An Address ON

DARWIN'S THEORY OF MAN'S DESCENT AS IT STANDS TO-DAY.

DELIVERED TO THE BRITISH ASSOCIATION*
BY THE PRESIDENT,

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IN tracing the course of events which led up to our present conception of Man's origin, no place could serve as a historical starting point so well as Leeds. In this city was fired the first verbal shot of that long and bitter strife which ended in the overthrow of those who defended the Biblical account of Man's creation and in a victory for Darwin. When the British Association assembled in this city in 1858 Sir Richard Owen, the first anatomist of his age, was its president. In a long address he reviewed the whole realm of Science. During its course he cited evidence which suggested a much earlier date for the appearance of Man on earth than was sanctioned by Biblical records, but poured scorn on the idea that Man was merely a transmuted ape. He declared that the differences between Man and ape were so great that it was necessary to assign mankind to an altogether separate Order in the animal kingdom. As this statement fell from the President's lips there was at least one man in the audience whose spirit of opposition was roused—Thomas Henry Huxley—Owen's young and rising antagonist. I have picked out Huxley because it is necessary, for the development of my theme, that we should give him our attention for a moment. The Leeds meeting passed off amicably, but two years later, in 1860, when this Association met in Oxford, Owen, in the course of a discussion, repeated the statement made at Leeds as to Man's separate position, claiming that the human brain had certain structural features never seen in the brain of anthropoid apes. Huxley's reply was a brief and emphatic denial, with a promise to produce evidence in due course—which was faithfully kept. This opening passage at arms was followed two days later by that spectacular fight in which the Bishop of Oxford, the representative of Owen and of Orthodoxy, left his scalp in Huxley's hands. To make his victory decisive and abiding, Huxley published, early in 1863, *The Evidences of Man's Place in Nature*, a book which settled for all time that Man's rightful position is among the primates, and that as we anatomists weigh evidence, his nearest living kin are the anthropoid apes.

My aim is to make clear the foundations on which rest our present-day conception of Man's origin, but I must turn to another issue, which, though it was merely touched upon by Sir Richard Owen, is of supreme interest to us now. Earlier in that year Sir Charles Lyell and Sir Joseph Hooker left with the Linnean Society what appeared to be an ordinary roll of manuscript, but what in reality was a parcel charged with high explosives, prepared by two very innocent-looking men—Alfred Russel Wallace and Charles Darwin. It must be admitted that these two men were well aware of the deadly nature of its contents, but Owen examined them and came to the conclusion that they were not dangerous; at least, he manifested no sign of alarm in his Presidential Address.

The Transformation of our Outlook on Man's Origin.

I cannot help marvelling over the difference of outlook between my audience and that which Sir Richard Owen had in this city sixty-nine years ago. The vast assemblage which confronted him was convinced, almost without a dissentient, that Man had appeared on earth by a special act of creation; the audience I address, and that larger congregation which the wonders of wireless bring within the reach of my voice, if not convinced Darwinists, are yet

prepared to believe, when full proofs are forthcoming, that Man began his career as a humble primate animal, and has reached his present estate by the action and reaction of biological forces which have been and are ever at work within his body and brain.

Darwin's Generalship.

This transformation of outlook on Man's origin is one of the marvels of the nineteenth century, and to see how it was effected we must turn our attention for a little while to the village of Down in the Kentish uplands, and note what Charles Darwin was doing on the very day that Sir Richard Owen was delivering his address. He sat in his study struggling with the first chapter of a new book: but no one foresaw, Owen least of all, that the publication of the completed book, *The Origin of Species*, fifteen months later (1859), was to effect a sweeping revolution in our way of looking at living things and to initiate a new period in human thought—the Darwinian Period—in which we still are. Without knowing it, Darwin was a consummate general. He did not launch his first campaign until he had spent twenty-two years in stocking his arsenal with ample stores of tested and assorted fact. Having won territory with *The Origin of Species*, he set to work to consolidate his gains by the publication in 1868 of another book, *The Variation of Animals and Plants under Domestication*—a great and valuable treasury of biological observation. Having thus established an advanced base, he moved forwards on his final objective—the problem of human beginnings—by the publication of *The Descent of Man* (1871), and that citadel capitulated to him. To make victory doubly certain he issued in the following year—1872—*The Expression of the Emotions in Man and Animals*. Many a soldier of truth had attempted this citadel before Darwin's day, but they failed because they had neither his generalship nor his artillery.

