, for instance, is entirely immune to the attacks of the anthrax bacillus, whilst all other kinds are susceptible. The cause of the difference is doubtless to be found in the most intimate regions of the chemistry of the body-cells. Now—in virtue, who can doubt, of his ultimate relationship to other animals—man shares his susceptibility to many diseases with various members of what were once called the "lower orders of creation." The resemblance between his cell-chemistry and that of the cow, that of the bird, and even that of the fish, is close enough to permit of his susceptibility, in common with all of these, to the attacks of the *bacillus tuberculosis*. Some diseases, however, are peculiar to man, as others are peculiar to other animal species: the limited scope of these diseases doubtless being due to the fact that the cell-chemistry of each species varies, in some measure, from that of every other.[2] Man, for instance, suffers from measles and whooping-cough. The lower animals, so far as we know, do

[1] See "The Evolution of Man" (English translation), by Ernest Haeckel, vol. i. pp. 399–401.

[2] In the last resort, the difference between one species and another is doubtless a matter of cell-chemistry.

not. But if we consider the whole series of diseases which are apparently peculiar to man, and proceed to make upon the lower animals experiments with their microbes—or in cases where the microbe has not been isolated, with infective material derived from a case of the disease—we find that a number[1] of the diseases thought to be peculiar to man are communicable to the anthropoid ape. If, now, we make further experiment with other animals, and especially with the lower apes, we find that *there is a whole series of diseases which are communicable to man and the anthropoid apes but to no other animal.*

If it is permitted to draw any inference from this fact—and, indeed, science does not ask any one's permission to think nowadays—we must regard it as a proof of blood-relationship between man and the anthropoid ape only one degree less striking than the instance furnished us by comparative hæmatology.[2]

Just as we found the surgeon practising on the anthropoid ape so as to enable him dexterously to operate on man, so we now find that medicine, also, is devoting great attention to the anthropoid ape as a subject for experiment. Already substantial results have accrued, to the immediate benefit of humanity, from the recognition of the fact that for purposes of practical medicine it comes almost to the same thing whether an experiment is performed—as most people agree is justifiable—upon the chimpanzee or—as most people think

[1] This work is in its infancy. It remains to be seen how comprehensive these statements may ultimately become.

[2] The study of the blood is nowadays so important that, if the word conchology is justified, so, surely, is hæmatology.

unjustifiable—upon man. My writing of this chapter, indeed, has been interrupted by the arrival of news from Paris which deals with a medical discovery of the first importance. A terrible and terribly prevalent disease, long thought to be peculiar to man, has lately been shown, by the workers at the Pasteur Institute, to be communicable to the anthropoid ape. A German bacteriologist discovered a microbe which he thought likely to be the causative agent of the disease. Having no anthropoid apes[1] at his disposal, Herr Schaudinn was unable to proceed any further with his work; but he sent some of his preparations to the Pasteur Institute, where Messrs. Metchnikoff and Roux have been enabled, by experiment on these animals, to confirm his results. It may also be noted that these workers have been enabled to obtain, from the anthropoid ape, a serum which arrests the course of the disease in man. This is, perhaps, the first instance in which man's relationship to the anthropoid ape has actually been turned to the direct account of the higher animal. In the case of the practising surgeon, the anthropoid ape is not absolutely indispensable; but, in this instance, it is, for no lower animal is susceptible to this disease, and therefore from none other can a protective serum be prepared.[2]

In discussing the evolution of man it is impossible

[1] So valuable have these creatures become that the comparatively affluent scientific centres are apt to leave none available for their poorer rivals.

[2] This paragraph, written in May, will not appear in print unless these researches are confirmed in the interval.

to omit a brief reference to the embryological evidence[1] recently accumulated. Some decades ago, very great stress was laid upon the evidence afforded by the study of individual development in favour of the theory of racial development. It was somewhat too roundly declared that the history of the individual is always a recapitulation of the history of the race. Subsequent work has shown that this recapitulation is very often not nearly so complete as had been alleged. It is constantly found that whole stages which must have played a prominent and lengthy part in the racial history are hardly represented, if at all, in the development of the individual. Hence some biologists, who are old enough to compare the facts now known with the too comprehensive assertions made in their youth, are inclined to say that too much stress has been laid on the embryological argument, and, indeed, that the "recapitulation theory" is only a metaphor, and a poor one at that.[2] Nevertheless, there remain thousands—tens of thousands—of embryological facts which are intelligible only on this theory; and, in my opinion, the embryological argument for organic evolution is stronger than it ever was. Let us grant that, in any particular species, certain stages of the racial history have little to represent them in the hitherto observed facts of the individual history. We do not maintain that the recapitulation is exact or complete; still less that the length and salience of the stages in the individual develop-

[1] This has already been alluded to in the second chapter.

[2] *Cf.* Chalmers Mitchell in the *Encyclopædia Britannica* (tenth edition).

ment are precisely proportioned to the length and salience of the stages in the racial history. It contents us that there are innumerable admitted facts which consort with this theory, and which, to those who deny it, are meaningless and bewildering,[1] besides defying the primary law of animal economy. It is incomprehensible why a developing animal should expend weeks or months in the formation of a large structure—a process which entails the expenditure of valuable energy—the said structure ultimately disappearing or undergoing atrophy, and at no time performing any function, unless we regard the performance of this "useless" process as enforced upon the individual in virtue of the fact that in its ancestors this structure was both permanent and useful. The human tail is a case in point.

Hence, whilst some decry the embryological argument as overrated, we may nevertheless consider the results of the extensive studies which have recently been directed to embryology in general and simian embryology in particular.[2]

It is found, as we have already seen, that the mere external correspondence between the embryo of man and of the anthropoid is extremely close. This correspondence is seen, on dissection, to obtain even in the more intimate details of internal development. But of great significance is the fact

[1] For the best consideration in English of the recapitulation theory, the reader should consult Mr. Archdall Reid's recently published "Principles of Heredity" (Chapman & Hall).

[2] For details the reader should refer to Haeckel's book already mentioned. The veteran zoologist of Jena is the chief living exponent of the relations of embryology to evolutionary theory. See Metchnikoff's "Nature of Man."

that the relations of the embryo to the mother pursue the same intricate course in both cases. Judged by embryology, man is a true "placental mammal." Both in the anthropoid ape and in man, we find the nutrition of the embryo effected first by one makeshift—which immediately recalls a plan that was very far from being a makeshift in the case of their common, though distant, ancestors—and then by another, which tells the same tale. Finally, there is established, in each case, that particularly efficient and versatile mode of connection between mother and fœtus which is termed the placenta.[1] The comparative study of placentation alone, throughout all the series of mammals from the marsupials (represented by the kangaroo) upwards, would alone suffice to establish the theory of common descent for all such mammals, even were no other lines of *à posteriori* evidence forthcoming. Here I merely allude to the subject, as it must be referred to in more detail when we come to consider —in another volume—the evolutionary teaching as to the origin of morality.

Ere we leave the subject of embryology in its relation to human descent I may refer briefly to the history of the human tail. Every now and again anatomists hear of the occurrence of a tail in an adult human being; but such external tails are only very rarely found to contain vertebræ and are usually no more than loose "tags" of fat-enclosing skin.

