EXAMINATION OF THE ARGUMENTS FOR AND AGAINST DARWINISM

J. MACLAREN

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A CRITICAL EXAMINATION

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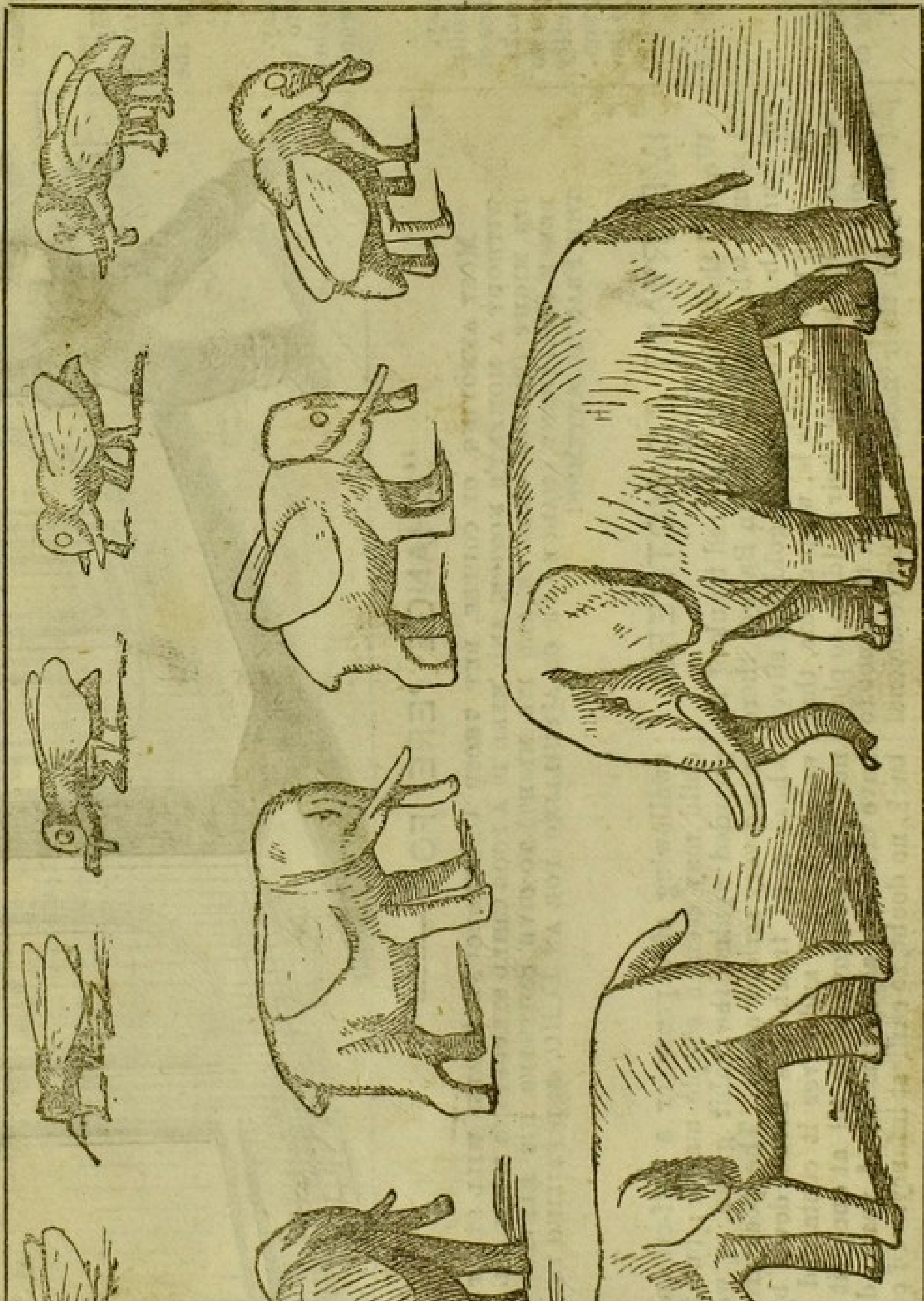

DARWINIAN DEVELOPMENTS: ORIGIN OF THE ELEPHANT.

From a weekly paper - a caricature

A CRITICAL EXAMINATION

OF SOME OF THE

PRINCIPAL ARGUMENTS FOR AND AGAINST

DARWINISM.

BY

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PREFACE.

'Many of the most celebrated literary critics, and some eminent mathematicians,' said Sir C. Lyell, 'have shown, in the discussions which have arisen on the origin of species, an entire incapability of weighing and appreciating the evidence for and against transmutation, chiefly for two reasons: they have never been called upon, as classifiers in natural history, practically to decide whether certain forms, fossil or recent, should rank as species or new varieties; and secondly, they are quite unconscious of the fragmentary nature of the record with which geologists have to deal. To one who is not aware of the extreme imperfection of this record, the discovery of one or two necessary links is a fact of small significance; but to those who are thoroughly imbued with a deep sense of the defectiveness of the archives, each new form rescued from oblivion is an earnest of the former existence of hundreds of species, the greater part of which are irrecoverably lost.' *

On the other hand, Professor Max Müller says that Mr Darwin knows the results of the science of language at second hand only, and does not show that real grasp of the whole bearing of the problem, which can be acquired by a life-long devotion only.† No doubt the same feeling would be expressed by the cultivators of metaphysical philosophy, whether belonging to the intuitional or the experiential school.

Here we have three abstruse sciences, which we are required to know thoroughly before we are to be considered competent to form an opinion on the Darwinian theory;

* Lyell's 'Geology,' 11th edit. vol. ii. p. 490.

† My 'Reply to Darwin.' 'Contemporary Review,' Jan. 1875, p. 306.

and it seems the height of presumption in an author, who makes no pretension to an accurate knowledge of any of these sciences, to deal with the question at all; still, I think that the views of Mr Darwin, his friends and opponents, ought to be intelligible to ordinary minds, and that, if we make allowance for our 'incapability' when we come into contact with any of these sciences, we may still be able to get some insight into the matter. I have, therefore, ventured in the following pages to examine the present state of the Darwinian controversy, and I have adopted the plan which was found useful in my 'Sketch of the History of the Currency,' namely, to place before the reader the arguments upon each side of the question in such a manner that he may be able to weigh their force for himself, and then to state the impression which they have made upon my own mind.

That impression is not favourable to Mr Darwin's theory. After a careful, and I hope an impartial, consideration of the question, I cannot help coming to the conclusion, quite unexpected at the outset of my inquiry, that it is impossible to account for the existing state of the organic world by the theory of simple variation and the survival of the fittest, or indeed by any system of simple evolution.

I have only to add that the question has been treated exclusively as one of evidence, without any reference to its theological bearings.

Constable Burton,
Bedale.

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ERRATA.

Page 87, *for* Carolina and Maryanne *read* Caroline and Marianne.

,, 151, and passim *for* angrœcum *read* angræcum

,, 283, *for* lowliness *read* lowness

,, 304, *for* lamina *read* laminæ

,, 366, *for* degrees *read* degree

,, 398, *for* alonates *read* alouates; and *for* congar *read* cougar

,, 420, *for* himself *read* itself

PART I.

THE ORIGIN OF SPECIES.

CHAPTER I.

Systems of natural history—The natural system—The classification of fossils—Species become extinct, and are succeeded by other species—Lamarck's theory that species are formed by the transmutation of pre-existing species—His account of the manner in which this transmutation takes place—Believes in progressive development—His mode of accounting for the existence of many creatures of a low type—His views as to the origin of man—Vast lapse of time required for these changes—Shown to be probable by Lyell in his Geology—The nebular hypothesis inconsistent with this view—How the earth might have been formed from a nebula—Violent action during the process—Lyell considers Lamarck's views to be purely visionary—Summary of Lyell's views as to this question at this time—Agassiz' Natural History of the United States—Animals of the Gulf of Mexico unchanged for two hundred thousand years.

NATURALISTS distribute all animals and plants into classes, orders, genera, and species. Species we may, at present at least, describe as groups of similar but distinct individuals, genera as groups of similar species, orders as groups of similar genera, and classes as groups of orders which resemble each other. The species is the final unit from which the system is built up; species, at least in the opinion of the older naturalists, are the work of nature primordially created as we see them, and secured from change by their incapacity to produce fertile hybrids by intercrossing.

Originally the object of this arrangement was merely to assist the memory in recalling the names of natural objects. The data upon which the difference of species was made to depend, were not always such as secured the grouping together of creatures having great real affinity to each other in form, habits, or instincts; even in the system of Linnæus man and bats were included in the same order.

This association arose from the plan which that great naturalist pursued of forming his species upon the consideration of too few of the peculiarities of the individuals, in this case from attending to the form of the teeth alone.

Later naturalists, Jussien, Cuvier, and others, by taking into account the anatomy and whole structure of plants and animals, have arranged them in groups which are supposed to show their real affinity to each other, so that we ought to be enabled by this system not only to recall the name of an individual plant or animal, but at the same time to point out its place in the general polity of nature.

This method of arranging natural objects is generally known as the natural system.

These later naturalists accepted in the main the doctrine of the primordial creation of species. But the practice which their system required of examining the whole structure and anatomy of individual forms, soon led to new views upon this point. As the number of known animals and plants rapidly increased, the affinities between them became so great that it appeared difficult, if not impossible, to point out their distinctive characteristics. Species appeared to melt into each other instead of being created primordially distinct; and it came to be thought, as we shall see, that animals and plants as we now find them might be but modified forms, descended in a long course of succession from ancestors very different from themselves, perhaps from a simple unit of life, a protoplasm cast upon the empty earth.

It is hardly necessary to observe that this subject, as treated by Mr Darwin and others, has of late attracted the greatest attention, and has given rise to many warm discussions and to many curious and subtle arguments.

The 'natural system' had one great advantage over those previously in vogue, namely, that by attaching great importance to anatomical structure, it enabled us to classify those creatures of which we have only the fossil remains.

The occurrence of the bones of animals in beds of gravel, and of marine shells in mountainous situations far removed from the sea, long proved a source of great perplexity to naturalists: the bones were supposed to be the remains of men and animals which had perished in the deluge, and were often referred to as showing the superior size of mankind in those days; and the shells were attributed to a kind of plastic virtue in nature, whose exuberant fertility could not avoid producing these half-formed bodies.

It is now well known that these bones

and shells belonged to species of animals who inhabited our globe in former times, and these creatures have been classified by naturalists almost as completely as living species. Of some of these extinct animals we have but small fragments of bone, but of others sufficient specimens have been obtained to enable anatomists to complete the entire skeleton, and there is perhaps no more extraordinary or interesting sight in London than the collection of these skeletons exhibited in the British Museum.

In the course of classifying these fossil remains it soon became evident that there had been a succession of species. Those found in the oldest rocks decreasing by degrees in number as we advance upward in the series of strata, until they finally become either wholly or partially extinct, their places being taken in the newer rocks by other races who became extinct in their turn. It is generally supposed, though the point is not quite settled, that for the most part in this succession of species the progress was from a simple to a more complex form. The oldest remains of a former world are those of invertebrate animals. Then appeared fish, then reptiles, then birds, and lastly mammalia, man himself not appearing until a comparatively recent period. Of the fossil species of the oldest rocks none are now in existence, except, perhaps, some of the infusorial animalcules, and one or two of the lowest forms of marine invertebrata. As we approach the present epoch, more and more of the extinct fossil species are similar to those now found in a living state.

And now we come to what Sir John Herschel called 'the mystery of mysteries,' * namely, the origin of species. Were these new species which successively appeared on the earth specially created at their respective times of appearance, or were they the descendants of those which had preceded them?

A French naturalist, Lamarck, was the first person whose views on this subject attracted much attention. Lamarck had undertaken to classify the invertebrate animals, and in executing his task he found such

* His letter to Lyell in the ninth Bridgewater Treatise, p. 203.

difficulty in arranging the fossil and recent individuals of that extensive and obscure branch of natural history into groups which could be distinguished from each other, that he came to the conclusion that there was no such thing in nature as a real species, and he was led to suppose that species as we see them had been derived by transmutation from other species.

Every considerable alteration in the local circumstances in which each race of animals lives causes, says Lamarck, a change in their wants, and these wants excite them to new actions and habits. These actions require the more frequent employment of some parts before but lightly exercised, and thus greater development follows as a consequence of their more frequent use. Other organs no longer in use are impoverished and diminished in size, nay, are sometimes utterly annihilated, while in their places new parts are produced to discharge new functions.

'It is not the organs, or, in other words, the nature and form of the parts of an animal which give rise to its habits and its particular faculties; but, on the contrary, its habits, its manner of living, and those of its progenitors, have in the course of time determined the form of its body, the number and conditions of its organs, in short, the faculties which it enjoys. Thus otters, beavers, waterfowl, turtles, and frogs were not made web-footed in order that they might swim, but their wants having attracted them to the water in search of prey they stretched out the toes of their feet to strike the water and move rapidly along its surface. By the repeated stretching of the toes, the skin which united them at the base acquired a habit of extension, until, in the course of time, the broad membranes which now connect their extremities were formed.'

'In like manner the antelope and the gazelle were not endowed with agile forms in order that they might escape by flight from carnivorous animals, but having always been exposed to the danger of being devoured by lions, tigers, and other beasts of prey, they were compelled to exert themselves in running with great celerity, a habit which in the course of many generations gave rise to the peculiar slenderness of their legs and to the agility and elegance of their form.'

'The giraffe was not gifted with a long flexible neck because it was destined to live in the interior of Africa where the soil was arid and devoid of herbage, but being reduced by the nature of that country to support itself upon the foliage of lofty trees, it contracted a habit of stretching itself up to reach the high boughs until its neck became so elongated that it could raise its head to the height of twenty feet above the ground.'

Lamarck seems to have supposed that all animals had originated from some marine form. Inert matter was first endowed with life; in the course of ages sensation was superadded to mere vitality; sight, hearing, and the other senses were afterwards acquired; then instinct and the mental faculties, until finally, by virtue of the tendency of things to progressive improvement, the irrational was developed into the rational.

Lamarck had to explain how it happens that, after the lapse of an indefinite number of years, there were still so many beings of the simplest structure, why the majority of existing creatures remained stationary throughout this long succession of epochs, while others have made such prodigious advances. Why are there such multitudes of infusoria and polyps, of confervæ and other cryptogamous plants? why has the process of development acted with such unequal and irregular force upon the various classes?

We shall find this fact of very difficult explanation in all the theories of evolution.

Lamarck's solution of this difficulty is that nature is not an intelligence nor the Deity, but a delegated power, a mere instrument constituted by the Supreme Being, and subject to laws which are the expression of His will. This nature is obliged to proceed gradually in all her operations, she cannot produce animals and plants of all orders at once, but must always begin by the formation of the most simple kinds, and out of them elaborate the more compound. Nature is daily engaged in the formation of the elementary rudiments of animal and vegetable existence, which are the only living things she gives birth to directly.

To meet the difficulty of the unequal action of the tendency to improvement, and the consequent difference in the degree of perfection to which different races may have attained, Lamarck says that the tendency to progressive improvement is interfered with by the force of external circumstances, such as variations in climate, and other physical conditions, which affect different races unequally as they spread themselves gradually over the globe.

Lamarck supposed that man came into the world in the following manner. One of the quadrumanous animals which had reached the highest state of perfection, lost by constraint of circumstances the habit of climbing trees, and of hanging on by grasping the boughs with its feet as with hands; the individuals of this race being obliged for a long series of generations to use their feet exclusively for walking, and ceasing to employ their hands as feet, were transformed into bimanous animals, and having acquired a habit of holding themselves upright, their legs and feet assumed insensibly a conformation fitted to support them in an erect attitude, speech and other human attributes, and finally reason, arose from the new position in which the creature was placed.

Lamarck's views were received with derision: he could produce no instance of any change of form occurring in any animal during the 2000 years of which history took account. And as men were then generally satisfied that the world had not existed for more than about 6000 years, and as they knew that no such changes as Lamarck's views required had occurred during the period with which they were conversant, they did not believe that they could have taken place in the three or four thousand years of which they had no knowledge.

However, as the science of Geology was more cultivated, it became evident that the world had existed for much more than 6000 years. Beds of rock were discovered of enormous thickness, evidently formed from sediment produced by the destruction of previously existing rocks, themselves the results of still earlier deposits, and the formation of these deposits was such as to make it highly improbable that they could have been produced by the Mosaic deluge, or indeed by any one sudden cataclysm. Everything spoke of a great lapse of time.

Then in 1830 appeared Lyell's 'Principles of Geology, being an Inquiry how far the former changes of the Earth's surface are referable to causes now in operation.' In this work an attempt was made to show that no violent or extraordinary convulsion of nature was necessary to account for the phenomena exhibited in the crust of the earth. We cannot enter upon any detailed examination of Sir C. Lyell's proof of this position, we must content ourselves with remarking that his views are now very generally accepted by geologists, and with noticing some of the points in which geology bears more immediately upon our subject. Sir C. Lyell brings strong evidence to prove that large tracts of land have sunk beneath the ocean, and that other large districts have been upheaved. Continents have been melted down into groups of islands, and islands and distant continents have been united by means of the upheaval of the intermediate bed of the ocean. The distribution of the whole dry land on the face of the globe has, so to speak, been re-arranged from time to time. The reader will at once see that this supposition implies an enormous extent of time, if only forces such as we now see in operation are supposed to be at work; and it helps to explain the occurrence of particular creatures in particular places, without the necessity of supposing special creations to have taken place in those places, as the previous state of the world would account for their existence there.

Another similar point is also of special importance in our inquiries. It is shown that our earth has passed through several changes of climate. The plants which occur in the oldest sedimentary rocks indicate a climate much warmer than that which we have at present, fossil plants occurring in or near to the Arctic circle similar to those now found in a living state only within the tropics; again, this warm climate has been succeeded by an epoch of comparatively great cold, when the Arctic ice extended as far south as the middle of England, and in some countries much further.

These facts, again, imply a great lapse of time, and will also assist us in ascertaining the possibility of the migration of plants and animals across countries which now appear to be impassable barriers to their progress, the climate of the Torrid zone being supposed to have been then no warmer than that of Europe at present.

The great support given to the Darwinian theory by Lyell is the great age of the world, but this support is rather diminished by some very recent views. An old theory, which is very inconsistent with the notion of an almost infinite duration of the world in its present state, has of late been revived by Professor Tyndall: we allude to his theory that our solar system is the result of the cooling down of a nebula, the old theory of the nebular hypothesis, as it has been called, now brought forward again strengthened by the discoveries of modern science.

Perhaps we can explain Professor Tyndall's views very shortly by taking the case of a globe very similar to our earth: now let us impart to this globe a certain amount of heat and the water would begin to boil and would soon all be turned into steam; add still more heat, and some of the more easily-fused solids would begin to melt; increase the heat still more, and some of these solids would assume the form of vapour, until at last by increasing the heat sufficiently the whole contents of the solid globe would occupy a vast space (heat causing expansion), in the form of an incandescent gaseous cloud.

Now let us reverse the process and suppose, in the first instance, such a wide-spread, fiery, gaseous cloud; let this cloud cool a little, it would contract, and some of its component parts which required the greatest amount of heat to enable them to exist in a gaseous form would become liquid; let the cooling continue, those liquids would become solid, and other gases liquid; these in their turn would become solid, and so the process would go on, till we had the globe again as it was when we first took it in hand.

Professor Tyndall finds such fiery clouds in the nebulæ which are at present visible in the sky, and which the spectroscope has shown to be gaseous bodies, and he infers that our globe has been formed during the condensation of a similar fiery cloud.

The nebular hypothesis when first suggested by Laplace was not received with favour, partly, at least, because it could not then be shown that there existed any such nebulæ as his theory required; many of the nebulæ seen in the sky were found, when viewed by good telescopes, to consist of groups of stars so close together and so distant from us, that viewed with inferior instruments they appeared like clouds. As our telescopes were improved, more and more nebulæ were resolved into starry groups, and it was supposed that it was only from want of power in our instruments that we could not resolve the remaining nebulæ.

Sir J. Herschel, during his survey of the stars of the southern hemisphere at the Cape of Good Hope, was led to doubt the starry nature of some nebulæ. He observed some nebulæ so placed that it was next to impossible that their respective distances from our earth should be very different, yet some of these he could resolve into starry groups, while others retained their nebulous appearance when viewed by the same telescope. This result he thought could be accounted for only by the fact that these nebulæ were really gaseous.

This fact has now been plainly proved by modern spectroscopic observations; one great difficulty in the way of the nebular hypothesis is therefore removed.

We must observe here that the light of many of these nebulæ is very faint, so much so that it is very difficult to believe that they have been thoroughly analyzed by the spectroscope, moreover they appear to consist of two or three elements only, and therefore do not contain the materials out of which a globe like ours could be manufactured.

But the nebular hypothesis is no doubt greatly supported by the fact disclosed by the spectroscope, that many of the elements of which our earth is composed exist in a gaseous state in the sun; iron, sodium, hydrogen, and many other elements, have been shown to exist in this state in the sun.

Perhaps a hint thrown out by Mr Proctor, that Jupiter shines partly by his own light, may bear upon the subject of the nebular hypothesis. Jupiter is the largest of the planets, and would therefore be the latest to become cool; moreover, the planet is surrounded by enormous masses of vapour, and is of comparatively slight density, circumstances which point to a high temperature.

There is one evident difficulty in the way of Professor Tyndall's views very similar to that experienced by Lamarck, namely, how does it happen that there exist some bodies in this nebulous state, while others, like our earth, have long been condensed? Are these existing nebulæ newer creations than our solar system, or are they, if possible, subject to different laws?

Assuming Professor Tyndall's views to be correct, we may fancy what would happen when the earth had cooled to such a degree as to allow water to exist in a liquid state. What would be the state of affairs if the ocean were constantly boiling! what vapours would arise, what torrents of rain would descend, incomparably more powerful than any we witness, and they would fall upon a heated surface which would send them back again in clouds of vapour, soon to be again condensed and to fall in renewed torrents.*

Here, then, would be a power at work which would greatly shorten the time required, according to Sir C. Lyell's views, to reduce the surface of the earth to its present state.

Whether Sir C. Lyell's arguments in favour of the position that existing forces are sufficient to have brought about the changes which have taken place upon our planet will still be considered conclusive, remains to be seen. Arguments which might have been readily received against the effects of a state of affairs, the existence of which was highly incredible, may not appear so satisfactory when that state of affairs appears to be actually before our eyes.

We must, however, here mention that among rocks of very high antiquity, even so far back as the carboniferous strata, slabs of stone are found, which when recent had been marked by falling rain, and the prints of the rain-drops are said to be identical with those caused by rain at present, evidence that the

* Babbage's Ninth Bridgewater Treatise, p. 185.

rains of those ancient days were similar to those which now fall.*

The reader will note that Professor Tyndall's theory, if true, will give new life to the belief which long prevailed, that the different species of fossil animals and plants appeared in the world from time to time as the earth cooled down and became gradually fitted for their reception.

We must note that up to the 10th edition of his work on the 'Principles of Geology,' which appeared in 1866, Sir C. Lyell (from whose pages we have taken our account of Lamarck's views much abridged) discountenanced all approach to the theory of a transmutation of species. He showed that Lamarck could not give a single instance of a change in any *important organ*.† That his idea of the continuous creation of the lower forms of life was quite imaginary, and that domestic animals when turned out at full liberty in the New World, where all the plants they ate and the air they breathed were quite different from what they had been accustomed to,

* Lyell's 'Geology,' 11th edit. vol. ii. p. 327.
† Ibid., 9th edit. p. 571.

circumstances which should have insured a great degree of variability, yet showed a strong tendency to revert to one single form.*

Sir C. Lyell gives us the following summary of his views as to this question at this time.

(1) There is a capacity in all species to accommodate themselves to a certain extent to a change of external circumstances, the extent varying greatly according to the species.

(2) When the change of situation which they can endure is great, it is usually attended by some modifications of the form, colour, size, structure, or other particulars; but the mutations thus superinduced are governed by constant laws, and the capability of so varying, forms part of the permanent specific character.

(3) Some acquired peculiarities of form, structure, and instinct are transmissible to the offspring, but these consist of such qualities and attributes only as are intimately related to the natural wants and propensities of the species.

* Lyell's 'Geology,' 9th edit. p. 587.

(4) The entire variation from the original type which any given kind of change can produce may usually be effected in a brief period of time, after which no further deviation can be obtained by continuing to alter the circumstances, indefinite divergence either by way of improvement or deterioration being prevented, the least possible excess being fatal to the existence of the individual.

(5) The intermixture of distinct species is guarded against by the sterility of mule offspring, for it does not appear that true hybrid races have ever been perpetuated for many generations.

(6) From the above considerations it appears that species have a real existence in nature, and that each was endowed at the time of the creation with the attributes and organization by which it is now distinguished.*

At this time also Sir C. Lyell believed in the very recent origin of man, and argued that he could not be considered as merely the last link in the series of progressive development of species, because man's superiority

* Lyell's 'Geology,' 9th edit. p. 611.

consists in his reason, he is not superior to animals in the faculties and attributes which he shares with them. The sudden passage from an irrational to a rational animal is a phenomenon of a distinct kind from the passage from the more simple to the more perfect forms of animal organization and instinct. To pretend that such a step, or rather leap, can be part of a regular series of changes in the animal world is to strain analogy beyond all reasonable bounds.*

Professor Agassiz is a warm opponent of the theory of the transmutation of species. In his 'Natural History of the United States,'† published in 1857, he maintains that the identity of the animals preserved as mummies by the Egyptians 5000 years ago with animals of the like kind now living, is a proof of the stability of species, and he shows that on the coast of Florida there exists a series of coral reefs, six in number, one within the other, which must have required for their formation thirty thousand years, the animals forming them remaining unchanged during

* Lyell's 'Geology,' 9th edit. p. 147 to 149.

† p. 51.

that period. And he further shows that in all probability two hundred thousand years elapsed during the formation of a portion of the peninsula of Florida, in which time no change had taken place amongst the animals of the Gulf of Mexico.

CHAPTER II.

Variations amongst domestic animals; are they stable?—The same point amongst animals and plants in a state of nature —Great fecundity of animals and plants — Consequent struggle for existence—Red clover and carnivorous animals —The fittest survive or are naturally selected—Slow action of natural selection—Observations upon Mr Darwin's views —Illustration of the action of natural selection—How very divergent characters are formed by natural selection— Variations follow some law—What is meant by this expression—Effects of use and disuse of organs—Beings low in the scale of nature are the most variable—Economy of nutriment—Mr Darwin's difficulties and his explanation of them—Natural selection makes creatures only slightly more perfect than their immediate neighbours—Elimination of useless organs—Case of European plants in New Zealand—Natural selection cannot produce in a being anything injurious to it—Case of the red clover—Action of natural selection upon instincts—The extent to which hybrids are sterile—The imperfection of the geological record —Reason why species have not varied equally—Have organisms advanced in degree?—Geographical distribution of plants and animals—Homologous, embryonic, and rudimentary organs.

We will now proceed to examine the theory of evolution which is more particularly connected with Mr Darwin's name.

In 1860 two naturalists, Mr Darwin and Mr Wallace, both great travellers, and both impressed with what they had observed of the distribution of animals and plants in different countries, suggested at the same time the same explanation of the origin of species, namely, variation transmitted by inheritance, and natural selection or the survival of the fittest.

We will take Mr Darwin's views first as given in his first edition of the 'Origin of Species.' They are based upon his observation of variation as it occurs amongst animals and plants in a state of domestication.

Variations, he says, it is well known take place amongst animals and plants in a state of domestication. These variations are to a very great extent transmitted to the offspring of the individuals in which they occur. Man, taking note of such variations as make animals and plants more useful to himself, and selecting those individuals to breed from which have thus varied to his advantage, gives rise to whole races differing widely from the species from which they are originally derived, hence our breed of race and cart horses, of short-horn cattle, and of fancy pigeons.

The changes which take place in our domestic animals, and which tend to produce the required form, are so small as to be imperceptible to any but skilful and practical men, yet when properly accumulated they produce great results.

Mr Darwin then refers to a statement often made by naturalists, namely, that our domestic varieties when run wild gradually but certainly revert in character to their original stocks; and he adds, if it could be shown that our domestic varieties manifested a strong tendency to reversion, that is, to lose their acquired characters, whilst kept under unchanged conditions, and whilst kept in a considerable body, so that free intercrossing might check by blending together any slight deviations of structure, we could deduce nothing from domestic varieties in regard to species. But there is not a shadow of evidence in favour of this view; to say that we could not breed our cart and race horses, and long and short-horned cattle, and the like, for an unlimited number of generations, is contrary to all experience.

Now is it not notorious that our breeders do keep their animals under unchanged conditions of life, and in considerable numbers, and yet are obliged to be most careful in the selection of the animals which are allowed to breed, or their flocks and herds would lose their improved character? Does not this fact show most distinctly that there is a tendency in these variations to return to their original form, or at least to lose their improved form. The improvement may be inherited for a few generations but at last it disappears. No doubt we can continue to breed our cart and race horses, our long and short-horned cattle, for an indefinite period, but we do so only by a constant struggle against this natural tendency to revert.

Mr Darwin will not allow that man has chosen for domestication animals and plants having an extraordinary inherent tendency to vary. How could a savage possibly know when he first tamed an animal whether it would vary in succeeding generations? Has the little variability of the ass or the guinea fowl prevented their domestication? I cannot doubt, says Mr Darwin, that if other animals and plants equal in number to our domesticated productions, and belonging to equally diverse countries, were taken from a state of nature, and could be made to breed for an equal number of generations under domestication, they would vary on an average as largely as the parent species of our domesticated productions have varied. We shall see that this question of the different degrees of variability in different species is of the greatest importance.

Mr Darwin goes on to say that varieties occur amongst animals and plants in a state of nature, as well as amongst those which are domesticated; he gives no instance of such variation, apparently from want of space, as he says he could produce a long list of cases in which variation had occurred in parts, which naturalists would acknowledge to be of importance with reference to the determination of species. It is certainly unfortunate that Mr Darwin should have followed this plan, we should have liked to have seen some of these instances of variation. There is, however, no doubt that they do occur; the question is, whether they are stable, and therefore capable of accumulation, or whether they are merely temporary and fugitive sports, speedily absorbed in the original forms. This latter view was entertained by most naturalists. Mr Darwin maintains the former position, that they are stable, but gives no other proof of the fact than a reference to the stability of variations amongst animals and plants in a state of domestication, a point as to which he certainly seems to be in error, and it is a most important one, as it lies at the foundation of his whole system.

No doubt variations under nature may be stable, but we have no proof of the fact, and it was probably on this account that Mr Darwin had recourse to what happens amongst domestic animals and plants, as there he could see what becomes of such variations as occur.

Here we may observe, that although we may not be able to perceive any instance of those small natural variations transmitted and preserved by heredity, actually taking place before our eyes, yet if they are stable and are modified births, we ought, amongst plants at least, to have abundant evidence of the fact. Some plants are propagated only by seed, others in a great degree by suckers and offsets. These latter ought evidently, according to Mr Darwin's theory, to show a less amount of variation than others which are propagated by seed alone; as in the case of the suckers, there is no opportunity for the action of modification by descent. This point does not seem to have attracted the attention of Mr Darwin, or any of his followers, except that he mentions that the Jerusalem artichoke is never propagated by seed, and consequently no varieties of it have been produced.* But there is not much evidence as to this point.

At present we will admit that variations under nature which are for the advantage of the creature in which they occur, are stable and capable of being accumulated, and we may go on with our examination of Mr Darwin's views on that supposition.

From the great fecundity of animals and plants, if none of them were destroyed their numbers would become so great that no

* p. 142, 6th edit. p. 114.

country could support them. Hence, there must be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. There is no exception to the rule that every organic being naturally increases at so high a rate that if some were not destroyed the earth would soon be covered with its progeny. The elephant is considered to be the slowest breeder of all known animals, yet Mr Darwin has calculated that at the end of the fifth century there would be above fifteen millions of elephants descended from the first pair.

The amount of food for each species of course gives the extreme limit to which each can increase. The elephant and rhinoceros are never destroyed by beasts of prey; even a tiger will not attack a young elephant protected by its dam.

But the average number of a species (number in existence for the time being) will often depend upon the number of the enemies which prey upon it, and upon climatal changes which act not only directly upon it but indirectly by limiting the supply of food and by favouring rival races.

Mr Darwin gives us a very curious illustration of this point: he says, the flowers of the common red clover can be fertilized only by humble-bees. Field mice prey upon the young of these bees, and, in consequence, they are more abundant near villages where numbers of the mice are devoured by cats; thus the abundance or scarcity of a plant may depend upon the numbers of a carnivorous animal.

Mr Darwin adds that if humble-bees became extinct red clover would become extinct too. We shall soon see the great importance of this point. At present we must note that for a plant to be incapable of continuing its race except by the instrumentality of a particular insect only, is evidently a disadvantage to it in comparison with other flowers which can be fertilized by any insects, as such a plant would be less likely than others to produce seeds.

The struggle for existence will almost invariably be most severe between individuals of the same species, for they frequent the same districts, require the same food, and are exposed to the same dangers.

Mr Darwin then goes on to inquire how this struggle for existence will act in regard to variation, and deduces from its action his principle of Natural Selection, or, as now sometimes called, the survival of the fittest.

Let it be borne in mind, says Mr Darwin, how infinitely complex and close fitting are the mutual relations of all organic beings to each other, and to their physical conditions of life; can it then be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other variations, useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and leaving offspring? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable variations and the rejection of injurious variations is Natural Selection.

'Change in the conditions of life would be favourable to natural selection by giving a better chance of profitable variations, and unless profitable variations do occur, natural selection can do nothing; not that any great degree of variability, or any great physical change, as of climate, is necessary to produce new and unoccupied places for natural selection to fill up, for as all the inhabitants of a country are struggling together with nicely balanced forces, extremely slight modifications in the structure of an individual would often give it an advantage over others. No country can be named in which all the native inhabitants are now so perfectly adapted to each other, and to the physical conditions under which they live, that none of them could anyhow be improved, for in all countries the natives have been so far conquered by naturalized productions, that they have allowed foreigners to take firm possession of the land, and therefore we may safely conclude that the natives might have been modified with advantage so as to have better resisted such intruders.'

'As man has produced a great result by

his methodical selection, what may not nature effect? Man can act only on external and visible characters, nature can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life; every selected character is fully exercised by her, and the being is placed under well-suited conditions of life. Man keeps the natives of many climates in the same country, he seldom exercises each selected character in some peculiar and fitting manner, he feeds a long and a short-beaked pigeon in the same manner, he does not exercise a long-backed or long-legged quadruped in any peculiar manner, he exposes sheep with long and short wool to the same climate, he does not allow the most vigorous males to struggle for the females, he does not destroy all infirm animals. How short is man's time, and consequently how poor will his products be compared with those accumulated by nature during whole geological periods.'

'Natural selection is daily and hourly scrutinizing throughout the world every variation, even the slightest, rejecting all that is bad, preserving and adding up all that is good, silently and insensibly working whenever and wherever opportunity offers at the improvement of each organic being in relation to its organic and inorganic conditions of life. We see nothing of these slow changes in progress until the hand of time has marked the long lapse of ages, and then so imperfect is our view into long past geological ages, that we only see that the forms of life are different from what they formerly were.'

Mr Darwin says * that he is well aware that this doctrine of natural selection is open to the same objections as were at first urged against Sir Charles Lyell's noble views on the 'Modern Changes of the Earth, as illustrative of Geology;' but we now very seldom hear the action, for instance, of the coast waves, called a trifling and insignificant cause, when applied to the excavation of gigantic valleys, or to the formation of the longest lines of inland cliffs. Natural selection can act only by the preservation and accumulation of infinitesimally small inherited modifications, each profitable to the preserved

* p. 95.

being; and as modern geology has almost abolished such views as the excavation of a great valley by a single diluvian wave, so will natural selection, if it be a true principle, banish the belief of the continued creation of new organic beings, or of any great and sudden modification of their structure.

In writing the 'Origin of Species,' Mr Darwin certainly seems to have had constantly in mind Sir C. Lyell's method of dealing with the science of geology.

Mr Darwin says that he fully admits that natural selection will always act with extreme slowness. Its action depends upon there being places in the polity of nature which can be better occupied by some of the inhabitants of the country undergoing modification of some kind; the existence of such places will often depend upon physical changes which are generally very slow, and on the immigration of better adapted forms having been checked. But the action of natural selection will probably still oftener depend upon some of the inhabitants becoming slowly modified, the mutual relations of many other inhabitants being thus disturbed. Nothing can be effected unless favourable variations occur, and variation itself is apparently always a very slow process; the process will often be greatly retarded by free intercrossing. Many, says Mr Darwin, will exclaim that these several causes are amply sufficient wholly to stop the action of natural selection; he does not think so. On the other hand, he says, he does believe that natural action will always act very slowly, often only at long intervals of time, and generally on only a very few of the inhabitants of the same region at the same time.