History as Written by Darwin.

Will Darwin's victory endure? Before attempting to answer this question, let us look at what kind of book *The Descent of Man* is. It is a book of history—the history of Man, written in a new way—the way discovered by Charles Darwin. I will illustrate the Darwinian way of writing history. If a history of the modern bicycle had to be written in the orthodox way, we should search dated records until every stage was found which linked the two-wheeled hobby-horse, bestrode by tall-hatted men at the beginning of the nineteenth century, to the modern "jeopardy" which now flashes past us in country lanes. But suppose there were no dated records—only a jumble of antiquated machines stored in the cellar of a museum. We should then have to adopt Darwin's way of writing history. By an exact and systematic comparison of one machine with another we could infer the relationship of one to another and tell the order of their appearance, but as to the date at which each type appeared and the length of time it remained in fashion, we could say very little. It was by adopting this circumstantial method that Darwin succeeded in writing the history of Man. He gathered historical documents from the body and behaviour of Man and compared them with observations made on the body and behaviour of every animal which showed the least resemblance to Man. He studied all that was known in his day of Man's embryological history and noted resemblances and differences in the corresponding histories of other animals. He took into consideration the manner in which the living tissues of Man react to disease, to drugs, and to environment; he had to account for the existence of diverse races of mankind. By a logical analysis of his facts Darwin reconstructed the history of Man.

Darwin's Position has become Impregnable.

Fifty-six years have come and gone since that history was written; an enormous body of new evidence has poured in upon us. We are now able to fill in many pages which Darwin had to leave blank, and we have found it necessary to alter details in his narrative, but the fundamentals of Darwin's outline of Man's history remain unshaken. Nay, so strong has his position become that I am convinced that it never can be shaken.

* The address has been slightly shortened by the omission of a few sentences. (See also page 459.)

The Evidence of Fossil Remains.

I say confidently that Darwin's position has become impregnable because since his death in 1882 we have succeeded in tracing Man by means of his fossil remains and by his stone implements backwards to the very beginning of that period of the earth's history to which the name Pleistocene is given. We thus reach a point in history which is distant from us at least 200,000 years, perhaps three times that amount. Nay, we have gone farther, and traced him into the older and longer period which preceded the Pleistocene—the Pliocene. It was in strata laid down by a stream in Java during the later part of the Pliocene period that Dr. Eugen Dubois found, ten years after Darwin's death, the fossil remains of that remarkable representative of primitive humanity to which he gave the name *Pithecanthropus*, or Ape-man; from Pliocene deposits of East Anglia Mr. Reid Moir has recovered rude stone implements. If Darwin was right, then as we trace Man backwards in the scale of time he should have become more bestial in form—nearer to the ape. That is what we have found. But if we regard *Pithecanthropus* with his small and simple yet human brain as a fair representative of the men of the Pliocene period, then evolution must have proceeded at an unexpectedly rapid rate to culminate to-day in the higher races of mankind.

Man's Descent has not been in a Straight Line.

The evidence of Man's evolution from an ape-like being, obtained from a study of fossil remains, is definite and irrefutable, but the process has been infinitely more complex than was suspected in Darwin's time. Our older and discarded conception of Man's transformation was depicted in a well known diagram which showed a single file of skeletons, the gibbon at one end and Man at the other. In our original simplicity we expected, as we traced Man backwards in time, that we should encounter a graded series of fossil forms which would carry him along a straight path to an anthropoid ancestor. We should not have made this initial mistake if we had remembered that the guide to the world of the past is the world of the present. In our time Man is represented not by one but by many and diverse races—black, brown, yellow, and white; some of these are rapidly expanding, others are as rapidly disappearing. Our searches have shown that in remote times the world was peopled, sparsely it is true, with races showing even a greater diversity than those of to-day, and that even then the same process of replacement was at work. We have to thread our way, not along the links of a chain, but amongst the meshes of a complicated network.