[1] This wonderful organ is known to human mothers and nurses as the "after-birth," and, when its indispensable work is done, is usually contemptuously thrown "on the back of the fire."

Nevertheless, it is quite erroneous to suppose that man has "lost his tail": as erroneous as the explanation—on Lamarckian principles—of this supposed loss: that when man took to sitting his tail tended to be rubbed away, and that this acquired character was transmitted by heredity to his descendants.

In point of fact, man still has a tail. In the early stages of the development of the human individual, this tail is actually visible and unmistakable—in accordance with the recapitulation theory. At the (intra-uterine) age of four weeks, the human tail is twice as long as the legs. But even when we come to examine the adult we find the imperfect skeleton of a tail—and more than the skeleton.

The human spinal column is terminated in the adult by four degenerate and fused vertebræ, the single bone which, in the adult state, results from their fusion being known as the coccyx. This bone is curved, its front surface being concave forwards, and thus it is both hidden and functionless in man. Pain in this region is not infrequently relieved by the surgeon, who excises the bone. Only those individuals upon whom this operation has been performed are properly to be called tail-less. The rest of humanity can no more be denied possession of a tail, because it is hidden and useless, than the whale can be denied possession of hands because they have ceased to indicate their existence externally and are of no functional importance to him.

I have said that we possess more than the mere skeleton of the tail. We also possess muscles

which unquestionably correspond to those employed by the lower animals in moving the tail; though this power has lapsed in man even more completely than the power of moving the external ear by the degenerate muscles which are still attached to it, even in adult man. But this is not all. In man and other mammals—and indeed in other orders of vertebrates as well—the supply of blood to the posterior (in man the lower) portion of the body, is conveyed by a large artery known as the *aorta*, which runs backwards (in man downwards) along the lower (in man, the front) aspect of the spinal column. This great artery ultimately terminates by a Y-shaped division into two large vessels, one of which passes sidewards towards the left, and the other towards the right lower limb. In the obviously tailed animals there proceeds from the point of division, or from just above it, a much smaller artery which runs straight downwards along the lower surface of the tail, thus continuing, along this terminal portion of the spinal column, the course which the great aorta pursued along its first portion. In the tailed animals this artery is known as the *caudal artery* (Lat. *cauda*—the tail). Now in the higher apes and in man, the "tail-less," there is found, proceeding from the aorta in the same manner, a minute artery which takes the same course towards the coccyx, and which, in human anatomy, is called the coccygeal artery. But every comparative anatomist knows full well that this so-called coccygeal artery is none other than the caudal artery of the tiger or the ox or the marmozet. Recalling the terms already defined, we

say that the tiny coccygeal artery of man is the homologue and the analogue of the important caudal artery of his poor relations.

In concluding this inevitably long chapter, we must now more precisely consider, in so far as we can, the relationship of man to the anthropoid apes. Despite constant correction, there still widely prevails the error that biologists teach the descent of man from one or other of the existing apes. This, however, is not merely not taught, but is explicitly denied. I grant that, from the point of view of implications, it really matters little whether we declare man to be a descendant of the chimpanzee, or that man and the chimpanzee are descended from a common ape-ancestor. But the distinction is of great scientific importance nevertheless; and we must therefore devote some attention to it, the history of science having taught us that the supposed "importance" or "unimportance" of any inquiry must not be taken as an imperative that we must or must not pursue it. If the Universe is really a *Universe*—a cosmos and not a chaos—then Truth is one and indivisible; and the negligible Truth does not and cannot exist. Indeed, from this very inquiry we can draw an illustration of my contention that, in the last resort, no sincere inquiry will be found to be without practical importance. If it must be held that any species of the present anthropoid—say the chimpanzee—is the exact living representative of the type from which man is descended, then the opponents of the theory of organic evolution are

justified in regarding our inability to produce the bony or other remains of any form intermediate between man and the chimpanzee, as a serious gap in our chain of evidence. "How is it," they might very properly, and do very improperly, say, "that, if man is descended from the chimpanzee, you can produce any number of chimpanzees, any number of men, but cannot adduce a single specimen of the chimpanzee-man? There is plainly a 'missing-link,' and if you cannot find it, your theory must be regarded as unproven."

Now the true and final answer to this argument is that it proceeds on a wholly false assumption for which our opponents, did they take the trouble to master the views they oppose, can find no warrant in our writings.[1] In a moment I shall state the teaching which is actually to be attributed to evolutionists; and we shall see that the inquiries into the *exact* relationship of man and the anthropoid have justified themselves in that they dispose of the objection that we cannot produce the missing-link. But it is well here to note that, indeed, there are elsewhere many points in the whole scheme of animal and vegetable life where apparent gaps are evident. But this fact can be explained in accordance with the oldest and most assured evolutionary principles—and the explanation is of importance

[1] It is recorded of that most un-Roman-Catholic of Roman Catholics, the late distinguished historian, Lord Acton, that he taught the duty of understanding and mastering the opinions one rejects as thoroughly as those one accepts. When at last this ideal is everywhere realised, there will be no need, I fancy, ever again to quote the sublime cry of philosophic faith, "Magna est veritas et prevalebit." Truth *will have prevailed.*

not only in relation to organic but also to social and mental evolution. The generalisation which has been reached in so many spheres, is that *intermediate types tend to disappear*. Now we must beware of confused thinking, which is not infrequently to be met in the neighbourhood of this assertion. It will not do to call all (assumed) types that have disappeared intermediate, and then to say that intermediate types tend to disappear. Otherwise we are guilty of advancing, as a truth, what the logicians call a "verbal proposition," which really says nothing at all. But by intermediate types we mean types representing the transition from one mode of life, or one environment, to another. Such types naturally tend to disappear, for they are not well adapted to any environment: they are "neither fish, flesh, fowl, nor good red herring." The types that persist are those which are definitely adapted to a constant environment. The marine mammals, such as the whale, were in all probability driven to the water by the fierce competition on land, where the mammalian family must have originated; but we find no living representatives, nor indeed any remains, of the hard-driven types which endeavoured to eke out an existence on land when they could and in the water when the land was denied them. Such a type, properly adapted to no environment, could not persist.[1]

Leaving this digression, which deals with a fact of some importance in relation to one of the

[1] Similarly the batsman who plays neither "forward" nor "back," but the "half-cock stroke," is apt to disappear—bowled.

apparent difficulties of the evolutionary theory, we may return to our consideration of the importance which attaches to the conclusion that no living ape can be regarded as representative of the simian ancestors of man. Its importance, as we have seen, lies in the fact that it immediately disposes of the objection that we cannot produce any evidence of the "missing-link." There is no missing-link: no more than there is a missing-link between a man and his first cousin. This is the sufficient reason why we have no evidence of one. Man and the anthropoid apes must be regarded as the descendants of a common simian ancestor to which no name can be attached. Some interest certainly invests in the inquiry as to which of the extant anthropoids may be regarded as most nearly resembling their common ancestors and ours. Opinion has varied from time to time, but recent work done in the anthropological department at Cambridge appears to endorse the old opinion that this distinction belongs to the gibbon. In other words, this is the least specialised of the extant anthropoid apes.