Mr Darwin makes these admissions because the variations are so small and so rare that they escape our perceptions until they are accumulated. The long interval supposed to exist between the variations may seem opposed to Mr Darwin's notion of natural selection being always at work, but we must remember that in proportion as the period of time during which they occur and are accumulated is long, so the variations called infrequent may be both numerous and, in comparison, rapid. But on this supposition how vast is the period of time necessary to allow of the evolution of all the varied forms of life on the globe!

We have seen that it is the most closely allied forms, varieties of the same species, and species of the same genus, which come into the severest competition with each other, consequently each new variety or species during the progress of its formation will generally press hardest on its nearest kindred, and tend to exterminate them. It is evidently difficult to see how improved forms can co-exist with the original form, they would starve it out.

As to Mr Darwin's statement of the superiority of selection by nature to selection by man, we do not think it is quite fairly put. In almost every respect, except length of time in which to act, selection by man appears to have the advantage over selection by the survivorship of the fittest. Man protects the improved individual from all dangers; the survival of the fittest leaves him exposed to nearly the same danger as the other individuals of the species. Man allows only improved individuals to breed, and selects both the male and the female. The survival of the fittest allows all the individuals to breed indiscriminately, the improved with the unimproved, or even with those who have varied disadvantageously, the improved individual having only a slightly better chance of leaving offspring than other individuals, inasmuch as it is rather better adapted than they to the conditions of life.

As an illustration of the action of natural selection Mr Darwin takes the case of the wolf, and says he can see no reason to doubt that the swiftest and slimmest wolves would have the best chance of surviving and so be preserved or selected. Provided always that they retained strength to master their prey (this is an important proviso, as it seems probable that what the wolf gained by the modification of its form in one respect it might lose in another). There is no more reason to doubt this than that man can improve the fleetness of his greyhounds by careful and methodical selection. The reader will remember that the greyhounds are secured by the care of man from any chance of being injured through their being confined by their change of structure to a particular species of prey.

Mr Darwin goes on to say that a cub might be born with an innate tendency to pursue certain kinds of prey; such a tendency is common among domestic animals; some cats pursue winged game chiefly, others prefer hares or rabbits. Now if any slight innate change of habit or of structure benefited an individual wolf it would have the best chance of surviving and of leaving offspring; some of its young would probably inherit the same habit and structure, and by the repetition of this process a new variety might be formed which would either supplant or co-exist with the parent form of wolf. (How could it co-exist with the parent form if it were superior to it?)

We may carry out the hint which Mr Darwin has here given us and produce from a wolf some herbivorous animal. Let us suppose some wolf to have acquired the habit of eating ripe fruit; * it would probably be enabled to digest a certain amount of this

* Many dogs eat ripe fruit.

kind of food without any previous modification of form and without losing any of those powers which enabled it to catch prey; such a wolf, then, might have some advantage over other wolves and might survive them all if there occurred a famine of prey. Here the reader will note that we assume a change of circumstances sufficient to destroy the unimproved individuals.

We should now have no wolves but those which lived partly on fruit and partly on prey. If the famine of prey ceased and it became as abundant as ever, each wolf would not require its full powers to catch the amount of prey which was indispensable to it. If some of these wolves were slightly modified in structure so as to approach more nearly that of an herbivorous animal, losing some of their power to catch prey, they could still subsist; some of them might become more addicted to the use of vegetables, might take to digging up and eating roots: if now there came a famine of fruit and prey these root-eating wolves would alone survive. Here, then, we have an approach to an herbivorous animal, and if the same course were repeated sufficiently often we might get a perfect herbivorous form.

The reader will note that we have made several assumptions here which are perhaps not allowable. But we may admit that natural selection may improve a race, certainly it will keep it from degenerating.

Mr Darwin goes on to say that natural selection, as he has hitherto described it, is not sufficient to account for the formation of a species. He says, mere chance, as we may call it, might cause one variety to differ in some character from its parents, and the offspring of this variety again to differ from its parents in the very same character and to a greater degree, but this alone could never account for so habitual and large a degree of difference as that between the species of the same genus. How is this degree of difference to be obtained by means of natural selection? Mr Darwin gets over this difficulty by again referring to what takes place amongst domesticated animals; he takes the case of two breeds of fancy pigeons, differing very much from each other, and supposes two breeders to modify these breeds in opposite directions, one, for instance, to breed such pigeons with a long beak and the other to breed them with a short beak, and thus in time breeds would be produced differing extremely from each other in this respect. So amongst animals in a wild state, by supposing great divergency of character to exist amongst the individuals of the species which is to be modified, and supposing modifications to take place in opposite directions and in the most divergent of these individuals, new species would be produced.

'Let two very divergent species branch out on all sides into other races, some of these races would meet in the space in the polity of nature intermediate between these two species, and the stronger would destroy the weaker, causing gaps in the continuity of the series, and leaving the surviving races now very different and very widely separated from each other, in fact species collected in groups round each extremity of the divergent species. We see, says Mr Darwin, this peculiar arrangement of species actually existing. This is one of his strongest points, and he seems to think it admits of no other explanation than that which he has given. It is evidently one of those points, the importance of which can be appreciated only by a practical naturalist.'

Species having such very divergent characters do exist in nature, for, says Mr Darwin, such divergence of character would enable such species to seize upon more vacant places in the polity of nature. The divergence of character would be of advantage to the species possessing it, and such species would therefore be naturally selected, and would exist in preference to those which did not possess such divergence of character.

Mr Darwin's reference to what has happened amongst pigeons does not seem very happy. Can we find that we have made any great advance towards the formation of new species of these birds? Sir John Sebright, a great pigeon-fancier, said, according to Mr Darwin, that he could produce any given feather in three years, but it would take him six to produce a given head or beak. Now, pigeons have been domesticated from a very early period, they have been in the hands of breeders for 2000 years at least. It seems strange that much greater differences than those now observed should not exist amongst them, considering what Sir John Sebright effected in the short space of six years. We should have expected to find the most extraordinary variations taking place amongst so plastic a race as pigeons, if anywhere; yet in all essentials the pigeons we see are pigeons still, they use the same food, their habits are, in the main, the same as those of other pigeons, and they breed freely with each other.

The following extract from the *Field* of the 23rd January, 1875, may perhaps be interesting to the reader, if not familiar with the practice of pigeon breeding.

'Carriers have many sorts of beak wattles, the best and handsomest are tilt wattles. There are also very high wattles that tilt but little, these are the next best, both for beauty and breeding from. There are also high wattled birds that run flat on the top from their being so very full of wattle. Carriers are subject to the spout, so-called from the lower eyelid falling away from the eyeball in the shape of the spout of a jug, and this spout must be removed as it causes great inflammation of the eye, and the bird never of itself gets better. In consequence of the eye and beak wattle growing so large, carriers are unable to feed themselves properly from the ground, but must have their food placed in a vessel of some kind. Carriers are very apt to have canker just at the point of the lower mandible. If not attended to, the point of the lower mandible rots off.'

The reader will perhaps think it difficult to derive any inference of scientific value with reference to natural variations from such an instance as this.

Mr Darwin takes care to point out that, though he seems to speak of variations as if they occurred by accident, he believes that they follow some law, though of the nature of that law we are profoundly ignorant. And here it is very difficult to find out what Mr Darwin means by the expression 'follow some law.' There are passages in the chapter which seem to hint not only at a separate law of variation as to frequency, but also at some influence which such separate law of variation has upon the ultimate form produced by natural selection.

These passages are to the following effect,—

* 'Change in conditions of life has but a slight direct effect in producing variation; habit and the use or disuse of parts are more potent; but these effects have often been largely combined with, and sometimes over-mastered by, the natural selection of innate differences.'

Mr Darwin says (alluding to the occasional appearance of stripes in the shoulders and legs of horses) he who believes that each equine species was independently created, will, he presumes, assert that each species has been created with a tendency to vary in this particular manner, so as often to become striped like other species of the genus. To admit this view is, Mr Darwin says, to reject a real for an unreal, or at least for an unknown cause. It makes the work of God a mere mockery and deception. Mr Darwin would almost as soon believe with the old and ignorant cosmogonists, that fossil shells had never lived, but had been created in stone so as to mock the shells now living on the sea-shore.†

* p. 143; 6th edit. 114. † p. 167.

Now here we find Mr Darwin speaking of the selection of innate differences, and then ridiculing the idea that any tendency to vary in a particular manner has been implanted at creation. What is the nature of these innate differences?

Mr Darwin seems to approve of the very general opinion of naturalists, that beings low in the scale of nature are more variable than those which are higher. Lowness in this case means that the several parts of the organism have been but little specialized for particular functions, and as long as the same part has to perform diversified work, we can perhaps see why it should remain variable in the same way as a knife which has to cut all sorts of things may be of almost any shape, while a tool for some particular object had better be of some particular form.

Mr Darwin calls our attention to the correlation of variations, that is, when variation takes place in any part of an animal or plant, the simultaneous occurrence of another variation in some other part of the same individual, not necessarily beneficial to it, a fact which he finds important in explaining some particular phenomena of variation.* And here, in explaining how structures sometimes disappear, Mr Darwin states a general principle which, we shall find, is of the greatest importance, namely, that natural selection is continually trying to economize in every part of the organization. If under changed conditions of life a structure before useful becomes less useful, any diminution, however slight, in its development, will be seized by natural selection, for it will profit the individual not to have its nutriment wasted in building up a useless structure.

Mr Darwin says he can thus only understand a fact with which he was much struck when examining cirripedes; namely, that when a cirriped is parasitic within another, and is thus protected, it loses more or less completely its own shell or carapace. This is the case with the male Ibla, and in a truly extraordinary manner with the Proteolepas. Now the saving of a large and complex structure when rendered superfluous, would be a .decided advantage to each successive individual of the species. Mr Darwin says

* p. 148, or p. 117, 6th edit.

many similar instances could be given. This is a most important point, to which we shall often recur.

Mr Darwin then alludes to difficulties in the way of his theory which had occurred to himself, and some of which were, he says, so grave that even at the time of writing his book he could not reflect upon them without being staggered.

These difficulties he classes under the following heads:—

(1) Why, if species have descended from other species by insensibly fine gradations, do we not everywhere see innumerable transitional forms? Why is not all nature in confusion instead of the species being, as we see them, well defined?

(2) Can we believe that natural selection could produce, on the one hand, organs of trifling importance, as the tail of a giraffe, which serves as a mere fly-flapper, and such a wonderful structure as the eye?

(3) Can instinct be acquired and modified through natural selection?

(4) How can we account for species when crossed being sterile, and producing sterile

offspring, whereas when varieties are crossed their fertility is unimpaired?

The objection to Mr Darwin's views that there are no fossil examples of transitional forms may, he says, be met by the extreme incompleteness of our geological collections. But, passing over this point, he addresses himself to the task of explaining why we do not meet with such forms in a recent state. He says—

'In travelling over a continent from north to south we in general find at successive intervals closely allied species, these species frequently meet and interlock, and as the one becomes rarer and rarer, the other becomes more and more frequent, till the one replaces the other; yet these species, where they intermingle, are generally as absolutely distinct from each other as are specimens taken from the metropolis inhabited by each. Why do we not find closely linking intermediate varieties?' This difficulty, Mr Darwin says, for a long time quite confounded him. He explains it as follows:—

The range of the inhabitants of any country by no means exclusively depends upon insensibly changing physical conditions, but in a large part upon the presence of other species upon which it depends for food, or by which it is destroyed, and as these species are already defined objects (however they may have become so) not blending into one another by insensible gradations, the range of any one species, depending, as it does, on the range of others, will tend to be sharply defined. Moreover, each species on the verge of its range where it exists in lessened numbers will be extremely liable to utter extermination, and thus its geographical range will come to be still more sharply defined. We have to consider whether this very subtle explanation is a sufficient answer to the fact that no such transitional species are found; we shall soon see the views of other physiologists upon this point.

Mr Darwin here repeats his position that new varieties are very slowly formed, for variation is a very slow process, and natural selection can do nothing until favourable variations *chance* to occur, and until a place in the natural polity of the country can be better filled by some modification of one or more of its inhabitants; and the existence of such places will depend upon slow changes of climate, or the occasional immigration of new inhabitants, or upon some of the old inhabitants becoming slowly modified, the new forms thus produced and the old ones acting and re-acting on each other, so that in any one region, and at any one time, we ought to see only a few species presenting slight modifications of structure in some degree permanent, and this, says Mr Darwin, assuredly we do see, but he gives us no examples.

Here Mr Darwin makes one observation of much force in favour of his views. He says, those who believe that each being has been created as we now see it, must have felt surprise when they have met with an animal having habits and structures not at all in agreement. What can be plainer than that the webbed feet of ducks and geese are formed for swimming? yet there are upland geese in the Falkland Islands which rarely or never go near the water, and no one except Audubon has seen the frigate bird, which has all its toes webbed, alight on the water. On the other hand, grebes and coots are eminently aquatic, although their toes are only bordered by membranes. What seems plainer than that the long toes of the grallatores are formed for walking over swamps and floating plants? yet the water-hen is nearly as aquatic as the coot, and the landrail nearly as terrestrial as the partridge. In these cases habits have changed though not structure (as in our case of the modified wolf); the change of habits enables the creature to subsist where it could not have subsisted before, and it is naturally selected. In time the structure would conform to the new habits. The commencement of such a change is shown in the deeply-scooped membrane between the toes of the frigate bird. (The frigate bird is a very powerful gull, which ranges at very great distances from land, and lives by compelling the smaller gulls to give up the fish which they have caught, never catching any fish itself. Its webbed feet, however, might often be of advantage to it, seeing the distance from land to which it habitually roams.) The reader has no doubt noticed the habits of our domestic geese, they are grazing animals, almost as completely as sheep; they do not, like the duck tribe, feed upon water insects or plants, and seem to seek the water only for recreation, and to cleanse their feathers.

It is obviously very difficult to account for these differences between habit and structure on the theory of special creation. Still the existence of these formations which are not suitable to the wants of the creatures in the situations in which they are found, is equally unfavourable to Mr Darwin's views, for according to his theory that natural selection economizes organization, useless forms ought to be eliminated by it. Indeed, useless forms ought never to be found, for, as all changes due to natural selection are slow, and are the results of the accumulation of very small variations, the process of the elimination of useless forms ought to go on as rapidly as the acquisition of the new habits. In the domestic goose there are no signs of any change in the web of its feet.

As to the formation of the eye, we know, says Mr Darwin, nothing of the manner in which a nerve first becomes sensitive to light; but granted an optic nerve, coated with pigment as the visual organ of the articulata, we can have no difficulty in tracing the course of natural selection which should raise this organ to the condition in which we see it in the higher animals. Here we must agree with Mr Darwin, if we accept his views at all, for if natural selection is to have any influence whatever, it would have the greatest in matters of the greatest importance. It is more difficult to account on this theory for the production of organs of little importance, as the tail of the giraffe.

Given the existence of an organ, we can easily see how it can be modified. There are fishes, says Mr Darwin, which not only breathe the air dissolved in water by means of their gills, but also breathe free air by the swim-bladder, which has a communication with the free air. It is easy to see, he says, how in process of time the swim-bladder might come to do the whole work of respiration, and the fish would become one of the higher vertebrata. Mr Darwin suggests indeed from the nature and position of the lungs of land animals, that they are but modified forms of a swim-bladder, and that we are all descended from an ancient aquatic prototype, furnished with a floating apparatus or swim-bladder.

Mr Darwin then refers to certain cases in which it is very difficult to account for the production of an organ by natural selection. The production of neuter insects, as amongst bees and ants, is one case which Mr Darwin treats of separately; another case is the occurrence of electric organs in fishes, so different from each other that it is impossible to suppose they could be descended from a common ancestor. In these latter cases Mr Darwin supposes that natural selection hits upon the same result in two different species, much in the same way as two inventors hit upon the same discovery at the same time without any communication with each other. As to this point we may note that inventions are generally the consequence of the state of knowledge at the time. There are thus many circumstances which lead different people up to the same results. This is a very different thing from the production of the same forms by an independent series of fortuitous variations from very different and very remote original forms.

Perhaps the reader may remark that in this passage and some others Mr Darwin speaks of a common ancestor, traces of whose form appear in his descendants, as if we were not to derive the origin of species from the beginning of things like Lamarck, but from some stand-point of a later date. It is difficult to see where we are to take our stand.

As to organs of little importance, such as the tail of the giraffe, we are to consider, says Mr Darwin, that we do not exactly know what organs are really important; and, secondly, many organs now of little importance to the individual, may have been of great importance to the ancestor from which it has descended. We see of what great importance the tail is to most aquatic animals, and if, as appears probable from the state of the lungs in land animals, they are descended from an aquatic ancestor, their tails may be merely remnants of their former condition, preserved as not being injurious to them in their present form.

But on the principle of natural selection these remnants would not be preserved. Suppose a wolf's tail to become useless to it, we should soon on that principle have a race of tail-less wolves, for those who got rid of so much useless weight would outstrip the others, carry off the prey, and alone be preserved.

'Natural selection does not tend to make creatures absolutely perfect, it merely makes them slightly more perfect than their immediate neighbours. The endemic productions of New Zealand, for instance, are perfect as regards each other, but not as regards the similar productions of Europe to which they are rapidly yielding. The correction for the aberration of light is said, on high authority, not to be perfect in that most perfect organ, the eye. Again, the sting of a bee cannot be regarded as perfect, for when it is used as a means of defence it cannot be withdrawn, and causes the death of the creature which uses it.'

With respect to the position that the endemic productions of New Zealand are perfect as regards each other, but not as regards the similar productions of Europe, we must suppose that variations have not occurred among the productions of New Zealand to the same extent as among those of Europe, and thus natural selection has not had so good an opportunity of improving them. This is certainly a strong point in favour of Mr Darwin's theory, for the number of the species of plants and animals endemic to New Zealand is much less than that of those found in any equal area in Europe, and of course they do afford a less field for the occurrence of variation and natural selection.

Still there are some points connected with this subject which require notice. Plants cannot continue to grow with vigour for a length of time in the same ground: agriculturalists find this, and change their crops. The same thing occurs in nature: when a forest is destroyed by fire or wind, a different species of tree appears from that which was destroyed. It is uncertain whether this arises from the exhaustion of those peculiar qualities of the soil which are essential to the welfare of the particular plant, or whether there is a secretion from the roots of plants which in time makes the soil uncongenial to them. The species and genera which have been introduced into New Zealand are quite distinct from the native plants, and must have found a territory which was quite new to them, unexhausted and unpolluted. It is by no means certain that some Australian plants might not overpower European genera,—witness the vigour with which the Eucalyptus grows in the south of Europe. If the watercress has become a nuisance in New Zealand by choking up the rivers, we have the American weed invading us and subjecting us to the like inconvenience. And we must remember that in Europe, almost every place which foreign plants might naturally occupy is in the hands of man, who would interfere to check their progress.

That there is some ground for these remarks, is shown by the fact that European plants when introduced into Australia, grew with more vigour than they do in their native country. The watercress is described as making shoots twelve feet in length, and three-quarters of an inch in diameter; it is not therefore the European vigour of our plants, that vigour which they have acquired in the battle of life at home, which enables them to overcome the native plants, but something which they find in the climate or the soil of the new territory, which gives them strength which they never had before. With respect to the increase of the animals of Europe which have been introduced into New Zealand, we must consider that in many cases they have been protected and assisted by man, and we cannot be sure that they will continue to flourish as they do at present. In time the pasture may be injured by constant grazing, as is said to have happened in this country. It is supposed that the Scotch hills do not now carry so many sheep as when sheep were first substituted for black cattle, and the American weed is not now so troublesome in our rivers as it was at first.

The fact that some European plants grow so very much more vigorously in New Zealand than in their native home, may indeed be urged as an argument against Mr Darwin's views, for it is difficult to believe that variation and natural selection should have made no approach to these forms of vegetation, when there were places in the polity of nature at hand so eminently fitted for them.

We may add here that though it is only too true that the native race in New Zealand is fading away before the European settlers, this is the result of a contest between individuals of the same, not different species. We can easily allow that the men of Europe have been improved in many respects by natural selection. On that principle, all those whose constitutions were weak would be eliminated in proportion to the number struggling for existence; those families, for instance, who had a peculiar aptitude to suffer from measles would gradually disappear. The survivors would constitute a race to some extent fortified against this disease, an advantage which the natives of a small island could not share with them.

We shall find that Mr Darwin's position that natural selection makes creatures only slightly more perfect than their immediate neighbours, is of great importance, for it is on this ground that Mr Wallace, his companion in the discovery of natural selection, leaves him when they come to apply that theory to the appearance of man in the world.

Natural selection, Mr Darwin says, can never produce in a being anything injurious to itself; how then did it give the flowers of red clover such a form that they could be fertilized by one insect only? how did stags acquire the habit of shedding their horns? can it be of advantage to them to be left thus defenceless for months? There is nothing in the nature of horn which requires such renewal, for the horns of the buffalo are persistent. In the same way why should natural selection have given a crab and a lobster such a shell, that the creature should be obliged to throw it off in a piece, leaving itself naked, soft, and a prey to all kinds of fish. No doubt as these creatures are abundant they are suited to their condition. There must be some compensating cause at work in their favour, but this cause can hardly be due to natural selection as affecting their forms. Natural selection could never produce a form injurious in the first instance and then add compensation.

The beautiful plumage of birds may be another case of this kind, as it renders them more conspicuous to their enemies. The rattle of the rattlesnake may be an organ disadvantageous to it, as warning its prey of its approach. We shall see that Mr Darwin accounts for the beautiful plumage of birds by the action of sexual selection; the case of the red clover seems to have escaped his notice.

As to the action of natural selection upon instincts, Mr Darwin says it will be allowed that instincts are of as much importance to the welfare of animals as bodily structure. If, therefore, instincts vary advantageously to the individual, such individuals will be preserved; and he accounts on this principle for the existence of our hive bees and the many communities of ants which contain different classes: some are breeding individuals, some are sterile females who are the workers, and these are of different sizes and appearance, and some even are slaves. He says this division of labour is of advantage to the community, and though the workers are sterile and so cannot transmit their instincts to their descendants, yet we have but to throw the action of natural selection a step further back, and to suppose a selection of the breeding insects which should give birth to these different races of workers. And he again illustrates his position by reference to domestic animals, and argues that by a proper selection of males and females, a race of cattle might be established which should always produce long-horned oxen, even, we suppose, if they had themselves no horns. This is no doubt a very subtle case of natural selection; it is difficult to conceive creatures giving instincts to their offspring which they do not themselves possess. But that the parent bees and ants never possessed any instincts of this kind is by no means clear. Among wasps, in cold countries, the queens, who appear alone in the spring, must make nests and at first feed and attend to their young, in exactly the same manner as is done by the neuters at a later period of the summer.

The existence of these neuter insects is, says Mr Darwin, a complete answer to Lamarck's supposition that use, or disuse, or volition is the cause of permanent modification of form, for if these neuters acquired any advantage by this means they could not transmit it by descent.

With regard to hybrids, Mr Darwin allows that the view that species are endowed with the quality of sterility in order to prevent the confusion of all organic forms, is at first sight probable, and it is of the greatest importance in estimating the value of the theory of natural selection, as the sterility of hybrids being of no advantage to them, could not have been acquired by natural selection.

Mr Darwin states many facts to show that hybrids are not so sterile as is generally supposed, but he cannot in this manner get over the fact that sufficient sterility remains to prevent the confusion of species; he therefore endeavours to show that sterility is not an endowment of species, but is merely incidental to unknown differences between the reproductive systems of the individuals, just as in grafting trees the capacity of one species to take on another, is incidental to unknown differences in their vegetative systems. There is no more reason, he says, to think that species should have been endowed with various degrees of sterility to prevent them from crossing and blending in nature, than to think that trees have been specially endowed with various degrees of difficulty in being grafted together in order to prevent their becoming inarched in our forests.

But here it will occur to the reader that there is a wide difference between these cases: grafting, or rather accidental inarching in a forest, is of very rare occurrence, and is not the usual mode of reproduction like that by seeds, and moreover could never give rise to a confusion in species, as it makes no change in form, but merely places an unchanged graft on an unchanged stock. Incapacity of the graft to take could not be an endowment, for it is not needed. But sterility of hybrids may be an endowment, for it may be necessary to prevent confusion of species.

* Slight changes in the conditions of life, Mr Darwin says, benefit all organic beings, and slight crosses, that is, crosses between males and females of the same species which have varied and become slightly different, give vigour and fertility to their offspring. But greater changes in the conditions of life are injurious to organic beings, and often

* p. 267.

render them sterile. In the same way crosses between males and females which have become widely separated, produce hybrids that are sterile. Both series of facts seem to be connected together by some common but unacknowledged bond which is essentially related to the principle of life. This is a difficult point; it is not easy to see why a slight variation should produce vigour and fertility, and an increase of that variation the opposite results. Again, we must note that these greater changes in the conditions of life which often make organic beings sterile, as they are injurious to them, produce that result by impairing their health, but want of health is not necessarily the cause of sterility in hybrids, as witness our common mule.

Both Lamarck and our author are obliged to allow the general existence of a great degree of sterility amongst hybrids, and though they may give some instances of partial fertility, we are strongly reminded of the old canon, exception proves the rule.

With respect to this point, we may remark that when we look at the domestic mule, and consider its hardiness and general vigour of constitution, apparently well fitting it to fill a place in the polity of nature, we are almost irresistibly driven to the conclusion, that its sterility must be imposed upon it for some special purpose, such as the prevention of the confusion of species.

In treating of the imperfection of the geological record, Mr Darwin says, by the theory of natural selection, all living species have been connected with the parent species of each genus by differences not greater than we see between the varieties of the same species at the present time, and these parent species, now generally extinct, have in their turn been similarly connected with more ancient species, and so on backwards, always converging to the common ancestor of each great class, so that the number of intermediate and transitional links between all living and extinct species must have been inconceivably great. But, says Mr Darwin, if my theory be true, such must have lived upon this earth. Why does not geology give us evidence of this fact?

As to this point Mr Darwin refers to the poorness of our geological collections, to the fact that only a very small portion of the earth has been geologically examined, that long as must have been the period during which each formation had been deposited, it might not be long enough for the formation of a species, that many of the specimens in our collections have been obtained from caves and lacustrine formations, and that there are no caves or true lacustrine formations in the secondary rocks.

Mr Darwin allows that geology has done scarcely anything in breaking down the distinction between species by connecting them by numerous fine intermediate varieties; and that this is the gravest and most obvious of all the many objections which may be urged against his views.

'Another difficulty is the supposed sudden appearance of whole groups of allied species.' This difficulty is lessened by geological research. A few years ago the great class of mammals was always spoken of as having abruptly come in at the commencement of the tertiary series, and now one of the richest known accumulations of fossil mammals belongs to the middle of the secondary series. The fact that not a single bone of a whale had been found in any secondary formation, seemed fully to justify the belief that this great order had been suddenly produced between the latest secondary and earliest tertiary formation; but now, says Mr Darwin, the bones of a whale have been found in the upper green sand, some time before the close of the secondary period.

'A graver difficulty is the appearance of groups of allied species in the lowest known fossiliferous strata. These species must have been descended through many progenitors from one ancestor. Why are there no remains of this long series of beings in rocks below the lowest fossiliferous strata?' Mr Darwin candidly admits that these strata cannot have been wholly worn away by denudation, or obliterated by metamorphic action, and that the case is at present inexplicable, and may be truly urged as a valid argument against his views.

Mr Darwin says, following Lyell's metaphor, that he looks on the natural geological record as a history of the world imperfectly kept, and written in a changing dialect; of this history we possess the last volume alone, relating to only two or three countries. Of this volume, only here and there a short chapter has been preserved; and of each page, only here and there a few lines. Each word of the slowly changing language, in which the history is supposed to be written, being more or less different in the interrupted succession of chapters, may represent the apparently abruptly changed forms of life, entombed in our consecutive, but widely separated, formations. On this view, says Mr Darwin, the difficulties above discussed are greatly diminished, or even disappear.

As to the lapse of time, from the thickness of the sedimentary rocks, from the denudation of volcanic islands by the sea forming precipices from one to two thousand feet in height, from the obliteration of faults and other similar considerations, Mr Darwin supposes that more than three hundred millions of years may have elapsed since the latter part of the secondary period. What an infinite number of generations, he says, which the mind cannot grasp, must have succeeded each other in the long roll of years; how poor are our richest geological collections.

We may quote here a passage from Mr Galton's work on 'Hereditary Genius,' as it brings before the senses the idea of time; he counted the spikes of blossom on the chestnut-trees in the avenue in Bushey Park, which is a mile long, and found their number to be one hundred thousand.* 'Ever since this time,' says Mr Galton, 'whenever a million is mentioned, I recall the long perspective of the avenue of Bushey Park, with its stately chestnuts clothed from top to bottom with spikes of flowers, and I imagine a similar continuous floral band of ten miles in length.'

In treating of the geological succession of organic beings, Mr Darwin encounters Lamarck's difficulty. Species of different genera have not changed at the same rate or in the same degree. The Silurian Lingula differs but little from living species of this genus, whereas most of the other Silurian mollusks and all the Crustacea have changed greatly.

* Galton's 'Hereditary Genius,' p. 12.

In explanation of this fact, Mr Darwin says,* he believes in no fixed law of development, causing all the inhabitants of a country to change abruptly, or to an equal degree. The process of modification must be extremely slow, the variability of each species is quite independent of that of all others; whether such variability be taken advantage of by natural selection, and whether the variations be accumulated to a greater or lesser amount, thus causing a greater or lesser amount of modification in the varying species, depends upon many complex contingencies, on the variability being of a beneficial nature, on the power of intercrossing, on the rate of breeding, on the slowly changing physical conditions of the country, and more especially on the nature of the other inhabitants with which the varying species comes into competition. Hence it is by no means surprising that one species should retain the same identical form much longer than others; or, if changing, that it should change less.

In this passage the most remarkable statement is, that the variability of each species

* p. 314.

is quite independent of that of all others. Mr Darwin, we suppose, means that some species are naturally less variable than others, for this alone apparently could account for so great a persistence of form as that of the Lingula. The other circumstances mentioned by Mr Darwin as impeding or accelerating change, appear such as in the long run would affect pretty nearly to the same extent all organisms. Now, how can such a great difference in the tendency to vary have been obtained in the process of development from an inferior form? how comes the Lingula to have been endowed by natural selection with an incapacity to vary, while all the other creatures, its neighbours in time and space, and developed by the same agency, have escaped this incapacity which is a disadvantage to a species, as preventing it from occupying vacant places in the polity of nature?

And here Mr Darwin touches upon a point which we shall find to be of great importance, namely, the extent to which the changes which have taken place in organic beings have been progressive or otherwise.

There has, says Mr Darwin, been much discussion whether recent forms are more highly developed than ancient forms.

'Naturalists have not as yet defined to each other's satisfaction what is meant by high and low form, but in one particular sense the more recent form must, on Mr Darwin's theory, be higher than the more ancient, for each new species is formed by having had some advantage in the struggle for life over other and preceding forms.'

'If all the animals and plants of Great Britain were set free in New Zealand, we may believe that in the course of time a multitude of British forms would become thoroughly naturalized there, and would exterminate many of the natives. On the other hand, if all the native productions of New Zealand were set free in Britain, we may doubt whether any considerable number would be enabled to seize on places now occupied by our native plants and animals; under this point of view, the productions of Great Britain may be said to be higher than those of New Zealand, yet the most skilful naturalists, from an examination of the species of the two countries, could not have foreseen this result.'

Perhaps this test of the superiority of species is not a very fair one; we must remember that the climate of New Zealand though of the same kind as our own, inasmuch as it is insular, is warmer and more genial, and the plants, at least of New Zealand, could not exist in England; if the test were tried in the warmer parts of the continent, they would meet with a continental climate, which, from its dryness and rapid changes of temperature, would probably be very injurious to them; certainly the fact noticed by Mr Darwin, that the most skilful naturalist, from an examination of the species of the two countries, could not have foreseen the victory of the European species, tends to show that the power was not in the plants themselves, but a consequence of the circumstances in which they were placed.

Mr Darwin says that Agassiz insists that ancient animals resemble to a certain extent the embryos of recent animals of the same classes. This theory accords well with the theory of natural selection; the truth of it, however, is not proved, though Mr Darwin expects to see it hereafter confirmed, at least in regard to subordinate groups which have branched off from each other within comparatively recent times. We shall see the importance of these passages when we come to consider Mr Darwin's explanation of the fact, that there are at present in existence so many creatures of a low type, notwithstanding the continued action of variation and natural selection.

To answer the question, how we are to account for particular forms being confined to particular spots on the earth, without having recourse to the theory of creation, Mr Darwin points out, that many regions now apparently isolated were formerly connected, the intervening land having subsided. It is found that islands, separated from continents by seas which are very shallow, giving probable evidence of a recent subsidence of land, contain a large proportion of the genera common on the nearest continent, while the reverse is the case if the intervening sea is deep.

Mr Darwin also suggests, that at the glacial period, the temperature of the tropics was such, that animals and plants of the northern temperate zone could pass to the southern hemisphere, and vice versâ, though on the increase of heat on the termination of that epoch, they would be separated by an impassable barrier of heat.

We need not dwell longer on these points; it may be, and is usually allowed, that animals and plants may have been distributed over the earth as we now see them, notwithstanding that they were created in one place. We may allow this upon the whole, though it is a most remarkable fact, that the extinct animals of Australia, and of the most southern part of America, are of species similar to those now in existence there, though these are peculiar to those countries, showing that the present order of animal life has existed in those regions for an indefinite period.

Most of the animals of Australia are marsupial, that is, carry their young, which are born in a very embryonic state, in ventral pouches, and such animals do not now exist in the old world, and therefore could not apparently have reached Australia by immigration. But in answer to this difficulty, it appears from geology that the animals inhabiting Europe in the earlier ages were marsupial. They might have migrated to Australia in that state of development, and have remained comparatively unchanged, on Mr Darwin's view, because of the less amount of variation and the less severe struggle for existence which have taken place there. As to the animals of South America which belong to the order edentata, similar genera are found at this day in the northern parts of that continent. It is very remarkable that the fossil remains in these two countries, and notably in South America, give evidence of the existence of animals of enormous size, the recent animals of their class being comparatively diminutive Armadillos and Anteaters.

The same remark applies, in a lesser degree, to the extinct animals of the other parts of the world, many of the fossil species having been much larger than those of a similar kind now living. Many of the larger kinds have now become altogether extinct, and even in India the fossil remains of several species of elephants have been discovered, though there is only one living species of these animals. As has been observed, the power of producing large animals appears at present to be on the wane. Does this point to a state of the earth when only partially cooled down to its present state, and when all the natural phenomena we now witness were on a grander scale?

As to the succession of the same types in the same areas during the later tertiary periods, Mr Darwin says this fact is easily accounted for by natural selection, for the inhabitants of each quarter of the world will obviously tend to leave in that quarter, during the next succeeding period of time, closely allied, though in some degree modified, descendants. But after very long intervals of time, and after great geographical change, permitting much inter-immigration, the feeble will yield to the more dominant forms.

Mr Darwin remarks that whole orders are wanting on oceanic islands, that is, islands at a great distance from any continent. Frogs, toads, and newts are not found on any of the many islands with which the great ocean is studded, yet the physical condition of these islands is well fitted for these animals, as is shown by the extent to which they have multiplied when introduced by man. The reason of this is, that these animals and their spawn are instantly killed by sea-water, so that their immigration by passing the sea would be very difficult. But why, says Mr Darwin, on the theory of creation they should not have been created there, it is very difficult to explain.

'Terrestrial mammals offer another similar case: they are not met with on any island more than 300 miles from a continent or great continental island, yet it cannot be said that small islands are not fitted for the support of small mammals, for they occur in many parts of the world on very small islands if close to a continent, and hardly an island can be named in which our smaller quadrupeds, when introduced by man, have not become naturalized and greatly multiplied. It cannot be said, on the ordinary view of creation, that there has not been time for the creation of mammals, for many volcanic islands are sufficiently ancient, as shown by the stupendous degradation which they have suffered, and by their tertiary strata. There has also been time for the production of endemic species belonging to other classes, and on continents it is thought that mammals appear and disappear at a quicker rate than other and lower animals.'

'Aërial mammals do occur on oceanic islands. New Zealand possesses two bats found nowhere else in the world. Norfolk Island, the Viti Archipelago, the Bonin Islands, the Carolina and Maryanne Archipelagos, and the Mauritius, all possess their peculiar bats. These bats are supposed by Mr Darwin to be the descendants of immigrants, who have been modified in their new home in relation to their new position.'

The reader will probably agree with Mr Darwin that these facts are strong evidence that these oceanic islands have not been peopled by direct acts of creation, as they are so fitted for animals which do not exist upon them, and it is a fair inference, perhaps, that nowhere have the creatures which we see fitted for their places been so produced, and to that extent these facts are evidence of the production of all creatures by some form of evolution, though not perhaps necessarily by natural selection. But there is another point which will perhaps here strike the reader, why, on these islands of such antiquity as to allow of the production of endemic species by natural selection, do we see no trace of any approach to an incipient terrestrial mammal, the place being so well fitted for them? We shall meet with this point again.