Diversity of Form in Ancient Times.

We committed a still further blunder. Seeing that in our search for Man's ancestry we expected to reach an age when the beings we would have to deal with would be simian rather than human, we ought to have marked the conditions which prevail amongst living anthropoid apes. We ought to have been prepared to find, as we approached a distant point in the geological horizon, that the forms encountered would be as widely different as are the gorilla, chimpanzee, and orang, and confined, as these great anthropoids now are, to limited parts of the earth's surface. That is what we are now realizing; as we go backwards in time we discover that mankind becomes broken up, not into separate races as in the world of to-day, but into numerous and separate species. When we go into a still more remote past they become so unlike that we have to regard them not as belonging to separate species but different genera. It is amongst this welter of extinct fossil forms which strew the ancient world that we have to trace the zigzag line of Man's descent.

Discordant Evolution.

We made another mistake when we set out on the search for Man's ancestry; indeed, some of us are still making it. We expected that Man's evolution would pursue not only an orderly file of stages, but that every part of his body—skull, brain, jaws, teeth, skin, body, arms, and legs—would at each stage become a little less ape-like, a little more Man-like. Our searches have shown us that Man's evolu-

tion has not proceeded in this manner. In some extinct races, while one part of the body has moved forwards another part has lagged behind. We now know that, as Darwin sat in his study at Down, there lay hidden at Piltown, in Sussex, not thirty miles distant from him, sealed up in a bed of gravel, a fossil human skull and jaw. In 1912, thirty years after Darwin's death, Mr. Charles Dawson discovered this skull, and my friend Sir Arthur Smith Woodward described it, and rightly recognized that skull and jaw were parts of the same individual, and that this individual had lived, as was determined by geological and other evidence, in the opening phase of the Pleistocene period. We may confidently presume that this individual was representative of the people who inhabited England at this remote date. The skull, although deeply mineralized and thick-walled, might well have been the rude forerunner of a modern skull, but the lower jaw was so ape-like that some experts denied that it went with the human fossil skull at all, and supposed it to be the lower jaw of some extinct kind of chimpanzee. This mistake would never have been made if those concerned had studied the comparative anatomy of anthropoid apes, for then they would have been prepared to meet with the discordances of evolution. The same irregularity in the progression of parts is evident in the anatomy of *Pithecanthropus*, the oldest and most primitive form of humanity so far discovered. The thigh-bone might easily be that of modern man, the skull-cap that of an ape, but the brain within that cap, as we now know, had passed well beyond an anthropoid status. If merely a lower jaw had been found at Piltown an ancient Englishman would have been wrongly labelled "Higher anthropoid ape"; if only the thigh-bone of *Pithecanthropus* had come to light in Java, then an ancient Javanese, almost deserving the title of anthropoid, would have passed muster as a man.

Blanks Still Remain in the Geological Record.

Such examples illustrate the difficulties which beset the task of unravelling Man's ancestry, and there are others; there still remain great blanks in the geological record of Man's evolution; as our search proceeds these blanks will be filled in. By the discovery of fossil remains we have followed Man backwards to the close of the Pliocene period, which endured at least for a quarter of a million years, but we have not yet succeeded in tracing him through this period. It is true that we have found fossil teeth in Pliocene deposits which may be those of an ape-like man or of a man-like ape; until we find other parts of their bodies we cannot tell. When we pass into the still older Miocene period—one which was certainly twice as long as the Pliocene—we are in the heyday of anthropoid history. Thanks to the labours of Dr. Guy E. Pilgrim, of the Indian Geological Survey, we know already of a dozen different kinds of great anthropoids which lived in Himalayan jungles during middle and later Miocene times; we know of at least three other kinds of great anthropoid apes which lived in the contemporary jungles of Europe. Unfortunately we have found as yet only the most resistant parts of their bodies—teeth and fragments of jaw. Do some of these fragments represent an ancestor of man? We cannot decide until a lucky chance brings to light a limb-bone or a piece of skull, but no one can compare the teeth of these Miocene anthropoids with those of primitive man, as has been done so thoroughly by Professor William K. Gregory, and escape the conviction that in the dentitions of the extinct anthropoids of the Miocene jungles we have the ancestral forms of human teeth.