Reference has already been made to the so-called *pithecanthropus erectus*, the only known evidence of whose existence consists of the remains discovered in Java. Popular writers have described this ape-man[1] as the "missing-link"; but this perpetuation of a wholly misleading term is to be deprecated. If the *pithecanthropus* must be called the "missing-link," it must be clearly understood that he is the missing-link not between man and any known ape,

[1] We have seen that some doubt attaches to the most favoured interpretation of Dubois' discovery.

but between man and the ape, now extinct, from which man and the extant anthropoids may claim common descent.

Already we have devoted some little space to the consideration of the factors which may possibly go some way towards explaining the causes which led to the vast superiority of one descendant of this extinct ape over all his other descendants. Of this most attractive subject too little is known for me to return to it here. But we may properly state the two extremes of opinion on this matter. At one pole is the view to which—as involving a fallacy of very great importance—we must return, that there is a *law of progress*, and that man has developed from the ape in virtue thereof. At the other pole is the view that man, instead of being the inevitable superior descendant of lower animals, is a mere "fluke" or "sport" of the ape—that all kinds of variations occur in animal species, and that, as it chanced, there occurred an exceptionally intelligent variation in some species of ape many ages ago—of which "sport"—to use the gardeners' term—man is the present representative. This view, which must surely be regarded as unphilosophical in the extreme, is expressed by Professor Metchnikoff in his work, recently translated into English by Dr. Chalmers Mitchell, under the title "The Nature of Man." On analysis this idea is seen to deny the fundamental conception of science, that *causation is universal*, that law rules all. In point of fact, heredity and variation are "governed by law"—to use a convenient if somewhat too metaphorical phrase

—no less than all other phenomena, and the assertion that the appearance of man on this planet was accidental, is essentially unscientific; for it is the first assertion of science that accidents do not happen. The unparalleled manner in which the human species has spread and thrived proves that man is a necessary product of evolution, not in virtue of any law of progress, but in virtue of the fact that evolution constantly tends towards more perfect adaptation and relation and mutual fitness of the evolved products. As the most adaptable species that exists, man is not the product of an accident—or, if he is, it was the sort of accident that *had to happen*. If this important qualification be included, any one is welcome to enjoy whatever remains he can detect of the pseudo-idea usually conveyed by the word.

According to Genesis, the human race is the fruit of a first pair, Adam is the father and Eve the "mother of all living." Not a few inquirers, when they abandon this legend for the teaching of knowledge, carry with them an unexamined assumption that there must nevertheless have been a "first pair."[1] But in all probability the transition from the ape to man was gradual and prolonged; nor was there any point at which an observer could have said, "The parents are simian but the

[1] The very large proportion of my space which I have allotted to the evolution of man may be justified by the obvious pre-eminence of this subject in importance; but also by the circumstance that this little book is meant to be read, not only for its own sake, but as a preliminary to the consideration of other matters which relate almost entirely to man.

children human." This belief accords with the old aphorism that Nature does nothing by leaps—*Natura nihil facit per saltum.* In our consideration of heredity and variation we shall see that this dictum cannot be accepted by us as unreservedly as it was by even Darwin himself; but we may nevertheless be assured that the intrusion of this idea of the "first pair" into the modern theory of man's origin is quite unwarranted. It will not interfere with the studies of the next generation, who will not be handicapped, as we have been, by the early instillation of untruth in the guise of truth. The mere consideration of the lowest types of humanity *now* extant is sufficient to show us that, even if the human race owes its origin to a somewhat marked variation—a mutation, as De Vries would say—yet its beginnings can no more have answered to any standards we should care to call human than do the beginnings of any human individual to-day.

There is, however, another popular phrase which deserves more serious consideration. It may be asked how much meaning the evolutionist may allow to any discussion concerning the "cradle of the race." Must this phrase be allowed to lapse, or left to those who seek for the Garden of Eden and the footprints of the angel with the flaming sword somewhere in Mesopotamia? On the contrary, the phrase may still retain a meaning that corresponds not to fiction but to fact. The evidence of science is so far confirmatory of Genesis as to refer the origin of man to Asia. That is a big word, and I will not venture to delimit it, save to exclude the colder zones of Asia. Certainly one would not

venture to call Java the "cradle of the race" on the scanty evidence it affords.

We must avow that the human race is descended from an Old World monkey and not from any New World monkey, because man, as we have already seen, is most unquestionably related—so far as physical characters, external and internal, skeletal, dental and visceral, may be trusted—to the Old World monkeys, much more nearly than are they to the monkeys of the New World. This was conclusively proved by Huxley more than forty years ago.

How, then, if Asia was the cradle of the race, do we find men in America and in Australia? The question is pertinent, and the answer full of interest. There is no reasonable doubt whatever that the aboriginal men of the New World are really of Mongolian origin. Their ancestors crossed over from North-Eastern Asia to North America, who shall say how long ago? The evidence for this belief is derived from many sources. This is not a manual of anthropology, so I must content myself by merely mentioning the yellow skin of the so-called Red Indian, and by alluding to the extraordinary resemblances, physical, social, and psychological, which anthropologists have traced notably between such races as the Aztecs and the modern Japanese.

Then, as to the even more instructive case of the Australasian aboriginal. His existence, like that of the Australian mammals—such as the egg-laying duckmole and the kangaroo—teaches us that, as there are other reasons to believe, Australia was once continuously connected by land with Asia.

Indeed some students aver—not forgetting the Javanese evidence — that the cradle of the race may have been not Asia, but a lost continent over which the southern waters now roll.

And this raises the last question to be noted—very briefly—in this long chapter. How old is the human race? Properly to discuss the grounds on which an answer to this question may be based would entail the consideration of many geological facts and inferences. But assuming that the data from which students have constructed the geological time-table are trustworthy, and thereafter noting the lowest levels at which human remains have been found, and taking into account such further evidence as is available, we may assert, with due qualifications, that in all probability the human race is about two hundred and fifty thousand years old. To those who have never concerned themselves with geology, and who estimate time rather by the length of the individual life or the epochs of historians than by the cosmic standards, this period of a quarter of a million years may seem very long. But to many of us, who are less in the thrall of these very inadequate units of measurement, the period allotted for the evolution of man as we know him at his best, from man as he must once have been, seems very short. Shorter still does it seem when we consider the estimates—based upon the rate of solar shrinkage, and (later) upon the known facts as to the terrestrial distribution of radium—that have been made as to the period of time which must elapse "till the sun grows cold," and human life as we know it ceases to be possible. I have elsewhere

ventured to suggest that, thus considered, the present age of the race, as compared with the age to which it may well attain, is as the age of an infant one year old to that of a more than centenarian. "The best is yet to be."

CHAPTER XII

SOME COMMON ERRORS CONSIDERED

In the last chapter we have already considered one of the commonest errors in the popular conception of the theory of organic evolution—the belief that biologists teach the descent of man from the chimpanzee or the orang-outang; and we have seen that this—like every other error—tends to beget more errors still, since it has led to the notion that the simian origin of man must be regarded as unproven in the absence of definite evidence as to the existence, in the past if not to-day, of a "missing-link."

But there remain several other erroneous notions which I must endeavour duly to stigmatise, and which deserve such prominence as a separate chapter-heading can afford them, since—though they have been exploded time and again—they are still constantly to be met with, error being tenacious of life though always doomed to die at last; which consummation may this chapter hasten.