We may mention here a very curious fact, namely, that the Fauna of Madagascar has some similitude to that of South America, though these countries are so distant from each other, and though the continent of Africa lies between them; certain small animals resembling hedge-hogs in appearance found in Madagascar are thought to be most nearly allied to an American genus, and the Quadrumanous animals of that island approach some of the American species of monkey. A moth with a very long tongue, similar to that of the moths of Madagascar, has lately been found in Brazil.* To explain these facts on the Darwinian theory, the supposition is made that a large continent formerly existed, stretching out on the one side towards India, and on the other side towards America, and that Madagascar is a remnant of this ancient country.

We now come to the manner in which Mr Darwin accounts for the occurrence of homologous and rudimentary organs, for the progressive development of the embryo in mammals, and for the similarity of form displayed by animals in a young state, but lost as they grow older, and this is certainly one of the most satisfactory parts of his theory.

Homologous organs are those which are similarly situated and which resemble each other in form and plan, though answering widely different purposes.

Why, says Mr Darwin,† should the brain be enclosed in a box composed of numerous and extraordinarily shaped pieces of bone? As Owen has remarked, the benefit derived

* 'Quarterly Review,' vol. xlviii. p. 191.
† p. 437.

from the yielding of the separate pieces in the act of parturition of mammals, will by no means explain the same construction in the skulls of birds. Why should similar bones have been created in the formation of the wing and leg of a bat, used, as they are, for such totally different purposes? Why should one crustacean, which has an extremely complex mouth formed of many parts, consequently always have fewer legs; or conversely, those with many legs have simpler mouths? Why should the sepals, petals, stamens, and pistils in any individual flower, though fitted for such widely different purposes, be all constructed on the same pattern?

On the theory of natural selection we can satisfactorily answer these questions, for all these creatures have descended from a common ancestor. The reader will remember that Paley accounts for the existence of these organs, as having been created for the sake of uniformity of plan.

'The same fact of descent from a common ancestor will account for the similarity of the young of animals to each other in the early stages of growth, and to the appearance in them of characters which they afterwards lose; thus the whelps of the lion are frequently striped, striped skins being the usual form amongst the cat tribe; so the fact that the foals of some horses have striped legs points to their descent from a common ancestor of the horse and the zebra.'

'Rudimentary organs, in the same way, can be accounted for as having once been of importance to the common ancestor, and preserved as not being injurious, though no longer useful. Many snakes have the rudiments of a pelvis and hind limbs. There are teeth in the jaws of fœtal whales, which when grown up have not a tooth in their heads; and the like occurs in the jaws of fœtal calves, which, in addition to their proper teeth, have rudimentary teeth which never cut through the gums.'

Mr Darwin also mentions the imperfect mammæ which occur in the male of the human race, and in some other mammals, which he considers to be rudimentary. We shall find that this question is surrounded with difficulties which we will consider when we come to examine the last edition of Mr Darwin's 'Origin of Species.' Here we may note that if these rudimentary organs tend to show that species have come into being by descent, it does not follow that they have been produced in accordance with Mr Darwin's special theory of variation and the survival of the fittest.

We have seen that Mr Darwin has from time to time spoken of an ancestor of some group as a definite origin of it, and this leads to the question how far he extends the doctrine of modification of species. Upon this point he says,* all the members of whole classes can be connected together by chains of affinities, and all can be classified on the same principle in groups subordinate to groups. Fossil remains sometimes tend to fill up very wide intervals between existing orders. Organs in a rudimentary state plainly show that an early progenitor had the organ in a fully developed state. Throughout whole classes various structures are formed on the same pattern, and at an embryonic age the species closely resemble each other. Mr Darwin

* p. 483.

therefore believes that animals have descended from at most only four or five progenitors, and plants from an equal or lesser number.

Analogy, he says, would lead us one step further (but analogy may be a deceitful guide), namely, to the belief that all organic beings which have lived on this earth have been descended from some one primordial form into which life was first breathed.

And here we may remark, that there seems to be one great distinction between animal and vegetable life which would render the creation of at least two primordial forms necessary. Animals live by bringing about chemical combinations; by a process of destruction, so to speak: their life causes carbon to unite with oxygen and form the invisible gas called carbonic acid; plants, on the other hand, live by decomposing this acid, by separating the oxygen from the carbon, giving the first element to our atmosphere, and forming their own substance in great measure out of the latter element.

CHAPTER III.

Mr Wallace on natural selection—Wild varieties cannot revert—Frightful picture of the destruction of life on the globe—View of the action of natural selection—Great change required in the conditions of life—As to protective colours and mimicry—Review of the 'Origin of Species' by Bishop Wilberforce—Admits the struggle for life—Denies the occurrence of variations capable of development into new species—Man's tampering with nature—Mr Herbert Spencer's 'Principles of Biology'—Organic forms extremely unstable—Persistence of low forms of life—Darwin's theory not applicable to complex organs—Dr Hooker's flora of Australia—Darwin's theory in great part true—Uncertainty as to species of plants—Views as to man's tampering with nature—As to progressive development, and as to European plants in Australia—Dr Asa Gray's natural selection not inconsistent with natural theology—Believes in transmutation—But by the action of a first cause—Variation has been led along certain beneficial lines—Three modes of action of an efficient force compatible with design—North British Review—Chances against the survival of the improved individual—Effects of free intercrossing in obliterating varieties—Darwin's answer to these remarks.

Mr Wallace* does not enter so fully into the subject as Mr Darwin, but we must notice

* 'Contributions to Natural Selection,' 2nd edit. p. 40.

some of his remarks: he does not attempt, like Mr Darwin, to show that varieties occurring amongst animals and plants in a state of domestication are constant. There is, he says, no analogy between varieties occurring in a state of nature and those of domestic animals. Wild animals require the full exertion of all their faculties to preserve their own existence and to provide food for their offspring. Every improved individual would have to exert to the full its newly-acquired powers, and could not revert to its former state without perishing.

In pursuing this subject Mr Wallace draws a frightful picture of the destruction of animal life which is constantly going on. Very few birds, he says,* produce less than two young ones each year, many have six, eight, or ten, four will certainly be below the average; and if we suppose that each pair produces young only four times in the course of their life, and that also will be below the average, supposing them not to die either by violence or want of food, yet at this rate a single pair of birds would have increased to nearly ten millions in fifteen years, whereas we have

* Wallace's 'Natural Selection,' p. 29.

no reason to believe that the number of birds in any country increases at all in fifteen or in one hundred and fifty years. It is evident, therefore, that in each year an immense number of birds must perish—as many, in fact, as are born; and as on the lowest calculation the progeny in each year are twice as numerous as the parents, it follows that, whatever be the average number of the individuals existing in any given country, twice that number must perish annually. On the average all of each brood above one become food for hawks and kites, wild cats and weasels, or perish of cold and hunger as winter comes on, that is, before they have had an opportunity of leaving progeny. We shall soon see the great importance of this point.

Mr Wallace then proceeds to consider the case of variations, and he supposes that variations have occurred in a species, some to the advantage of the individuals and some to their disadvantage, as compared with the powers of the original species to preserve its life. The 'population,' as Mr Wallace styles it, of the inferior variety would never equal that of the original species, while that of the improved variety would exceed it. An alteration of physical circumstances is then supposed to occur in the district—a long period of drought, a destruction of vegetation by locusts, or the irruption of some carnivorous animal—any change, in fact, rendering existence more difficult to the species in question. The least numerous and most feebly organized variety would suffer first, and would soon become extinct. If the adverse circumstances continued the parent species would perish in the next place—finally, the improved variety would alone remain, and on a return to favourable circumstances, would rapidly increase in numbers and occupy the place of the extinct species and variety.

Upon these points we may observe, that the extinction of the species and variety is easily accounted for, but we are not told how the varieties arose. Again, Mr Wallace seems to think that until the occurrence of the unfavourable circumstances, the two varieties and the species might be co-existent and live together in amity. There is no suggestion of any struggle for life going on amongst them, or of any action of natural selection. Why should this be the case? Again, why, before the adverse circumstances occurred, did not intercrossing obliterate the varieties? Also, after those circumstances had ceased, the improved variety, for a time at least, would apparently not require the exercise of its whole powers to preserve its existence, might it not retrograde in the same manner as the original species? However, it seems clear, that if the adverse circumstances continue, only the improved race will survive. Mr Wallace says, changes of external conditions are universal and unceasing, and there must be changes in organic forms to keep them in harmony with the changed conditions. We can agree with Mr Wallace here, provided that the change in the conditions of life is so great, that only the improved individuals can live after it has taken place; but this implies that the change is considerable, both in the conditions of life and in the organic beings, and we do not see such changes taking place, and they are not contemplated in Mr Darwin's theory.

We may remark here, that during the

glacial period, animals were exposed to great changes in the conditions of life, and yet neither varied nor perished.

Mr Wallace says, no evidence can be brought against the stability of variations occurring in a state of nature from the fact that varieties of domestic animals revert, because these animals if turned out at large could not exist without reverting; the variations, in fact, which had occurred in them were not for their advantage in a feral state, and when deprived of the care of man they must perish, or revert to the normal type.

This is no doubt true, but if, as formerly suggested, varieties of domestic animals are inclined to revert to the normal form, or at least to vary from their improved form, even when under the care of man, while their food, climate, and conditions of life are constant, the cessation of the selection of particular breeders by man being the only change in their circumstances, then such tendency to retrograde is clearly a proof of the instability of variations.

Mr Wallace mentions many cases in which the peculiar colours of different animals seem to be due to natural selection. The lion and other animals of the desert are of the colour of the desert. The species of the cat tribe which have spotted skins are arboreal in their habits, and their skins resemble the leafy covering in which they are shrouded. The females of many birds which build in exposed situations are of inconspicuous colours, while the males are highly adorned; the only exception to this rule is in those few cases in which the male birds sit on the eggs. In those cases in which both sexes are highly coloured, the nests are placed in holes or covered with domes. These are curious facts, and no doubt can be accounted for by natural selection, as the creatures which were least conspicuous would be the most likely to escape their enemies. Perhaps the case of the cat tribe is not quite in point, as those creatures are nocturnal in their habits, and colour could not be of much importance by night. Again, the universal adaptation of colour to the region in which they exist, seems to leave the relative position of the inhabitants of the desert to each other without advantage on any part.

Mr Wallace calls attention to the fact that many insects have the outward forms and colours of insects to which they are not closely allied, and he believes that these forms are a protection against their enemies; he mentions a peculiar class of butterflies which are very abundant in South America, and which from their strong scent and taste are disagreeable to insect-eating birds, and he says, that amongst the large swarms of these butterflies many individuals are to be found of other species who have apparently appropriated their peculiarities of form and colour. This, no doubt, is an excellent instance of the action of natural selection, as the insects which mimicked the others would escape their enemies, would be preserved and would breed, and here, too, we should think would be a good opportunity of discovering the process of variation actually going on; we ought to see insects in all stages of modification towards the required form. Perhaps the discovery may be made, for, as Mr Wallace observes, the natural history of the tropics has been as yet very imperfectly studied.

Mr Wallace mentions the case of certain kinds of caterpillars which were invariably rejected as food by birds, frogs, lizards, and spiders, apparently on account of their disagreeable taste, as the frogs, after seizing them, sit with their mouths gaping open, and an expression of disgust, until they get rid of them, though they did not hesitate to swallow stinging bees and wasps. It is remarkable that some kinds of caterpillars only should be protected; are they, or the butterflies which produce them, particularly numerous like the offensive butterflies of South America?

'The Origin of Species' was reviewed in the *Quarterly Review* for 1860, by the late Bishop Wilberforce. The Bishop would probably have been considered by Sir C. Lyell 'as labouring under the incapability of weighing the arguments for and against transmutation.' It must, however, be most interesting to note the impression which 'The Origin of Species' made upon such a man. The Bishop says he readily admits that a struggle for life actually exists, and that it tends continually to lead the strong to exterminate the weak, that this struggle tends to preserve the full vigour of the race, and he also allows that the stronger species will supplant the weaker.

'But there are not in nature such variations as will enable this struggle for existence to exalt the individuals in which they occur above the normal level of the species, nor is there at work in nature, co-ordinate with the law of competition and with the existence of such favourable variations, a power of accumulating such favourable variations through successive descents.

'There is not a single fact tending to prove Mr Darwin's position, that varieties are incipient species. With all the change wrought in the appearance and manners of pigeons, there is not the faintest beginning of any change in what that great comparative anatomist, Professor Owen, calls the characteristics of the skeleton, or other parts of the frame, upon which specific differences are founded. There is no tendency to sterility, nor is there any appearance of the power of accumulating variations, for Mr Darwin allows sudden returns to the parent stock in colour, and other appearances, showing that the tendency of the variations is not to become fixed, but to vanish. So clear is this, that it is well known that relaxation in the breeder's care effaces all the established points of difference, and the fancy pigeon reverts again to its simpler ancestor.'

The Bishop quotes with great approbation Professor Owen's account of the changes which have taken place amongst dogs: 'No species of domestic animal manifests so great a range of variety in regard to general size, to colour, and character of hair, and to the form of head. Yet, under the extremest marks of variety, the naturalist detects in the dental formula, and in the construction of the cranium, the unmistakeable generic and specific characters of the Canis familiaris.' Note also, says Professor Owen, how unerringly and plainly the extremest varieties of the dog kind recognize their own specific relationship, how differently does the giant Newfoundland behave to the dwarf pug, on a casual rencontre, from the way in which either of them would treat a jackal, a wolf, or a fox.

The Bishop remarks that all the variations which have occurred amongst domesticated animals are in the nature of monstrosities, none of them are advantageous to the creatures themselves. We have a hint here of two points—(1) If men have watched so carefully the variations of their domestic animals and plants, how comes it that they have not noticed variations among them useful to the animals and plants themselves? and (2) are not the variations which occur among domesticated animals and plants caused by man's tampering with nature, and therefore throw no light on the natural modification of species?

As to this latter point, Mr Darwin says,* If organic beings had not possessed an inherent tendency to vary, man could have done nothing; he unintentionally exposes his animals and plants to various conditions of life, and variability supervenes, which he cannot even prevent or check.

Consider, says Mr Darwin, the simple case of a plant which has been cultivated during a long time in its native country, and which, consequently, has not been subjected to any change of climate. It has been protected to a certain extent from the competing roots of plants of other kinds; it has generally been

* 'Animals and Plants,' p. 2, vol. i.

grown in manured soil, but probably not richer than many an alluvial flat; and, lastly, it has been exposed to changes in its conditions, being grown sometimes in one district, sometimes in another, in different soils. Under such circumstances scarcely a plant can be named which, though cultivated in the rudest manner, has not given birth to several varieties. It can hardly be maintained that during the many changes which this earth has undergone, and during the natural migration of wild plants, from one land or island to another, tenanted by different species, such plants will not often have been subjected to changes in their condition, analogous to those which inevitably cause cultivated plants to vary, and will therefore vary like them.

Man, says the Bishop, can only develop one part by the sacrifice of another; the bull-dog gains in strength, and loses in swiftness; the greyhound gains in swiftness, but loses in strength; even the English race-horse loses much which would enable it in the battle for life to compete with its rougher ancestor. So, too, with our prize cattle; their greater tendency to an earlier accumulation of meat and fat is counterbalanced, as is well known, by loss of robust health, fertility, and the power of yielding milk. There is not a shadow of ground for saying that man's variations ever improve the typical characters of the animal, as an animal; they do, but by some monstrous development, make it more useful to himself; and hence it is that nature, according to her universal law with monstrosities, is ever tending to obliterate the deviations, and return to the type.

If these changes, says the Bishop, are so numerous among existing creatures as Mr Darwin supposes, it is inconceivable that no beginning of transmutation has been seen in the countless tribes of animal life. From the highest down to the lowest and most variable species, no new organ has been known to be developed, no new natural instinct to be formed, and as to this point, it must be borne in mind, that the lives of many of the lower forms are very short, and many generations of them would succeed each other in a short time.

The Bishop then enters into the question of the geological record, which he, quoting Murchison and Owen, does not consider so imperfect as Mr Darwin. In particular, he thinks it absolutely certain that the earlier formations, before the deposit of the lowest Silurian strata, which, Mr Darwin says, must, if his theory be true, have swarmed with life, have been thoroughly examined by geologists, and exhibit no signs of life. As we have seen, we can hardly enter into these geological questions with advantage, but we may be sure that the facts are not so clear against Mr Darwin as the Bishop supposes; besides, all negative evidence of this kind is liable to be rendered useless by new discoveries, as has often been shown in the progress of geology.

We may note here a remark of the late Sir John Herschel, who suggested that the deposit of a thick stratum upon the bed of the ocean might cause heat to rise into it from the interior of the earth, in the same way as a man's skin grows warmer in a winter day by putting on an additional great-coat. According to this view there is nothing casual in the formation of metamorphic rocks; all strata, once buried deep enough, and due time allowed, must assume that state, all records of former worlds must ultimately perish.*

To return to the Review, the Bishop says Mr Darwin's theory is based upon the merest hypothesis, supported by the most unbounded assumptions. What new words are these, for a loyal disciple of the true Baconian philosophy? 'I can conceive, It is not incredible, I do not doubt, It is conceivable.' As to this point we may notice an observation by Mr Darwin † that false facts in science are extremely hurtful, but false views do but little harm, as every one takes a salutary pleasure in proving their falseness, and when this is done, a path towards error is closed, and the road to truth is often at the same time opened.

The Bishop says, that as to many of the difficulties which Mr Darwin says are inexplicable on the theory of creation, he himself gives no real answer. Thus, in the case of the occasional appearance of stripes on asses and

* Babbage's 'Ninth Bridgewater Treatise,' p. 217.

† 'Descent of Man,' vol. ii. p. 385.

horses, which Mr Darwin says cannot be explained as created, and which he explains as signs of a remote ancestor, who was striped. How is the striping of the one species (the ancestor) a less real difficulty than the striping of many?

As to the question asked by Mr Darwin, were all the infinitely numerous kinds of animals and plants created as eggs, or seed, or as full grown; and in the case of mammals, were they created bearing the false marks of nourishment from the mother's womb?

The Bishop says, the difficulty here glanced at is extreme, but it is one for which the transmutation theory gives no clue. It is inherent in the idea of the creation of beings, which are to reproduce their like by mutual succession, for in such a world, place the beginning where you will, that beginning must contain the history of the past which existed only in the mind of the Creator. If, with Mr Darwin, to escape the difficulty of supposing the first man at his creation to possess in that framework of his body false marks of nourishment from his mother's womb, we consider him to have been an improved ape (here the Bishop anticipates by many years Mr Darwin's views), we only carry the difficulty up from the first man to the first ape, and so on. If we go to the primeval fungus, still that fungus must have had humus to nourish it, and that humus must itself be a mark of a pre-existing vegetation. The most advanced school of transmutationists endeavour to show, as we shall see, that the protoplasm, which they consider the unit of life, is formed by the combination of certain inorganic bodies.

The Bishop quotes a passage from 'The Origin of Species,' in which Mr Darwin says that 'we ought not to marvel if all the contrivances in nature be not, so far as we can judge, absolutely perfect; and if some of them be abhorrent to our idea of fitness, we need not marvel at the sting of a bee causing its own death; at drones being produced in such vast numbers for one single act, with the great majority slaughtered by their sterile sisters; at the astonishing waste of pollen by our fir-trees; at the instinctive hatred of the queen-bee for her own fertile daughters; at ichneumonidæ feeding within the live bodies of caterpillars, and at other such cases. The wonder indeed is, on the theory of natural selection, that more such cases of the want of absolute perfection have not been observed;' and the Bishop then observes that the real temper of this whole speculation as to nature itself may be read in these few lines. It is a dishonouring view of nature.

The Review then takes a theological view of the case into which we cannot enter. The Bishop adds that he trusts Mr Darwin is mistaken in believing that he can count Sir C. Lyell as one of his converts, though the Lyellian hypothesis, itself not free from some of Mr Darwin's faults, stands eminently in need, for its own support, of some such new scheme of physical life as that propounded here; and the Bishop hopes that, with the help of Sir C. Lyell and that of his brethren, this flimsy speculation may be completely put down.

Mr Herbert Spencer, to whom we owe the expression 'survival of the fittest,' treats of the subject of evolution in his 'Essays' and in his 'Principles of Biology;' his manner of dealing with the subject is for the most part too metaphysical and too theological for our views, but we may notice some points.

Mr Herbert Spencer says that organic matter is built up of molecules so extremely mobile that the slightest variation in their surrounding conditions destroys their equilibrium and causes them to assume altered structures, and he refers to the effects of heat and light, and more especially of chemical affinity as shown in the process of animal nutrition and fermentation.

'Nitrogenous compounds are well known to be extremely unstable, many of them (dynamite, for instance) explode on the slightest incentive, sometimes without any apparent cause. The seed of a plant contains nitrogenous substances in a far higher ratio than the rest of the plant, and the seed differs from the rest of the plant in its ability to initiate, in the absence of light, extensive vital changes, the changes constituting germination. Similarly, in the bodies of animals, those parts which carry on active functions are nitrogenous, while parts that are less nitrogenous, as the deposits of fat, carry on no active functions. In no part of any organism where vital changes are going on is nitrogenous matter wholly absent.'

'It is probable that these extremely unstable compounds have everywhere the effect of communicating to the less unstable compounds associated with them molecular movements like those which they are themselves undergoing.' *

The reader will consider how far these views tend to prove that variations do occur in animals and plants. Certainly the variations which Mr Darwin has taught us to look for in organisms are apparently very different from explosions, or from anything like sudden movements, which would seem to be the natural mode of action of these nitrogenous compounds. Is not the supposed analogy in reality fanciful?

Mr Herbert Spencer supposes that the incidence of external forces, arising from changed surroundings or environment, gives rise to variations from a simple to a more complex form.

'Any primordial aggregate must in itself and through its descendants gravitate from

* 'Principles of Biology,' p. 39, vol. i.

uniformity to multiformity in obedience to the more or less multiform forces acting upon it, and as these multiform forces are themselves ever undergoing slow variations and complications, the process ever advancing towards a temporary limit, but ever having its limit removed, must go on unceasingly.'

Mr Herbert Spencer says, it does not follow that this passage from a simple to a more complex form has been going on universally, for though every environment in the earth's surface undergoes changes, and though usually the organisms which the environment contains cannot escape certain resulting new influences, yet occasionally such new influences are escaped by the survival of species in the unchanged parts of their habitats, or by their spread into neighbouring habitats which the change has rendered like their original habitats, or by both. Any alteration in the temperature of a climate or its degree of humidity is unlikely to affect simultaneously the whole area occupied by a species, and further, it can scarcely fail to happen that the addition or subtraction of heat or moisture will give to some adjacent area a climate like to that to which the species has been habituated. If, again, the circumstances of a species are modified by the intrusion of some foreign kind of plant or animal, it follows that, since the intruders will not spread throughout its whole habitat, the species will in one or more localities remain unaffected by them.

'Especially among marine creatures must there frequently occur cases in which modifying causes are continually eluded. Much more uniform as are the physical conditions to which the sea exposes its inhabitants, it becomes possible for such of them as live on widely-diffused food to be widely distributed, and wide distribution generally prevents the members of a species from being all subject to the same cause. Our commonest cirrhiped,* for instance, subsisting upon minute creatures that are everywhere dispersed through the sea, needing only to have some firm surface on which to build up its shell, and in scarcely any danger from surrounding animals, is able to exist on shores so widely remote from one another that

* 'Principles of Biology,' vol. i. p. 429.

nearly every change in the actions of incident forces must fall within narrower areas than that which the species occupies. In nearly every case, therefore, a portion of the species will survive unmodified. Its easily-transported germs will take possession of such new habitats as have been rendered fitter by the change that has unfitted some parts of its original habitat. Hence, on successive occasions, while some parts of the species are slightly transformed, another part may continually escape transformation by migrating hither and thither where the simple conditions needed for its existence recur in nearly the same combinations as before. And so it will become possible for it to survive with comparatively trifling structural changes throughout long geological periods.'

We have given this passage at length, as it contains Mr Herbert Spencer's view of one of the greatest difficulties of the evolution theory, namely, how to account for the existence at the present time of so vast a number of simple forms of life. The reader will remark that Mr Herbert Spencer uses the words 'occasionally elude' as if the preservation of these lower forms was a comparatively rare occurrence. Again, as there is no part of the world in which modifying influences have not some time or other improved the inferior forms, they could have eluded these influences only by constantly migrating from place to place. Is this conceivable? Again, why should these inferior forms seek to elude an influence which tended to modify them advantageously?

Beside the action of direct external forces, Mr Herbert Spencer calls in two other elements to complete changes of structure: (1) Direct Equilibration, which is, in other words, self-adaptation, or the influence of the use or disuse of organs, this is the principle which adjusts all the parts of the organism; and (2) Indirect Equilibration, which is apparently the same thing as Mr Darwin's natural selection.

Mr Herbert Spencer allows that natural selection does much, but there are cases in which it cannot act. Among any organs which habitually act in concert, an increase of one can be of no service, unless there be a concomitant increase of the rest. The co-operative parts must vary together, or variation will be detrimental; a stronger muscle must have stronger bones to resist its contractions; must have stronger correlated muscles and ligaments to secure the neighbouring articulations; must have larger blood-vessels to bring it supplies; must have a more massive nerve to bring it stimulus, and some extra development of a nervous centre to supply this extra stimulus. It cannot be maintained that all these co-operative parts vary simultaneously, increase and decrease together.

In such cases as these, as Mr Herbert Spencer will not allow of any inherent tendency to vary in a particular manner, which is only a form of special creation, which he says is a thing not definitely conceivable, he accounts for the formation of these structures by self-adaptation, and he gives the case of the horns of a stag; any increase in their size would be of no advantage, or rather a disadvantage, to the creature, unless the strength of its neck was increased, and this again would require further modification in other parts of the body. Mr H. Spencer seems to think that the heavier horns would in time produce the requisite increase in the muscles of the neck and the modification in the other parts of the body of the deer, and he says Mr Darwin has not paid sufficient attention to the effects of use and disuse of parts.

We shall see that Mr Darwin is inclined to allow that perhaps he has not attended sufficiently to the influence of the use and disuse of parts, but he certainly would not be required to make that admission in this case of the increased size of a deer's horns. In the first place, heavy horns on a weak neck would be a great disadvantage to the creature so encumbered, and it would perish in the battle of life long before use could strengthen its neck or adapt its form to its new horns; nor does the case present any very great difficulties to the action of Mr Darwin's theory. The strengthening of the neck and the development of the body might have occurred before the increase of the horns, and the heavy horns might have arisen as the finish of the whole.

We may, perhaps, notice here a case of variation, suggested by Mr Herbert Spencer, in which the variation would certainly be eliminated by intercrossing. Mr Herbert Spencer says, in any race of animals variations may occur of advantage to the individual in which they arise, which will yet not enable it to starve out its own companions who have not enjoyed that variation, because they may have varied also advantageously, though in a different direction. Let us take as an instance a pack of wolves, and suppose one or two individuals to have acquired greater speed, they would not be able to prevail over others who, their speed being unaltered, had gained a better sense of smell. Varieties inferior in some respects might co-exist with varieties superior in some points. It seems a necessary consequence that in such a case as this intercrossing would soon restore the race to its original state.

We may note here that Mr Herbert Spencer's views as to variability seem quite inconsistent with the existence of such an innate incapacity to vary, as that which we have seen is exhibited by the Lingula, by the ass, and the guinea-fowl, the chemical composition of these animals being exactly the same as that of other creatures.

Dr Hooker, in the Introduction to his 'Flora of Tasmania,' states that he no longer advocated the doctrine of the specific creation of species, because every candid mind must admit that the facts and arguments upon which a naturalist may have grounded his convictions require revision since the publication of the ingenious and original reasonings and theories of Mr Darwin and Mr Wallace.

'The limits of the majority of the species of plants are so undefinable that few naturalists are agreed upon them. The number of known species of flowering plants is by some naturalists assumed to be under eighty thousand, and by others over a hundred and fifty thousand. (The reader will perhaps think that here all nature is indeed in confusion.) Dr Hooker seems to think that species are rendered distinct by the extinction of intermediate forms, and he considers those genera, the species of which are of very difficult determination, to be new and increasing genera, and those in which the species are well defined, to be old and decreasing genera, the distinct definition of species being due to the destruction of intervening links. Dr

Hooker, however, does not seem to think that the fact that species appear to melt into each other is conclusive evidence of their being lineally related, because, on the supposition of special creation, we should still find them running into each other, for the creative hypothesis assumes that nature created species with mutual relations analogous to those which exist between the lineal descendants of a family. This is indeed the leading idea in all natural systems.'

Dr Hooker seems to have no hesitation as to the existence of any amount of variation. He quotes with approbation Mr Herbert Spencer's position, that all organisms are unstable; he says, all vegetable forms are more or less prone to vary, though the rate at which plants vary is always slow. Sports even of colour are comparatively rare phenomena. Dr Hooker enters into an inquiry as to which species are the most prone to variation, and ultimately, with some hesitation, agrees with Mr Darwin, that the species of large genera are comparatively more variable than those of small genera.

There seems nothing here as to the greater or less variation of plants as they are propagated by seed, or by suckers, possibly because the mode of propagation is not considered a specific character.

'Varieties of cultivated plants do not when neglected revert to the original type; they degenerate, as the seedling of a fine apple is often a crab, but it is not the original wild crab of our woods. The newly-acquired characteristics of the variety are never so entirely obliterated by the degeneration that it has no longer a claim to be considered as a variety.' This may be true, but Mr Darwin's theory would seem to require stability in the variation; what form the degenerate offspring assumed would not apparently be material.

It is certainly a curious fact connected with this subject that, as noticed by Dr Hooker, wall-fruit such as the peach comes true from seed. This is the case to such an extent that the peach is commonly raised in that way in America. It is not known in a wild state, but is supposed to be a modified form of the almond; so varieties of wheat are constant, and the wild form of wheat is not known.

Dr Hooker says that all we do, with

respect to cultivated plants, is to place them under conditions which nature does not provide at the same particular time and place. That nature might supply the conditions may be inferred from the fact, that the plant is found to be possessed of the means of availing itself of them when provided, while at the same time it retains all its functions, not only unimpaired, but in many cases in a more highly developed state. We have no reason to suppose that we have violated nature's laws in producing a new variety of wheat, we may have only anticipated them, nor is its constitution impaired because it cannot unaided perpetuate its race. It is in as sound and unbroken health and vigour during its life as any wild variety, but its offspring (the seeds) have so many enemies that they do not perpetuate the race. (Yet the seeds of other plants, wild buck-wheat, for instance, have as many enemies as wheat, and they can perpetuate their race.)

Dr Hooker seems to think that both Mr Darwin and Mr Wallace argue,* that the general effect of variation by selection must

* p. 24.

be, to establish a general progressive development of the whole animal kingdom. (We shall see that this is not now altogether Mr Darwin's view.) But Dr Hooker here touches upon Lamarck's difficulty. He says, granting that multiplication and specialization of organs are the evidence and measure of progression; that variation explains the rationale of the operation which results in the progression, the question arises, what are the limits to the combination of physical causes which determine this progression, and how can the specializing power of nature stop short of causing every race or family ultimately to represent a species.

'The earlier cryptogamous plants were more highly organized than those now in existence, and that the Fir tribe preceded Monocotyledons and many Dicotyledons in date of appearance on the globe, is a fact quite incompatible with progressive development, in the scientific acceptation of the term.'

Dr Hooker says that to his mind the doctrine of progression, considered in connection with the hypothesis of the origin of species being by variation, is by far the most profound of all that have ever agitated the schools of Natural History, and he did not think it had been treated in the unprejudiced spirit which it demanded. We shall find this point of great importance and of great difficulty.

Dr Hooker says it has been urged against the theory that existing species have arisen through the variation of pre-existing ones and the destruction of intermediate varieties, that it is a hasty inference, from a few facts in the life of a few variable plants, and is therefore unworthy of confidence; but he says the opposite theory, which demands an independent creative act for each species, is an equally hasty inference, from a few negative facts in the life of certain species, of which some generations have proved invariable. (The grand total of unstable species probably exceeds that of the stable.) According to the creative hypothesis, every fact connected with the production of species is swallowed up in the gigantic conceptions of a power intermittently exercised in the development, out of inorganic elements, of organisms the most bulky and complex, as well as the most minute and simple. The realization of this conception is, of course, impossible; the boldest speculator cannot realize the idea, of a highly organized plant or animal starting into life within an area that has been the field of his own exact observation and research. It is a curious fact, says Dr Hooker, illustrative of a well-known tendency of the mind, that the few writers, who have in imagination endeavoured to push the doctrine of special creations to a logical issue, either place the scene of the creative effort in some unknown corner of the globe, far removed beyond the ken of scientific observation, or suppose it to have been enacted at a period when the physical conditions of the globe differed both in degree and kind from those which now obtain; thus in both cases arguing *ad ignotum ab ignoto*.

'On the other hand, the advocate of creation by variation may have to stretch his imagination, to account for such gaps in a homogeneous system, as will resolve its members into genera, classes, and orders; but in doing so, he is only expanding the principle which both theorists allow to have operated in the resolution of some groups of individuals into varieties: and if all those attributes of organic life, which are involved in the study of classification, representation, and distribution, are barren facts under the theory of special creations, but receive a rational explanation under another theory, it is to this latter that the naturalist should look for the means of penetrating the mystery which envelopes the history of species.'

Dr Hooker, when he wrote this Introduction to the 'Flora of Tasmania,' had devoted twenty years to the study of plants, and had classified many large and small Floras, arctic, temperate, and tropical, insular and continental, embracing areas so extensive, as to justify the assumption that the results derived from these would be applicable to the whole vegetable kingdom; his assent, therefore, to Mr Darwin's views cannot but prove that they must at least be worthy of the highest consideration.

We do not, however, quite understand to what extent he accepts Mr Herbert Spencer's position that all organisms are in a state of instability. If this were so, we should expect to find general changes occurring, and not partial ones, in a few individuals of a species.

Dr Hooker says, it can easily be shown, that the Australian Flora is of as high a type as any on the globe, and we must hence assume not only the antiquity of the Flora, but that it was developed in a much larger area than it now occupies. It was probably in reference to these views of his friend, that Mr Darwin stated that the most experienced naturalists were not prepared to find the plants of Australia yielding before those of Europe.

With reference to the fact, that many English plants are naturalized in Australia, while no Australian plants are naturalized in England, Dr Hooker says,* apart from the difference of climate, he is disposed to consider that the three elements, (1) abundant exportation of seed from Europe into Australia for agricultural and horticultural purposes, and scanty export of Australian seed produce to England, (2) better adaptation of Australia than England to support numerous forms of vegetable life, and (3) abundance of un-

* p. 105.

occupied ground in Australia, as compared with England, are, combined, all but sufficient to account for the predominance of so many European naturalized plants in Australia, and for the converse state of things in England. But it may still remain to be seen, whether the altered circumstances which seem to be temporally favourable will prove to be so permanently; perhaps they may over-stimulate, and will, by gradually effecting a change on the constitution of the naturalized plants, either render them eventually distinct forms, or bring on degeneracy, and consequently extinction. Here Dr Hooker evidently seems to think that European plants, when introduced into Australia, receive a peculiar stimulus from the soil or climate to which they may owe their luxuriance rather than to superior constitutional vigour acquired in the battle of life at home.

Dr Hooker is evidently not prepared to accept Mr Darwin's views in full on this point.

We may mention here that though the cardoon, a plant resembling a prickly artichoke, which is cultivated in European gardens for the sake of the fleshy midrib of the leaf, when become wild in the plains of South America, grows with such vigour that it reaches as high as a horse's back, there exists in the same region a species of thistle, apparently native, which reaches as high as the head of the rider, showing that the ground is admirably adapted to such plants.

The following extract from the 'Gardener's Chronicle' of the 22nd of May, 1875, gives us an account of the vigour with which the eucalyptus grows when planted in a favourable situation in the old world: 'In 1868 and 1869 the Societé Generale Algeriene planted about 30,000 eucalyptus on the borders of a lake, where they throve so exceedingly well that it was decided in 1870 to increase the number to 100,000. Previous to 1868 there was no woody vegetation in the locality, now the banks of the lake are covered with a little forest of eucalyptus, those planted in 1870 having attained a height of twenty or twenty-five feet.' Here we have an instance of a New Zealand plant filling up a vacant place in the polity of nature which all the old world vigour of natural selection had failed to occupy.

In 1861, 'Natural Selection not inconsistent with Natural Theology, a Free Examination of Darwin's treatise on the Origin of Species,' by Dr Asa Gray, a distinguished American botanist, was published in this country, a work which we believe had considerable influence in promoting the favourable reception of Mr Darwin's views, though its author did not himself accept them unconditionally.