Date of Man's Emergence.

It is useless to go to strata still older than the Miocene in search of Man's emergence; in such strata we have found only fossil traces of emerging anthropoids. All the evidence now at our disposal supports the conclusion that Man has arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee, and that the date at which human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period. On our modest scale of reckoning, that gives Man the respectable antiquity of about one million years.

Proofs of Our Anthropoid Ancestry.

Our geological search has not produced so far the final and conclusive evidence of Man's anthropoid origin; we have not found as yet the human *imago* emerging from its anthropoid encasement. Why, then, do modern anthropologists share the conviction that there has been an anthropoid stage in our ancestry? They are not blind to the degree of difference which separates Man and ape in structure, in appearance, and in behaviour. I must touch on the sources of this conviction only in a passing manner. Early in the present century Professor G. H. F. Nuttall of Cambridge University discovered a trustworthy and exact method of determining the affinity of one species of animal to another by comparing the reactions of their blood. He found that the blood of Man and that of the great anthropoid apes gave almost the same reaction. Bacteriologists find that the living anthropoid body possesses almost the same susceptibilities to infections, and manifests the same reactions, as does the body of Man. So alike are the brains of Man and anthropoid in their structural organization that surgeons and physiologists transfer experimental observations from the one to the other. When the human embryo establishes itself in the womb it throws out structures of a most complex nature to effect a connexion with the maternal body. We now know that exactly the same elaborate processes occur in the anthropoid womb and in no other. We find the same vestigial structures—the same “evolutionary post-marks”—in the bodies of Man and anthropoid. The anthropoid mother fondles, nurses, and suckles her young in the human manner. This is but a tithe of the striking and intimate points in which Man resembles the anthropoid ape. In what other way can such a myriad of coincidences be explained except by presuming a common ancestry for both?

The Evolution of Man's Brain.

The crucial chapters in Darwin's *Descent of Man* are those in which he seeks to give an historical account of the rise of Man's brain and of the varied functions it subserves. Darwin was not a professional anatomist, and therefore accepted Huxley's statement that there was no structure in the human brain that was not already present in that of the anthropoid. In Huxley's opinion the human brain was but a richly annotated edition of the simpler and older anthropoid book, and that this edition, in turn, was but the expanded issue of the still older original primate publication. Since this statement was made thousands of anatomists and physiologists have studied and compared the brain of Man and ape; only a few months ago Professor G. Elliot Smith summarized the result of this intensive inquiry as follows:

“No structure found in the brain of an ape is lacking in the human brain, and, on the other hand, the human brain reveals no formation of any sort that is not present in the brain of the gorilla or chimpanzee. . . . The only distinctive feature of the human brain is a quantitative one.”

Though the difference is only quantitative its importance cannot be exaggerated. In the anthropoid brain are to be recognized all those parts which have become so enormous in the human brain. It is just these expansions which have given Man his powers of feeling, understanding, acting, speaking, and learning.

The Evidence of Psychology.

Darwin himself approached this problem not as an anatomist but as a psychologist, and after many years of painstaking and exact observation convinced himself that,

immeasurable as are the differences between the mentality of Man and ape, they are of degree, not of kind. Prolonged researches made by modern psychologists have verified and extended Darwin's conclusions. No matter what line of evidence we select to follow—evidence gathered by anatomists, by embryologists, by physiologists, or by psychologists—we reach the conviction that Man's brain has been evolved from that of an anthropoid ape and that in the process no new structure has been introduced and no new or strange faculty interpolated.

Unexplained Problems.