The second common error, then, which we may proceed to brand, consists in the identification of the theory of organic evolution with Darwin's theory as to a certain factor in the process. In

point of fact, "natural selection"—to use Darwin's phrase—is almost daily found to be more certainly and more widely expressive of a truth, and this circumstance naturally tends towards the persistence of the error in question; but it nevertheless behoves us clearly to understand that the theory of organic evolution does not make any assertion whatever as to the manner in which the process has been and is being effected, and is independent of any such assertion. The truth of the theory is not involved in the truth of the Darwinian elucidation of a certain mode of evolutionary action. Were natural selection proved to be a fiction to-morrow, we should still hold, as firmly as ever, to the theory of organic evolution, not only because there is none other in the field, but also because we are in possession of innumerable facts which consort with the theory, whilst we are unacquainted, either through our own inquiries or those of our opponents, with any one fact which is incompatible with the theory. The astronomer is possessed, mainly through the labours of Newton, of evidence that there is a universal "force" called gravitation. At present he has no decided notions as to the manner in which gravitational attraction is effected, and indeed he may well have to wait many years for the desired explanation. Meanwhile he will very properly continue to assert the existence of a process which he expressly declares that he cannot explain. The analogy must not be pressed too far. Evolution acts in many ways, gravitation probably in only one, but the man who explains the *modus operandi* of gravitation will properly be

comparable to Darwin, who elucidated one *modus operandi* of evolution. Meanwhile the biologists have the advantage of the astronomers, and are as surely entitled to assert the existence of a fact which they can in large measure explain as are the astronomers in asserting the existence of a fact which they cannot explain. Frankly I will venture to say that, in the light of modern knowledge, organic evolution is an obvious and self-evident fact. To the astronomers, knowing what they do, gravitation is an obvious and self-evident fact. Yet it met, at its first announcement, with opposition based on the superstition of the day. Newton was accused of leading men to atheism by substituting impersonal law for the personal superintendence of the Deity. Freed from similar superstitions, we are able to see that the theory of organic evolution is as obvious and irresistible an inference from the biological facts as is the theory of universal gravitation from the astronomical facts; and ere we accept an inference so palpable, we no more need a Darwin to tell us how evolution is effected than the astronomer needs the explanation of a Le Sage or any one else to justify him in the belief that gravitation is a fact. Darwin's explanation of organic evolution may be wrong; Le Sage's explanation of gravitation may be and probably is wrong; but men with eyes need no theories of vision or solar physics to enable them to see the sun at high noon. To those who ask them how they can possibly declare that they see the sun, without the aid of any theory as to how vision is effected, they may reply with the blind

man who was asked to frame an hypothesis to explain the recovery of his sight: "One thing I know, that whereas I was blind, now I see."

Similarly we should see the fact of organic evolution, even though we had no idea of its explanation and had never sought for one.

One consequence of this unfortunate confusion of a fact with a certain explanation of it is to be traced in the third error which we may now consider. Men regard the explanation, natural selection, as an essential part of that which it explains, the fact of organic evolution. Now this fact is merely a fact of change: change which may be for the "better" or for the "worse" or may be neither. But when natural selection is regarded as an essential part of organic evolution, a wholly erroneous inference is drawn. The phrase readily lends itself to the process of personification—a circumstance which led Spencer to substitute for it the expression, "survival of the fittest"—and men dimly conceive of "Nature" (which is practically equivalent to "Providence") as selecting what types she prefers for perpetuation. Now Nature (or Providence) will surely preserve the *best* (they think), and even Spencer's phrase does not succeed in averting the erroneous interpretation, for survival of the fittest is readily construed in accordance with the notion already half-formulated, as survival of the *best*. Briefly, then, the law of evolution is a law of progress: all things are on an upward journey, under the guidance of Providence.

Whether or not we may accept any attempt at

an analysis of the manner in which this wholly erroneous rendering of the facts is reached, it is sufficient to observe that it is reached. It is thought that the law of evolution is tantamount to a law of progress, and, since law is law, it must be inevitable progress. Now a belief in human progress was characteristic of the Liberalism of the early nineteenth century, and it was imparted to Spencer in his youth. In 1852 he was feeling his way, though he did not then know it, to the discovery of the law of universal evolution, and in that year he wrote an essay entitled "Progress: its Law and Cause." But further thought showed him that the word must be abandoned, and in 1857 he substituted for it—the date will be historic—the non-committal term evolution. Yet, after nearly half a century, there is still foisted on to the word evolution the very notion which it was introduced to avoid. The notion is totally false. The facts of biology lend no support to the view that what we mean by progress is a necessary consequence of natural law. They conclusively prove that, in virtue of evolution, progress is possible; but, likewise, that—also in virtue of evolution—retrogression is possible, *equally possible.*

From all orders and families and species, alike of the vegetable and the animal world, there may be adduced instances in refutation of the theory that there is a law of inevitable progress. Evolution, in all spheres, organic, inorganic, and psychic, tends constantly and consistently not towards what we call progress, but towards more and more complete adaptation of its products to their environment.

Given the necessary constancy and simplicity of the conditions, the product will remain constant: it will neither regress nor progress, once adequate adaptation has been established. Many lowly animal and vegetable forms have persisted unchanged throughout long geological epochs which must have consumed millions of years. These forms have gained complete adaptation to their environment, they have not been subject to the action of any of the factors of organic evolution, and therefore they have undergone no change for ages, and will persist until at last the conditions under which they have so long persisted cease to obtain. This fact of the persistence of types is entirely in accordance with evolutionary theory, and affords us no difficulty whatever. But here also our opponents find an opportunity for basing an objection to the theory on their imperfect understanding of it. Forgetful of the immeasurable difference between relative persistence—even for millions of years—and absolute persistence—a mistake which is readily intelligible when we remember whence their ideas of a "long time" are derived—they point to these long-constant types, and ask us how we propose to reconcile their persistence with what they conceive to be our theory of ceaseless ascent from lower to higher organic forms. The evolutionists are for ever asserting—they say—that species are not immutable; how then comes it that many species *are* immutable?[1] But there is a very real difference between the assertion that species may undergo change—if

[1] For "immutable" they should properly say "relatively persistent."

aught occurs to change them—and the assertion that, in virtue of some wholly mystic and unintelligible principle, they are constantly undergoing change. This latter assertion, upon the validity of which the objection depends, is entirely without any warrant in fact, and, on analysis, is seen to involve the assumption that certain phenomena occur without a cause or that the cause is supernatural—a "hidden purpose" or "teleological principle."[1]

Many years ago, before the doctrine of organic evolution had been placed on a philosophical basis, the great Cuvier used the fact of the persistence of types as an argument against the then highly unorthodox views of Lamarck. There being every reason to suppose that I should not improve on Huxley's reference to this fact, did I make the attempt, I will quote his words:[2]

The French expedition to Egypt had called the attention of learned men to the wonderful store of antiquities in that country, and there had been brought back to France numerous mummified corpses of the animals which the ancient Egyptians revered and preserved, and which, at a reasonable computation, must have lived not less than three or four thousand years before the time at which they were thus brought to light. Cuvier endeavoured to test the hypothesis that animals have undergone gradual and progressive modifications of structure, by comparing the skeletons and such other parts of the mummies as were in a fitting state of preservation, with

---

[1] Teleology (from Gr. *tele-*, at a distance, as in telegraph) is the "science" which explains *final causes*, *i.e.* causation by the end or purpose towards which things are supposed to move.