Dr Gray, like his brother botanist Dr Hooker, admits the existence of any amount of variation; he agrees to some extent with Mr Darwin. 'Species of the same genus are not distinguished from each other by equal amounts of difference. In large genera the unequal amount of resemblance shows itself in the clustering of the species around several types, or central species, like satellites around their respective planets, obviously suggesting that they are satellites detached by divergent variation. That such closely-related species may be only varieties of higher grade, earlier origin, or more favoured evolution, is not a very violent supposition, and the actual geographical distribution of species upon the earth's surface tends to suggest the same notion. For, as a general thing, all or most of the species of a peculiar genus, or other type, are grouped in the same country, or occupy continuous, proximate, or accessible areas. No scientific explanation has been offered to account for the geographical association of kindred species except the hypothesis of a common origin.'

If, says Dr Gray,* Mr Darwin had been content with explaining the diversification and succession of species between the tertiary period and the present time, his theory would probably have not been violently objected to by the savans of the day. It is, however, impossible to stop here; the theory hitches on wonderfully well to Lyell's uniformitarian theory in geology, that the thing that has been is the thing that is, and shall be; that the natural operations now going on will account for all geological changes in a quiet and easy way, only give them time enough; a view which finds large and increasing, if not general, acceptance in physical geology, and of which Darwin's theory is the natural complement.

* p. 12.

So the Darwinian theory, once getting a foothold, marches boldly on, follows the supposed near ancestors of our present species farther and yet farther back into the dim past, and ends with an analogical inference which makes the whole world 'kin.' Dr Gray did not like the features of this new theory, but he hoped to find it innocent.

Dr Gray argues * that variation has been led along certain beneficial lines. That species are the work of a First cause, just as much if the variations which occur are transmutations, as if they were direct creations. 'We acknowledge that God is our maker, not merely the originator of the race, but our maker as individuals, and none the less because it has pleased him to make us in the way of ordinary generation. If any of us were born unlike our parents and grandparents in a slight degree, or in any degree whatever, would the case be altered?'

Dr Gray says,† 'the strongest point made against the compatibility of Darwin's hypothesis with Design in nature is made when natural selection is referred to, as picking out

* p. 38. † p. 43.

those variations which are improvements from a vast number which are not improvements, but perhaps the contrary, and therefore useless or purposeless—born to perish. But even here the difficulty is not peculiar, for nature abounds with analogous instances. Some of our race are useless, or worse, as regards the improvement of mankind, yet the race may be designed to improve. Multitudes of rain-drops fall back into the ocean, and are as much without a final cause as the incipient varieties which come to nothing. Does it therefore follow that the rains which are bestowed upon the soil with such rule and average regularity were not designed to support animal and vegetable life?

Are we bound to suppose Efficient cause in all cases exerted upon nothing, to evoke something into existence, and this thousands of times repeated, when a slight change in details would make all the difference between successive species? Why may not the new species be designed diversifications of the old?* To do any work by an instrument must require, and therefore presuppose, the

* p. 44.

exertion rather of more, than of less, power than to do it directly.

There are, perhaps, says Dr Gray, only three views of Efficient cause which may claim to be both philosophical and theistic:—

(1) The view of its exertion at the beginning of time, endowing matter and created things with forces which do the work and produce the phenomena.

(2) This same view, with the theory of insulated interpositions, or occasional direct action, engrafted upon it—the view that events and operations in general go on in virtue simply of forces communicated at the first, but that now and then, and only now and then, the Deity puts his hand directly to the work.

(3) The theory of the immediate, orderly, and constant, however infinitely diversified, action of the intelligent Efficient cause.

It must be allowed, says Dr Gray, that, while the third is pre-eminently the Christian view, all three are philosophically compatible with design in Nature. Dr Gray suspects that Mr Darwin prefers the first conception, but he is not wholly excluded from adopting the middle view, although the interventions he would allow are few and far back.

We shall find that Mr Darwin is not inclined to accept the position in which he is here placed by Dr Gray. But we think that the Darwinian theory was rendered much more generally acceptable to many people by these observations, and they have no doubt had great influence in supporting the view now very generally adopted, that species of animals and plants have come into their present state through some mode of development.

In the ninety-second number of the 'North British Review' there is a review of Mr Darwin's book, which contains some very remarkable passages. The Reviewer says that the advantage gained by one individual who has been favourably modified is utterly outbalanced by numerical inferiority. A million creatures are born, ten thousand survive to produce offspring: one of the million (from a favourable variation) has twice as good a chance as any other of surviving, but the chances are fifty to one against the gifted individual being one of the hundred survivors.

No doubt the chances are twice as great against any other individual, but this does not prevent them from being enormously in favour of some average individual. All that can be said is, that the favoured 'sport' would be preserved once in fifty times. In the second place, let us consider what would be its influence on the main stock when preserved. It will breed and have a progeny of, say one hundred; now this progeny will on the whole be intermediate between the average individual and the sport. The odds in favour of one of this generation will be, say, one and a half to one, as compared with the average individual. The odds in their favour will, therefore, be less than that of their parents, but, owing to their greater number, the chances are that about one and a half of them would survive. Unless these breed together, a most improbable event, their progeny would again approach the average individual, and so on until all trace of the original improvement disappeared.

An illustration is given to bring this conception home: 'suppose a white man to have been wrecked on an island inhabited by negroes, and to have established himself in friendly relations with a powerful tribe whose customs he has learnt; grant him every advantage which we can conceive a white can have over a native, yet it does not follow that after an unlimited number of generations the inhabitants of the island will be white. Our shipwrecked hero might become king, he might kill a great many blacks in the struggle for existence, he could have a great many wives and children. In the first generation there will be dozens of intelligent young mulattos much superior in average intelligence to the negroes. We might expect the throne for some generations to be occupied by a more or less yellow king, but can any one believe that the whole island can gradually acquire a white or even a yellow population?'

The Reviewer is aware that the white colour is not the cause of the superiority, but he uses it simply as bringing before the senses the way in which qualities belonging to an individual must be gradually obliterated.

As to this point, we may observe that the Reviewer allows that the colour would for a considerable time affect that of the native race. Why should this influence cease at a particular point of time? It would, no doubt, not cease to exist, though the diffusion of the colour might be so great as to cause it to be imperceptible to our sense of sight; and the case put by the Reviewer is not quite in point. Mr Darwin supposes the existence of a tendency to vary. To bring the case within his view there ought to be repeated appearances of a white man, and if this happened, the number of the natives not increasing, there would soon be a marked change in their colour.

But here we must observe, that the Reviewer does not seem to estimate at its full amount the influence of free intercrossing in retarding changes in races; he seems to contemplate only the case in which improved individuals cross with the original form, not considering the influence which would be exerted by the free intercrossing of individuals who had varied injuriously. As all these changes are assumed to be very small, though injurious variations might ultimately be rigidly destroyed, this would not happen immediately, some of these individuals would have almost as good a chance as the improved individuals of breeding before they became extinct, and would, to a great extent, still further retard the improvement made in the race by the advantageous variation.

The other point, that it is fifty to one that the improved individual perishes before it has time to leave posterity, is, we must think, a difficulty in Mr Darwin's way of the very gravest kind. Remembering the frightful amount of destruction of animal life which Mr Wallace has shown to take place, it seems impossible to doubt that the improved individual would very seldom indeed survive to produce offspring.

These objections are not absolutely fatal to the theory of natural selection, but they require an enormous increase in the time allowed for its operation, that time being already, on other considerations, immense. And we must note that this difficulty applies to the case of the improvement of a race by natural selection as well as to the introduction of a new species.

Mr Darwin says,* with reference to the

* 6th edit. p. 71.

Reviewer's remarks, that the justice of them cannot be disputed; if, for instance, a bird of some kind could procure its food more easily by having its beak curved, and if one were born with its beak strongly curved, and which consequently flourished, nevertheless there would be a very poor chance of this one individual perpetuating its kind to the exclusion of the common form. (Mr Darwin might have said perpetuating its kind at all, as the chances are fifty to one against its living long enough to have offspring.) But Mr Darwin goes on to say that there can hardly be a doubt, judging by what we see taking place under domestication, that this result (the exclusion of the common form) would take place from the preservation during many generations of a large number of individuals with more or less strongly-curved beaks, and from the destruction of a still larger number with the straightest beaks.

We cannot but think Mr Darwin is here led entirely wrong by his reference to what occurs in a state of domestication, for under domestication there is no fifty to one against the survivorship of the improved individual;

on the contrary, it is carefully protected against all those causes which bring about such a great mortality amongst wild creatures; what occurs amongst domestic animals is clearly not a case in point in this respect. Moreover, among domestic animals only the improved individuals would be allowed to leave offspring.

Mr Darwin seems now inclined to insist less strongly upon the efficacy of very minute variations occurring at long intervals. He says, 'there can be little doubt that the tendency to vary in the same manner has often been so strong, that all the individuals of the same species, or only a third, fifth, or tenth part of the individuals, may have been thus affected, of which fact several instances could be given.' This seems a strange admission for Mr Darwin to make. We must remember that he adopted the position of minute variations because of the difficulty or impossibility of showing that large ones occurred, and he here loses all opportunity of using his favourite course of argument; he cannot refer to what occurs amongst domestic animals, for assuredly we do not witness such general and marked variations in them. We may, perhaps, here mention a fact with which most sportsmen are familiar, the occasional occurrence of individuals of the common rabbit which are coal black in colour. These black rabbits are never numerous, perhaps one or two in a thousand, and they disappear without leaving any trace of their existence, forms intermediate in any degree between them and the common rabbit never occurring. Does the blackness make them disagreeable to their fellows, or is it a consequence of defective sexual formation.

The Reviewer remarks that the difficulty of classification, which led Mr Darwin and Lamarck to conclude that species are descendants of species, is not peculiar to the natural sciences, and he mentions the difficulties which chemists experience in arranging the objects with which they have to deal now-a-days. There are just as fine-drawn distinctions as to what is an acid and what is a base, as eager discussions which substance in a compound plays the part of acid or base, as there can possibly be about the line of demarcation between animal or vegetable life, and any of the characteristics used to determine the groups that claim a given shell or plant. The difficulty of classification and the affinities of groups must be great in proportion to the number of objects to be classed. We may add that the science of chemistry is now even more unsettled than when these remarks were penned. We do not observe that the Reviewer takes any notice of the peculiar manner in which Mr Darwin supposes species to be assembled in groups.

The Reviewer remarks that, if Mr Darwin's theory be true, the number of varieties differing from one another a very little must be infinitely great, so great indeed as probably to far exceed the number of individuals which have existed of any one variety; it would therefore be more probable that no two specimens preserved as fossils should be of one variety, than that we should find a great many specimens collected from a very few varieties, providing, of course, that the chances of preservation are equal for all individuals. It is really strange that vast numbers of perfectly similar specimens should be found, the chances against their preservation as fossils are so great, but it is also very strange that the specimens should be so exactly alike as they are, if, in fact, they came and vanished by a gradual change. We shall meet with this point again.

CHAPTER IV.

Darwin on the fertilization of orchids—Some orchids fertilized by particular insects only—Case of the Angrœcum sesquipedale and of the Coryanthes Macrantha—Abundance of orchid seed and scarcity of seedling plants—Duke of Argyle's Reign of Law—Admits evolution of species under a guiding will—The organs of reproduction of orchids a proof of this—Mr Wallace's observation upon this point—Humming-birds—Mr Wallace's observations upon the Reign of of Law—The Duke of Argyle's reply—The peculiarity of organs of reproduction of orchids not the result of natural selection—Owen's comparative anatomy—Fossil ancestors of the horse—Bucephalus—Extinct corals—Owen's views as to derivation—Mr Darwin's animals and plants under domestication—As to the stability of variations—Cross-bred rats—Different degrees of variability—In what sense variations are accidental—Reference to fragments fallen from a cliff—Asa Gray's point that variation has been divinely directed.

We come now to Mr Darwin's work on the fertilization of Orchids, his object evidently being to show that the extraordinary structure of the flowers of these plants was beneficial to them, and thus to meet to some extent the objections made to the theory of natural selection, from the fact that there are in nature many structures which have been created for the sake of beauty and variety.

The pollen masses of almost all orchideous plants are enclosed in sacks in such a manner that the pollen cannot be shaken on to the stigma, nor the flowers fertilized by insects in the usual manner. But there are many special contrivances by which the pollen is made to adhere to the tongues of insects in such a manner and position, that though they do not fertilize the flower from which they take the pollen, they must with that pollen fertilize any other flower of the same kind which they may visit.

There are some very curious points connected with this plan for the fertilization of the flowers of orchids; namely, in some of them, the nectary which should secrete the honey to attract the insects is entirely dry, containing no honey whatever, insomuch that a German Naturalist, knowing that fertilization by insects is indispensable to these plants, believes that they exist by an organized system of deception. Mr Darwin does not agree with him, having too good an opinion of the judgment of moths to suppose that they would be attracted by an empty nectary, and he is inclined to believe that the nectaries of these plants secrete honey internally, and that the moths have some means of piercing through the membrane with which this honey is covered. It is certainly a most remarkable circumstance, that any impediment should be placed in the way of the action of insects when of such great importance to the plant. Mr Darwin seems to think that the time required by the moth to pierce the membrane may be of advantage to the process of collecting the pollen. But this fact, and that of the moths being able to pierce the membrane at all, are, he allows, very doubtful cases.

We may observe that the adherence of the pollen masses to the tongues of the moths is a great discomfort to them, the pollen masses are so viscid that the insects cannot free themselves from them. Mr Darwin gives a figure of the tongue of a moth with eleven pollen masses adhering to it, and states that, thus encumbered, it could not have reached the extremity of the nectary, and must have starved to death. If such cases were of ordinary occurrence, we should suppose moths would become aware of their danger, and avoid such flowers, so that the contrivances for effecting their fertilization might seem to counteract themselves.

Another point is that the bee orchis, and almost only the bee orchis, is capable of self-fertilization, certainly a most remarkable exception to the general polity of the tribe; is it for the good of the plant or to its disadvantage?

'In the Angrœcum sesquipedale, of which the large six-rayed flowers, like stars formed of snow-white wax, have excited the admiraation of travellers in Madagascar, a whip-like green nectary of astonishing length hangs down beneath the labellum.' In several flowers grown in England, Mr Darwin found the nectaries eleven and a half inches long, with only the lower inch and a half filled with very sweet nectar.

Mr Darwin found that to effect the fertilization of this plant, it must be visited by very large moths, with a proboscis thick at the base, and that this proboscis would have to be thrust in as far as possible, even by the largest moths, before they could withdraw the pollen masses attached to their proboscces, and that only such moths, on repeating the same action in another flower, could leave these masses on the stigma, and fertilize it. If the angrœcum in its native forests secretes more nectar, so that the nectary becomes filled, small moths might obtain their share, but they would not benefit the plant. The pollen masses would not be withdrawn until some huge moth with a wonderfully long proboscis tried to drain the last drop. If such great moths were to become extinct assuredly the Angrœcum would become extinct. On the other hand, as the nectar, at least in the lower parts of the nectary, is in fact preserved for these great moths safe from other moths, the extinction of the Angrœcum would probably be a serious loss to these very large moths.

We can now, says Mr Darwin, thus partially understand how the astonishing length of nectary may have been acquired by successive modifications. As certain moths of Madagascar became larger through natural selection, those individual plants of the Angrœcum which had the longest nectaries (and the length of the nectary varies much in some orchids), and which consequently compelled the moths to insert their probosces up to the very base, would be best fertilized. Those plants would yield most seed, and the seedlings would generally inherit larger nectaries, and so it would be in successive generations of the plant and moth. Thus it would appear that there has been a race in gaining length between the nectary of the Angrœcum and the probosces of certain moths, but the Angrœcum has triumphed, for it still flourishes and abounds in the forests of Madagascar, and still troubles each moth to insert its proboscis as far as possible to drain the last drop of nectar. The reader will perhaps feel inclined to ask when is this race to cease?

Another case is that of Catasetum saccatum, which, on certain parts of the flower being tickled, shoots out its pollinia with such violence, that on one occasion they stuck upon a pane of glass three feet distant from the plant. They are thus capable of giving a bee so sharp a blow, that he might be immediately inclined to leave the flower, and try another one to which he would carry the pollen masses.

We will mention one other case, as in the sequel we shall find it the most curious of all. In the flower of an orchid, named Coryanthes Macrantha, are two little horns which secrete so much nectar that it slowly drops down; one flower will secrete about an ounce (at least half a wine-glass full). The deeply hollowed end of the labellum hangs some way down beneath the two little horns, and catches the drops that fall from them, just like a bucket suspended some way beneath a dropping spring of water.

When Mr Darwin wrote his account of the fertilization of orchids, the particular manner in which this curious mechanism was employed in ensuring the fertilization of the flowers was not known. In a recent edition of his 'Origin of Species,' Mr Darwin gives an account of this manner, and a most curious account it is; we give it here as more immediately connected with this part of our subject; we shall often have to refer to it. 'When the bucket, into which drops of nectar (almost pure water) fall from the two little secreting horns above it, is half full, the water flows over by a spout in the side, the basal part of the labellum stands over this bucket, and is itself hollowed out into a sort of chamber with two lateral entrances. The most ingenious man, says Mr Darwin, if he had not witnessed what takes place, could never have imagined what purpose all these parts serve. But Dr Crüger saw crowds of large humble-bees visiting the gigantic flowers of this orchid, not to suck nectar, but to gnaw off the ridges within the chamber above the bucket. In doing this, they frequently pushed each other into the bucket, and their wings being thus wetted they could not fly away, but were compelled to crawl out by the spout. Dr Crüger saw a continual procession of bees thus crawling out of their involuntary bath. The passage is narrow, and is roofed over by the column, so that a bee, in forcing its way out, first rubs its back against the viscid stigma, and then against the viscid glands of the pollen masses; the pollen masses are thus glued to the back of the bee which first happens to crawl out of a lately expanded flower, and are thus carried away. Mr Darwin had sent to him in spirits a flower with a bee which had been killed before it had quite crawled out, with a pollen mass still fastened on its back. When the bee thus provided flies to another flower, *or to the same flower a second time*, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen mass necessarily comes first into contact with the viscid stigma and adheres to it, and the flower is fertilized.'

In treating of the nectar-producing organs of orchidaceous plants, Mr Darwin remarks, that in nearly all the flowers of Angrœcum distichum which had been sent him from Kew, insects had bitten holes through the nectaries so as to get more readily at the nectar. If insects, says Mr Darwin, were invariably to follow this bad habit in the plants' native African home, it would soon become extinct, for it would never produce any seed.

It will probably strike the reader that it is not likely that the insects of Africa should be so much behind those of Europe in instinct as to neglect this easy mode of obtaining their food, considering the habit which our humble-bees have of biting holes into the nectaries of all flowers to which they cannot get easy access. Every gardener knows how they spoil his heaths; we cannot doubt that many if not all the flowers of the Angrœcum are bitten in their native homes, and we are almost inclined to think that there must be some simpler mode of fertilizing these flowers than that so graphically described by Mr Darwin, who does not seem to think that moths are so simple as to visit an empty nectary.

The advantage to be gained on the utilitarian principle by all these curious contrivances is, that each flower should not be set with its own pollen, but with that of another bloom, a circumstance which is supposed to produce abundant and vigorous seed. Now, in the first place, one orchid, the bee orchis, does not possess this advantage, as we have seen. It is not one of the most common of orchids, but on a soil which suits it, chalk or limestone, it is tolerably abundant, and would probably be more so, if it were not so much sought after by collectors. It is certainly much more plentiful than many of our native species, which cannot, according to Mr Darwin, be fertilized by their own pollen; and we must here remark that in the very curious case of the Coryanthes, where the machinery is the most elaborate of all, there is no security, scarcely a probability, that each flower should be fertilized by the pollen of another. We see in this case that the bee may return to the flower to which it first went, and whose pollen mass is sticking to its back; it is evidently most likely that it would do so, as this flower would be the nearest to it, and it would naturally like to return to the banquet from which it had just been driven, and thus the flower will be fertilized with its own pollen. The case is different from that of a bee or moth seeking honey and leaving an exhausted flower, as they would not probably repeat their visit to a flower when they had sucked the nectar, but here there seems sufficient attraction in the prominent ridges to draw troops of bees to the same flower. How, then, could this elaborate machinery have been formed by natural selection, since the seed is not improved by it? We shall soon see other reasons why this structure cannot be due to natural selection.

There is yet another point connected with this subject which is remarkable. Mr Darwin mentions the amazing number of seeds produced in one capsule; he found six thousand two hundred in one capsule of Orchis maculata, and there were thirty capsules on the same plant, giving a total of 186,300 seeds. As this orchid, he says, is perennial and is not in most places increasing in number, one seed alone of this large number once in every few years can produce a plant.

It is certainly a most curious fact that so few seeds of orchids seem to vegetate. With other wild plants, though the number of mature individuals cannot perhaps be much increased, yet we constantly see great masses of seedlings rising so thickly together that they evidently perish by starving each other out. We never see such masses of young orchids, and it is well known that only one or two of our most experienced cultivators of these plants have succeeded in raising them from seed. We are almost inclined to suppose that, in spite of all the elaborate machinery employed in effecting their fertilization, after all the greater part of the seeds must be bad.

The Duke of Argyle, in his 'Reign of Law,' says, that if asked whether he believed that every separate species has been a separate creation, not born but separately made, he must answer that he does not believe it. The facts do suggest to the mind the idea of the working of some creative law, almost as certainly as they convince us that we know nothing of its nature, or of the conditions under which it does its glorious work. But law is the servant, not the master of the creator, and requires the constant supervision of a guiding will to produce the effects which we see. The various forms of the organs of reproduction in the Orchid family, which Mr Darwin has so well described, do in fact show the most decided evidence of a creative will.

'Mr Darwin himself cannot avoid being influenced by a consciousness of this, and he instinctively uses language in accordance with this feeling; he exhausts every form of words and of illustration by which intention or mental purpose can be described,—"contrivance," "curious contrivance," "beautiful contrivance," these are expressions which recur over and over again.'

As to this remark, Mr Darwin, in a subsequent edition of his work on the 'Origin of Species,' merely acknowledges that he had been too careless in the use of his terms.

But Mr Wallace gives us an answer to this view of the action of a Creative will in the formation of these plants, and a very curious answer it is.

'All these extraordinary circumstances attending the fertilization of orchids are not necessary, many other flowers are fertilized without any such machinery, and therefore it is absurd to suppose the Creator purposely producing this particular mode of fertilization just as a human mechanic might produce a toy.' Mr Wallace then, without seeming to be aware that his own views are open to the objection which he has just taken, goes on to explain the production by natural selection of this unnecessary plan, and takes the case of the Angrœcum sesquipedale, and gives the same description of the manner in which its fertilization is effected as Mr Darwin. Mr Wallace predicts that a species of moth with a very long tongue will be found some day or other in Madagascar, the native country of the Angrœcum.

The reader will note that if the elaborate machinery employed in the fertilization of orchids is not necessary, it cannot have been produced by the survival of the fittest during a course of evolution from some remote ancestor of simple form; clearly the least elaborate machinery which could effect the object would in such a case be naturally selected. If the production of unnecessary forms is an absurdity on the supposition of special creation, it is an impossibility on that of natural selection.

Another case mentioned in the 'Reign of Law,' as not capable of explanation by Mr Darwin's theory, is that of the extreme beauty of the plumage of the humming-birds.* 'Dif-

* 'Reign of Law,' p. 231.

ferent parts of the plumage have been selected in different genera as the principal subject of ornament. In some it is the feathers of the crown worked into different forms of crest; in some, it is the feathers of the throat, forming gorgets and beards of many shapes and hues; in some, it is a special development of neck plumes, elongated into frills and tippets of extraordinary beauty. In a great number of genera the feathers of the tail are the special subjects of decoration, and this on every variety of principle and plan of ornament,' and so on.

'Mere ornament and variety of form,' says the Duke, 'and these for their own sake, are the only principle or rule with reference to which creative power seems to have worked in these wonderful and beautiful birds, and if we cannot account for the differences in the general style and plan of ornament on the principle of natural selection, still less is it possible on that principle to account for the kind of difference which separates from each other the different species in each of the genera. The radiance of the ruby or topaz in one species is replaced, perhaps, by the radiance of the emerald or the sapphire in another.'

Mr Darwin, we shall see, would account for the occurrence of these various beauties on the principle of sexual selection, that is, that the most beautiful males have been preferred by the females, and that thus in time the race has been improved, and the ornaments acquired, though of no use to the individual in the struggle for life. We shall, however, also see that there is, in all probability, a fatal flaw in the arguments by which he supports this view.

In his observations upon the 'Reign of Law,' Mr Wallace endeavours to show that there is no reason why the organic world should not be governed by general laws similar to those which regulate the inorganic world, and here we think his remarks have great weight.

'When we look,' says Mr Wallace,* 'upon a landscape we see hills and vales fitted for the wants of man, we see special adaptation in the fact that in the lower parts of the

* Wallace's 'Natural Selection,' 2nd edit., p. 277.

rivers the streams are broad and placid, fitted for navigation by the numerous population supported by the fertile plains which lie upon their banks, while higher up towards the mountains they become insignificant streams, fitted only for the use of the shepherds who dwell in these rocky places.'

'Yet all this scene is the result of the action of fixed laws, is caused by the process of change eternally going on in the inorganic world without any interference of a contriving mind. Why are we required to believe in the continued action of such a mind in the region of organic nature? here the laws at work are more complex, the adjustment more delicate, the appearance of special adaptation more remarkable, but why should we measure the Creative mind by our own? Why should we suppose the machinery too complicated to have been designed by the Creator, so complete that it would necessarily work out harmonious results. The theory of "continual interference" is a limitation of the Creator's power; it assumes that He could not work by pure law in the organic, as He has done in the inorganic, world. It assumes that He could not foresee the consequence of the laws of matter and mind combined, that results would continually arise contrary to what is best, and that He has to change what would otherwise be the course of nature in order to produce that beauty, variety, and harmony which even we, with our limited intellects, can conceive to be the result of self-adjustment in a universe governed by unvarying law. If some adaptations could arise, why not others? if any varieties of colour could be developed, why not all the varieties we see? No attempt is made to explain this except by reference to the fact that purpose and contrivance are everywhere visible, and by the illogical deduction that they could only have arisen from the direct action of some mind, because the direct action of our minds produces similar contrivance. It is forgotten that adaptation, however produced, must have the appearance of design. The channel of a river looks as if it were made for it; it is made by it.'

In the last edition of the 'Reign of Law' the Duke of Argyle notices these remarks of Mr Wallace; and first, as to the Angrœcum sesquipedale, the Duke says: 'How came this orchis to require any exact adjustment between the length of its nectary and the proboscis of an insect? This is not a general necessity even among the orchids. In the British species, such as Orchis pyramidalis, it is not necessary that any such adjustment should exist, and thus a number of insects of various sizes are able to carry away the pollinia and assist in the fertilization. This would obviously be the most favourable condition for all orchids in the battle of life. If the nectaries began first to lengthen, how came the moths not to leave them for other flowers? If, on the contrary, they began to shorten, how came they not to be favoured and resorted to by other moths of a smaller size? Can we assume that somehow there were always ready some moths still larger to favour the longer variety, and that somehow there were no smaller moths to favour the shorter? Why should the race in this particular species be always in the direction of nectaries getting longer, and not rather in the direction of nectaries getting shorter? Obviously the same hypothesis might be so turned as to account for either result with equal ease.

'And then there is a much larger question than any of these which remains behind. How came orchids to be dependent upon insects at all for fertilization? It cannot be argued that this is a necessity arising mechanically from the nature of things, because exactly the same end is attained in ten thousand other flowers which do not possess the same structure. But what is the bearing of this fact upon the theory? Is it not this—that the origin of such curious structures and complicated relations cannot be accounted for on any principle of mere mechanical necessity?'

They not only cannot be accounted for on any principle of mechanical necessity, but they are absolutely injurious to the plants in which they occur, and would cause the extinction of the race were not special means provided to counteract the defect, a course of proceeding quite impossible on the principle of natural selection or the survival of the fittest.

The Duke goes on to say—'Elementary forces may indeed always be detected, for they are always present. But the manner in which they are worked irresistibly suggests some directing power, having as one of its aims mere increase and variety in that ocean of enjoyment which constitutes the sum of organic life.'

Remembering, in addition to these points, that the elaboration of these complicated structures is quite opposed to Mr Darwin's position that natural selection always economizes expenditure, the reader will probably think the above observations of great weight.

With respect to Mr Wallace's remarks as to the position laid down in the 'Reign of Law,' that the creative law requires the constant exercise of a guiding will, the Duke observes: 'I have said nothing of "incessant interference," of "continual re-arrangement of details," or of "the direct action of the mind and will of the Creator." On the contrary, I have said that no purpose is ever attained in Nature except by the enlistment of laws as the means and instruments of attainment; that we have "no certain reason to believe that God ever works otherwise than through the use of means;" or, in other words, through the instrumentality of those elementary forces or properties of matter and of mind which we call "Laws." No doubt the idea of Omnipresence, which is the distinctive idea of God's work as distinguished from man's work, is an idea which it is difficult for us to grasp. I do not deny or dispute that "self-action" is and must be the aspect in which Nature presents herself to us. It could not be otherwise, unless the Invisible were to become the object of sight and touch. But in proportion as we appreciate the infinite intricacy of natural adjustments, in the same proportion do we estimate the impossibility of conceiving them the results of mechanical necessity.'

Here we think the point lies in the expression 'Omnipresence as the distinctive idea of God's work.' Does the Duke of Argyle mean that God is more present with the working of the laws which govern the animal and vegetable kingdom than with the working of those which regulate the inorganic world, as, for instance, the law of gravity. If so, then, as of course that presence cannot be purposeless, it does imply interference, and it seems impossible to deny that the position is open to Mr Wallace's objection, whatever weight that may have.

Mr Owen * says that Cuvier would not allow that the horse of the present day could have descended from the fossil Palæotherium unless some intermediate forms could be discovered. Such forms have now been found, and Mr Owen says the problem is in a very different position from that which it occupied in the time of Cuvier, and that if the alternative be presented to him, species by miracle or by law, as applied to Palæotherium, Paloplotherium, Anchitherium, Hipparion, Equus, he accepted the latter without misgiving, and recognized such law as continuously operative throughout tertiary time. All these extinct ancestors of the horse differed from each other in a greater degree than do the horse, zebra, and ass. We have, therefore, here no evidence of any minute changes.

The Palæotherium had well-developed lateral hoofs, its hoof being triple. In the Hipparion these lateral hoofs had become rudimentary, small spurious hoofs dangling

* 'Comparative Anatomy,' vol. iii. p. 790.

by the side of the main hoof, and in the horse, as is well known, these rudimentary hoofs are wanting, though they sometimes appear as monstrosities, as Mr Owen remarks was the case with Bucephalus, the favourite horse of Alexander.

The fact Mr Owen says of the threefold hoof re-appearing at once in this case, shows that the original change from that form to the single hoof would be sudden too, and is opposed to the idea that species are transmuted by slow degrees. It also shows, he says, that a species might originate independently of any external influence. That change of structure would precede that of use and habit, and that fortuitous fitness of surrounding circumstances or a personified selecting Nature would have had no share in the transmutative act. We may here note that the complete disappearance of the lateral hoofs in the horse is in accordance with what we should expect from the action of natural selection in favouring the economy of structure.

Mr Owen here alludes to the fitness of the organization of the horse and the ass to the needs of mankind, and to the occurrence of these forms at the period immediately preceding or coincident with the earliest evidence of the existence of the human race. No one, he says, can look at the beautiful horses in the saddling-ground at Epsom on a Derby day without feeling that he sees before him the most beautiful of quadrupeds, and the most useful to man. We will go on to Mr Owen's other views. As to the extinction of species, he says,* he was at length led to recognize one cause of extinction as being due to defeat in the contest which, as a living organized whole, the individual of each species had to maintain against the surrounding agencies. Mr Darwin, Mr Owen says, wishes to apply the same reasoning to the origin of species, and though Mr Owen does not recognize the proof of this view, he feels bound to allow that the occurrence of so much evidence in favour of extinction by law is corroborative of the truth of the ascription of the origin of species to a secondary cause.

After describing the manifold species of coral which have united to form the Coral

* p. 798.

Islands of the Southern Ocean, and of which the greater part are now extinct, Mr Owen says, Was direct creation, after the dying out of its result as a 'rugose coral,' repeated to constitute the succeeding and superseding 'tabulate coral'? Must we, also, invoke the miraculous power to initiate every distinct species of both Rugosa and Tabulata (extinct species of coral)? When we endeavour to conceive or realize such mode of origin, not of them only, but of their manifold successors, the miracle, by the very multiplication of its manifestations, becomes incredible,—inconsistent with any worthy conception of an all-seeing, all-provident Omnipotence. It is not above but against reason.

Let us then, says Mr Owen, test the propounded explanations of their origin by secondary law. That of 'appetency' (Lamarck's view) subsides from the impotency of a coral-polype to exercise volition. The weak point, says Mr Owen, of Lamarck's creative machinery is its limited applicability, namely, only to creatures high enough in the scale of creation to 'want to do something.'

As to the influence of natural selection, Mr Owen cannot conceive how it could have acted amongst these forms of coral to cause one form to pass into another, or what possible external influence could have affected them. Mr Owen then goes on to give us his own views of what was the probable nature of the secondary force whereby species have been derived one from another. The law is 'An innate tendency to deviate from parental type operating through periods of adequate duration.

'Derivation' (that is, Mr Owen's derivation of one species from another by a natural tendency) holds that every species changes in time by value of inherent tendencies thereto. (What sets derivation in motion?) 'Natural selection' holds that no such change can take place without the influence of altered external circumstances educing or selecting such change.

'Derivation' sees among the effects of the innate tendency to change, irrespective of altered surrounding circumstances, a manifestation of creative power in the variety and beauty of the results; and in the ultimate forthcoming of a being susceptible of appreciating such beauty, evidence of the preordaining of such relation of power to the appreciation. 'Natural Selection' acknowledges that if ornament or beauty, in itself (that is, without benefit to the possessor), should be a purpose in creation, it would be absolutely fatal to it as a hypothesis.'

As to Mr Owen's own law of a tendency to deviate from parental form, we may remark that it seems rather vague, and that he does not attempt to show how it is to be set in motion, as he rejects the intervention of miraculous power.

In 1868 Mr Darwin published two tolerably bulky volumes 'on the Variation of animals and plants under domestication.' This work contains a vast variety of curious facts, but we fail to see that it has in any material degree advanced Mr Darwin's views as to the origin of species. When we have been shown what selection by man can do amongst pigeons, we are not carried any further towards our object by being told that similar results can be obtained by the same means amongst poultry, and rabbits, or dogs.

In fact, the argument seems to be the other way. If selection by man has been tried on so many different kinds of animals and plants, without in any case giving rise to a physiologically distinct species, we should be inclined to conclude that natural selection could not be more successful.

We should have expected to find here some evidence as to the stability of variations amongst domestic animals and plants. Mr Darwin says * that domestic races propagate their kind far more truly and endure for much longer periods than most naturalists are willing to admit. Breeders feel no doubt on this head. But he does not say that the races are absolutely stable, and he constantly makes use of expressions which lead us to believe that a careful selection of breeding individuals must be made. He says,† the prevention of free crossing, and the intentional matching of individual animals, are the corner-stones of the breeder's art. No man in his senses would expect to improve or modify a breed, *or keep* an old breed true and distinct, unless he separated his animals.

* Vol. ii. p. 246. † Vol. ii. p. 85.

Again, alluding to the difficulty of producing a breed of sheep in Germany with wool equal in fineness to that of the merino, he says,* he is led to suspect that under the climate of Germany there is a constant tendency to degeneration in the wool of merinos, unless prevented by careful selection. In another place we find Youatt quoted as to the necessity of annually drafting the flock, as many animals will certainly deviate from the standard of excellence which the breeder has established in his own mind.

Mr Darwin says when one of two mingled races exceeds the other greatly in number, the latter will soon be wholly or almost wholly absorbed and lost, and he gives as an example the case of some snake rats (mus alexandrinus) which had escaped from the Zoological Gardens. For some time afterwards the keepers frequently caught crossbred rats, at first half-breeds, afterwards with less and less of the character of the snake rat, till at length all traces of it disappeared. On the other hand, in some parts of London near the Docks, where fresh rats

* p. 89.

are frequently imported, an endless variety of intermediate forms may be found between the black, brown, and snake rat.

The reader will note how much these facts militate against Mr Darwin's theory of the origin of species, which requires a few forms to be preserved in their integrity, though in the midst of hosts of others capable of breeding with them.

Mr Darwin, in his account of the various domestic animals, has to notice that they have not varied in the same degree. The goose, the peacock, and the guinea-fowl having varied very little. As to the goose, which has been domesticated for a long time, probably, says Mr Darwin, no desire has been felt to raise varieties, but still this bird has naturally a stability of constitution. The peacock does not breed freely with us and is not kept in large numbers. The guinea-fowl, though supposed to be in its wild state an inhabitant of very hot and very arid districts in Africa, has not varied at all, notwithstanding the greatly changed conditions of life to which it has been subjected in this country.