But finality is not in sight; our inquiries are but begun. Will the day ever come when we can explain why the brain of man has made such great progress while that of his cousin the gorilla has fallen so far behind? Can we explain why inherited ability falls to one family

and not to another; or why, in the matter of cerebral endowment, one race of mankind has fared so much better than another? We have as yet no explanation to offer, but an observation made twenty years ago by one on whom Nature has showered great gifts—a former President of this Association and the doyen of British zoologists, Sir E. Ray Lankester—deserves quotation in this connexion:

“The leading feature in the development and separation of Man from other animals is undoubtedly the relative enormous size of the brain in Man and the corresponding increase in its activities and capacity. It is a striking fact that it was not in the ancestors of Man alone that this increase in the size of the brain took place at this same period—the Miocene. Other great mammals of the early Tertiary period were in the same case.”

When primates made their first appearance in the geological record they were, one and all, small brained.

Darwin's Conception of Evolution Illustrated.

I have spoken of Darwin as an historian. To describe events and to give the order of their occurrence is the easier part of an historian's task; his real difficulties begin when he seeks to interpret the happenings of history and detect the causes which produced them. Up to this point I have been considering only the materials for Man's history, and placing them, so far as our scanty

information allows, in the order of their sequence, but now we have to seek out the biological processes and controlling influences which have shaped the evolutionary histories of Man and ape. It will repay us to use the evolution of new types of motor cars as an illustration. In the evolution of motor vehicles Darwin's law of Selection has prevailed; there has been severe competition, and the types which have answered best to the needs and tastes of the public have survived. The public has selected on two grounds—first for utility, thus illustrating Darwin's law of Natural Selection—and secondly, because of appearance's sake; for, as most people know, a new car has to satisfy, not only the utilitarian demands of its prospective master, but also the aesthetic tastes of its prospective mistress, therein illustrating Darwin's second law—the law of Sexual Selection. The public has selected types of car, but it has had no direct hand in designing and producing modifications and improvements which have appeared year after year. To understand how such modifications are produced the inquirer must enter a factory, and not only watch artisans shaping and fitting parts together, but also visit the designer's office. In this way he will obtain a glimpse of the evolution of motor cars. If we are to understand the machinery which underlies the evolution of Man and of ape, we have to enter the “factories” where they are

Rough diagram to illustrate the relation in time of the several geological periods mentioned by Sir Arthur Keith. More precise delineations will be found in the frontispieces of Volumes I and II of his *Antiquity of Man* (London: Williams and Norgate, 1925).

produced—look within the womb and see the ovum being transformed into an embryo, the embryo into a foetus, and the foetus into a babe. After birth we may note infancy passing into childhood, childhood into adolescence, adolescence into maturity, and maturity into old age. Merely to register the stages of change is not enough; to understand the controlling machinery we have to search out and uncover the processes which are at work within developing and growing things and the influences which co-ordinate and control all the processes of development and of growth. When we have discovered the machinery of development and of growth we shall also know the machinery of Evolution, for they are the same.

If the simile I have used would have sounded strange in Darwin's ear, the underlying meaning would have been familiar to him. Over and over again he declared that he did not know how "variations" were produced, favourable or otherwise; nor could he have known, for in his time hormones were undreamt of and experimental embryology scarcely born. With these recent discoveries new vistas opened for students of Evolution. When we compare the evolutionary machinery in a motor factory with that which regulates the development of an embryo within the womb, we realize how different the two processes are. Let us imagine for a moment what changes would be necessary were we to introduce "embryological processes" into a car factory. We have to conceive a workshop teeming with clustering swarms of microscopic artisans, mere specks of living matter. As we pass along we note that every part of a car is in process of manufacture, each part being the business of a particular brigade of microscopic workmen. There is no apprenticeship in this factory; every employee is born, just as a hive-bee is, with his skill already fully developed. No plans or patterns are supplied; every workman has the needed design in his head from birth. There is neither manager, overseer, nor foreman to direct and co-ordinate the activities of the vast artisan armies. And yet if parts are to fit when assembled, if pinions are to mesh and engines run smoothly, there must be some method of co-ordination. It has to be a method plastic enough to permit difficulties to be overcome and the introduction of advantageous modifications when these are needed. A modern works manager would be hard put to it were he asked to devise an automatic system of control for such a factory, yet it is just such a system that we are now obtaining glimpses of in Nature's living workshops.

The Machinery of Development and Growth.