[2] "Lectures on Evolution."

the corresponding parts of the representatives of the same species now living in Egypt. He arrived at the conclusion that no appreciable change had taken place in these animals in the course of this considerable lapse of time, and the justice of his conclusion is not disputed. It is obvious that, if it can be proved that animals have endured, without undergoing any demonstrable change of structure, for so long a period as four thousand years, no form of the hypothesis of evolution which assumes that animals undergo a constant and necessary progressive change can be tenable; unless, indeed, it be further assumed that four thousand years is too short a time for the production of a change sufficiently great to be detected.

Other evidence, concerned with lower types, is still more striking, for it shows that types may persist unchanged for hundreds of thousands, if not for millions, of years.

Now it is of very great interest, in this connection, to study such evidence as may be available in the case of man, who is not only the highest, but also—as the highest should be—the most adaptable and versatile of animals. Where, then, shall we seek for the oldest exact records of human anatomy? Perhaps these are to be furnished by Egyptian mummies; but I believe that the oldest exact records of surface-characters are furnished us by the recent discoveries of Dr. Arthur Evans in Crete. In this belief I have taken the opportunity to study—not, unfortunately, the originals—but some very fine photographs of Cretan statuary which Dr. Evans exhibited at a recent Exhibition of Old Masters—most appropriately named—at the Royal

Academy. Some of these photographs show the perfect modelling and complete reproduction of surface-detail which the old master of Knossos—perhaps Dædalos himself—achieved when treating the limbs of his models. Even in the photographs it is possible to observe the disposition of the superficial muscles of the forearm, for instance, and even the disposition of the subcutaneous veins. But every detail I could detect was familiar: there was no single feature that may not be observed in any forearm of to-day, nor was any modern feature missing in these Cretan forearms, the precise surface-anatomy of which has been thus permanently recorded by the sculptor's art. Now the approximate date assigned by Dr. Evans to these statuettes is about two thousand years before Christ; so that, in four thousand years, the surface-characters of the limbs of man have undergone no change. It seems not improbable that we shall never be able to obtain any evidence, as to these characters, older than that which Dr. Evans has unearthed.

Having seen that many organic forms tend to persist unchanged throughout long epochs, we may further observe a still more serious objection to the popular misinterpretation of evolution—the fact that many animal and vegetable species can be proved to have degenerated.[1] In the familiar barnacle (*Lepas anatifera*) we have a most striking

[1] "Progress" is a term which has reference merely to a human ideal. No cosmic or universal meaning can be attached to it. When we use the term degeneration, we indicate merely such a change as carries a species further from our ideal.

instance of degeneration, for its course is exhibited even in the history of the individual. The larvæ of the barnacle are small *free-swimming* crustacea, but as they develop (observe the distinction between development and progress), they attach themselves by the head to such suitable objects as a ship's hull or a piece of floating wood. Thus the adult or fully-developed barnacle is far inferior to the larva, for it is little more than a fixed fleshy stalk, upon which grows the body and its shell. Here is a palpable case of what we call degeneration, and, in accordance with the theory of recapitulation, we find that the barnacle is descended from species the individuals of which are free-swimming both in youth and in adult life.

Then, again, let us consider the case of the parasites. They amount to thousands on thousands, both of animal and vegetable species. Their characteristic is that they live upon or in the bodies of individuals of some "higher" species. Now the higher species are later in point of time. How did the parasites gain a living before the evolution of the higher forms upon which they now batten? Furthermore, it is evident that the primæval forms of life cannot have been parasitic, for no hosts were forthcoming. Hence we are forced to the necessary inference that all parasitic species are descended from non-parasitic ancestors; and this view is supported—not that it is in need of such support—by the fact that many animal and vegetable species are known, the individuals of which are independent in their youth but parasitic when adult. In such instances, both racial and individual, evolution and

development involve not progress, not even conservatism or stagnation, but positive deterioration. Yet it is always the fittest that have survived, such as the tapeworm, the tubercle bacillus, and the "dry-rot." Plainly the fittest are not infrequently the worst.

It is now many years since John Stuart Mill rebuked the common habit of speech which avers that there is an essential difference between practice and theory. Erroneous theory on matters of practical bearing means erroneous practice, and conversely. Now the nature of evolution is a matter which has a practical bearing, and men cannot afford to hold erroneous theoretical views thereupon. Hence we find that the common error of regarding evolution as something that may be trusted to "go on by itself," always making for progress meanwhile, is showing signs of disastrously affecting practice. If it has not done so to any large extent hitherto, that is merely because a belief in this conception of evolution is not widespread—not because practice and theory are separable, save in the abstract. The obvious inference from this erroneous view of organic evolution is that our motto should be *laissez-faire*. The thing is in "higher hands than ours": we may fold our hands and leave it to follow its appointed course. As we shall observe in greater detail later, this view, were it generally accepted, would be utterly disastrous. Organic evolution does not proceed without *causes* or factors. If, then, these factors, for one reason or another, be thrown out of action, the process will entirely cease. Plainly they cannot all be thrown out of action in the case of the human

species; but much can be done, *and has been done*, in this direction.

For instance, suppose an alteration, such as has already been effected in many communities, in the environment. Suppose that food and air and space be so provided in the environment that the law of natural selection is limited in its action: universal survival being substituted for the survival of the fittest—evolution will doubtless continue, the racial type will continue to undergo modification, but the course will be different. The weakling, the diseased, the criminal, the imbecile, the insane, will assume a new importance. Under the action of natural selection, and its analogue, social selection, these types would have tended to disappear: *now* they will tend to persist. Or suppose that by a comprehensive system of "State-feeding"—let us say—we ensure that the fittest feed not only their own fit children but the unfit children of the unfit. The fit children must do with less so that the unfit may be fed. Plainly we are doing our best to substitute for the law of the survival of the fittest a law of survival of the unfittest: as Spencer puts it, we are engaged in "destroying the worthy in making worse the unworthy." In these new conditions the fittest of the old conditions are become the unfittest, and conversely. Or, again, once we have spoken of parasitism, let us exercise a little imagination and ask ourselves whether the evolutionary process which leads to parasitism in the bacteria and the intestinal worms has no analogy in the parasitism of some men to-day upon that long-suffering host which we call society. Needless to say this is the

worst parasitism — indeed, the only parasitism to which an adjective implying a moral judgment can be attached. *Corruptio optimi pessima.*

CHAPTER XIII

HAS PHYSICAL EVOLUTION REACHED ITS GOAL?

Even after so many pages we cannot leave the consideration of human evolution. There remains a question of great interest and importance: Has physical evolution reached its goal in man? Though this question seems at first sight to be absurd, since the very conception of evolution excludes the idea of finality, or seems to be a mere survival of the idea that man is the lord of creation; and though it is evident that some physical characters of man are still changing, yet I hope to show that there is a well-defined sense in which this question may properly be asked, and answered in the affirmative. If such answer should hold good, it will devolve upon us to consider the consequences that must flow from a fact so momentous.