Is not this difference of variability greatly against Mr Darwin's theory? If, amongst the small number of animals which have been domesticated, any are found to be invariable or nearly so, is it not probable that many wild animals do not vary at all? and, in fact, as the variation which does occur in domestic animals is so small, is it not a natural conclusion that species are fixed? Again, if all organisms have been evolved from a common ancestor, ought they not to have the same degree of variability? at any rate, they could not in that manner acquire invariability, for invariability would be a disadvantage to a species, as preventing it from occupying vacant places in the polity of nature.

In connection with this point, Mr Darwin notices a very curious case of variation, namely, the sudden appearance in a flock of common pea-fowl of the black-winged or Japanned variety, a bird so distinct from the common form as to be sometimes classed as a separate species.

In this work, Mr Darwin explains in what sense the variations with which he deals are accidental. He says, let an architect be compelled to build an edifice with uncut stones fallen from a precipice. The shape of each fragment may be called accidental, yet the shape of each has been determined by gravity, the nature of the rock, and the slope of the precipice, events and circumstances all of which depend upon natural laws, but there is no relation between those laws and the purpose for which each fragment is used by the builder. In the same manner the variations of each creature are determined by fixed and immutable laws, but these bear no relation to the living structure which is built up through the power of selection.

This is a very important passage; it seems clear that the nature of the edifice must to a great extent depend upon the form of the stones with which the builder is provided.

The reader will at once see that the fragments which fall from a slaty cliff will be very different from those which come from a rock of limestone or granite; the former fragments will be somewhat in the form of flat slabs, while the latter will probably be rough and angular blocks. When the builder comes to roof his edifice, if he has fragments of limestone or granite to deal with, he will be obliged to make his roof in the form of an arch, while it will be flat if the fragments have fallen from a slaty cliff. And here we are led to inquire whether there can be any analogy between the fragments of the cliffs and the variations of organic beings; the cliffs are formed of different elements, and are not descendants of some common form; the organisms, on the contrary, are formed of the same elements, and are descended, according to Mr Darwin's theory, from a common ancestor, circumstances which would, we should think, secure a very close agreement between their variations in every way.

In another passage Mr Darwin says, the shape of the fragments at the base of our precipice may be called accidental, but this is not strictly correct, for the shape of each depends upon a long sequence of events all obeying natural laws.

And here, says Mr Darwin, we are led to face a great difficulty, in alluding to which he feels that he is travelling beyond his proper province. 'Can it be reasonably maintained that the Creator specially ordained for the sake of the breeder each of the innumerable variations in our domestic animals and plants, many of these variations being of no service to man, and not beneficial, far more often injurious, to the creatures themselves? Did He ordain that the crop and tail feathers of the pigeon should vary, in order that the fancier might make his grotesque pouter and fantail breeds? Did He cause the frame and mental qualities of the dog to vary, in order that a breed might be formed of indomitable ferocity, with jaws fitted to pin down the bull for man's brutal sport? But if we give up the principle in one case, no shadow of reason can be assigned for the belief that variations alike in nature, and the result of the same general laws, and which have been the ground-work of the most perfect forms in the world, were intentionally and specially guided. However much we may wish it, we can hardly follow Professor Asa Gray in his belief, "that variation has been led along certain beneficial lines," like a stream "along definite and useful lines of irrigation."' *

As to this point the question may arise, are the variations which occur among domestic animals natural, or do they arise from man's tampering with nature by placing the animals in circumstances in which they could never be placed by nature?

* 'Animals and Plants,' vol. ii. p. 432.

CHAPTER V.

Mr Murphy's 'Habit and Intelligence'—Complex organs, as the eye, not formed by natural selection—Mr Darwin's answer—The eye formed in three distinct lines of descent —Time insufficient for the action of natural selection—Sudden appearance of new species possible—Mr Mivart's 'Genesis of Species'—cases in which incipient changes could not be naturally selected—Mr Darwin's indirect answers—The giraffe—The whalebone whale—The eyes of flat fish —The structure of orchids—The mammary gland—Variations may be considerable—Natural selection cannot attain the same end by different means—Eye of the cuttle-fish and vertebrata—Instances of large variations—Mr Darwin as to this point—Small variations are merely oscillations—Some intermediate varieties should exist—Lapse of time insufficient for the Darwinian hypothesis—Mivart's own views—Innate tendency to vary—Lyell's 'Geology,' 11th edition, gives a hesitating assent to Darwin's theory—Doubts as to varieties resisting cross breeding—Account of M. Gaudry's fossils—Lyell's 'Antiquity of Man'—Darwin's view that natural selection will account for regression as well as progression—Non-existence of small mammals on islands—Organisms constant during vast periods of time—Why no development took place—Non-existence of classes of plants and animals in New Zealand.

Mr Murphy, in his 'Habit and Intelligence,' agrees with Mr Herbert Spencer, that organs consisting of many parts cannot be produced by natural selection, because it is impossible to suppose that all the parts vary simultaneously; but he does not agree with him that in all such cases the result is due to self-adaptation, the eye cannot have been so produced. Neither the action of light on the eye, nor any action of the eye itself, can have any tendency whatever to produce the deposit of black pigment that absorbs the stray rays, nor to shape the transparent humours into lenses, nor to form the iris and its nervous connections.

Mr Murphy allows that his argument against the power of natural selection to form the eye, falls to the ground if it can be shown that it is not necessary for more than one variation to take place at a time.

As to this point, Mr Darwin,* after remarking that a similar argument had been urged by Mr Pritchard, though more cautiously, in his sermon preached before the British Association at Nottingham, says that if the eye were abruptly and greatly modified, no doubt many parts would have to be simul-

* 'Animals and Plants,' vol. ii. p. 222.

taneously altered, in order that the organ should remain serviceable. But he thinks this is not the case with smaller changes. A small change in one part of the eye might take place without being injurious to the other parts of the organ, and if of advantage to the creature in which it occurred, it would be preserved by natural selection, and so in time a great change may have been effected in the eye.

Mr Murphy says he does not see much force in this argument, but he allows the subject is most intricate; he says he knows of no reason for thinking it possible that any apparatus consisting of lenses can be improved by any method whatever, unless the alterations in the density and the curvature are perfectly simultaneous, and the improbability of this taking place by mere spontaneous variation is practically infinite. We must agree with Mr Darwin as to this point, and we think Mr Murphy's allusion to the lenses is against him, for the eye is said not to be achromatic. Now, if its being made so can be called an improvement, the object could probably be effected either by an alteration in the nature of one or more of the humours, the curvature remaining the same, or by an alteration in the curvature, the humours remaining unchanged.

Another argument against the formation of the eye by natural selection brought forward by Mr Murphy, has apparently greater force. The eye has been formed not in one, but in three distinct lines of descent; well-developed eyes are found in the higher orders of annulosa, of mollusca, and of vertebrata. It is not necessary, says Mr Murphy, to enter into the question whether these groups could be descended from a common ancestor, for if they were, that ancestor must have been of too low a type to have had eyes. The eye, therefore, must have been separately perfected in those three groups. We shall soon meet with this point again.

Mr Murphy concludes that the facts of organization may be accounted for in part by the direct action of external inorganic forces on the organism; in part by the action of the organism itself, producing a self-adaptation; and in part by natural selection among spontaneous variations. But that in addition to, and in co-operation with, all these, there must be a principle of organizing intelligence.*

Mr Murphy says were natural selection not only one cause of change, which it certainly is, but the principal cause, improvement ought to take place most rapidly in the classes where there is most variability and least fixity of form. Now variability, as between individuals, is greatest in the lowest classes, but this does not cause the production of new species to go on among them with any corresponding rapidity. Geologists, on the contrary, appear to be agreed that old species disappear and new ones come to take their places most rapidly in the highest classes, and this is an important argument in favour of believing that advance in development is due to some vital power which is most energetic in the highest classes, and not to any mere inorganic agency like natural selection.

Mr Murphy thinks that there cannot have been time enough to develope all organic beings by the accumulation of such slow variations as those suggested by Mr Darwin; he thinks it possible that new species may

* 'Habit and Intelligence,' vol. i. p. 323.

have arisen suddenly; and he mentions the case of a poppy appearing suddenly with a remarkable variation in its fruit, and the similar case of a plant of Datura tatula producing a smooth instead of a spiny fruit, cases which Mr Murphy states amounted to specific differences; he also alludes to the Ancon sheep which suddenly appeared in America. Mr Darwin says all such monstrous variations would be eliminated in a wild state by intercrossing, but Mr Murphy thinks this would not happen, or at least is by no means certain to happen, as among wild animals instinct prompts them to unite with their own kind. Again, he says, if a wild race did appear suddenly how could the fact be ascertained? If the first of a newly-begotten species were found the fact of its discovery would tell nothing about its origin. Naturalists would register it as a very rare species, having been only once met with, but they would have no means of knowing whether it was the first or the last of its race. The reader will note here some very loose statements. Are the changes in the poppy, the datura, and the sheep such as constitute a new species? Is it true that the varieties would have a strong tendency to breed with their like only?

Mr Mivart, who is now a Professor in the Roman Catholic College at South Kensington, is an evolutionist, though he differs on many points from Mr Darwin. Natural selection, he allows, must act an important part in the production of known plants and animals; it accounts for the similarity between the existing and fossil animals of Australia and of South America, the existing creatures being the modified descendants of a common stock. It explains the existence of rudimentary organs as being the inherited diminished representatives of parts of large size and functional importance in the remote ancestors of the various animals in which these rudimentary organs occur.

The singular facts of homology are capable of deeper explanation by natural selection. Man, the horse, the whale, and the bat have all the pectoral limb, whether it be the arm, the foreleg, the paddle, or the wing, formed on essentially the same principles. Again, the butterfly and the shrimp, different as they are in appearance, are yet constructed on one common plan; no *à priori* reason is conceivable why such similarities should be necessary, but they are readily explained on the assumption of a genetic relationship and affinity between the animals in question, assuming, that is, that they are the modified descendants of some ancient form, their common ancestor.

Natural selection also explains, Mr Mivart allows, the embryonic resemblance of animals, and finally, by this principle, and by this alone, as yet is any explanation given of the so-called mimicry of animals and plants which Mr Wallace has described.

(1) But natural selection is incompetent to account for the incipient stages of useful structures.

(2) It does not harmonize with the coexistence of closely similar structures of diverse origin.

(3) There are grounds for thinking that specific differences may be developed suddenly instead of gradually.

(4) That species may have definite though very different limits to their variability.

(5) That certain fossil transitional forms are absent which might have been expected to have been present.

(6) That some facts of geographical distribution intensify other difficulties.

(7) That the objection drawn from the physiological differences between species and races (hybrids) still exists unrefuted.

(8) That there are many remarkable phenomena in organic forms upon which it throws no light whatever.

We will now examine some of the arguments by which Mr Mivart supports these views and Mr Darwin's answers to them.

In the first place Mr Mivart takes occasion to observe, that the conservation of minute variations is of course plain and intelligible enough in such cases as those which tend to increase the destructive powers of beasts of prey on the one hand, or to facilitate the flight or concealment of the animals pursued, on the other, provided always that those minute beginnings are of such a kind as really to have a certain efficacy in favour of the conservation of the individual possessing them (that is, natural selection can perfect races by improving qualities of which they are already possessed); but natural selection cannot give rise to new species, because small variations towards a form altogether new would not be of advantage to the individual in which they occurred. This is Mr Mivart's great point, and it is hardly possible to over-estimate its importance.

Mr Mivart then takes, in the first place, the long neck of the giraffe, but he does not enlarge so much on the inutility of a small elongation of neck, as upon the fact that the other animals of the same order as the giraffe, though placed under the same difficulty of getting food in a time of drought, remained as short-necked as ever.

To this Mr Darwin replies,* that Mr Mivart's objection can best be met by an illustration. In every meadow in England in which trees grow we see the lower branches browsed to an exact level by the horses or cattle, and what advantage would it be, for instance, to sheep, if kept there, to acquire slightly longer necks? In South Africa the competition for browsing on the higher

* 'Origin of Species,' 6th edit. p. 179.

branches of the acacias and other trees must be between giraffe and giraffe, and not with the other ungulate animals. But here we think the question is not where is the competition now, but what was the competition which the nascent giraffe had to encounter when its neck began to increase in length? at that time all the other ungulata would clearly be competitors with the nascent giraffe, so far as height was concerned.

Mr Mivart mentions several cases in which very small incipient variations could not be of material service to the creatures in which they occur. To take the instance of the whalebone or baleen, which forms a kind of net-work or sieve in the mouth of the Greenland whale, by means of which it sifts the small creatures on which it feeds out of the sea-water which passes through its mouth. Mr Mivart seems to think that a very imperfect or incomplete form of this machinery would not be useful, as it would not be sufficient to detain these small creatures.

Upon this point Mr Darwin remarks,* that the ancestral form from which these

* 6th edit. p. 185.

whales descended had probably merely a roughened palate with small unequal points of horn, which aided it in seizing or tearing its food, and which afterwards were developed by natural selection into the baleen of the whale.

This is a difficult case, as it seems impossible to see in what way this incipient modification of the ancestral form could be beneficial to it. What it gained by approaching the form of the whalebone whale in being able to catch some of the small medusæ and crustacea on which such whales now feed, would be counterbalanced by the loss of power to catch fish; the whalebone must be a great incumbrance in catching fish. Can we conceive a state of affairs in which the sea abounded in some kind of prey, in the capture of which a mouth with teeth and whalebone mixed would have been an advantage to the creature possessing it?

The position of the eyes in flat fishes is noticed by Mr Mivart as incapable of being brought about by natural selection. In the young of these fishes, the eyes are on opposite sides of the body as in other fishes, but in the adult state both eyes are, as is well known, on the upper side, the eye in the individual actually moving to the upper side as the young fish grows. That such an arrangement should occur suddenly is, Mr Mivart says, conceivable enough, but how could an incipient approach to this arrangement be of advantage to the fish if it were so small that it left the eye still on the under side?

To this Mr Darwin replies,* by giving a description of the mode in which the transition of the eye from one side to the other takes place. The young flat fishes, while very young, cannot long retain a vertical position, owing to the excessive depth of their bodies, the small size of their lateral fins, and their being destitute of a swim bladder. Hence, soon growing tired, they fall to the bottom on one side; while thus at rest they often twist the lower eye upwards, to see above them; by this action the forehead between the eyes is contracted in breadth, and in time both eyes come to be on the same side. Thus, says Mr Darwin, we see that the first stages

* 6th edit. p. 186.

of the transit of the eye from one side to the other, which Mr Mivart considers would be injurious, may be attributed to the habit, no doubt beneficial to the individual and to the species, of endeavouring to look upward with both eyes while resting on one side at the bottom.

And here is another case in which the reader will perhaps think that Mr Darwin has missed the point of the objection taken to his view. Mr Mivart does not allude to what takes place amongst the young of flat fish at present, but to the state of affairs before the habit of twisting the lower eye upwards had attained to such perfection as to cause both eyes to come to be on the same side. Mr Mivart supposes this habit to have been acquired by degrees, and he alludes to its inutility in its earlier stages when the twisting of the lower eye was not sufficient to bring it on the same side as the other, leaving it still useless as a visual organ.

This movement of the eye in flat fishes is a most extraordinary phenomenon, unless it takes place at so very early a period after leaving the egg that we may consider it an act of birth.

Amongst plants Mr Mivart points out that the complicated machinery for fertilizing the flowers of orchids can be of no use until very considerably developed. To which Mr Darwin replies,* by showing the gradations in structure which occur in the different kinds of orchids, from flowers almost similar to the usual form of other flowers up to those in which the peculiarities of the tribe are complete, as in the case of the Coryanthes; and Mr Darwin says, and truly says, that all these gradations, the smallest as well as the greatest, are equally adapted to secure the fertilization of the flower. But we do not think this is doubted by Mr Mivart; he means that we are to take the case of any one orchid, the Coryanthes, for instance, and trace the steps by which it acquired its wonderful machinery, and then show how the incipient stages were beneficial,—for instance, how a small unfinished bucket could have been of use.

Another case is that of the mammary gland or breast. Is it, says Mr Mivart, conceivable that the young of any animal was

* 'Origin of Species,' 6th edit. p. 195.

ever saved from destruction by accidentally sucking a drop of scarcely nutritious fluid from an accidentally hypertrophied sebaceous gland of its mother. (Mr Mivart is considering what would happen when mammalia first came into existence, passing from some other race which did not suckle its young.)

And here Mr Mivart says that the change in the surrounding conditions of life, which enables the sucking young one to survive as the fittest, should be synchronous with the change in the structure, is a coincidence of very remote probability indeed. Mr Mivart suggests the existence of some harmonizing law, simultaneously determining the two changes or connecting the second with the first by causation which would remove the accidental character of the coincidence.

As to the incipient state of the first mammals Mr Darwin says * that Mr Mivart does not state the case fairly. It is admitted by most evolutionists that mammals are descended from a marsupial form, and if so the mammary gland will have at first been developed within the marsupial sack. Now,

* 6th edit. p. 189.

with the early progenitors of mammals, almost before they deserved to be thus designated, is it not at least possible that the young were nourished by a secretion from the glands of the whole inner surface of the sack? Those animals which secreted the most nutritious fluid would prevail over those which secreted a poorer fluid, and in time the glands would be collected into a breast.

Mr Mivart alludes to the rattle of the rattle-snake, and to the hood of the cobra, which it inflates before inflicting its bite, as cases of properties injurious to the individual possessing them. Mr Darwin answers this by suggesting that these structures are useful to the animals, as tending to frighten birds and other animals who may be inclined to attack them. As to this point, it seems strange that two of the most formidable creatures on the face of the globe should require such protection.

Mr Mivart attaches great importance to the view brought forward in the 'North British Review,' as to the improbability of the improved individual surviving to leave offspring. After quoting the Reviewer's remarks he says, if the most favourable variations have to contend with such difficulties, what must be the chance of the preservation of the incipient development of baleen in a whale and the like? But here we must remember that the Reviewer's point is as much opposed to the improvement of a race by natural selection which Mr Mivart accepts, as to the formation by the same means of a new species which he rejects.

We shall see that Mr Mivart thinks a considerable variation may be advantageous, though a small one is not so. But where are we to draw the line? The reasons which he gives to prove this point would apparently require the full development of a new species, with all its powers complete at once, before it could sustain its place in the polity of nature.

Mr Mivart says there are many examples in the organic world of similar functional results being attained by the most diverse means. Thus the body is sustained in the air by birds and bats. In the first case it is so sustained by a limb in which the bones of the hand are excessively reduced, but which is provided with immense outgrowths from the skin, namely, the feathers of the wing. In the second case, the body is sustained in the air by a limb in which the bones of the hand are enormously increased in length, and so sustain a great expanse of naked skin, which is the flying membrane of the bat's wing. When we go to lower animals, we find flight produced by organs, as the wings of insects, which are not modified limbs at all. In the vegetable kingdom, the atmosphere is often made use of for the scattering of seeds, by their being furnished with special structures of very different kinds.

Again, if we consider the poisoning apparatus possessed by different animals, we find in serpents a deeply-channelled tooth; in wasps, and bees, the sting is formed of modified parts, accessory in reproduction; in the scorpion, we have the median terminal process of the body specially organized; in the spider, we have a specially constructed antenna; and finally, in the centipede, a pair of modified thoracic limbs. It would be easy, says Mr Mivart, to produce a multitude of such instances of similar ends being attained by dissimilar means, and he contends that, by the action of natural selection only, it is so improbable, as to be practically impossible, for these structures to have ever been independently developed; it is so, he says, because the number of possible variations is indefinitely great, and it is therefore an indefinitely great number to one against a similar series of variations occurring, and being similarly preserved in any two independent instances.

Mr Mivart supposes that these structures have been produced, not by merely hap-hazard indefinite variations in all directions, but by the concurrence of some other and internal natural law, or laws, co-operating with external influences, and with 'Natural Selection' in the evolution of organic forms.

We shall find this point discussed at some length in the 6th edition of 'The Origin of Species.' Here we may note, that Mr Darwin considers each organism to vary in a manner peculiar to itself, variations will therefore be different. Natural selection will have different materials to work upon, and the structures formed by it will necessarily be different.

Mr Mivart refers to the fact mentioned by Mr Murphy, that the eye must have been perfected in at least three distinct lines of descent, and says that in the cuttle-fish, sclerotic, retina, choroid, vitreous humour, lens, aqueous humour, all are present as in the vertebrata, and the process of formation appears to have been the same, or at least in some respects the same, in the eyes of these molluscous animals as in the eyes of vertebrata, for in the latter, the cornea is at first perforated, while different degrees of perforation of the same part are presented by different adult cuttle-fishes. Mr Mivart points out that the conditions requisite for effecting vision are not so rigid, that similar results must in all cases be independently arrived at. In the dragon-fly we meet with an eye of an unquestionably high degree of efficiency, but formed on a type of structure only remotely comparable with that of the cephalopod.

With reference to this point, Mr Darwin denies that there is any real similarity between the eyes of cuttle-fish and vertebrate animals. An organ of vision must be formed of transparent tissue, and must include some sort of lens, for throwing an image on the back of a darkened chamber, and beyond this superficial resemblance, there is hardly anything in common between the eyes of cuttle-fishes and vertebrata; and if there were such resemblance if we allowed that the eye in the one case was formed by natural selection, we must allow it in the other. As two men sometimes hit upon the same invention, so it appears in the above case, that natural selection working for the good of each being, and taking advantage of all favourable variations, has produced similar organs, as far as function is concerned, in distinct organic beings, which owe none of their structure in common to inheritance from a common ancestor.* The reader must consider how far this explanation is sufficient to meet the difficulty arising from the extreme improbability of such an occurrence.

Mr Mivart thinks that the independent development of these similar structures by

* 'Origin of Species,' 6th edit. p. 152.

natural selection alone, as in the former case is so improbable as to be, in fact, impossible, he goes on to say that some law of nature must exist though as yet unknown, which, perhaps, assisted by natural selection, may give rise to these simultaneous results. We shall soon see more of his views on this point. We may remark here, that Mr Darwin's admission that certain common conditions in the external world have caused the cephalopoda and the vertebrata to form analogous eyes without derivation by inheritance from a common ancestor, seems to have struck Sir C. Lyell as a strong instance of the action of some law other than natural selection.*

Mr Mivart is inclined to believe that sudden and rather large variations frequently occur, and he gives many examples: for instance, English greyhounds, when taken to the high lands of Mexico, were incapable of catching the native hares, being unable to keep up their speed in the highly rarefied air of those lofty plains, yet their descendants in the first degree were free from this

* 'Geology,' vol. ii. 11th edit. p. 498.

defect. The Ancon breed of sheep, too, were rapidly developed from one ram, which accidentally appeared with a heavy head and clumsy form, which prevented it from leaping over boundary fences, and made its breed of value to the farmers in the part of America where it occurred. Other instances are given of a like nature, but we must note that Mr Mivart, like Lamarck and Mr Darwin, can give no instance of such a change in any material organ.

Mr Darwin gives as his reason for not believing that wild races have varied so abruptly as Mr Mivart supposes,* that such abrupt changes, if we reason by analogy to what happens amongst creatures in a state of domestication, would occur singly, and at long intervals of time, and would therefore, as formerly explained (alluding apparently to his assent to the views of the 'North British Review'), be liable to be lost by accidental causes of destruction and by intercrossing.

We are here naturally inclined to ask, why does not this reasoning apply to the

* 6th edit. p. 202.

small and infrequent variations which Mr Darwin's own theory requires? why should not these small variations be lost as readily as the larger ones? Mr Darwin has repeatedly allowed that they, as well as the suggested larger ones, occur only in a few individuals and at long intervals of time.

Embryology, Mr Darwin says, enters a strong protest against sudden development. Embryonic resemblance can be accounted for by the progenitors of existing species having varied after early youth, and having transmitted their newly acquired characters to their offspring at a corresponding age, thus leaving the embryos almost unaffected, to serve as a record of the past condition of the species.

Mr Darwin says that those who suppose sudden and great changes to have occurred, will have a great difficulty in accounting for the gradual manner in which species are seen to melt into each other. This is, no doubt, true.

Mr Mivart supposes that, in the intervals between the comparatively sudden modifications of species, they do not vary, and he supports this view by reference to the different degrees of variability which appear amongst domestic animals. The goose, the peacock, and the guinea-fowl are cited as examples of creatures which do not vary, and he says it is unreasonable to assert that *all* wild animals have a capacity for change, similar to that existing in some only of the domestic ones.

Mr Mivart thinks that the small variations which have been observed amongst wild animals are merely oscillations, and he shows that Mr Darwin, in controverting the generally received opinion that domestic varieties have little stability but are very liable to reversion, has shown that it is not all breeds which in a few years revert to the original form, but he has shown nothing more.

'In addition to these points, there remains in favour of specific stability the physiological difference between species and races, that is, the sterility of hybrids. Upon this point all that need be observed is, that sterility is brought about somehow, for it is undeniable that crossing is checked; and this is sufficient, no special kind of check being contended for.'

As to Mr Darwin's attempt to show that intermediate varieties would exist in lesser numbers than the more extreme forms, Mr Mivart allows they would do so sometimes, but it seems too much to assert that they would do so generally, still less universally, and little less than universal and very marked inferiority of numbers would account for the absence of certain series of minutely intermediate fossil specimens.

'If the Darwinian theory be true, it is absolutely incredible that birds, bats, and pterodactyles should have left the remains they have, and yet not a single relic be preserved in any one instance of any of those different forms of wing in their incipient and relatively imperfect functional condition. Wherever the remains of bats have been found, they have presented the exact type of the existing forms. The pterodactyles again, though a numerous group, are all true and perfect pterodactyles, though, says Mr Mivart, surely some of the many incipient forms which, on the Darwinian theory, have existed, must have had a good chance of preservation.'

Mr Mivart notices some remarks by Professor Huxley as to the similarity between birds and reptiles, and he allows that an approach towards a series of nearly related forms has been obtained in that of the existing horse, its predecessor Hipparion, and other extinct allies, but he says that these cases may be accounted for, on his principle of evolution, by distinct and strongly marked steps. It is the constant recurrence of very minute variations and their accumulation by natural selection, of which he can find no satisfactory record amongst fossils.

The reader will recollect that Mr Owen says, that the fossil ancestors of the horse differed more from each other than do the horse, zebra, and ass.

Allowing that the Darwinian theory would account for such changes as have occurred, adequate time being given for the production of them, Mr Mivart proceeds to question the existence of sufficient time, and on this point he refers to Sir William Thompson's conclusion that life on the earth must be limited to some such period as 100 millions of years, a period far too short, Mr Mivart says, for the evolution of all organic forms by natural selection. Mr Mivart does not give any opinion as to the soundness of Sir William Thompson's conclusion, he merely states that it has not been refuted, and has indeed been admitted by Mr Darwin himself.

Accordingly, in his last edition, Mr Darwin notices these views of Sir William Thompson, and allows that this period is hardly sufficient for the many and great mutations of life which have occurred. He notices, however, an opinion expressed by Sir William Thompson, that the world at a very early period was subjected to much more rapid and violent changes in its physical condition than those now occurring, and such changes might have tended to induce change at a corresponding rate in the organisms which then existed. But this supposition cannot help Mr Darwin's theory very much, for if those changes were more frequent and of greater extent than at present, there would be a proportionally greater probability of some evidence of them being preserved.

We will now consider Mr Mivart's own explanation of the manner in which the succession of organic beings has been brought about. It is impossible, he says, to account for some of the facts disclosed by comparative anatomy by the mere influence of the surrounding conditions of life. For example, we may take the migration of the eye of the sole from one side to the other. What is there here either in the darkness, or the friction, or in any other conceivable external cause, to have produced the first beginnings of such a movement?

'Each organism must have an innate tendency to develope in a symmetrical manner, must, in fact, have its own internal and special laws of growth and development subordinated by the action of external conditions, but not superinduced only *ab externo.*'

'The case is analogous to the crystallization of inorganic matter, crystals of each kind of matter take given forms peculiar to it.' We must note here that Mr Mivart does not mean even to hint that animals and plants are formed by a process of crystallization, but merely that the process by which they are made to vary is somewhat similar. The objection to this comparison is, that no matter has any *innate* power to crystallize at all, it can only do so by losing heat, or by being acted upon by some external power of a similar nature. When indeed it is set in motion by external forces, it is bound to follow a certain course, and so Mr Mivart might suppose that animals and plants when acted upon by external conditions might be obliged to follow a certain plan. The metamorphoses of insects would give an example of the action of Mr Mivart's law of evolution: when the egg is laid by the butterfly or beetle it is impressed with certain conditions, which ensure the successive existence of the grub, the chrysalis, and the perfect insect.

If each organism has its own law of growth and development, we seem to get back to special creation, for it is difficult to understand how a great number of special laws of growth can result from any general law.

We may note here that Mr Mivart's theory of laws of development peculiar to each species, seems to be as hostile to the action of natural selection in those cases in which he allows its influence as in any others. And lastly, it does not require the necessity of large variations, for if the variations must follow some given law, it is of no consequence whether the incipient forms are useful or the contrary.

In the second edition of his 'Genesis of Species,' Mr Mivart quotes passages from Mr Darwin's 'Descent of Man,' in which he says Mr Darwin seems to admit all that he (Mivart) need demand. The passages are as follows: * 'In the greater number of cases we can only say that the cause of each monstrosity lies more in the nature and constitution of the organism than in the nature of the surrounding conditions.' Again, speaking of the disappearance of spots and stripes in pigs, deer, and tapirs, he remarks, 'whether this change was effected through sexual or natural selection, or was due to the direct action of the conditions of life, or some other unknown cause, it is impossible to decide.' Again, he says of the existing causes of modification, 'they relate much more closely to the constitutions of the varying organism than to the nature of the

* 'Genesis of Species,' p. 262.

conditions to which it has been subjected.' Finally, says Mr Mivart, with regard to the transformation of specific characters we have the following noteworthy passage: 'An unexplained residuum of change, perhaps a large one, must be left to the assumed uniform action of these unknown agencies, which occasionally induce strongly marked and abrupt deviations of structure in our domestic productions.'

We will now see what Sir C. Lyell says to Mr Darwin's views, and in the first place, we find him acknowledging* that he had not done justice to Lamarck. He says that in the abstract which he gave of Lamarck's theory, and which we have copied, he had omitted to cite many examples of the impoverishment and final disappearance of organs by disuse; amongst other facts, the abortive teeth concealed in the jaws of some mammalia are mentioned by Lamarck, such teeth not being required because the food is swallowed without mastication; other matters of the same kind noted by Lamarck were not mentioned by Sir C. Lyell in his earlier editions.

* 'Geology,' 11th edition, vol. ii. p. 274.

Sir C. Lyell seems to give a hesitating assent to Mr Darwin's views. One of his greatest difficulties seems to be, how to account for the fact which Mr Darwin's theory requires, that small variations are not absorbed in the species (the point raised by the 'North British Reviewer'). Sir C. Lyell says if any degree of reluctance were exhibited by slight variations to intermarry (with the original species), we could understand how closely allied forms could inhabit the same region; but this is not the case, they intercross freely, and as the individuals of the normal type are the most numerous, slight variations are usually soon merged in the general average, so that the new characters disappear.

'The mutual absorption in this manner of the European and negro races, the one into the other by a certain number of intermarriages with one of the two stocks, has been frequently verified. The efficacy of the principle above adverted to, in causing species to breed true for ages, and checking lawless divergences in spite of the numerous variations which occur in every generation, is obvious. The only difficulty is to conceive how, if there be such proneness in each aberrant form to merge into the normal type, a new and permanent species can ever be established.'

As to this point Sir C. Lyell, like the 'North British Reviewer,' does not seem to take into account the tendency to repeated variations, which would certainly, in some degree, moderate the power of intercrossing to prevent change.

It is of course in the province of geology that Sir C. Lyell's remarks are most important: 'We are only beginning to trace back the passage through a series of gradational forms from the living mammalia to those of the Pliocene, and still older Miocene periods. But in this department the evidence already obtained since the time of Cuvier, in favour of transmutation, is certainly very striking. By no naturalist has its bearing been more clearly pointed out than by M. Gaudry, who, under the influence of the great teachers who preceded him, entered on the inquiry with a theoretical bias directly opposed to the conclusions (transmutation of species) which he now so ably advocates.' Sir C. Lyell saw the specimens collected by this zealous naturalist, and having had the connecting links supplied by species obtained in other parts of the world laid before him, was able to appreciate the more fully the force of the evidence appealed to in favour of transmutation. 'In the list of proboscidians given by M. Gaudry, we behold, chronologically arranged, more than thirty distinct species, beginning with the mastodon, of the middle Miocene period, found in France, and continued through those of the upper Miocene of Ava, the Sewalik Hills, Pikermi, and Eppelsheim, to the Pliocene forms of Southern India, Italy, and England, where both the mastodons and elephants occur. Finally, we are conducted to the Post-Pliocene or quaternary species of Europe and America, till we end with the two existing elephants, of India and Africa. Again, of the rhinoceros family, besides the five living species, fifteen extinct ones are enumerated, and in addition to these, some generic forms of older or Eocene date, belonging to the same great family. The fossil pedigree of the horse tribe is equally instructive, traced from the Middle and Upper Miocene Hipparion of France, Germany, Greece, and India, through the Pliocene and Post-Pliocene equine species of Europe, India, and America, to the living horse and ass.'

The personal inspection of these fossils by so experienced a geologist as Sir C. Lyell is a fortunate occurrence; they afford, no doubt, strong evidence of transmutation, but the reader must remember, not necessarily transmutation by Mr Darwin's theory of natural selection.

Sir C. Lyell says the real question at issue, that on which 'The Origin of Species' has thrown so much light, is not, whether we can explain the creation of species, but whether species have been introduced to the world one after the other in the form of new varieties of antecedent organisms in the way of ordinary generation, or have been called into being by some other agency, such as the direct intervention of the First Cause. Was Lamarck right in assuming progressive development to be true, and in supposing that the changes of the organic world may have been effected by the gradual and insensible modification of older pre-existing forms? Mr Darwin, without absolutely proving this, has made it appear in the highest degree probable, principally by showing the manner in which a multitude of new and competing varieties are always made to survive in the struggle for life. The tenor of his reasoning is not to be gainsaid by affirming that the causes or processes which bring about the improvement or differentiation of organs remain as inscrutable as ever.

Sir C. Lyell adds, when first the origin of species by transmutation was proposed, it was objected that such a theory substituted a material self-adjusting machinery for a Supreme Creative Intelligence. But the more the idea of a slow and insensible change from lower to higher organisms, brought about in the course of millions of generations according to a pre-conceived plan, has become familiar to men's minds, the more conscious they have become that the amount of power wisdom, design, and forethought required for such a gradual evolution of life, is as great as that which is implied by a multitude of separate, special, and miraculous acts of creation.

In these remarks there is not, perhaps, a very accurate appreciation of Mr Darwin's work, but they are eminently valuable as giving us the impression which that work made upon so experienced a cultivator of natural science.

In a still later work, the last edition of his 'Antiquity of Man,' Sir C. Lyell, after mentioning that many geologists from the time of Professor Sedgwick believed in the theory of progression, that is, that animals and plants had varied from a lower to a higher type, and after stating some objections and exceptions to this law, goes on to say, that it would be an easy task to multiply objections to the theory under consideration, but he refrains from this, as he regarded it as not only a useful, but rather, in the present state of science, as an indispensable hypothesis, and one which, though destined hereafter to undergo many and great modifications, will never be overthrown.

Sir C. Lyell is surprised that Mr Darwin and Dr J. Hooker should not give a very ready assent to the theory of progression, while many naturalists accept that theory who are unfavourable to the transmutation doctrine. May this hesitation arise from the difficulty, which is found when accepting that theory, of accounting for the existence of so many creatures of a low type. Yet Sir C. Lyell says, that one of the principal claims of Mr Darwin's theory to acceptance is, that it enables us to dispense with a law of progression as a necessary accompaniment of variation. It will account, he says, equally well for what is called degradation, or a retrograde movement towards a simple structure.

Sir C. Lyell's attention had evidently not been called to the difficulties which surround this point.

'Unquestionably the non-existence of quadrupeds in oceanic islands seems to imply, as Mr Darwin argues, that nature does not dispense with the ordinary law of reproduction when she peoples the earth with new forms, for if what has been called special creation were alone at work, we might naturally look for squirrels, rabbits, polecats, and other small vegetable feeders and the beasts which prey on them, as often as for bats, in the spots alluded to.'