I have employed a crude simile to give an inkling of what happens in that factory where the most complicated of machines are forged—the human body and brain. The fertilized ovum divides and redivides; one brood of microscopic living units succeeds another, and as each is produced the units group themselves to form the "parts" of an embryo. Each "part" is a living society; the embryo is a huge congeries of interdependent societies. How are their respective needs regulated, their freedoms protected, and their manœuvres timed? Experimental embryologists have begun to explore and discover the machinery of regulation. We know enough to realize that it will take many generations of investigators to work over the great and new field which is thus opening. When this is done we shall be in a better position to discuss the cause of "variation" and the machinery of Evolution.

If we know only a little concerning the system of government which prevails in the developing embryo we can claim that the system which prevails in the growing body, as it passes from infancy to maturity, is becoming better known every year. The influence of the sex glands on the growth of the body has been known since ancient times; their removal in youth leads to a transformation in the growth of every part of the body, altering at the same time the reactions and temperament of the brain. In more recent years it has been observed that characteristic alterations in the appearance and constitution of the human body can be produced by the action of other glands—the pituitary, thyroid, parathyroid, and adrenals. Under the disorderly action of one or other of these glands individuals may, in the course of a few years, become so changed in appearance that the differences between them

and their fellows become as great as, or even greater than, those which separate one race of mankind from another. The physical characters which are thus altered are just those which mark one race off from another. How such effects are produced we did not know until 1904, when the late Professor E. H. Starling, a leader amongst the great physiologists of our time, laid bare an ancient and fundamental law in the living animal body—his law of hormones. I have pictured the body of a growing child as an immense society made up of myriads of microscopic living units, ever increasing in numbers. One of the ways—probably the oldest and most important way—by which the activities of the communities of the body are co-ordinated and regulated is by the postal system discovered by Starling, wherein the missives are hormones—chemical substances in ultra-microscopic amounts, dispatched from one community to another in the circulating blood. Clearly the discovery of this ancient and intricate system opens up fresh vistas to the student of Man's evolution. How Darwin would have welcomed this discovery! It would have given him a rational explanation to so many of his unsolved puzzles, including that of "correlated variations." Nor can I in this connexion forbear to mention the name of one who presided so ably over the affairs of this Association fifteen years ago—Sir E. Sharpey-Schafer. He was the pioneer who opened up this field of investigation and has done more than anyone to place our knowledge of the nature and action of the glands of internal secretion on a precise basis of experimental observation. With such sources of knowledge being ever extended and others of great importance, such as the study of heredity, which I have left unmentioned, we are justified in the hope that Man will be able in due time not only to write his own history but to explain how and why events took the course they did.

I have attempted to answer a question of momentous importance—What is Man's origin? Was Darwin right when he said that Man, under the action of biological forces which can be observed and measured, has been raised from a place amongst anthropoid apes to that which he now occupies? The answer is Yes! and in returning this verdict I speak but as foreman of the jury—a jury which has been empanelled from men who have devoted a lifetime to weighing the evidence. To the best of my ability I have avoided, in stating the evidence on which our verdict was found, the role of special pleader, being content to follow Darwin's own example—Let the Truth speak for itself.

DISCUSSION ON THE HYGIENE OF MENSTRUATION IN ADOLESCENTS.*

I.—DEVELOPMENTAL CHANGES DURING ADOLESCENCE.

BY

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I WELCOME the opportunity of opening this discussion on the hygiene of menstruation in adolescents. The subject is a most important one and, as it is a matter which falls peculiarly within the province of the confidential family physician, there could be no more suitable gathering than this in which to discuss it. Few matters in regard to feminine hygiene have a more profoundly far-reaching importance. The wise management of a girl's life at the period of adolescence gives the functions of her reproductive organs a good start, and if these behave normally to begin with there is the more likelihood that they will continue to do so. The converse is equally but not more true, although it is much more frequently brought to our

* Report of a discussion in the Section of Obstetrics and Gynaecology at the Annual Meeting of the British Medical Association at Edinburgh. Dr. J. Haig Ferguson, President of the Section, was in the chair.