We may diagrammatically conceive the world of living things as V-shaped, consisting of two divergent yet necessarily inter-related and mutually dependent stems which we call animal and vegetable. By reason of causes on which it would not be well here to speculate, the animal stem has acquired an immeasurable superiority over the vegetable, in virtue of the development therein of mind. I submit then that the question of this chapter may

be asked and answered in exclusive reference to the animal stem. The future evolution of vegetable life is, no doubt, a matter of deep interest; but it is not to be named, for either practical or philosophic importance, beside that which we are now to discuss.

If, then, we contemplate animal life as a whole, and with an eye directed to physical characters less for themselves than for their relation to mental characters, we find that we may make a broad and simple classification. In general terms, animals are either invertebrate or vertebrate.[1] Now from the supreme point of view of mind, the vertebrate may

[1] At this point a somewhat lengthy footnote is indispensable. Were this little volume concerned with organic evolution for itself alone, rather than organic evolution as an indispensable study in preparation for that of mind, society, and morality, it would have been necessary to devote much consideration to that great stage in the process which was marked by the appearance of back-boned animals. Only the stage marked by the appearance of many-celled, as against one-celled, organisms, and that marked by the appearance of man himself, can rival or exceed the importance that must be attached to the evolution of the vertebrates. Now it can be shown that this was a gradual process. The older and more familiar terms, *vertebrate* and *invertebrate*, are desirably replaced by the terms *chordata* and *achordata*. All vertebral columns are preceded, in the history of the individual, by the formation of a structure called the notochord, around which, in the higher forms, the vertebral column and skull are developed. But, from the point of view of what Goethe first called *morphology* (the science of form), it matters not whether the notochord persists or is later replaced by a spinal column. Hence all animals that have a temporary or permanent notochord are called *chordata*, whilst those that have not are called *achordata*. The convenience and justice of the newer terminology is apparent when we find that there are various intermediate, worm-like forms, represented even to-day, which have a partially developed notochord—"half" a notochord; and these we call the *hemichordata*. Their study has abundantly demonstrated a most important link in the chain of organic evolution.

be regarded as immeasurably superior, as well as from the point of view of morphology. To this generalisation the social insects, such as the bee and the ant, offer a limited but extremely striking exception. Nevertheless, even whilst recognising that their claims are not lightly to be set aside, we may proceed to confine ourselves, in answering the question whether physical evolution has reached its goal, exclusively to the vertebrates.

Assuming, then, for the nonce at any rate, that we may justly answer this question with sole reference to the vertebrate family, we may attempt to express, in very broad outline, the general tendency of physical evolution in this family. And we find it possible to frame an exceedingly simple expression thereof. Characteristic of the vertebrates is the possession of two pairs of limbs. Now as we survey the whole family, from the fish to man, we find that there is a tendency to specialisation—*i.e.* to evolution in regard to the structure and function of these limbs. The posterior pair alone tend to discharge the function of locomotion upon the ground, which was previously discharged by anterior and posterior limbs alike. The pair of limbs which are nearest to the supremely important *brain* and to the very important *mouth*—*i.e.* the fore-limbs—tend to assume more complicated functions. If we briefly trace the history of the vertebrate groups this becomes apparent. From the fish there is evolved the amphibian, which spends only its earlier stages in water, and is an air-breather when adult.[1] From it proceeds the reptile, which in its

[1] Speaking very broadly, we may say that the tadpole is a fish, the (adult) frog a reptile.

turn gives origin, as has been abundantly proved, to the birds. Also from the amphibian, in all probability, the mammal is descended. Now let us compare the fore-limbs of the bird and the mammal. In each case we find signs of the specialisation already referred to. In the case of the bird, this has resulted in the allotment of the fore-limbs to the performance of a special type of locomotion—flight. This is well; but could not the fore-limb have realised higher possibilities? and are not these now closed to the wing of the bird? In the case of the mammal, which, in virtue perhaps especially of its reproductive method, has reached a higher plane than the bird, we find various specialisations of the fore-limbs. In the bat, for instance, a web has been formed between the fingers, and the fore-limbs, like those of the bird, have been specialised for flight. Here, also, it would seem that the evolutionary process has ended in a *cul-de-sac*.

But, ignoring such exceptions as the bat, and keeping, so to speak, to the main line of advance, what do we find to be the history of the fore-limbs? Surely the greatest potentialities open out before a line of evolution which does not involve the sacrifice of one-and-a-half fingers, and the simplification of the rest, as in the bird, nor the permanent attachment of the finger-edges to each other, as in the bat, nor the loss of three digits out of five, as in the pig, or of four out of five, as in the horse. Surely the policy of retaining all the fingers, and the independent mobility of each, will carry furthest the creature that adopts it. This was the policy of the monkey-tribe.

But, given this complete five-fingered, independent-fingered, versatile, nervous appendage to the fore-limbs, its highest possibilities were not yet attainable; only occasionally and at some cost could this organ display its powers. Finally, however, the ape achieved such an alteration in the mechanics of its body as to free the fore-limbs entirely from purposes of progression. Then appeared man. True, the bird can stand at ease on its hind-legs, but it has devoted its fore-limbs to the empire of the air; and the bird cannot "have it both ways." Man—to keep up our figurative manner of speech—forewent the possibility of flight (at this stage!) and was rewarded by finding that these fore-limbs could accomplish that which is impossible for the bird's wing. The *erect attitude* gave him the *unfettered* possession of a complete and hitherto relatively unspecialised hand, with which he now can chisel a Laocöon, paint a Sistine Madonna, write a Hamlet.

Thus we have traced the evolution of the vertebrate to the point at which the head is no longer the part of the body that is to the front (being thus enabled by its organs of sense to perceive whatever is encountered in locomotion), but crowns the spine. The eyes command a wider horizon, and naturally look forward in parallel lines, thus ensuring the constant advantage of binocular vision. The possibilities of the completely furnished fore-limbs are no longer finite: are infinite. It matters not how large the brain becomes, how heavy the head, for it is nicely balanced on the spine, which drops vertically to the supporting ground. This, plainly, is the paragon of animals.

And the question arises, what further step can be conceived?

Such changes as can be imagined are not positive, but negative. Undoubtedly the jaws of man are undergoing involution. Already his teeth but rarely last a lifetime. His hands clothe and house him, so that he is becoming less hairy. He will in all probability retain only such hair as may have æsthetic value and be preserved by sexual selection; only such teeth as are needed for the biting of such food, *e.g.* an apple, as is most pleasant when attacked in its natural state; whilst sexual selection and the æsthetic sense may preserve the incisors as comely accompaniments of a smile. Perhaps his nails may disappear. Doubtless his intestinal canal may undergo much simplification, and cease to include various parts which are now of only historical or surgical interest.

But we may grant all this and more, and yet maintain not only that physical evolution has reached its goal in man, but also that no further stage *can be conceived.* Figure this creature of the future, as hairless, toothless, nailless, as you please, gigantic as to head, small as to muscle: he will still be palpably a man: though modified, yet plainly a modified man, in a much truer sense than man can be called a modified ape. It is, therefore, submitted by certain students that the assumption of the erect attitude constituted a final stage in physical evolution.