On the other hand, Sir C. Lyell says he has found it difficult to reconcile the antiquity of certain islands, such as those of the Madeiran Archipelago, and those of still larger size in the Canaries, with the total absence of small indigenous quadrupeds. It is at least certain that, since the close of the Newer Pliocene period, Madeira and Porto Santo have constituted two separate islands, each in sight of the other, and each inhabited by an assemblage of land-shells, for the most part different, or proper to each island. About thirty-six fossil species have been obtained in Madeira, and thirty-five in Porto Santo, only eight of the whole being common to both islands, and five of these eight are represented by distinct varieties in each island. In each the living land-shells are equally distinct, and correspond, for the most part, with the species found fossil in each island respectively. In these islands the evidence of a vast lapse of time is derivable from inorganic, as well as from organic, phenomena.

During this period no mammalia, not even of small species, excepting bats, have made their appearance either in Madeira or Porto Santo, or in the larger and more numerous islands of the Canarian group. Why did not some bats, after they had greatly multiplied, and were hard pressed by a scarcity of insects on the wing, betake themselves to the ground in search of prey, and, gradually losing their wings, become *non-volant insectivora?* One might also be tempted to ask, says Sir C. Lyell, how it happened that the seals which swarmed on the shores of Madeira and the Canaries, were never induced, when food became scarce in the sea, to venture inland farther and farther, until they began to occupy some of the places left vacant in the economy of nature?

'It is said that one of the bats in an island of the Canarian group is of a peculiar species, and that some of the Cheiroptera of the Pacific Islands are even of peculiar genera. If so, we seem, on organic as well as geological grounds, to be precluded from arguing that there has not been time for great divergence of character.' We seem also, says Sir.

C. Lyell, entitled to ask why the bats and rodents (placental forms) of Australia, which are spread so widely among the marsupials over that continent, have never been developed into higher placental types, since we have now ascertained that that continent was by no means unfitted to sustain such mammalia, for these, when once introduced by man, have run wild.

Sir C. Lyell then suggests answers which might perhaps be given to these criticisms of some of Mr Darwin's views.

(1) Bats and seals are aberrant and highly specialized types (that is, their characters differ greatly from those of their nearest allies), and, therefore, are precisely those which might be expected to display a fixity and want of pliancy in their organization. (2) Other bats might come from the nearest continents, and by crossing with the bats already in the island, would keep the breed true, and in the same way the breed of seals would be kept true, for they are wandering animals. As to the forms of the bat tribe, said to be peculiar to certain islands, we know too little of the species of living bats of

the neighbouring continents to be sure that the insular bats are really peculiar, and perhaps the continental species of bats may have become extinct, while those of the islands may have been preserved by their isolation. As to the rodents and bats of Australia, we are yet too ignorant of the fossils of that region to be sure that they are forms of very ancient date, and the pre-occupancy of the country by the larger species of kangaroo and carnivorous marsupials may have checked the development of the placental rodents and bats, even if we concede the possibility of such forms being convertible by variation and progressive development into higher grades of mammalia.

Here we may remark, that though bats may be types of peculiar fixity of organization, there seems no reason why some of them might not have begun to vary in habit like the upland geese, and sought part of their food on the ground.

The cause of the great difference between the land-shells of Porto Santo and Madeira is the isolation of these two islands for a long period, during which their different forms have been derived from some types, or, perhaps, from only one type accidentally introduced to each island.

Now here we have some means of estimating the time required for the formation of new forms of life by the process of natural selection. These islands were in existence at the end of the Pliocene, perhaps, says Sir C. Lyell, during the Upper Miocene period. Here we see that a period of time of geological significance has not sufficed to do more than cause one form of snail to vary into another form of the same kind of creature. Does geology furnish us with a sufficient number of multiples of this unit of time to enable us to account for the evolution, by such means as are now in operation, of all the forms of life from the lowest to the highest forms?

Sir Charles Lyell says,* 'when he formerly advocated the doctrine that species were primordial creations, and not derivative, he endeavoured to explain the manner of their geographical distribution, and the affinity of living forms to the fossil types nearest to

* 'Geology,' 11th edit. vol. ii. p. 469.

them in the tertiary strata of the same part of the globe, by supposing that the creative power had, at successive geological epochs, introduced new forms best suited to each area and climate, so as to fill the places of those which may have died out. According to this view we should have expected marsupials in Australia, new sloths and armadillos in South America, new heaths at the Cape, new roses in the northern, and new calceolarias in the southern hemisphere. But Mr Darwin and Dr Hooker reply that when animals or plants migrate into new countries, the most successful colonists belong to genera, classes, and even orders, distinct from those of the invaded country, and soon become dominant at the expense of the endemic species. Such is the case with the placental quadrupeds in Australia, and with horses and many foreign plants in the Pampas of South America. Hence the transmutationists infer, that the reason why these foreign types, so peculiarly fitted for these regions, have never before been developed there, is that they were excluded by natural barriers. But these barriers of sea, or desert, or mountain, could never have been of the least avail, had the creative force acted independently of material laws, or had it not pleased the Author of nature that the origin of new species should be governed by some secondary causes, analogous to those which we see preside over the appearance of new varieties which never appear except as the offspring of a parent stock very closely resembling them.'

Since the above lines were written Sir C. Lyell has passed from amongst us; we add a short extract from the 'Gardener's Chronicle' of the 27th of February, 1875, which we think is particularly appropriate: 'When Darwin came, many of us looked to Lyell as a mighty champion of the idea of permanence in species to demolish Darwinian speculation. But amongst the first converts was Lyell himself, and no one has exercised greater authority in diffusing Darwinian notions as to the probable gradual modification of living organisms than Lyell himself. In this matter Lyell showed a noble spirit of self-abnegation, which philosophers of his calibre have not always practised. To unsay and recast the teachings of an honoured career, and adopt from honest conviction the views of another, is not so common a thing under such circumstances that it may be passed over without notice. It redounded to the credit of Lyell, and was a vast source of strength to the rising doctrines of Darwin.'

CHAPTER VI.

Mr Darwin's last edition of 'The Origin of Species'—Variability of seedling plants—Lamarck's difficulty—What constitutes progression—Natural selection tends to improve organisms, but sometimes causes them to retrograde or remain stationary—Difficulties of this view—Organisms cannot have acquired different degrees of variability by natural selection—Stability of the Foraminifera—Views as to progression—Fundamental difference between organs apparently the same—Economy of vital energy—Could plants acquire luscious fruit, honey, and hooked awns before there were birds, bees, and furred animals?—Beauty for its own sake only—Colour of American forest—Professor Tyndall—Stability of animals since the glacial period—Duration of the glacial period—The molothrus—The Eozoon—Difficulty of accounting for imperfect mammæ in the male—Summary of the points against Mr Darwin's views—Insufficiency of the theory of variation, or the survival of the fittest, or of any system of simple evolution—Views of Owen and Mivart—The origin of species as great a mystery as ever.

We will now see what are Mr Darwin's present views as shown in the last edition of his 'Origin of Species.'

Mr Darwin says that, with respect to the action of the conditions of life upon any organism, we must bear in mind that there are two factors—the nature of the organism, and the nature of the conditions. The former seems to be much the more important, for nearly similar variations sometimes arise, under, as far as we can judge, dissimilar conditions; and, on the other hand, dissimilar variations arise under conditions which appear to us nearly uniform.

With reference to the point we raised in our account of the first edition of Mr Darwin's 'Origin of Species,' that if there were stable variations in nature, though we could not see them, we could be sure of their existence, if we could find a difference in the rate of variation between the species of plants which were propagated by seeds only, and those which were increased by suckers; we find it stated in this last edition that there is great difficulty in classifying the species of oaks in consequence of the close affinity of the species, so much so indeed, that M. A. de Candolle, who has undertaken to classify them, has been converted by Mr Darwin, or at least has become an evolutionist.

The difficulty in the classification of the oak tribe would, no doubt, be favourable to Mr Darwin's views, but it appears, on the other hand, that the species of Rubus and Rosa, the bramble and the rose, are equally difficult to classify, and these plants, although they produce seed freely, also increase by suckers; the bramble, in particular, is a travelling plant, the ends of the long curving shoots which it sends out in the summer root when they touch the ground.

We have already seen Mr Darwin's answer to the remarks of the 'North British Reviewer' as to the chance which an improved individual would have of surviving to leave offspring, and have come to the conclusion that it is not satisfactory, the reference to what takes place among domestic animals being out of place.

In his first edition Mr Darwin referred slightly to the difficulty which Lamarck felt in accounting for the existence of a multitude of the lowest forms of life; but in his last edition we find the question treated at considerable length. Mr Darwin says natural selection acts exclusively by the preservation and accumulation of variations which are beneficial under the organic and inorganic conditions to which each creature is exposed at all periods of its life. The ultimate result is, that each creature tends to become more and more improved in relation to its conditions. This improvement inevitably leads to the gradual advancement of the organization of the greater number of living beings throughout the world.

Mr Darwin says it is difficult to decide what characters shall be considered as forming a high state of organization, and he prefers Von Baer's standard, namely, the amount of the differentiation of the different parts in the same organic being (that is, the extent to which each organ is fitted for, and confined to, one class of functions only), or 'as Milne Edwards would express it, the completeness of the division of physiological labour.'

'Taking this standard of high organization, natural selection clearly tends towards it, for all physiologists admit that specialization of organs, inasmuch as in that state they perform their functions better, is an advantage to each being and would be naturally selected. On the other hand, bearing in mind that all organic beings are striving to increase at a high ratio, and to seize upon every unoccupied or less well-occupied place in the economy of nature, we may see that it is quite possible for natural selection gradually to fit a being to a situation in which several organs would be superfluous or useless; in such cases there would be retrogression in the scale of organization.'

Yet Mr Darwin, though he thus allows that natural selection inevitably leads to the gradual improvement of the greater number of living beings throughout the world, and though he speaks of retrogression by means of natural selection as a possibility only, goes on to state that Lamarck's difficulty, namely, how to account for the existence of such a vast number of creatures of a low type, is not felt in the application of his theory, because * natural selection, or the survivorship of the fittest, does not necessarily include progressive development,—it only takes advantage of such variations as arise and are beneficial to each creature under its complex conditions of life.

* p. 98.

And it may be asked what advantage it would be to an infusorial animalcule, or even to an earth-worm, to be more highly organized? The reader will ask, where are we to draw the line? And after the modification the earth-worm would be an earth-worm no longer, and the higher organization might certainly be of use to it. Moreover, it must have been at some time or other advantageous to the lowest forms to become more highly organized, or the higher forms could not have been developed from the lower ones by natural selection.

'Nearly the same remarks,' says Mr Darwin, 'are applicable, if we look to the different grades of organization within the same great group: for instance, in the vertebrata, to the co-existence of mammals and fish; amongst mammalia, to the co-existence of man and the ornithorynchus; amongst fish, to the co-existence of the shark family and the lancelot, which fish, in the extreme simplicity of its structure, approaches the invertebrate class. But mammalia and fish hardly come into competition with each other. The advancement of the whole class of mammals, or of certain members of that class, to the highest grade, would not lead to their taking the place of fishes'—(But we may ask, if the same changes took place amongst the fishes, and why should they not do so, might they not lead to fishes taking the place of mammals?) 'and members of the shark family could not tend to supplant the lancelot, for the lancelot has for its sole companion and competitor on the barren sandy shores of south Brazil, only an anomalous annelid.'

These observations, however, seem to hint at a pause in the play of natural selection, leaving things as they are. Why should not the progressive development go on in each great group? The struggle for life is the most severe amongst the most nearly related individuals, why should not fishes be continuously improved into reptiles and so on? an improved form of lancelot would be a greater enemy to its unimproved brethren than the shark family.

We can easily perceive, in accordance with Mr Darwin's position, that 'natural selection requires the previous existence of a vacant place in the polity of nature,' how variation, diverging in every direction from a common source, might fill up all such places, different individuals becoming modified in the exact degree necessary to fill them, whether that variation were towards a higher or a lower degree of organization. And we can see how natural selection, working within these places, might tend to make the occupants more perfectly fitted for them. But what is then to happen? are we to understand that when these vacant places are thus filled up modifications cease, because no modification advantageous to the individual can take place? If so, the whole process seems a mere mode of creation of species, and if those vacant places in the polity of nature are very numerous, the affinities of the species occupying them would be great in proportion, and we should have, as at present, species apparently passing into each other.

If natural selection is the agent by which creatures have been made more perfect, it is inconceivable that so few only of organic beings should have been advanced. It cannot be that some creatures have never varied, or varied very little, for they have, according to

Mr Darwin's theory, acquired their qualities by natural selection, and therefore they must be all equally, or nearly equally, capable of variation, for variability is an advantage to a species, by enabling it to occupy more vacant places in the polity of nature, and we cannot suppose that mere accident placed some few beings only, in a state to profit by natural selection.

In his chapter on the geological succession of organic beings, Mr Darwin, in speaking of the development of ancient compared with living forms, touches again upon these points. He says, by the fundamental test of victory in the battle of life, as well as by the standard of the specialization of organs, modern forms ought, on the theory of natural selection, to stand higher than ancient forms. Is this the case? A large majority of palæontologists would, says Mr Darwin, answer in the affirmative; and it seems that this answer must be admitted as true, though difficult of proof.

It is no valid objection, says Mr Darwin,* to this conclusion that certain Brachiopods have been but slightly modified from an ex-

* p. 307.

tremely remote geological epoch; and that certain land and fresh-water shells have remained nearly the same from the time when, as far as is known, they first appeared. It is not an insuperable difficulty that Foraminifera have not, as insisted on by Dr Carpenter, progressed in organization since even the Laurentian period (so called because the rocks containing the remains of those creatures, the oldest rocks in which traces of life have been discovered, occur in the mouth of the river St Lawrence), for some organisms would have to remain fitted for simple conditions of life; and what could be better fitted for them than those lowly Protozoa? No doubt they are well fitted for their position, but why should they not have varied like other creatures? If the evolution theory be true, all creatures must at some time have (as we shall find remarked by a late writer) been of this lowly form. How did some of them rise in the scale while so very many others remained unchanged?

We have seen that Mr Herbert Spencer supposes changed surroundings to influence all organisms within the environment, and makes the continuance of the lower types due to their being beyond the environment or escaping it. Moreover, he says, that from the multiform nature of the forces acting on the organism, the change must be from a simple to a more complex form.

Mr Darwin says, when organisms have advanced up to any *given* point, there is no necessity, on the theory of natural selection, for their further continued progress, though they will, during each successive age, have to be slightly modified so as to hold their place in relation to slight changes in their conditions. The reader will ask what is the given point? at what stage of the long course of evolution from the first forms of living beings was it reached?

In another part of the book, when considering Nageli's position, 'that many of the structural differences of plants are quite unimportant to the welfare of the species, and that there must therefore be an innate tendency towards progressive and more perfect development,' Mr Darwin seems to claim this result for natural selection. He says,*

* p. 176.

'Although we have no good evidence of the existence in organic beings of an innate tendency towards progressive development, yet this necessarily follows from the continued action of natural selection; for the best definition which has ever been given of a high standard of organization is the degree to which the parts have been specialized, and natural selection tends towards this end, inasmuch as the parts are thus enabled to perform their functions more efficiently.'

We cannot but think Mr Darwin's views in connection with these points eminently unsatisfactory. The struggle for existence amongst kindred, which is the mainspring of his theory, seems to have dropped out of sight.

In this edition Mr Darwin shows that the electric organs of the twelve species of fish which possess them are placed in different parts of their bodies, and are not therefore homologous, and thus he gets over the difficulty of accounting for these organs as acquired from a common ancestor. The difficulty remains of accounting for the occurrence of these organs independently through natural selection, a difficulty which

Mr Darwin allows is very great, though not so serious as the former one; he explains it, as in the first edition, by supposing that in all these cases natural selection has adopted the same plan of formation, much in the same way as two inventors simultaneously, but independently, hit upon the same invention.

We have seen, however, in our examination of the first edition of 'The Origin of Species,' that there is no analogy between the action of two inventors and development from very distant ancestors by series of independent variations.

Of the electric fishes, the Torpedo and the Gymnotus electricus are the most celebrated. These fishes are entirely unlike each other. The torpedo is a flat fish something like a skate, but of a rounder form, and inhabits the sea. The gymnotus is a large yellow eel-like fish, and lives in the fresh-water rivers and ponds of South America. Humboldt describes the gymnotus as sufficiently powerful to stun a horse, and it can exert its electrical power in whatever direction it pleases. The following passage from Humboldt's 'Personal Narrative' will give the reader a vivid idea of the powers of this creature. Humboldt was very anxious to obtain specimens of these electric eels, but the Indians whom he employed to procure them were unsuccessful for some time; they then said they would 'fish with horses.' Accordingly they brought about thirty wild horses and mules which they forced to enter the pool. * 'The extraordinary noise caused by the horses' hoofs makes the fish issue from the mud, and excites them to combat. These yellowish and livid eels, resembling large aquatic serpents, swim on the surface of the water and crowd under the bellies of the horses and mules. A contest between animals of so different an organization furnishes a very striking spectacle. The eels defend themselves by the repeated discharge of their electric batteries. During a long time they seem to prove victorious. Several horses sink beneath the violence of the invisible strokes which they receive from all sides in organs the most essential to life, and, stunned by the force and frequency of the shocks, disappear under the water. Others,

* 'Personal Narrative,' vol. iv. p. 348, English Translation.

panting, with mane erect, and haggard eyes, expressing anguish, raise themselves and endeavour to flee from the storm by which they are overtaken. They are driven back by the Indians into the middle of the water; but a small number succeed in eluding the active vigilance of the fishermen. These regain the shore, stumbling at every step, and stretch themselves on the sand, exhausted with fatigue, and their limbs benumbed by the electric shocks of the gymnoti.'

How and whence can this marvellous power have been developed by two fishes so different from each other? Why, again, did so few species of fish alone acquire it by the action of simple evolution? Why, if all organisms arose from the simplest form by that action, are there no traces of this power in any of the other numerous species of fish?

The luminous insects are mentioned by Mr Darwin as another case in which a peculiar structure is found in animals which are not nearly related to each other, and here another difficulty occurs. The bright light emitted by the insects would appear to be injurious to them as likely to attract enemies, and therefore could not be developed by natural selection. Mr Darwin says much discussion has taken place as to the use of its light to the glow-worm, and that at last Mr Belt* has hit upon the true explanation. These luminous insects are disagreeable to the insect-eating mammals and birds. Their light serves to proclaim their quality to these mammals and birds, who, without it, might in the darkness seize and kill them, though they would not eat them. The light thus serves as a kind of safety-lamp to the glow-worm. As to the point that the male glow-worm does not not shine nearly so brightly as the female, Mr Darwin says the female has most need of a light, as being in appearance more like the larva of some creature, and larva being a particularly acceptable kind of prey, she would be peculiarly liable to capture.

Mr Darwin goes on to say, that in all these cases, though the general appearance of the organs may be the same, there are always some fundamental differences between them, and this is a natural consequence of the principle that the nature of each variation de-

* Naturalist in Nicaragua.

pends on two factors, namely, the nature of the organism, and that of the surrounding conditions. The variability of two organisms would not have been exactly the same, consequently natural selection would have had different materials to work upon in order to acquire the same functional result, and the structures thus acquired would almost necessarily have differed. Mr Darwin says that this line of argument seems to have had great weight in leading Fritz Müller to accept the views maintained by him in this volume; to us it is peculiarly puzzling. Here we have the result of natural selection influenced beforehand, fixed, in fact, by the nature of the variations. If we carry out this view far enough it would seem that natural selection would be at an end altogether.

It is a common rule in nature, says Mr Darwin,* that the same end should be gained, even in the case of closely related beings, by the most diversified means. How differently constructed is the feathered wing of a bird, and the membrane-covered wing of a bat; and still more so the four wings of a butter-

* p. 153.

fly, and the two wings with the elytra of a beetle. Bivalve shells are made to open and shut, but upon what a number of patterns is the hinge constructed,—from the long row of neatly interlocking teeth in a Nucula, to the simple ligament of a Mussel! Seeds are disseminated by their minuteness, by their capsule being converted into a light balloon-like envelope—by being embedded in pulp or flesh formed of the most diverse parts, and rendered nutritious, as well as conspicuously coloured, so as to attract and be devoured by birds—by having hooks and grapnels of many kinds, and serrated awns, so as to adhere to the fur of quadrupeds—and by being furnished with wings and plumes as different in shape as they are elegant in structure, so as to be wafted by every breeze.

Some authors, says Mr Darwin, maintain that organized beings have been formed in many ways for the sake of mere variety, almost like toys in a shop, but such a view of nature is incredible. Mr Darwin then goes on to describe the various processes by which different flowers are fertilized. With several kinds this is effected by the pollen grains, which are light, being blown by the wind by mere chance on the stigma; and this is the simplest plan which can be conceived. An almost equally simple, though very different, plan occurs in many plants, in which a symmetrical flower secretes a few drops of nectar, and is consequently visited by insects, who carry the pollen from the anthers to the stigma. From these simple plans Mr Darwin goes on to describe the complicated machinery by which some orchids are fertilized, and gives us the description of the Coryanthes which we have quoted in our account of his work on the fertilization of orchids.

How, says Mr Darwin in these instances, can we understand the graduated scale of complexity, and the multifarious means for gaining the same end? The answer is that already given on the previous point, namely, when two forms vary, which already differ from each other in some slight degree, the variability will not be of the same exact nature, and consequently the results obtained through natural selection for the same general purpose will not be the same.

Now, as to these points, is it possible to conceive that because two organisms differ slightly from each other, their variations should be such as to compel natural selection in the one case to form a simple flower, a wild-rose, for instance, and in another a complex flower like the Coryanthes with its nectar secreting horns, its bucket to half drown the bees which come to it, and its covered passage through which the said bees are obliged to pass?

And is there not a larger question behind all this? is not simplicity of structure a necessary result of every plan of simple evolution from a few original forms of life? Would not the struggle for existence, and the consequent necessity for economy of vital expenditure, make the production of such a form as the Coryanthes impossible, on the supposition of natural selection?

There is one most important point in these passages, namely, the rich colouring of fruit, the secretion of nectar by flowers, and the acquisition of hooks and grapnels by seed-vessels, could have been of no use to plants, therefore could not be due to natural selection, unless birds, bees, and furry quadrupeds had previously been in existence. Can we conceive this to have been the case? Is it consistent with geological evidence to suppose that furry animals existed before plants were fully developed? Could birds and bees have come into the world before the food which was to sustain them? Does not Mr Darwin's theory wholly fail us here?

In this edition Mr Darwin says * 'that he fully admits that many structures are now of no use to their possessors, and may never have been of any use to their progenitors; but this does not prove that they were formed solely for the sake of beauty or variety.' But it proves that they could not have been produced by natural selection, or the survival of the fittest, and indeed they must be protected in some way from the action of that principle. It is precisely in getting rid of superfluous parts that we can most readily see how the survival of the fittest could act. It ought to do its work in this respect quite as rapidly as in producing new species, and therefore when any change of circumstances rendered any part of a

* p. 160.

structure useless, that part ought immediately to disappear.

With respect to the belief that organic beings have been created beautiful for the delight of man, or for the sake of mere variety, a doctrine which, if true, Mr Darwin allows would be fatal to his theory, he observes that the sense of beauty obviously depends upon the nature of the mind. We see this in the men of different nations admiring an entirely different standard of beauty in their women. Beautiful objects existed in nature before man appeared on the globe. Flowers have been rendered beautiful by natural selection that they might be easily observed by insects. Mr Darwin says he has come to this conclusion from finding it an invariable rule, that when a flower is fertilized by the wind it never has a gaily-coloured corolla.

This is no doubt true, but, on the other hand, there are some flowers which are not conspicuous, and yet can be fertilized only by the agency of insects. Thus, though some of Mr Darwin's favourite tribe of orchids are extremely beautiful, many of them have small inconspicuous flowers of a dirty yellowish-green colour.

There is one case of beauty in plants which seems rather hurtful to them, we allude to the adhesive matter with which the flowers of many of the most beautiful heaths are covered. This substance gives the appearance of a bright polish to the flower, but it is so viscid that flies even of a considerable size are caught by it, and detained until they perish. We should be inclined to think the peculiarity would be disadvantageous to the flower, as tending to diminish its chance of being visited by insects.

There is no doubt that, as Mr Darwin observes, colour does attract birds to fruit. It has been observed in gardens that the blackbirds and thrushes attack the red currants before the white ones, and in almost every case, fruit as it ripens assumes a rich and attractive appearance.

But insects are probably attracted to flowers by their scent rather than their appearance; bees are seen in much greater numbers on such flowers as those of the heliotrope and the mignonette, than on those which are more gaudy but scentless, a fact well known to bee-keepers, by whom mignonette is frequently sown in the vicinity of their hives.

Mr Darwin attributes the beautiful plumage of birds, and the splendid colours of butterflies, to sexual selection, the most beautiful males having been always preferred by the females. We shall see reason in the sequel to think that Mr Darwin is wrong in this view, here we will only notice that we meet with a new difficulty. Mr Darwin has just told us that the sense of beauty obviously depends upon the nature of the mind. Is it not a most extraordinary circumstance that the females of birds, fishes, and reptiles, even of insects, should have the same sense of beauty that highly cultivated man has? we say highly cultivated man, because, as a rule, savages, though they may bedaub themselves with bright colours, do this rather to make themselves terrible than beautiful, they have no idea of harmony of colour; even among ourselves uneducated people often see little or no beauty in any natural object.

And here we again meet with the difficulty we have so often had to encounter: how comes it that, with so general an appreciation of the same kind of beauty, some species remain destitute of it, notwithstanding the influence of sexual selection? No doubt all the species of animals and plants are beautiful and wonderful, but why, according to Mr Darwin's view, are they not more or less beautiful in the same way, not that their beauty should be of the same degree, but of the same nature?

There is another case of beauty in organic beings—we allude to the beauty of the foliage of trees. The young shoots of many tropical trees are as brilliantly coloured as flowers; the beautiful foliage plants, now so much in fashion, are another instance. A still stronger example is presented to us in the splendid masses of colour with which every wood glows in the early autumn. In none of these cases can the attraction of insects or sexual selection have played any part, nor is it possible to conceive that these bright colours could ever have been of importance to the trees. No doubt they are due to physical conditions, but so, as Mr Mivart has observed, must be the appearance of every natural object. We shall return to this question when examining Mr Darwin's views as to the descent of man, but we may notice here, that though the beautiful colour of the autumn leaves may be due to physical conditions, those conditions are not necessary concomitants of decay in leaves, for many decaying leaves are not richly coloured. We add a short description of an autumnal forest scene in Canada: 'Even in cloudy days the hue of the foliage is of so intense a yellow that the light thrown from the trees creates the impression of bright sunshine, each leaf presents a point of sparkling gold. But the colours of the leafy landscape change and intermingle from day to day, until pink, lilac, vermilion, purple, deep indigo, and brown, present a combination of beauty that must be seen to be realized, for no artist has yet been able to represent, nor can the imagination picture to itself, the gorgeous spectacle.'*

This glorious scene appears to have had

* 'Quarterly Review' for 1861, p. 20.

an influence upon the mind of one who, as he could not have considered it created for the sake of beauty, ought to have looked upon it with indifference. Professor Tyndall, speaking of an interview with Agassiz in America, says, 'when we rose from luncheon, we all, as if by a common impulse, halted in front of a window, and continued there a discussion which had been started at table. The maple was in its autumn glory, and the exquisite beauty of the scene outside seemed, in my case, to interpenetrate without disturbing the intellectual action.' Professor Tyndall adds that Agassiz, turning to the gentlemen present, earnestly, almost sadly, said—I was not prepared to see this theory (Mr Darwin's) received as it has been by the best intellects of our time.* Agassiz seems also, as might be expected, to have been affected by the natural beauty which he beheld.

Mr Darwin complains that some of those who object to his views have not taken the trouble to understand the subject. He says that a distinguished German naturalist has asserted, that the weakest part of the theory

* 'Address at Belfast,' p. 45.

is, that all organic beings are considered imperfect, whereas, what he, Mr Darwin, really says is, that all are not so perfect as they might have been in relation to their conditions, and this is shown to be the case by so many native forms in many quarters of the world having yielded their place to intruding foreigners; nor can organic beings, even if they were at one time perfectly adapted to their conditions of life, have remained so when these conditions changed, unless they themselves likewise changed.

Several points are before us here: what proportion of all organic beings are not so perfect as they might have been, that is, are, or ought we to say have been, imperfect? how many are imperfect now? are there any imperfect creatures in the old world; if not, is natural selection no longer at work? then, again, why has not natural selection made those creatures perfect with respect to their surroundings?

Another question put to Mr Darwin, is, How, on the principle of natural selection, can a variety live side by side with the parent species? a difficulty which, we have seen, occurs naturally to the readers of Mr Darwin's work. The answer, he says, is, that if both the variety and the parent species have become fitted for slightly different habits of life, they might live together. Is not this requiring two variations to occur at the same time, a coincidence which Mr Mivart has said is so impossible. Mr Darwin seems to think that distinct varieties are generally found occupying separate districts, but he does not explain how this happens, or how the observation applies to the case of the small, infrequent variations which his theory requires.

In his last edition, referring to the arguments for the stability of species, drawn from the animals preserved by the Egyptians, Mr Darwin says, the many animals which have remained unchanged since the commencement of the glacial period would have been an incomparably stronger case, for these have been exposed to great changes of climate, and have migrated over great distances; the fact of little or no modification having been effected since the glacial period would have been of some avail against those who believe in an innate and necessary law of development, but is powerless against the doctrine of natural selection, or the survival of the fittest, which implies that when variations or individual differences of a beneficial nature happen to arise, these will be preserved, but this will be effected only under certain favourable circumstances. The reader will, perhaps, not be quite satisfied with this solution of the difficulty, which merely takes another form. If no variation of a beneficial nature has happened to those creatures during so very long a period, it is evident that the time necessary to produce all organic life from one or from a few forms is simply inconceivable.

As to the duration of the glacial period, we will refer to Sir C. Lyell, who says,* 'it must be conceded that the period required for the coming on of the greatest cold, and for its duration when most intense, and the oscillations to which it was subject, as well as the retreat of the glaciers, and the great thaw or disappearance of ice from many mountain chains where the snow was once perpetual,

* Lyell's 'Geology,' 11th edit. vol. i. p. 286.

required not tens, but hundreds of thousands of years.' Now, if no variation has occurred amongst animals or plants during this immense period, though the circumstances have been very favourable for variation, is it possible to receive variability as the only cause of the production from a simple form of the vast variety of forms which we see? This is such positive evidence of stability, opposed to a mere hypothesis of variation, that we feel surprised that Mr Darwin can go on with his argument in the face of it.

Another objection is, that many characters appear to be of no service whatever to their possessors, and could not therefore have been acquired through natural selection. Mr Darwin's answer to this objection amounts to this: (1) We do not know what structures are of no importance to an organic being; witness the various parts of the flowers of orchids long supposed to be useless, but now found to be of the highest importance to their fertilization, and which probably have been gained by natural selection. We have seen that Mr Darwin is not entitled to make this statement, even qualified as it is, as being probable only. (2) Many forms of parts are due to correlation of growth, being the results of alteration in other parts. (3) Some forms arise from spontaneous complete variations, such as the production of a nectarine by a peach tree, a cause of variation which Mr Darwin said he had undervalued in his earlier editions, though he still thinks it utterly incapable of giving rise to the innumerable structures which are so well adapted to the habits of each species. As to the existence of structures which are not useful to the individual, we must again observe that we should expect they would be eliminated by natural selection, according to Mr Darwin's position,* that natural selection economizes organization, inasmuch as the support of unnecessary structures is a disadvantage in the battle of life.

We have seen some of Mr Mivart's objections to Mr Darwin's theory, and his answers to them, which appeared to be beside the points in dispute. Here Mr Darwin complains that Mr Mivart passes over the effects of the increased use and disuse of parts,

* p. 117.

which Mr Darwin says he had always maintained to be highly important, and had treated in his 'Variation under Domestication' at greater length than any other writer. Mr Mivart also assumes that Mr Darwin attributes nothing to variation independently of natural selection, whereas, in the work just referred to, he had collected a greater number of well-established cases than can be found in any other work.

As to this point we may observe, that Mr Darwin need not trouble himself about the effects of use and disuse, and independent variation, for if he considers that natural selection can bring about the existence of neuter bees and ants, in the formation of which use and disuse could have had no share, as they leave no descendants, he need not doubt its power in other cases.

Mr Darwin, in this edition, does give an instance of a variation which may be said to be actually in progress. One species of the American genus Molothrus, allied to our starling, sometimes builds a nest for itself, and sometimes seizes that of another bird, occasionally throwing out the young ones; it generally sits upon its own eggs, but it is suspected of being parasitical occasionally, as its young are sometimes seen following old birds of a different kind, and clamouring to be fed by them. The parasitic habits of another species of this genus are much more highly developed, though still far from perfect; it invariably lays its eggs in the nests of other birds, but they lay many eggs in the same nest, and also drop many on the ground. A third species of the same genus has completely the habit of a cuckoo, laying one egg only in each nest.

In this edition Mr Darwin alludes to the discovery of the Eozoon * in the Laurentian formation of Canada. He admits its animal nature, which had been disputed. It belongs to the most lowly organized of all classes of animals, but is highly organized for its class; it existed in countless numbers, and preyed on other minute organic beings, which must have lived in great numbers. Thus, says Mr Darwin, the words which I wrote in 1859 about the existence of living beings long before the Cambrian period, have proved

p. 287.

true. Nevertheless, the difficulty, says Mr Darwin, of assigning any good reason for the absence of vast piles of strata rich in fossils beneath the Cambrian system, still remains very great.

Mr Darwin also refers to some newly discovered fossils, which undoubtedly do bridge over to some extent the gaps between species, and afford an additional argument in favour of the production of species by modified descent.

In this edition, when speaking of rudimentary organs, after having stated that they are probably the remains of organs which by disuse have become aborted, Mr Darwin says, there remains this difficulty: after an organ has ceased being used, and has become, in consequence, much reduced, how can it be still further reduced in size until the merest vestige is left? and how can it be finally quite obliterated? It is scarcely possible that disuse can go on producing any further effect after the organ has been once rendered functionless. Some additional explanation Mr Darwin says is here requisite which he cannot give. He goes on to say that the principle of economy of growth will perhaps come into play in rendering a useless part rudimentary. But he says this principle will almost necessarily be confined to the earlier stages of the process of reduction; for we cannot suppose that a minute papilla, for instance, representing in a male flower the pistil of the female flower, and formed merely of cellular tissue, could be further reduced for the sake of economizing nutriment. Here we must ask, why not? Why is a general law like that of the economy of vital force to stop short in its action? where is it to stop? It is convenient, no doubt, for Mr Darwin's argument that the law should stop short somewhere, for it ought to obliterate all rudimentary organs if organic beings do owe their structure to the survival of the fittest.

And there is another case of great difficulty with reference to this subject: Mr Darwin treats the imperfect mammæ found in the males of the human race as rudimentary. To make out this, it must be shown that they are the remains of organs formerly of importance; accordingly, in another work,* we

* 'Descent of Man,' vol. i. p. 211, or second edition, p. 163.

find Mr Darwin gravely supposing that during a former prolonged period the male mammals aided the females in nursing their offspring, and that afterwards from some cause, as from a smaller number of young being produced, the males ceased giving their aid, and disuse of the organs would lead to their becoming inactive. Now here are suppositions in abundance; any theory could be proved in this manner, if we were at liberty to treat suppositions as facts. In this case there seems one fatal objection even to the supposition, namely, the secretion of milk in the female is not constant, it is a consequence of the act of parturition; how could anything which occurred in the body of the female act upon that of the male, so as to give rise to a secretion of milk in him?

Mr Darwin does not seem to rely exclusively upon this manner of accounting for the imperfect mammæ, he in another place suggests that they may be due to what he says is a well-known law of inheritance, 'secondary sexual characters are transmitted to the other sex in an imperfect form, as in the case of spurs, plumes, and brilliant colours acquired by the male birds for battle or ornament, and transmitted to the females in an imperfect or rudimentary condition.' As to this point, we may observe in the first place, that, as remarked by Mr Mivart, Mr Darwin has not established the truth of this fact as a general law, but has assumed it to be such from his observation of what happens among birds. But the great point against him in this matter is, that the mammæ are not secondary sexual characters, but of the first importance. Among animals, and even among uncivilized human races, they are as absolutely necessary to the continuance of the race as any organ of reproduction. Of course there is no instance among birds or elsewhere of the principal organs of reproduction being transmitted from one sex to the other in a rudimentary state,—at any rate, in a state so slightly rudimentary as these mammæ, which Mr Darwin himself says are rather badly developed—than rudimentary organs, as they have been known to become active and to afford a fair quantity of milk.

These rudimentary mammæ certainly afford no support to Mr Darwin's theory, they rather appear to agree with the doctrine of uniformity of character. Are they connected in some mysterious way with the mode in which the sex of the offspring is determined?

Mr Darwin remains true to himself. In his recapitulation, in his last edition, he still speaks of the variations amongst domestic animals and plants as being undoubtedly stable, and he takes no notice of any of the objections to his theory, excepting those which have occurred to himself, remaining apparently quite untouched by any of the observations which had been made upon his views. Even the remarks of the 'North British Reviewer' to which he assented, which he used against Mr Mivart, and which, in the opinion of most persons, we may say, are almost fatal to his theory, are not noticed, nor do any of Mr Mivart's observations appear to have made any impression; perhaps, as we have seen, their force was not fully felt.