Reluctant to believe this assertion, one may proceed to imagine some development which might fairly be regarded as introducing an organism as different from man the erect as he is different from

the unerected ape. It is of course easy to conceive of the advantages of having, say, four free limbs instead of two, or six fingers on each hand instead of five. But it is not possible to conceive how such modifications could be produced by the known factors of organic evolution; two well-guided limbs would be worth twenty ill-guided. We must therefore rather look to the brain as the seat of further physical changes. But whatever enlargement of the brain, whatever further complications of its convolutions or thickening of its grey matter be conceived, the creature so equipped would still be man; *Uebermensch* or "superman" if you please, but still man. The physical characters that differentiated his body as a whole from the human body of to-day would be characters not of evolution, but of involution. Psycho-physical evolution may but have left the mark; but physical evolution has reached its goal.

CHAPTER XIV

THE FUTURE EVOLUTION OF MAN

It is, then, to his mind rather than his body that we must look for the future evolution of man. But mind and body are closely related, and the material cell which reproduces a father's body in his child may also reproduce his mental characters. Indeed, Professor Karl Pearson may be regarded as having proved that there is a very high degree of correlation between the inheritance of physical and the inheritance of mental characters. Hence, whilst we

may scarcely look for the evolution of such new physical characters as would mark any important further stage in physical evolution, we must regard as quite possible such minute but momentous physical changes in the average cerebrum of the race, as would imply the exaltation of its mental and moral characters. And if, as evolutionary considerations teach us, the ennoblement of our kind is possible, it behoves us to ask ourselves whether we have the power to effect it; for no other aim so worthy can be conceived.

We have seen that the necessary conditions of organic evolution are heredity and variation. In virtue of their action, the individuals composing any given generation of men are possessed of widely different physical characters, and these are liable to be transmitted, also in virtue of these same conditions, to their descendants. But these individuals also present widely different moral and mental characters. The question arises whether these, also, are capable of transmission. After decades of inquiry and controversy, we have reached the conclusion that indeed they are. On the other hand, we know that such mental acquirements as, say, a knowledge of several languages, are certainly not transmissible; whilst the inborn facility for learning them falls under the category of mental characters also stated to be transmissible. Plainly, then, we shall not succeed in elevating the race by educating the emotional and intellectual faculties of each generation, since the results of such education are not transmissible; but we might conceivably achieve our object by selecting those individuals in whom

the inborn characters, mental and moral, are the highest, and entrusting *solely to them* the duty of producing the next generation; whilst the individuals mentally and morally inferior were forcibly prevented from reproducing their inferiority. This would be to take a leaf out of Nature's book, by a deliberate application of the principle of natural selection. Nature effects the survival of the physically fittest; why should not we effect the survival of the morally and mentally fittest?

Appropriately enough, it is Mr. Francis Galton, the cousin of Charles Darwin, who has devoted himself to a consideration of these possibilities, and is now engaged in teaching us how we may apply the Darwinian principle to the highest of conceivable ends. This new study Mr. Galton has called *eugenics*—literally, good breeding—and I propose here to consider it in some detail. Mr. Galton imparts some measure of his own enthusiasm—which no accumulation of years can chill—to any one who is fortunate enough to be honoured by his confidence, but his innumerable ideas prove their inherent vitality in that they thrive even when removed from the invigorating atmosphere which surrounds the person of their begetter. Take them away, subject them to the breath of criticism, and they flourish more than ever. No kind of criticism has been lacking for Mr. Galton's idea of Eugenics; Mr. Wells, Mr. Bernard Shaw, Mr. Chesterton, have made pretty play with it; whilst, at the other extreme, serious students like Weismann and Westermarck and Archdall Reid have contributed that constructive criticism which commonly

flows from the real understanding of the subject under discussion.

Given that some mental and moral characters are worth more to mankind than others; given that such characters, good and bad alike, are, *in any measure*, transmissible by heredity; it follows that the practice of eugenics is no Utopian dream, but is a thing which, however difficult, does not exceed the bounds of possibility. If, in addition to these unquestionable postulates, it be further granted that the object is desirable, our imperative duty is, not to draw ridiculous pictures of eugenic practice and then point to their ridiculous features, but rather to ask ourselves what kinds of eugenic practice are practicable, and forthwith to direct the public attention to the answer.

Immediately, we find that some measure of eugenic practice already obtains amongst us. The man of bright and fertile mind, for instance, is more likely than the dullard to gain the admiration of a fellow-woman, and thus to leave his like behind him. Not only sexual selection but also natural selection thus serves eugenics, even in civilised marriage; for the intelligent man, or the conscientious man, is more likely than another to gain a post the possession of which gives him the means to marry. I need not multiply parallel instances.

The *negative* part of the eugenic proposal is already gaining wide acceptance. It is not good, we are beginning to see, that the idiot, the syphilitic, or the criminal or the "degenerate" in general, should be allowed to injure the coming race. But the negative practice of eugenics does not include

all that is possible, and two considerations connected therewith are constantly forgotten. The first is that conscious human intervention in this regard is not our only means of protection. Nature takes this matter into her own hands far more thoroughly than we always remember; certainly far more thoroughly than is recognised by the advocates of certain preposterously impracticable measures, such as the performance of a surgical operation on all such as somebody or other shall deem suitable subjects therefor. Nature herself places the ban of extinction upon degeneracy: the "rapid multiplication of the unfit" is a self-stultified phrase, since unfitness and infertility rise and fall together. Whilst, therefore, we may well approve the embargo proposed to be laid upon the insane and the criminal, we must remember that insanity and criminality would be immeasurably more ripe amongst us to-day than they actually are, had not some protective forces, not of conscious human origin, been always in action.

The second consideration, often forgotten by those who pin their faith exclusively to the negative proposals of eugenics, is that the mere extermination of those who fall below the normal standard of any race does not make for advance, but merely ensures against regression. Mr. Wells, in opposing Mr. Galton's teaching, has based his objections upon an extraordinary misunderstanding of the law of natural selection: "The real fact of the case is that in the all-round result the inferior usually perish, and the average of the species rises. . . . The way of Nature has always been to slay the hindmost,

and there is still no other way, unless we can prevent those who would become the hindmost being born. It is in the sterilisation of failures, and not in the selection of successes for breeding, that the possibility of an improvement of the human stock lies."[1]

This quotation contains all the errors that could be crammed into the space it occupies. Obviously the perishing of inferior apes would improve the average of the apes, but how would that yield us man? The Darwinian principle, as understood by Mr. Wells, could never explain the origin of any species, but merely the preservation of a species from degeneration. Further, "the way of Nature," as Darwin proved before Mr. Wells was born, has been "the selection of favoured races," and not the slaying of the hindmost. As to the alleged uselessness of the "selection of successes for breeding," it is to be hoped that no breeder of stock will judge the Sociological Society by this absurd utterance.

On the contrary, it is precisely in following the example of Nature by selecting successes for breeding that the possibility and the only possibility of an improvement of the human stock lies. Organic evolution depends upon factors, of which the chief is natural selection. This has served in the production of man from the ape; and a process which is absolutely identical therewith—notwithstanding that it happens to be consciously directed by man towards the ideal of fitness for a social environment, rather than by Nature towards the ideal of fitness for a natural environment—will serve for the evolution in man of psychical char-

[1] "Sociological Papers" (Macmillan), p. 60.

acters which—as no reason can be alleged for denying—may be as superior to those he now possesses as they are to the psychical characters of the ape.[1]

CHAPTER XV

SHOULD THESE THINGS BE TAUGHT TO OUR CHILDREN?