Mr Darwin complains that he has been much misrepresented, that it has been stated that he attributed the modification of species exclusively to natural selection, and he says that in his first edition, and subsequently, he placed in a most conspicuous position, namely, at the end of his introduction, the following words: 'I am convinced that natural selection has been the main, but not the exclusive, means of modification.'

Mr Darwin remarks in his last edition that, as a record of a former state of things, he had retained several sentences which imply that naturalists believe in the separate creation of each species, and he says he has been much censured for thus expressing himself. When the first edition of his work was published few naturalists believed in evolution. Now things are wholly changed, and almost every naturalist admits the great principle of evolution. And here, we think, we may congratulate Mr Darwin upon what is certainly a great achievement; we need say no more than that, owing to his wonderful powers of observation and unexampled diligence in his favourite pursuit, a very great step has been taken towards the free discussion of such subjects—most probably towards the discovery of truth. It is natural that Mr Darwin, like most original men, should be disinclined to admit modifications of his views.

We will now, before we examine the views of Mr Darwin, his friends, and opponents as to the Origin of Man, endeavour to form some estimate of the position in which the theory of the Origin of Species now stands with us.

Perhaps we must allow that Mr Darwin has proved part of his case, namely, that species have been introduced into the world by descent. We have seen that this point is admitted by Asa Gray, Hooker, Owen, Lyell, and Mivart, men familiar with all the minutiæ of natural science, and also by the Duke of Argyle, whose mind has been trained in a different school, and we have ourselves seen no reason to doubt Mr Darwin's conclusions as to this point. But Mr Darwin would not be content with this admission; he would not be satisfied until it could be shown 'how the innumerable species inhabiting the world have been modified so as to acquire that perfection of structure and of co-adaptation which justly excites our admiration.' * Mr Darwin thinks he has solved this problem by vari-

* Introduction to 'The Origin of Species,' p. 2.

ation and natural selection. Has he succeeded?

It is difficult to ascertain clearly what Mr Darwin's views as to the action of natural selection really are. As we have seen, he uses language and illustrations which would lead us to suppose that the results of the action of natural selection are, to some extent, influenced by the nature of the organism in which the variations occur; but, then, the organism has acquired its nature by natural selection, so that we appear to be just where we were. Taking, however, Mr Darwin's theory as it is generally understood, and as he himself seems usually to speak of it, namely, as the selection and preservation of small variations occasionally occurring,—we use the words occasionally occurring as Mr Darwin might object to the term fortuitously, —it is surrounded with difficulties.

Mr Darwin is certainly wrong in supposing that variations amongst animals in a state of domestication are stable. The improved races may not revert; they may in some cases remain true for considerable periods, but, in the long run, they do retrograde and lose their improved form; and thus the inference from what occurs amongst domestic animals is, that under ordinary circumstances variations amongst creatures in a natural state, if they did occur, would most probably be mere oscillations, as suggested by Mr Mivart.

We have instances of long-continued stability of form in the coral reefs of Florida, and in the animals of the Glacial epoch.

Assuming, however, that under ordinary circumstances small stable variations do occur, the time required to produce by their accumulation the species we now see, is so enormous, considering the slow rate of variation, as shown by the persistence of forms since the Glacial period, and considering the chances against any improved individual surviving to leave offspring, that we have seen even Mr Darwin considers it inconceivable, and rather hints at numerous individuals of a race being modified simultaneously, though this is, in fact, giving up his theory altogether. This point he would certainly have felt much more strongly had he not been misled by his habit of referring to what occurs amongst animals in a state of domestication, forgetting that in this case the improved individuals alone are allowed to leave offspring, and are carefully protected by man against the chances of destruction to which the wild individuals are exposed.

Other difficulties are that species cannot have very different degrees of variability if they have been produced by variation and natural selection. That fruit, honey, and the hooks of seed-vessels could not have been formed by natural selection without the impossible pre-existence of birds, bees, and furry animals. That the manner in which Mr Darwin accounts for the existence at the present time of innumerable forms of a low type, is eminently unsatisfactory. That Mr Darwin does not appear to meet Mr Mivart's objection that in many cases, as notably in that of the orchid named Coryanthes, an incipient state of the form would be useless, and therefore could not survive as the fittest. That species are, in fact, kept separate by the sterility of hybrids. That there are many cases in nature,—of colour, as of autumn leaves, and of form, as in the flowers of some orchids,—which are apparently of no use to the organisms possessing them. That there are structures which are absolutely injurious to the plants in which they occur, as the form of the flowers in red clover, and many orchids, which would deprive them of all chance of fertilization unless compensation for this defect were provided by special means, a course of proceeding which is impossible on the principle of natural selection. That the existence of imperfect mammæ in male animals is not satisfactorily explained; and lastly, that natural selection would tend to make all creatures simple in structure, instead of, as we see them, of very complex forms; and these difficulties are in addition to those which Mr Darwin has himself suggested and endeavoured to explain away.

To attempt to give a summary of the points which are in Mr Darwin's favour would, in fact, be to reproduce his book, for he truly says, that the whole volume is one continued argument in favour of his theory; and as to the views of his supporters, he had an opportunity of bringing forward such of them as he thought important in the last edition of his work.

To what conclusion, then, are we to come as to Mr Darwin's theory? We think it must be that natural selection or the survival of the fittest, even when aided by the influence of the use and disuse of parts, and of spontaneous variation, will not account for the actual state of the organic world. Apart from all other considerations, we think the vast variety of organic beings, and the complex structure of many of them, are totally inconsistent with Mr Darwin's theory, or indeed with any system whatever of simple evolution; such a system must require the greatest economy of vital expenditure, and, consequently, simplicity and comparative uniformity of structure.

We must remember that a system like that of Mr Darwin, which professes to account for the phenomena of organic life without the direct action of a First Cause, fails altogether as a system, if there be any case in nature for the explanation of which recourse must be had to a First Cause, because, if we acknowledge this necessity in any one instance, there is no reason why we should not accept it in other cases.

If we turn to the other schemes of evolution which we have met with, we shall find that of Mr Owen very vague. That of Mr Mivart, who says that each organism must have an innate tendency to develope in a symmetrical manner, must, in fact, have its own internal and special laws of growth and development subordinated by the action of external conditions, but not superinduced only *ab externo*, is also not very intelligible. It apparently means that variations must follow a certain direction from a law primordially impressed upon the organism, and this is, in fact, a form of special creation, and involves the obvious difficulty, upon how many organisms was the innate law originally impressed?

If we take the position laid down by the Duke of Argyle, that the law which regulates the introduction of new species requires the constant superintendence of the Deity, we get at once out of the realm of science into that of miracle.

Sir C. Lyell says, it is when there is a change from an inferior being to one of a superior grade, from a humble organism to one endowed with new and exalted attributes, that we are made to feel that, to explain the difficulty, we must obtain some knowledge of those laws of variation, of which Mr Darwin grants that we are at present profoundly ignorant. Though, in the main, a supporter of Mr Darwin's views, Sir Charles Lyell evidently felt there was something yet wanting.

Of course it is as easy to conceive that organisms were created to give birth to modified forms when the conditions of life changed around them, as to conceive that they were created to give birth to exact repetitions of their own forms when the conditions of life remain constant; but this leaves the mystery of the origin of species just where it was, and on no view of the case is the mystery explained.

CHAPTER VII.

M. Lecomte, 'Darwinisme et l'Origine de l'Homme'—Mr Darwin evades the points raised against him—Deep-sea soundings—Williamson on Foraminifera—Improvement of lower forms—Quotation from Haeckel—Oscar Schmidt and Darwinism—The Spongiadæ are in a state of continual change—Hybrids of hare and rabbit fertile—Variability of low forms essential to Darwin's theory, yet low forms of life exist—'Quarterly Journal of Science'—Difficulties of Darwinism—Colours and forms of animals—Poisonous snakes—Different effect of light on different animals—Melanism—Black swan—Hooker on insectivorous plants—Mode of action of these plants—The Sarracenia—The Nepenthes, or pitcher plants—The pitcher while in an incipient state of no use to the plant—Mr Darwin on 'Insectivorous Plants'—The Drosera—The Dionæa muscipula—Incipient forms useless—What is protoplasm?—The Amœba—The Actinophrys—Bathybius—Huxley and Tyndall—Origin of the matter of life—Aquosity—Professor Williamson as to the origin of life—Tyndall on spontaneous generation—Observations on this point—Mrs Somerville—Vast rapidity of the increase of the lower forms—The Diatom the basis of the scale of life.

Since the publication of the sixth edition of Mr Darwin's 'Origin of Species' the question has by no means been allowed to rest. M. Lecomte, in his 'Le Darwinisme et l' Origine de l' Homme,' combats the arguments of Mr Darwin and his friends. We need mention here only one or two remarks.

M. Lecomte complains that Mr Darwin evades rather than answers the objections brought against his views.

Some results of the deep-sea soundings are, M. Lecomte thinks, very much against Mr Darwin's theory,—the animalculæ which formed the great mass of white chalk must have lived together in vast numbers, must have been consequently subjected to a severe struggle for existence, must have, from the extent to which they were spread over the earth, been exposed to various conditions of life, and were of a very low type of organization,—all circumstances which ought, according to Mr Darwin, to have given rise to much variation, and great opportunity for the action of natural selection, and yet, as has been shown by the recent deep-sea soundings, these animalculæ still exist unchanged.

As to this point we will notice a passage in an article in the 14th number of 'The Popular Science Review,' by Professor Williamson, on the Foraminifera. Speaking of the Globigerina bulloides, and its constant companion the Orbulina universa, the Professor says these two are thorough cosmopolites, being found from pole to pole, and at every known depth. In shallow waters, or in the depths of the Atlantic; in icy seas, or under a tropical sun, they are ever the same. This indifference to external circumstances, arising out of their low organization, has enabled them to survive changes fatal to all animals of higher organization.

It is certainly not strange that creatures so accommodating in their habits should have survived great changes. The marvel is, how such delicate forms can exist under such very different circumstances. Is this power general among the lower forms of life? and is it in proportion to the degree of lowliness? It would certainly seem, from this instance, that the variations of an organism are more dependent upon its own nature than upon changes in the surrounding conditions of life.

M. Lecomte says the principal reason alleged by Darwin to explain the permanence of inferior forms is, that they have remained in that state because, to beings placed under very simple conditions of life, a superior organization would be useless, perhaps even hurtful. This M. Lecomte does not deny, but he says Darwinians have no right to use this argument, because, according to their system, the whole of the higher forms of life are the result of variation and progress among these creatures of a simple form.

To show the manner in which Darwinianists of some schools speak of their opponents, M. Lecomte quotes a passage from Haeckel in which the Professor declares that the want of proper ideas upon this question places many persons below dogs, horses, and elephants, because these beasts for the most part have not their horizon bounded by those high mountains of dogma and prejudice, which, with the greater part of mankind, vitiate from earliest youth the laws of thought, so that we find amongst these creatures juster and more natural judgments than we meet with among savans.*

M. Lecomte naturally expresses a wish to know the details of these remarkable judgments, which, however, are not given. As to

* p. 318.

this point we must note that, though Mr Darwin never employs language of this kind, he certainly, as noticed in the 'Edinburgh Review' for 1873, has become so thoroughly convinced of the truth of his theory, that he looks with a kind of compassion upon those who are not convinced by it, and he has apparently written himself into a belief that positions are indisputably true, which he at first put forward as hypothetical.

Professor Oscar Schmidt, in his 'Doctrine of Descent and Darwinism,' says,* he has shown that it is impossible to separate the sponges into classes, that his views have been confirmed by Haeckel, and that even now, the Spongiadæ have not attained comparative repose, but are in a state of continual change, and he quotes several recent German authors to show that, with respect to the Ammonites, it is impossible to separate them into species,—the so-called 'species' which characterize the great Jurassic and cretaceous formations are mere morphological series of variable constancy and duration.

It is difficult for us to form an opinion as

* p. 95.

to the value of these researches. The Professor himself seems very confident upon the point. He says,* whoever after these demonstrations (those of himself and Haeckel) cleaves to the phantom of species, without either proving that the facts have been falsely observed, or that they may be interpreted otherwise than in favour of the instability of species,—whoever, as Agassiz has recently done, ignoring any such researches, publicly asseverates that in no single case has the mutability of any species been exhibited, scarcely preserves the right to participate in the great controversy by which natural science is now perturbed.

We may note that the works of M. Schmidt and M. Haeckel on the Spongiadæ were published in 1866 and 1872, and that no notice is taken of their views by Mr Darwin in the last edition of his 'Origin of Species,' published in 1873. The point seems to be a mere repetition of Lamarck's difficulty as to the classification of the invertebrata. What follows would certainly incline us to hesitate before we gave entire confidence to our

* p. 95.

author's judgment as to the value of such statements, for he goes on to say that the dogma of the sterility of hybrids was formed without any experimental or general observation, and by ill-luck was confirmed by the most ancient and best known hybridization of the mule and the hinny. To this familiar example the Professor says he will oppose only one case of propagation successfully accomplished in recent times through many generations, that, namely, of the hybrid between the hare and the rabbit. The particulars of this experiment are not given, but as it is not noticed by Mr Darwin in his last edition of his 'Origin of Species,' though he was aware of its having been made, we may suppose he did not think it so conclusive as Professor Schmidt supposes it to be, and indeed we think, considering the well-known antipathy existing between the hare and the rabbit, it is most unlikely that their hybrid progeny should be conspicuous for fertility.

In many other groups, in most orders of the mammalia, says Professor Schmidt,* this phase of mobility has been replaced by a

* p. 102.

certain quiescence, and the forms now presenting themselves for observation and comparison are so well defined from one another that they fit into the system without difficulty as 'good species;' but good species are to be judged by the experiences made in regard to the bad ones, and if we knew them thoroughly, all species, without exception, would, as Haeckel says, be 'bad species.'

Professor Schmidt * holds the doctrine that life has been evolved from inorganic matter by mechanical causes, and he finds great fault with a passage in 'The Origin of Species' in which Mr Darwin says, 'there is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity from so simple a beginning, endless forms most beautiful and most wonderful have been and are being evolved.' In this concession, as Professor Schmidt calls it, he says Darwin has been untrue to himself, and it satisfies neither those who believe in the continuous work of creation

* p. 162.

by a personal God, nor the partisans of natural evolution. This may be so, but all who read Mr Darwin's works will feel that he is actuated simply by the desire to find out the truth without reference to the views of any party.

We shall soon have to examine Professor Huxley's views as to the manner in which living protoplasm is formed out of lifeless inorganic matter. Professor Schmidt admits that at present the question of spontaneous generation is not settled, but he says the belief in its existence is plain to those who admit that life is the result of mere combinations of inorganic matter; and that it never can be proved that spontaneous generation is not now going on, and if this could be proved, it could not be shown that spontaneous generation did not take place when first our planet reached the phase of development, in which the temperature of the surface admitted of the formation of water, and of the existence of albuminous substances.

'That mutability is slighter in lower than in higher organisms is a prejudice frequently repeated, and fortified by the old dogma of species. The doctrine of descent and selection, says Professor Schmidt, would fare ill if the case were so.'

Professor Schmidt has, of course, to answer the question, how does it happen that so many organisms of the lowest grade still exist; and here we think his mode of treating the subject shows the difficulty which evolutionists of Mr Darwin's school feel in attempting to explain it. The Professor seems to think the difficulty is, how the lower were able to hold their own against the higher forms, whereas the difficulty really is, how did the individuals of the lower forms hold their own against each other.

Professor Schmidt says,* 'in presence of the irrefutable facts of progress, it is enough to point out that the lower forms could and can continue to exist wherever they could find space as well as the other necessaries of life. While they have undergone only slight modifications, elsewhere the needful selection led to more profound metamorphoses; and on a subsequent geographical displacement, the newly transformed beings, accustomed to

* p. 192.

other conditions of existence, were again able to share sea and land with the stationary species.' Now all this account is extremely confused, partly, perhaps, because the Professor is writing, in what is to him, a foreign language; but the point, that the inferior forms experienced less change than those of a higher grade, is quite inconsistent with the view just advocated by him of the great mutability of the Spongiadæ.

We quote these passages chiefly to show how Mr Darwin's views are dealt with by the most moderate of a certain school of Continental thinkers.

In the 'Quarterly Journal of Science' for July, 1875, there is a paper on 'The Difficulties of Darwinism,' from which we take some very curious points.

'Why are mammalia so poorly, and birds so richly, coloured ? it is not difference of food, for there is no article of food used by birds which is not eaten by some beast. The hair, fur, and bristles of beasts cannot be said to differ chemically from the feathers of birds, so that we can see no reason why the one material should not display the same colours as the other. If we suppose that the beautiful plumage of birds is the result of sexual selection, then comes the question, how does it happen that the sense of beauty in the two great classes of warm-blooded animals is so very different?'

'Again, the colours of birds of prey are in general similar to those of the Felidæ. There are the same blacks and deep-browns on grey, buff, or stone-coloured grounds. Now, admitting that the stripes and spots of the beasts of prey may tend to conceal them when lurking in a forest, how can these spots and stripes assist a bird of prey in escaping notice while hovering in the air and seen against the sky?'

'In butterflies design seems to have reached its summit, but to what end? These exquisite and elaborate patterns cannot serve in any way to promote the safety of the insect, and they can hardly be needed for the mutual attraction of the sexes; for if so, why have butterflies a monopoly of this kind of beauty? For though colours even more brilliant than those of butterflies occur among beetles and some other insects, yet in design the Lepidoptera stand alone and unrivalled in all nature.'

'Many brilliant colours are found among beetles, but pink, rose, lilac, peach, pale-blues, pale-greens, and lavenders are wanting. In some cases the colours of a species seem exactly calculated to betray it to its enemies, or to warn its prey of its approach. Again, some brilliantly coloured beetles fly by night only.'

'The predominant colours among the Hymenoptera are yellow, orange, brown, and black, or metallic blue and purple. Why this limitation? These colours are scarcely the best adapted for the concealment of the insects among flowers and leaves.'

'Again, amongst beetles why do some of them possess extraordinary horns which appear to be of no use to them? And there is a still greater difficulty. The males of one species differ from each other as to their horns; some of them have long, and some have short horns. If we examine a spot of ground in Central or Southern Europe, upon which the spent bark from tanneries has been deposited, we shall find male specimens of Oryctes nasicornis, with large and small horns in about equal numbers. Now, if any decided benefit accrued from either conformation, we might expect that it would rapidly preponderate, and that the other form would, in the course of natural selection, be eliminated altogether. Similarly, if the large-horned males were preferred by the females, we should anticipate that the small-horned type would gradually disappear by the process of sexual selection.'

'The distribution in the animal world of the power of secreting poison also requires much additional light. The poison faculty does not occur among mammalia or birds, at least while they are in a healthy condition. Among reptiles it seems restricted to one particular group, the Ophidians. Why has no such power been evolved among warm-blooded animals and among non-ophidian reptiles? Why is the venom of serpents much more intense than is required for the destruction of their prey? The cobra feeds chiefly upon rats, yet its bite is amply sufficient to cause the death of a man, a swine, or a sheep, which it is utterly unable to swallow (snakes, we believe, do not generally use their poison to kill their prey); nor after all can the venom of snakes be of great value to them for defensive purposes, since the bite of few species, if of any, is sufficiently rapid in its effects to prevent the bitten animal taking instant revenge. As, therefore, increased activity of venom can have conferred little especial advantage upon its possessors, either in procuring food or for the purpose of self-defence, it is difficult to see how its development can have been effected on the principle of natural selection.' Perhaps it is hardly necessary to remark here, that we must not suppose that the fact that some snakes are poisonous, acts as a protection to the whole race. It is not probable that their wild enemies would be deceived on this point, and certainly the snakes which have poison could not have obtained it by natural selection for the good of their allies.

'Another point is, why are nocturnal mammalia scared and repelled by a light, while nocturnal insects are invariably attracted by it? What charm has the candle for the moth? Nocturnal birds, also, have been known to dash themselves against the windows of light-houses.'

But the most curious point is what the author of the paper calls Melanism, that is, a tendency to become black. 'In the more southern portions of the globe animal forms have a striking tendency to become black; thus there is the black swan in Australia, New Zealand has a black parrot, and in the high latitudes of South America there is a black humming-bird. Among insects the rose beetles, which have been called walking jewels from their brilliancy, appear in mourning in South Africa and Madagascar, where they are richly developed. Can natural selection be the cause of this? Take the case of a black swan: will his opportunities of surviving in the struggle for existence and of leaving posterity behind him be greater than if he had been white like the swans of the northern hemisphere? We want to find the law which connects the black swan with Australia, in preference to any other region of the world, and so far evolution leaves us as much in the dark as the old doctrine of distinct and special creation.'

Now as to these passages, we may remark that the points as to the colours of beasts and birds, and of beetles and other insects, and the distribution of the power of secreting poison, are no doubt difficulties in the path of Darwinism, but the case of the occurrence of beetles of the same species, some with long and some with shorn horns, is not, we think, a case in point; the beetles with the smaller horns are probably only ill-nourished individuals, they are not in reality variations at all; indeed, the occurrence of such numbers of individuals with the shorter horns takes the case out of Mr Darwin's theory.

Again, as to natural selection having given rise to black swans in the southern hemisphere, if we can establish the fact of a tendency of animals to acquire a dark colour in that part of the globe we should expect natural selection to produce a black swan in those regions, just as it is said to have produced a white swan in the old world. Why creatures have a tendency to assume a dark tint in the southern hemisphere is another and very curious point.

In his address to the British Association at Belfast in 1874, Dr Hooker took for his subject 'The Carnivorous Habits of some of our brother-Organisms—Plants.' The address is reported in the 'Athenæum' of the 29th of August, 1874, though not at full length, the experiments upon which Dr Hooker founds his conclusions not being given; this, however, is immaterial to us, as we could not have entered upon any consideration of them; it is sufficient for our purpose to try and ascertain how far the peculiar forms of these plants can be due to the action of natural selection.

'The curious hollow or trumpet-shaped leaves of the Sarracenia are furnished with a kind of hood which sometimes stands erect and sometimes over-arches the opening so as to exclude rain. During the period when the leaf is mature the mouth is smeared with a honeyed secretion, and this, in some instances, also exists along a trail leading to the ground on the outside of the leaf. Insects visit the pitchers for the sake of the sweet food, and losing their foothold, slip gradually down the smooth surfaces in the inside till they reach either the water which the pitcher contains, or a fluid secreted at the bottom, which very speedily kills them. Even if this is not effected, their escape is rendered impossible by the reflexed hairs with which the bottom and upper part of the pitcher are lined.' How far there is a true digestion in Sarracenia is not clearly made out, but Dr Hooker's experiments, it is said, appear to leave no doubt that, in Nepenthes, albuminous matters undergo, without decomposition, the softening and solution which is characteristic of that process, and it is said to seem pretty clear that absorption of the dissolved nitrogenous food also takes place.

The problem, says Dr Hooker, that forces itself upon our attention is, 'How does it come to pass that these singular aberrations from the otherwise uniform order of vegetable nutrition make their appearance in remote parts of the vegetable kingdom? Why are they not more frequent, and how were such extraordinary habits brought about or contracted? In the ordinary case of vegetable nutrition the roots take up certain matters from the soil; nitrogen forms nearly four-fifths of the air we breathe; yet plants can possess themselves of none of it in the free uncombined state. They withdraw, in minute quantities from the ground, nitrates and salts of ammonia, and with these they build up with starch, albuminoids, or protein compounds, necessary for the sustentation and growth of protoplasm. At first sight nothing can be more unlike this than a Dionæa or a Nepenthes capturing insects, pouring out upon them a digestive fluid, and absorbing the albuminoids of the animal in a form probably capable of appropriation for their own nutrition; yet there is something not altogether wanting in analogy in the case of the most regularly constituted plants. The seed of the Castor-oil plant contains, besides the embryo seedling, a mass of cellular tissue or endosperm, filled with highly nutritive substances. The seedling lies embedded in this; and as the warmth and moisture of germination set up changes which bring about the liquefaction of the contents of the endosperm, the embryo absorbs them, grows in so doing, and having taken up all it can from the exhausted endosperm, developes chlorophyll in its cotyledons under the influence of light, and relies for the future on its own resources.'

'The secretion of fluids by plants,' says Dr

Hooker, 'is not an unusual phenomenon. In many Aroids, a small gland at the apex of the leaves secretes fluids, often in considerable quantities, and the pitcher of Nepenthes is only a gland of this kind enormously developed. May not, therefore, the wonderful pitchers and carnivorous habits of Nepenthes have been acquired by natural selection, out of one such honey-secreting gland, as we still find developed in that part of the pitcher which represents the tip of the leaf? We may suppose insects to have been entangled in the viscid secretion of such a gland, and to have perished there, being acted upon by those acid secretions which abound in these and most other plants.'

But here we must ask, suppose insects were so caught, and did so perish, is it possible to conceive that the secreting gland could in its incipient state have absorbed the animal matter so procured—could, in fact, have acted the part of a stomach?

'The subsequent differentiation of the secreting organs of the pitcher,' says Dr Hooker, 'into aqueous, saccharine, and acid, would follow *pari passu* with the evolution of the pitcher itself, according to those mysterious laws, which result in the correlation of organs and functions throughout the kingdom of Nature.'

Now let us see what these pitchers are like. Mr Williams, of the Holloway Nurseries, describes the pitchers of Nepenthes Hookeriana, grown in his hothouse, as follows:—*'They measure some four inches in length by two inches in breadth, the front is ornamented with broad wings, which are ciliate at the edges.' We may add, that they hang down from the end of the leaf, upon what seems a prolongation of the mid-rib, a distance of perhaps two feet. The lid of a pitcher always stands open after the leaf has arrived at maturity, and the edge of the pitcher is not smeared with any sweet secretion, nor is the fluid which the pitcher contains in the least degree viscid. Here is a very great expenditure of vital force, and, on the principle of natural selection, this structure ought to be of very great importance to the plant; to compensate for this expenditure it ought to ensure a consider-

* 'Williams' Stove and Greenhouse Plants,' vol. ii. p. 254.

able supply of animal food. Now what is the case? insects are certainly found drowned in the pitchers, but not in great numbers. The author of these pages had last year a plant of Nepenthes Rafflesiana, which produced large pitchers in which he never saw any flies, yet it was in vigorous health; certainly there is never any crowd of insects hovering over these pitchers, as we see round ripe fruit. The pitchers indeed do not seem at all necessary to the welfare of the plants; it is often difficult to get them to make pitchers in our hothouses, and the same thing happens in nature. Mr Low, who discovered several species of these plants in Sarawak, gives the following account of them:—

*'The Nepenthes Ampullacea is a climbing plant, and found in thick jungles. The old stems, falling from the trees, become covered in a short time with leaves and vegetable matter, which form a coating of earth about them; they then throw out shoots which become in time new plants; but apparently the first attempts to form the leaf are futile,

* Low's 'Sarawak,' p. 69.

and become only pitchers, which, as the petioles are closely imbricated, form a dense mass, and frequently cover the ground as with a carpet of these curious formations. As it continues growing, the lamina of the leaves gradually appear, small at first, but every new one increasing in size, until the blades of the leaves are perfect, and the pitchers, which, as the leaves developed themselves, have become gradually smaller on each new leaf, finally disappear altogether when the plant climbs into the trees. This formation of the pitcher,' says Mr Low, 'is perceptible in all this curious tribe, though not to the same extent in all the kinds, the leaves of seedlings and weak plants always producing the largest pitchers.' There are some other very curious peculiarities in the structure of these plants. Mr Williams, speaking of Nepenthes Hookeriana, says, 'as the plants increase in height and age, the pitchers assume a totally different shape; they become narrow at the base, and lose the broad wings which ornament them in a young state. The position of the mid-rib which supports them is attached to the base of the pitcher in front when young, but in the second state it is completely reversed, and its attachment is behind—the change is not sudden. We have had,' says Mr Williams, 'plants with pitchers of both forms upon them at once, and also pitchers exactly intermediate in form between the upper and lower pitchers. The pitchers in both forms are dark green, profusely streaked and blotched with dark red.'

Are we to suppose that to have pitchers when in a young state, and to lose them when more mature, is an advantage to Nepenthes, and that this habit has therefore been naturally selected? Is the production of the long pitcher a gentle way of breaking off the supply of animal food to the plant, insects being more likely to escape from a pitcher of that shape than from the broad-based ones? If this is not the cause of the production of the long pitchers, how are we to account for them? We cannot suppose this explanation to be correct, for how can it be of advantage to an organism to shorten its supply of food? The embryo in the castor-oil seed ceased to feed upon the endosperm only because its store was exhausted, but this would not be the case with the flies upon which the Nepenthes had been accustomed to feed.

It is, then, to say the least, extremely doubtful whether the pitchers do provide food for the plant; but admitting that point, how can this peculiar structure have been developed from a simple viscid gland on the principle of the survival of the fittest? The difficulty is not how, when the pitcher was formed, its secreting organs were differentiated into aqueous, saccharine, and acid, but how the pitcher itself was formed; could it have been of advantage to the plant that the gland secreting the viscid fluid should have been removed from the top of the leaf to the end of a long pendulous mid-rib? Again, the pitcher could not detain flies until it had acquired its peculiar form complete. A plant with a half-formed pitcher could have no advantage in the battle of life, how then could such a plant survive in preference to others? Suppose a plant to occur with a pitcher rather more fully developed than its neighbours, rather further advanced towards perfection, but still incapable of drowning flies, how could such a plant survive as the fittest, when, in fact, it was no more fit than any others to maintain itself? Is not the structure of Nepenthes fatal to Mr Darwin's theory?

We may note, that it is an extraordinary fact, that evidence of the digestive power of the pitchers of Sarracenia should be wanting, seeing that the plant is so well provided with the honeyed trail to lead its prey to destruction. The reader will note that Dr Hooker gives no answer to the other question which he suggests, namely, why are such extraordinary structures not more frequent?

In 1875 Mr Darwin published his work on 'Insectivorous Plants,' in which, among others, he described the Drosera, the Pinguicula, and the Dionæa muscipula, and pointed out reasons for believing that they gained part, at least, of their nutriment from insects which they captured. We cannot follow Mr Darwin through his long course of experiments in proof of this fact, but we will try how far it is probable that these plants acquired their peculiar properties by natural selection.

The Drosera, or Sun-dew, is said to catch its prey by means of a viscid secretion which is exuded from the leaf, and stands upon its surface glittering in the sun like drops of dew, whence the name. When the fly is caught by this viscid secretion, certain hair-like bodies with which the leaf is studded, which Mr Darwin calls tentacles, and which, he says, have glands at their point, slowly close over it, pour out upon it a digestive secretion and absorb its juices.

Now we could conceive that the complicated organs at present existing in Drosera could have been developed from the plant having linear leaves, possessed of secreting and absorbing glands on their upper and their under sides, the plant supposed by Mr Darwin to be the parent of all the Droseraceæ; but this only removes the difficulty a step further back. Can we suppose this parent plant to have been at once formed by natural selection with glands capable of secreting and absorbing to such a degree as to enable it to prey upon insects? or must there have been some step in the slow course of development of all forms from a monad, at which these glands were yet too imperfect to do their work sufficiently well to be of service in procuring food for the plant? and if so, how could this imperfect and useless stage have been produced or preserved by natural selection?

These remarks apply with still more force to the case of Dionæa muscipula, which catches its prey, without any viscid secretion, by the sudden snapping together of the lobes of the leaf when touched by an insect, for it is evident that a trap of this kind must be wholly inefficient in an unfinished state. Then there is the other question, how did these plants alone require to be so favoured? Mr Darwin indeed says that the Drosera has only a very small root, and grows in very barren places, the soil of which contains little or no nitrogenous matter; but he allows that the plant must absorb water largely by its roots, to enable it to keep the quantity of viscid secretion, which it exposes to the sun, in a sufficiently moist state. This water is probably in great part rain-water, which contains ammonia, and so thirsty a plant would thus take a great amount of ammonia into its substance. Many orchids are found to grow with luxuriance in living sphagnum moss by itself, and require no special machinery to supply them with nitrogenous matter. As for Nepenthes, they grow in jungles, and ought not to require special supplies of nitrogenous food any more than any of the plants around them. All these secreting plants grow in very wet places.

We have lately met with the word Protoplasm. The reader may perhaps wish to know what it means. Briefly, then, Protoplasm is a viscid gelatinous substance with no formed organs, yet capable of irritability and contractibility, and of growing. Formerly it was considered that all organic bodies were formed of cells more or less aggregated, and it was supposed that the cell had the power of producing other cells, and that growth was thus effected. It is now believed that the cells are filled with protoplasm, and that it is the protoplasm that grows and clothes itself with new cells.*

Protoplasm can also exist in a free state, as

* Professor Williamson, 'Popular Science Review,' July, 1870.

in the microscopic creature called Amœba. This is a speck of protoplasm without any appearance of organs, constantly changing its form, flowing out, so to say, now in one direction, now in another, and capable of disposing itself over any nutritive particle it may meet, of exhausting it, and then letting it go.

A very interesting account is given of the actions of one of these lowest jelly-like forms of animal life, showing that they are not altogether devoid of instinct. An actinophrys was in the same vessel with vegetable cells charged with particles of starch; one of the cells had been ruptured, and a little of the internal matter protruded through the orifice. The actinophrys came, extracted one of the starch grains, and then crept to a distance; it returned and took all the starch grains one by one, always retiring to a distance and returning again, showing that it knew its way back, and where the starch granules were to be found. On another occasion Mr Carter saw an actinophrys station itself close to the ripe spore of a plant, and as the young zoospores came out one after the other, the actinophrys caught every one of them, and

and then retired to a distance, as if instinctively conscious that no more remained.*

The sticky mud brought up from the deep-sea soundings is said to consist of protoplasm, and this mud covers large areas of the bed of the ocean, and has received the name of Bathybius.†

Animal protoplasm consumes oxygen, and liberates carbonic acid, and is therefore destructive in its work; vegetable protoplasm acts in the same way until it is exposed to light, it then developes green corpuscles in its cells, and the protoplasm begins to decompose the carbonic acid of the atmosphere, to take carbon into the substance of the plant, and to give out oxygen; its course then is exactly the reverse of that of animal protoplasm.

It would seem, then, that as vegetable protoplasm alone produces these green corpuscles, it must be of a different nature from animal

* 'Edinburgh Review' for 1869, vol. cxxx. p. 159.

† Professor Huxley, the discoverer of Bathybius, now says that he seriously suspects that the thing to which he gave that name is little more than sulphate of lime, precipitated in a flocculent state from the sea water by the strong alcohol in which the specimens of the deep-sea soundings which he examined were preserved.—'Nature,' 19th August, 1875.

protoplasm, which does not produce them when similarly exposed to light.

The reader is probably aware that Professors Huxley and Tyndall and others suppose that protoplasm, with its vital force, is the necessary consequence of the combination in certain proportions of certain inorganic elements,—oxygen, hydrogen, carbon, and nitrogen; and Professor Huxley says, 'The existence of the matter of life depends upon the pre-existence of certain compounds; namely, carbonic acid, water, and ammonia. Carbon, hydrogen, oxygen, and nitrogen, are all lifeless bodies. Of these carbon and oxygen unite, in certain proportions and under certain conditions, to give rise to carbonic acid; hydrogen and oxygen produce water; nitrogen and hydrogen give rise to ammonia. These new compounds, like the elementary bodies of which they are composed, are lifeless. But when they are brought together, under certain conditions they give rise to the still more complex body, protoplasm, and this protoplasm exhibits the phenomena of life.' Here we may observe, that it is very strange that the union of four lifeless elements should produce life, when the union of two of them has no trace of any such result. We should expect, on Darwinian principles, that there would be some trace of life in the simpler compound, and here the reader will perhaps think that there is no evidence whatever that this mere combination of those lifeless compounds does produce life. It is found that protoplasm consists of them, and lives, and that is all.

Professor Huxley goes on to say,* 'When hydrogen and oxygen are mixed in a certain proportion, and an electric spark is passed through them, they disappear, and a quantity of water, equal in weight to the sum of their weights, appears in their place. There is not the slightest parity between the passive and active powers of the water and those of the oxygen and hydrogen, which have given rise to it. At 32° Fahrenheit, and far below that temperature, oxygen and hydrogen are elastic gaseous bodies, whose particles tend to rush away from one another with great force. Water, at the same temperature, is a strong though brittle solid, whose particles tend to cohere into definite geometrical shapes, and

* 'Lay Sermons,' 5th edit. p. 136.

sometimes build up frosty imitations of the most complex forms of vegetable foliage.'

'Nevertheless we call these, and many other strange phenomena, the properties of the water, and we do not hesitate to believe that, in some way or other, they result from the properties of the component elements of the water. We do not assume that a something called "aquosity" entered into, and took possession of, the oxide of hydrogen as soon as it was formed, and then guided the aqueous particles to their places in the facets of the crystal, and amongst the leaflets of the hoar-frost.'