It is impossible to close the present discussion of organic evolution without raising and most positively answering a question of some moment: Ought we to teach the main facts of organic evolution to our children?

We have here a great generalisation from all the facts of biology: a discovered principle which gives them a new meaning. That the generalisation is true no competent student can now be found to deny. We have seen that to any one acquainted with all the known facts of biology and geology, it would appear a truth as obvious as gravitation to the astronomer.

The first essential of any statement taught to a child is surely that it be true; the next perhaps that it be intelligible, else time and labour are spent in vain. No one will deny that the assertion of organic evolution is intelligible to the mind of the average child of, say, fourteen.

[1] It has been possible here only very briefly to introduce this great subject. I have been concerned merely to demonstrate the rational grounds for its study. The interested reader will find in the volume of "Sociological Papers" already named many pages of Mr. Galton, and a long and, in most cases, most important series of criticisms by students of many nations, some speaking as physicians, others as sociologists proper, biologists, statisticians, psychologists, and so forth. To these are added remarks by those who speak as professional jesters.

Granted that it is true and intelligible, there needs only to prove that it is important, and the case for teaching it is surely made good. If, then, we analyse our idea of importance and (accepting the usual silly terminology since it conveys the required meaning) ask whether the theory of organic evolution is of importance apart from "mere utility," or is merely of "utilitarian" importance, there can be no hesitation in answering both sections of the question affirmatively. I have repeatedly, in print—not in one place but in many—attempted to provoke some reader to a defence of "history" (falsely so-called) as of superior educative value than that majestic history with which the study of organic evolution is concerned. Hitherto no one, though the provocation has been extreme, has ventured to maintain the proposition that the contemptible gossip "about persons of no intrinsic worth living or dead," the alliances, the (occasionally accurate) dates, the endless tale of wars about unintelligible dogmas or unintelligent persons, and all the rest of the rubbish-heap of unappreciated or inappreciable facts—misnamed history—can be recommended as a means of culture or an avenue to wisdom, superior to those momentous truths which the past hundred years have revealed to us; and the discovery of which is the one outstanding event that the wise historian of the distant future will record as the "history" of the nineteenth century.

As to "practical utility," which some think the only justification for the teaching of anything, whilst others think that it brands a subject as "not fit for a gentleman"—the previous chapters have

completely failed of their purpose if they have not convinced the reader that modern biology—*i.e.* the theory of organic evolution and the facts clustered around it—is a science whose teachings are of immeasurable "practical utility" to the individual and to society. Only on the basis provided by the evolutionary psychology can a perfect system of education conceivably be devised; without this basis no parent can build as well as with it. As for the utility of our theory to society, much has already been said in the last chapter. But the advocates of eugenics, charm they, reason they, never so wisely, will not succeed in achieving that for which they strive until every citizen of even mediocre intelligence is acquainted with the principles of organic evolution.

But here we encounter the possible objection. Some will say that, even though these principles be true, and intelligible to the young, and of importance both educative and "practical," yet they need not be taught to children. When the boy grows up he will come across all these things; and that will be soon enough. Strong meat is not for babes.

In controversion of this opinion, I would first ask its advocates what they *do* propose to teach. It is palpably impossible to avoid teaching anything about the origin of man. The choice, then, would appear to rest between the teaching—to use language at once accurate and comprehensible—of lies or the teaching of the truth. Some reader objects to this assertion as unmannerly or superficial. He maintains that the statements of Genesis,

though untrue, are not to be called lies, but symbols of higher truths than are dreamt of in my philosophy; and that these statements may be imparted to our children because of the spiritual lessons which they teach. Now, omitting the various absurdities of Genesis, such as the creation of light before the creation of its source, and even granting the theory of Hugh Miller that the "days" of Genesis are really geological epochs, and teach us that "a thousand years in His sight are but as a moment," we may observe three leading assertions in this Creation-myth. The first is that it was said to the first man, "Thou shalt not know," and that, in consequence of his seeking to know, he and all his descendants were condemned. The second is that there is a personal devil. The third is that woman is the inferior of man. Which of these doctrines is the most grossly untrue, or which is calculated to be the most productive of human sorrow, I am at a loss to say.

My last argument in favour of the teaching of the truth, rather than of untruth, to our children is that the most horrible consequences ensue from the present course. The child whose confidence has been thus abused has a way of growing up; and finds himself in the mental environment of our time, in which some lies, at any rate, cannot survive. In some cases suddenly and consciously, but more often gradually and subconsciously, he discards all this rubbish; and that is well. But when much bulky dross contains some grains of purest gold, the discovery that the dross *is* dross may imperil that which is not dross. Or alter the

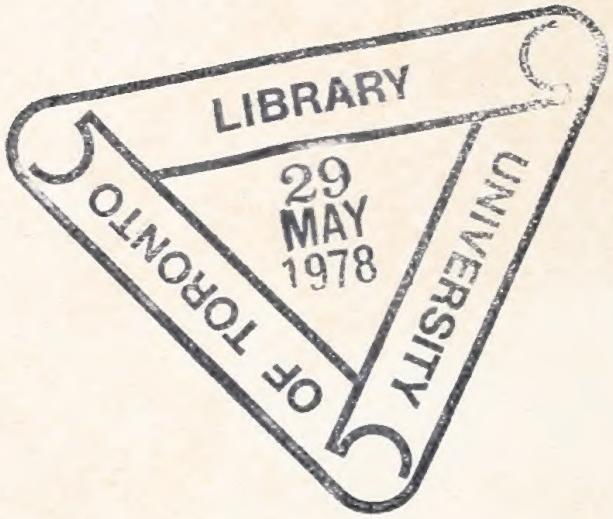
metaphor. The strength of a chain is the strength of its weakest link. You have made a chain of links that are lies and links that are truths, and you have used it to anchor your child's mind to the principles of right living. What happens when the lies lie broken? The youth throws away Adam, but he also throws away the Sermon on the Mount. He does not wait to discriminate. He accepts the teaching which makes all these things interdependent, the Fall and the law "That ye love one another." He learns that there has been no Fall; and he is logical enough (since, in the system taught him, truths have been erected upon lies) to assume that if the foundation is false, all is false. The mismade cable with which he has been provided parts at all its worthless links—the sound ones are of no avail—and he loses his *moral anchorage*. The responsibility for this supreme disaster falls not upon those who made the myths, nor upon those who preserved them, nor upon those who believed them, but upon those who did far worse than the father who gave a stone for bread, in giving, for the truth, lies which they knew to be lies.

In this and every day the thing that matters is *morality*. I advocate the teaching of the great facts of biology to our children, and the supersession of the untruths whose nature we now know, chiefly because it is only upon "the solid ground of Nature" that we can base a moral teaching of which it may be said, in the words of the Great Exemplar of morality—

"And the rain descended, and the floods came, and the winds blew, and beat upon that house, and it fell not: for it was founded upon a rock."

INDEX TO NAMES

Printed by Ballantyne, Hanson & Co.
Edinburgh & London


LIBRARY
29
MAY
1978
UNIVERSITY
OF TORONTO