'Is the case in any way changed when carbonic acid, water, and ammonia disappear, and in their place, under the influence of pre-existing living protoplasm, an equivalent weight of the matter of life makes its appearance?'

'It is true that there is no sort of parity between the properties of the components and the properties of the resultant, but neither was there in the case of the water. It is also true that the influence of pre-existing living matter is something quite unintelligible; but does anybody quite comprehend the modus operandi of an electric spark, which traverses a mixture of oxygen and hydrogen? What better philosophical status has vitality than aquosity?'

Huxley's argument seems to be, water has properties which oxygen and hydrogen have not, therefore it is not strange that protoplasm should have qualities, i.e. life, which its constituent parts have not. But this is not sufficient. To make the cases parallel, it must be shown that the qualities produced in the two cases are similar. Aquosity ought to be able to cause oxygen and hydrogen to combine, and form new water, just as vitality causes carbonic acid, water, and ammonia to form new vitality in new protoplasm. In fact, water is the result of a force, vitality is a force itself. It matters not that we are ignorant of the nature of electricity and of vitality, the point seems to be that the elements must be set in motion by force of some sort. In the case of the formation of protoplasm this force appears to be in the pre-existing protoplasm, and we give it the name of vitality.

This subject was considered by Professor Williamson in the 33rd number of 'The Popular Science Review.' He says, we 'require the admission of no new force to explain the combination of gases in the formation of water. The phenomena occur in accordance with known laws of affinity. The synthetical experiment is but one of a vast series of similar experiments, in each of which we can combine separate elements with absolute certainty that the resultants will be identical with, and fulfil all the functions of, the same products when formed in Nature's laboratory. But the case is different when we turn to living organisms. We may know the proportions of oxygen, hydrogen, carbon, and nitrogen existing in any form of protoplasm, we may even succeed in forcing those elements into an artificial combination having the same proportions, but in no single instance have we been able to endow such a combination with the powers of life. The resultant is not protoplasm. It does not live. It performs none of the vital functions.'

Professor Williamson says 'the living organism increases, multiplies, and reproduces itself through a power that is inherent, whereas a crystal can only do so through powers external to itself; whatever it may be, the vital power is always derived; no known combination of dead forces could have created it. Except in a few obscure cases, too ill-understood to be made the basis of a grave argument, protoplasm can always be traced, directly or indirectly, to some pre-existing form of protoplasm. We nowhere discover any power which, without the intervention of some already living agent, can convert inorganic matter into living matter.'

Proof of the fact of the spontaneous generation of the infusoria would evidently be a great support to the views of Professors Huxley and Tyndall as to the development of life by the combination of certain lifeless elements. They are, however, both opposed to that theory. Professor Tyndall says,* in his celebrated address to the British Association at Belfast, 'If you ask me whether there exists the least evidence to prove that any form of life can be developed out of

* 'Address,' 2nd edit. p. 55.

matter, without demonstrable antecedent life, my reply is, that evidence considered perfectly conclusive by many has been adduced; and that were some of us who have pondered this question to follow a very common example, and accept testimony because it falls in with our belief, we also should eagerly close with the evidence referred to. But there is in the true man of science a wish stronger than the wish to have his beliefs upheld; namely, the wish to have them true. And this stronger wish causes him to reject the most plausible support if he has reason to suspect that it is vitiated by error. Those to whom I refer as having studied this question, believing the evidence offered in favour of 'spontaneous generation' to be thus vitiated, cannot accept it. They know full well that the chemist now prepares from inorganic matter a vast array of substances which were some time ago regarded as the sole products of vitality. They are intimately acquainted with the structural power of matter as evidenced in the phenomena of crystallization. They can justify scientifically their belief in its potency, under the proper conditions, to produce organisms. But, in reply to your question, they will frankly admit their inability to point out any satisfactory experimental proof that life can be developed, save from demonstrable antecedent life.' Here again we are inclined to ask, can matter crystallize without the agency of some external force?

Notwithstanding this declaration by Professor Tyndall, the question of spontaneous generation is still agitated, and perhaps cannot be settled by experiment. As Professor Schmidt has remarked, 'if nothing appears, it may always be said that the failure is due to the conditions of the experiment, or if anything does make its appearance, that, notwithstanding every precaution, germs have made their way into the infusion.' There are, however, some considerations which we think are decidedly opposed to the belief, that infusoria are the result of spontaneous generation. In the first place, though of very simple structure, they have definite forms which are always the same; now it is almost impossible that any fortuitous combination of the elements of protoplasm should always produce these forms, we should expect that the result of such a combination would be amorphous protoplasm, such as the sticky mud or Bathybius said to be found in the depths of the ocean. Secondly, all these creatures are provided with the means of reproducing themselves, which would be a useless provision were there numbers recruited by spontaneous formation of protoplasm. Mrs Somerville mentions one of the lowest forms of vegetable microscopic organisms as increasing so rapidly, that in eight days 16,777,216 families may be formed from one resting spore.* Another tribe of microscopic plants, the Diatomaceæ, seems to increase still more rapidly. 'They are so numerous, that there is hardly a spot on the face of the globe, from Spitzbergen to Victoria Land, where they are not to be found. They abound in the ocean, in still and running fresh-water, and even on the surface of the bare ground. They extend in latitude beyond the limits of all other plants, and can endure extremes of temperature, being able to exist in thermal springs,

* 'Molecular and Microscopic Science,' vol. i. p. 189.

and in the pancake ice of the south polar latitudes. Though much too small to be visible to the naked eye, they occur in such countless myriads as to stain the berg and pancake ice wherever they are washed by the swell of the sea; and when enclosed in the congealing surface of the water they impart to the brash and pancake ice a pale ochreous colour.' * The mode of reproduction of these plants is well known, and there is no possibility of attributing their numbers to spontaneous generation. Some of the animal infusoria also increase with immense rapidity; a species of vibrio is said to multiply so fast as to tinge miles of newly-fallen snow a red colour in a single night.

These microscopic Diatoms seem to form the basis of the scale of life; they live and increase by the decomposition of inorganic matter, and they are themselves the food of the animal infusoria, who, in turn, are preyed upon by larger creatures.

We need not pursue this subject any further, it is to some extent beside our object, which is to ascertain how far the existing

* 'Molecular and Microscopic Science,' vol. i. p. 196.

state of the organic world is consistent with a system of evolution. We will just mention, to give an idea of the minuteness of the cells within which protoplasm acts, that one of the best scenes for observing its operations is the interior of the stinging hairs of the common nettle.

PART II.

THE DESCENT OF MAN.

CHAPTER VIII.

Huxley's 'Man's place in Nature'—The man-like apes—Their habits, dispositions, and manner of walking—Man differs less from the Gorilla than the Gorilla from the lower apes—The foot of man and of the Gorilla—The brain of man and of apes—Darwin's theory depends upon the production of a sterile variety by man's selection—Huxley's own views—No gradation of mental intelligence in the man-like apes—The Engis and Neanderthal skulls—Great antiquity of ape-like ancestor of man—Sir John Lubbock—Savages are not the degraded descendants of civilized man—Absence of cattle, metal weapons and pottery—Religion—Traces of a stone age among civilized nations—The Duke of Argyle—Man's divergence from a bestial form a step towards weakness—Man alone makes tools— Esquimaux—Fuegians—Sir John Lubbock's answers to the Duke's observations—Sir John Lubbock's 'Origin of Civilization and Præhistoric Times'—Tylor's 'Early History of Mankind and Primitive Culture'—No nation destitute of language—But many without religion—Doubts of Mr Tylor as to this point—Religion and laws of the Australians—Are the Esquimaux representatives of the cave men?—Are the Bushmen and the Pigmies of Central Africa remains of a people contemporary with the cave men?—Schweinfurth's account of the Akka — Livingstone's description of an aboriginal and a degraded people — Mr Wallace — Why man's body is not altered by natural selection—The brain power of savages beyond their requirements—Could not be acquired by natural selection, nor the nakedness of the skin—The hand and voice of man—His mental powers—Mr Darwin's answers to Mr Wallace.

MR DARWIN had mentioned, in the first edition of his 'Origin of Species,' that by his work 'light would be thrown on the origin of man and his history,' but he abstained from any deliberate attempt to trace the origin of man, as by doing so he thought he should only add to the prejudice against his views. The subject, however, was soon taken up by other writers.

In 1863 Professor Huxley published his 'Man's Place in Nature,' which he says contains the substance of what he had already published in the form of oral discourses during the previous three years. The work is divided into two parts, (1) The natural history of the man-like apes, and (2) The relation of man to the lower animals. We will examine both parts, as a knowledge of the structure and habits of the existing animals will assist us in forming an opinion as to the nature of the common ancestor from whom they and man are said to be descended.

'The man-like apes,' says Professor Huxley, 'have certain characters of structure and distribution in common; they have all the same number of teeth as man; in all the fore limbs are terminated by hands, provided with longer or shorter thumbs, while the great toe of the foot, always smaller than in man, is far more moveable than in him, and can be opposed, like a thumb, to the rest of the foot; none of these apes have tails, and none of them possess the cheek-pouches common among monkeys, and they are all inhabitants of the old world.' The reader will note that Professor Huxley speaks of feet, though naturalists generally call these animals Quadrumanous.

'The man-like apes are the Gibbons, the Orangs, the Chimpanzee, and the Gorilla. The Gibbons are the smallest, slenderest, and longest limbed of the man-like apes. Their arms are so long that they can touch the ground when erect. The Orangs have arms which reach to the ankles in the erect position of the animals. The Chimpanzees have arms which reach below the knees, the Gorilla has arms which reach to the middle of the leg.'

'Of the Gibbons half-a-dozen species are found scattered over the Asiatic Islands, and through Malacca, Siam, Arracan, and an uncertain extent of Hindostan. The largest attain a few inches above three feet in height, so that they are shorter than the other man-like apes, while the slenderness of their bodies renders their mass far smaller in proportion even to this diminished height. Their voices are extremely powerful, much more so than that of man, notwithstanding the smallness of their bulk.'

There is good testimony, says Professor Huxley, that various species of Gibbon readily take to the erect posture. He quotes Mr G. Bennett's description of the habits of a Gibbon, who says, 'he invariably walks in the erect posture when on a level surface, and then the arms either hang down, enabling him to assist himself with his knuckles, or, what is more usual, he keeps his arms uplifted in nearly an erect position.' (The reader will note that he cannot walk in such a manner as to use his arms at the same time for purposes quite independent of locomotion.) 'He walks rather quickly in the erect posture, but with a waddling gait, and is soon run down if he has no opportunity of escaping by climbing.' Another observer, also quoted, says, they walk erect when placed in an open field, balancing themselves very prettily by raising their hands over their heads, and slightly bending the arm at the wrist and elbow, and then run tolerably fast, rocking from side to side, and if urged to greater speed, they let fall their hands to the ground, and assist themselves forward, rather jumping than running, still keeping the body nearly erect.'

Somewhat different evidence is given by Dr Winslow Lewis: 'Their only manner of walking was on their inferior extremities, the others being raised upwards to preserve their equilibrium, as rope-dancers are assisted by long poles. Their progression was not by placing one foot before the other, but by simultaneously using both, as in jumping.'

Having given other evidence to the same effect, Professor Huxley says, 'After this mass of concurrent and independent testimony, it cannot reasonably be doubted that the Gibbons commonly and habitually assume the erect attitude. But, he adds, level ground is not the place where these animals can display their very remarkable and peculiar locomotive powers, and that prodigious activity, which almost tempts one to rank them among flying rather than among ordinary climbing mammals.'

'The hands and arms of the Gibbons are alone used in climbing; hanging to a branch by the right hand, the Gibbon launches itself by an energetic movement to a distant branch which he catches with the left hand, but the hold is less than momentary; the impulse for the next launch is acquired, the branch then aimed at is attained by the right hand again and quitted instantaneously, and so on in succession. A live bird was let loose in the apartment of a Gibbon at the Zoological Gardens. She marked its flight, made a long swing to a distant branch, caught the bird with one hand in her passage and attained the branch with her other hand, her aim both at the bird and at the branch being as if one object had engaged her attention.' This certainly appears very like an instance of calculation, but the whole system of locomotion of the Gibbons plainly shows that walking erect on the ground is not their natural mode of progression.

Mr Bennett, says Professor Huxley, had a Gibbon which had a peculiar inclination for disarranging things in his cabin. Among these articles a piece of soap especially attracted the Gibbon's attention, and for the removal of this he had once or twice been scolded. One morning, says Mr Bennett, I saw the little fellow taking the soap. I watched him without his perceiving that I did so, I pretended to write; he, seeing me busily occupied, took the soap and moved away with it in his paw. When he had walked half the length of the cabin, I spoke quietly without frightening him. The instant he found I saw him he walked back again and deposited the soap nearly in the place from whence he had taken it. There was, says Mr Bennett, something more than instinct in that action; he evidently betrayed a consciousness of having done wrong, and what is reason, if this is not an exercise of it?

'The Orang rarely exceeds four feet in height, but the body is very bulky. The

Orang is found only in Borneo and Sumatra, and is not common in either of those islands. The Orang is sluggish, exhibiting none of that marvellous activity characteristic of the Gibbons. Hunger alone seems to stir him to exertion. When the animal sits it curves its back and bows its head so as to look straight down on the ground; sometimes it holds on with its hands to a higher branch, sometimes lets them hang phlegmatically down by its side, and in this position the Orang will remain for hours together. Where he intends to sleep he prepares a sort of nest; little boughs and leaves are drawn together, and bent crosswise over one another, while, to make the bed soft, great leaves of ferns, of orchids, &c. are laid over them. The rude hut, says Sir James Brooke, which they are stated to build in trees would be more properly called a seat, or nest, for it has no roof or cover of any sort. When the night is cold the Orang covers himself with a heap of Pandanus or fern leaves.'

'The Orang climbs so slowly and cautiously, as in this act to resemble a man more than an ape, taking great care of his feet, so that an injury to them seems to affect him far more than the other apes. On the ground the Orang always goes laboriously and shakily on all fours. At starting he will run faster than a man, though he may soon be overtaken; the very long arms which, when he runs, are but little bent, raise the body of the Orang so that he assumes much the posture of a very old man bent down by age, and making his way along by the help of a stick.

'The Orang cannot put his feet flat to the ground, but is supported upon their outer edges. The hands are held in the opposite manner, their inner edges serving as the chief support. The Orang never stands on its hind legs, and all the pictures representing it as so doing are as false as the assertion that it defends itself with sticks and the like.'

Professor Huxley quotes Dr Müller's account of a large Orang which lived in captivity under his observation for a month: 'He was a very wild beast, of prodigious strength, and false and wicked to the last degree. If any one approached he rose up slowly with a low growl, fixed his eyes in the direction in which he meant to make his attack, slowly passed his hand between the bars of his cage, and then, extending his long arm, gave a sudden grip—usually at the face. He never tried to bite, though Orangs will bite one another, his great weapons of offence and defence being his hands. His intelligence was very great.'

'The adult Chimpanzees, measured by Dr Savage, never exceeded five feet in height. When at rest the sitting posture is that generally assumed. They are sometimes seen standing or walking, but when thus detected they immediately take to all fours and flee from the presence of the observer. Such is their organization that they cannot stand erect, but lean forward, balancing themselves by the position of their arms. The natural position is on all fours, the body anteriorly resting upon the knuckles; these are greatly enlarged, and the skin protuberant and thickened like the sole of the foot. They do not appear ever to act on the offensive, and seldom, if ever, on the defensive. When about to be captured they resist by throwing their arms round their opponent, and attempting to draw him into contact with their teeth. Biting is their principal act of defence. They make nests like the Orangs. The Chimpanzee is found from Sierra Leone to Congo'—a very considerable extent of the west coast of Africa.

'The Gorilla, whose habits are not so well known as those of the Chimpanzee, is about five feet in height, disproportionately broad across the shoulders, and thickly covered with coarse black hair, which becomes gray with age. The gait is shuffling, never upright as in man, but bent forward, and somewhat rolling, or from side to side. When it assumes the walking posture, to which it is said to be much inclined, it balances its huge body by flexing its arms upward.' The reader will note that in all these cases the power of walking seems to be very imperfect indeed. 'Their dwellings, if they may be so called, are similar to those of the Chimpanzee, consisting simply of a few sticks and leafy branches, which afford no shelter and are occupied only at night.'

'They are exceedingly ferocious, and always take the offensive, never running from man, as the Chimpanzee. The Gorilla makes his onset by striking his antagonist with the palms of his hands, or seizing him with a grasp from which there is no escape, and then throwing him down and biting him.'

'The Gorilla is an extremely local animal, being found only on the banks of the Gaboon river in West Africa.'

Professor Huxley then proceeds to consider the relation of these apes to man, and he argues that man must be placed in the same order with them, and not in an order by himself, because he differs less anatomically from the Gorilla than the Gorilla does from the lower apes.

'Man has been described as the only animal possessed of two hands terminating his fore limbs, and of two feet ending his hind limbs, and he has been said to differ fundamentally from all apes in the characters of his brain, which alone exhibits the structure known to anatomists as the posterior lobe, the posterior cornu of the lateral ventricle, and the hippocampus minor.'

Professor Huxley points out that there is a great resemblance between the several parts of the hand and foot in man, and shows that where the foot is kept bare, as amongst uncivilized nations, it has much more prehensile power than with us, where it is confined in boots or shoes. The Chinese boatmen are said to be able to pull an oar, and the artisans of Bengal to weave, by means of their feet.

Professor Huxley then examines the hind hand of a Gorilla, and argues that it is a true foot, a prehensile foot indeed, but in no sense a hand: it is a foot which differs from that of man, not in any fundamental character, but in mere proportions, in the degree of mobility, and in the secondary arrangements of its parts.

Professor Huxley then compares the feet of man, of the Gorilla, and of the Orang, and shows that the foot of the Gorilla differs more from that of the Orang than the foot of man differs from that of the Gorilla.

As to the brain, Professor Huxley says that he will content himself with assuring the reader that the posterior cornu and the hippocampus minor have now been seen usually, at least, as well developed as in man, and often better; not only in the Chimpanzee, the

Orang, and the Gibbon (very little is known about the brain of the Gorilla from his rarity), but in all the genera of the old world, baboons and monkeys, and in most of those of the New World. We may note here that the hippocampus minor and the hippocampus major are two prominences of the brain, the functional importance of which, Professor Huxley says, is entirely unknown.

'If man be separated by no greater structural barrier from the brutes than they are from one another, it seems to follow,' says Professor Huxley, 'that if any process of physical causation can be discovered by which the genera and families of ordinary animals have been produced, that process of causation is amply sufficient to account for the origin of man. At the present moment but one such process of physical causation has any scientific existence—namely, that propounded by Mr Darwin.'

'If the animated world presented us with none but structural differences, Mr Darwin would have demonstrated the existence of a true physical cause, amply competent to account for the origin of living species, man among the rest. But in addition to their structural differences, the species of animals and plants, or at least a great number of them, exhibit physiological characters, being for the most part incompetent to breed one with another, or if they breed, the resulting mule or hybrid is unable to perpetuate its race.'

'A true physical cause is, however, admitted to be such only on one condition, that it shall account for all the phenomena which come within the range of its operations.'

Our acceptance of Mr Darwin's theory must therefore, says Professor Huxley, be provisional, so long as one link in the chain of evidence is wanting; and so long as all animals and plants certainly produced by selective breeding (selective by man) from a common stock are fertile, and their progeny are fertile, with one another, that link will be wanting, for selective breeding will not be proved competent to do all that is required to produce natural species.

Professor Huxley, though he does not accept Mr Darwin's theory, takes still stronger views himself. He says, 'the whole analogy of natural operations furnishes so complete and crushing an argument against the intervention of any but what are termed secondary causes, in the production of all the phenomena of the universe; that, in view of the intimate relations between man and the rest of the living world, and between the forces exerted by the latter and all other forces, there can be no excuse for doubting that all are co-ordinated terms of Nature's great progression, from the formless to the formed—from the inorganic to the organic—from blind force to conscious intellect and will.'

Professor Huxley says he has shown that no absolute structural line can be drawn between the animal world and ourselves, and he believes that the attempt to draw a psychical distinction is equally futile, and that even the highest faculties of feeling and of intellect begin to germinate in lower forms of life; at the same time no one is more strongly convinced of the vastness of the gulf between civilized man and the brutes, or is more certain that, whether from them or not, man is assuredly not of them. The reader will note that this remark is confined to civilized man.

One point must have struck the reader in perusing these passages, namely, that if there is a gradation of structure in these creatures approaching more and more to that of man, there is certainly no such gradation in mental qualifications, for the Gibbon, the lowest of the series, seems to surpass them all in intelligence, and the Gorilla is a frightful brute.

In this work Professor Huxley gives an account of two fossil skulls from the caves of Engis, in the valley of the Meuse, in Belgium, and of the Neanderthal, near Dusseldorf. The Engis skull, upon the authority of Sir C. Lyell, belonged to a contemporary of the mammoth and of the woolly-haired rhinoceros, and the Neanderthal skull is of great, though uncertain, antiquity. Of the Engis skull Professor Huxley says, there is no mark of degradation about any part of its structure; it is, in fact, a fair average human skull.

The case of the Neanderthal skull is very different: 'under whatever aspect it is viewed, we meet with ape-like characters, stamping it as the most pithecoid of human crania yet discovered; still its capacity is about equal to that of the skull of an average Polynesian or

Hottentot skull, which would seem to show that the pithecoid tendencies indicated by the skull did not extend deep into the organization, and this conclusion is borne out by the dimensions of the other bones of the skeleton, which show that the absolute height and relative proportions of the limbs were quite those of an European of middle stature.'

Professor Huxley comes to the conclusion, that these fossil remains of man do not take us appreciably nearer to that lower pithecoid form, by the modification of which man has become what he is. Where then, says Professor Huxley, must we look for primæval man? Was he pliocene or miocene, or yet more ancient? Time will show. But in the mean while, if any form of the doctrine of progressive development is correct, we must extend by long epochs the most liberal estimate that has yet been made of the antiquity of man.

In 1868, at the meeting of the British Association at Dundee, Sir John Lubbock read a paper on Archbishop Whately's well-known position, 'that no community unaided ever did, or ever could, emerge from a state of utter barbarism into anything that could be called civilization.' In this paper Sir John Lubbock did not directly treat of the origin of man; but of course the state of existing savages may indirectly throw considerable light on the origin of mankind; and he spoke of the condition of the first man, or of the first being worthy to be so called, an expression hinting at the descent of man from some inferior being, and which attracted great attention.

Sir John Lubbock argues, that savages are not necessarily the degraded descendants of civilized races, as maintained by the Archbishop. 'In many cases, where evidence of the fact ought to have been found, there were no traces of it. The Australians, North and South Americans, and several other more or less savage tribes, living in countries eminently suited to our domestic animals, and to the cultivation of cereals, were yet ignorant of the one and the other. It is impossible that agriculturists and herdsmen—and such the Archbishop supposed men to have been from the beginning—should have ever entirely abandoned pursuits so easy and advantageous. Even if they did so, still herds of wild cattle would be found in those countries, or if these were exterminated, their skeletons would testify to their previous existence, whereas not a single trace of the domestic ox or sheep has been found in Australia or in America, and the fossil horse of South America is not of the same species as our domestic race.'

'No weapons or implements of metal have ever been found in any country inhabited by savages wholly ignorant of metallurgy. A still stronger case is afforded by pottery. Pottery is very indestructible; when used at all, it is very abundant, and is in most cases associated with burials. It is, therefore, a very significant fact, that no fragment of pottery has ever been found in Australia, New Zealand, or the Polynesian Islands. It is extremely improbable that an art so easy and so useful should ever have been lost by any race of men. The art of spinning and the use of the bow are also quite unknown to many savages. Another case is that some nations of savages have been found to be wholly without religion of any kind. Sir John Lubbock says that no nation could forget a religion which they once possessed.'

Sir John Lubbock then gives many instances in which savages have appeared to make advances in civilization, and then points out traces of original barbarisms amongst civilized nations. 'Not only throughout Europe, not only in Italy and Greece, but even in the so-called cradle of civilization itself, in Palestine and Syria, in Egypt and India, the traces of a stone age have been discovered. It may be said that these were only the fragments of those stone knives which were used in religious ceremonies, long after metal was introduced for secular purposes. But why were these stone knives used by the Egyptian and Jewish priests? Evidently because they had been in general use, and a feeling of respect made the priests reluctant to introduce a new substance into religious ceremonies.'

In his 'Primæval Man' the Duke of Argyle treats of the origin of man, of his antiquity, and of his mental, moral, and intellectual condition when first created.

'Man cannot have been developed from a brute form, because the divergence of his bodily frame from that of brutes is a divergence in the direction of greater physical helplessness and weakness, a divergence which, of all others, it is most impossible to ascribe to mere natural selection. The unclothed and unprotected condition of the human body, its comparative slowness of foot, the absence of teeth adapted for prehension or for defence, the same want of power for similar purposes in the hands and fingers, the bluntness of the sense of smell, so as to render it useless for the detection of prey,—all these are features which stand in strict and harmonious relation to the mental powers of man; but, apart from these, they would place him at an immense disadvantage in the struggle for existence. This, therefore, is not the direction in which the blind force of natural selection could ever work.'

'The creature, "not worthy to be called a man," to whom Sir John Lubbock has referred, was, *ex hypothesi*, deficient in those mental capacities which now distinguish the lowest of the human race, and any loss of bodily power unaccompanied with the acquisition of reason must have been impossible, when the lowest savages even now are often hard put to it to procure the food absolutely necessary to them. Man must have had human proportions of mind before he could afford to lose bestial proportions of body; if the change in mental power came simultaneously with the change in physical organization, then it was all we can ever know or understand of a new creation.'

The Duke of Argyle admits the great antiquity of man. This conclusion was natural to a mind accepting in the main the Scriptural account of the creation, because the older man could be proved to be, the greater is the probability that the various races of men whom we see on the globe may have descended from a single pair, a point of more importance than the maintenance of the chronology limiting his existence on the globe to a few thousand years.

The Duke argues that there is no necessary connection between a state of mere childhood in respect to knowledge and a state of utter barbarism, which must imply the lowest moral, as well as the lowest intellectual, condition. 'No proof that man was ignorant of the industrial arts can afford the smallest presumption that he was also ignorant of duty, or ignorant of God.'

'Traces of barbarism are not necessarily proofs of primæval barbarism, the barbarism may have been mediæval. Traces of the feudal system do not prove that that system was primæval, barbarism may be the result of a development of corruption.'

The Duke says, 'The hooded crow is in the habit of lifting shell-fish to a certain height in the air, and then letting them fall upon the rocks of the shore, in order to break the shells. Some species of monkey will even use any stone which may be at hand for the purpose of breaking a nut. The elephant tears branches from the trees, and uses them as an artificial tail to fan himself, and keep off the flies. But between these rudiments of intellectual perception and the next step,—that of adapting and fashioning an instrument for a particular purpose,—there is a gulf, in which lies the whole immeasurable distance between man and the brutes.'

'The man who first lifted a stone and threw it practised an art which not one of the lower animals is capable of practising. This act involves the idea and the knowledge of projectile force, and of the arts by which direction can be given to that force.'

'Did Dr Whately mean that man must have been instructed by God how to throw a stone, or wield a stick, or to hurl a javelin, or build a hut? If so, at what point did such lessons in mechanics stop? Is it not more probable that this knowledge was communicated to man in the form of intuitive powers of perception and discovery.'

'Man has always been man and nothing else. There is quite as much ingenuity and skill displayed in the manufacture of a stone knife as in that of one of iron. The great ingenuity and resource shown by many of the rudest tribes have hardly been sufficiently appreciated.' Here we must note the stone knives first used by man were mere chips of flint; a long period is supposed to have elapsed between the time at which these chips were first used and the time when men began to grind and polish stones into the form of weapons.

'Quarrels and wars between tribe and tribe, induced by the mere increase of numbers, and the consequent pressure on the means of subsistence, have been always, ever since man has existed, driving the weaker races farther and farther from the older settlements of mankind.' The Duke takes the distribution of man on the Continent of America as an illustration of his views, and shows us the Esquimaux in the north, watching at the blow-hole of a seal for hours in a temperature of 75 degrees below the freezing point, and when at last his prey is struck, feasting on its raw blood and blubber. 'To civilized man it is hardly possible to conceive a life so wretched, and in many respects so brutal, as the life led by this race during the long-lasting night of the arctic winter.'

'Neither an agricultural nor a pastoral life is possible on the borders of the frozen sea. The rigours of the region they now inhabit have reduced this people to the condition in which we now see them, and whatever arts their fathers knew, suited to more genial climates, have been, and could not fail to be, utterly forgotten.'

'To turn to the other extremity of the great Continent of America, to Cape Horn, and the island off it, which projects its desolate rocks into one of the most inhospitable climates in the world. The inhabitants of Tierra del Fuego are perhaps the most degraded among the races of mankind. How could they be otherwise? Their country, according to Mr Darwin,* is a broken mass of wild rocks, lofty hills, and useless forests; and these are viewed through mists and endless storms. The habitable land is reduced to the stones of the beach. In search of food they are compelled to wander unceasingly from spot to spot, and so steep is the coast, that they can only move about in their wretched canoes. These poor wretches, says Mr Darwin, speaking of some Fuegians, were stunted in their growth, their hideous faces were bedaubed with white paint, their skins filthy and greasy, their hair entangled, their voices discordant, and their gestures violent. Viewing such men, one can hardly, says Mr Darwin, make oneself believe that they are fellow-creatures and inhabitants of

* 'Naturalist's Voyage.'

the same world. Whence can these savages have come? what could have tempted, or what change compelled, a tribe of men to leave the fine regions of the North, and travel down the Cordillera, or backbone of America, to invent and build canoes which are not used by the tribes of Chili, Peru, and Brazil, and then to enter on one of the most inhospitable countries within the limits of the globe? Under the circumstances in which these people are placed 'how little can the higher powers of the mind be brought into play! What is there for imagination to picture, for reason to compare, for judgment to decide upon?' Yet even these savages have all the perfect attributes of humanity, which are developed the moment they are placed under favourable conditions, as was shown in the case of the Fuegians brought to England by Captain Fitzroy.' (This is a most important point.) It is absurd, says the Duke, to argue that the condition of these outcasts can be assumed as representing the aboriginal condition of man.

Sir John Lubbock argues, that the low condition of the Australian savages is no proof that they were incapable of raising themselves, because the materials of improvement are wanting in that country, which affords no cereals, nor any animals capable of useful domestication; but this argument, the Duke says, would equally account for the natives of that country having degenerated from their ancestors, who must have come from some country where corn and cattle were known. 'Man is not an animal of the Fauna of Australia, he must therefore have come to it from some other lands. It is not probable that the human beings who migrated into Australia, had the means of taking corn or cattle with them, so that the knowledge of these things must have died out.'

'The Tasmanians, too, must have reached that country in canoes, for they could not have walked across the sea, yet they had no canoes when first visited by Captain Cook.'

The Duke does not notice the case of the Pottery.

With respect to Sir John Lubbock's position, that it is difficult to believe that any people which once possessed a religion should ever entirely lose it, the Duke says, if there is one fact more certain than another in respect to the nature of man, it is that he is capable of losing religious knowledge, of ceasing to believe in religious truth, and of falling away from religious duty.

'The farther we go back in the history of man, the more clear become the traces of some pure traditions, and the rays of some primæval light. Such evidence as history and philosophy and criticism afford on the course of religious knowledge, is not in favour of the doctrine of a gradual rise, but, on the contrary, of continuous corruption and decline. If there is one thing, says Professor Max Müller, which a comparative study of religions places in the clearest light, it is the inevitable decay to which every religion is exposed. Whenever we can trace back a religion to its first beginnings we find it free from many blemishes that affected it in its later stages. One of the most ancient religions of the world is represented in its earlier form in the Sanskrit Vedas, and it has become lower, ruder, more corrupt in its conceptions of the Divine Nature, in its notions of acceptable worship, and in the social institutions which are connected with belief.'

In conclusion the Duke says, 'I set little value on the argument of Whately, that, as regards the mechanical arts, man can never have risen unaided. The aid which man had from his Creator may possibly have been nothing more than the aid of a body and of a mind, so marvellously endowed, that thought was an instinct, and contrivance at once a necessity and a delight. But I set still less value on the arguments of Sir J. Lubbock, that primeval man must have been born in a state of utter barbarism, on the ground that this is the actual condition of the outcasts of our race, or that industrial knowledge has advanced from small beginnings, or that there are traces of rude customs among many nations now highly civilized; first, because, along with a complete ignorance of the Arts, it is quite possible that there may have been a higher knowledge of God, and a closer communion with Him; secondly, because many cases of existing barbarism can be distinctly traced to adverse external circumstances, and because it is at least possible that all real barbarism has had its origin in like conditions; thirdly, because the known character of man and the indisputable facts of history prove that he has within him at all times the elements of corruption; that even in his most civilized condition he is capable of degradation,—that his knowledge may decay, and that his religion may be lost.'

In a paper read before the British Association at Exeter in 1869, Sir John Lubbock replies to the Duke of Argyle's observations. As to the position, 'that there is no necessary connection between a state of mere childhood with respect to knowledge and a state of utter barbarism, words, which if they have any definite meaning at all, imply the lowest moral, as well as the lowest intellectual, condition,' Sir John Lubbock says: 'To every proposition in this remarkable sentence I entirely demur; there is, I think, a very intimate connection between knowledge and civilization; nor do the words, utter barbarism, mean low morality, for morality implies responsibility, and consequently intelligence, which the savage possesses in a very slight degree; he cannot, therefore, be immoral.' Here we think that the Duke of Argyle's views cannot be called remarkable; he merely means to state that men may be religious and moral without being learned; and, whether this opinion be right or wrong, it is certainly not peculiar, for it is almost universally treated as a truth.

As to the point that savages are the mere outcasts of the human race, Sir J. Lubbock points out that until the historical period these 'mere outcasts' occupied almost the whole of North and South America, all northern Europe, the greater part of Africa, the great Continent of Australia, and the beautiful Islands of the Pacific. As to the point that the natives of Tasmania must have reached that country in canoes, for they could not have walked on the sea, Sir John Lubbock says, this argument would apply to the kangaroo and echidna, which also could not have walked on the sea; and adds, though the Duke admits the antiquity of man, he does not appreciate the geological changes which have taken place during the human period. Sir John Lubbock here apparently alludes to a continuity of land formerly existing in Australia, perhaps connecting that territory at a very ancient time with the old world. We have seen that the Fauna of the old world at a very remote period contained marsupial animals. Sir C. Lyell states* that, assuming the theory of progressive development to be true, we should expect to find Monotremata (to which the Echidna belongs) in the primary, marsupials (to which the kangaroo belongs) in the secondary formations. Is it possible that man can have been a contemporary with these forms of life, and migrated with them from the old world into Australia?

The reader will note here a curious point. If savages have not degenerated, then the highest men in the world at the time when they spread over the globe were such as the Tasmanians were when first seen by Captain Cook. It is not easy to see why such a people should have penetrated into every corner of the globe, or how they could do it.

Sir John Lubbock understands the Duke to mean that strong nations drive out the weaker ones, while he believes that the exten-

* 'Geology,' vol. i. p. 162.

sion of the human race was due to internal necessity and the pressure of population; was effected by peaceful, not by hostile, force; by prosperity, not by misfortune. Of old, as now, founders of new colonies were men of energy and enterprise, animated by hope, anything but mere outcasts of the human race. Here it is very difficult indeed to agree with Sir John Lubbock. What man of energy, animated by hope, would have ever selected Terra del Fuego as a habitation? The reader will note that both the Duke of Argyle and Sir John Lubbock consider the pressure of want, the difficulty of procuring food, to be, in fact, the motive-power which sets the stream of mankind in motion, so that there is not much real difference between them.

The natives of Brazil, possessing a most beautiful country, are lower than the Esquimaux, of whom Sir John Lubbock, quoting the works of various travellers who have visited them, gives a very favourable account. They are sober, steady, and faithful, provident as to their own property, and careful of that of others when under their charge. Socially they are a lively, cheerful, and chatty people;

fond of associating with each other and with strangers. In their domestic relations they are exemplary. The man is an obedient son, a good husband, and a kind father. The children when young are docile, when grown up they are dutiful to their parents. Orphan children are readily adopted and well cared for until they are able to provide for themselves. In this paper Sir John Lubbock, quoting Mr Tylor, mentions another case in which old habits have been preserved by religious rites. The Brahmins, when they require fire for religious purposes, will not use ordinary fire, nor even fire derived from flint and steel, but obtain it by a fire-drill, that is, by the friction of two pieces of wood, a method still employed by many savages.

Sir John Lubbock explains that he did not allude to a degradation of religious belief, but to a total loss of it, when once possessed, as being impossible. Sir John traces the progress of religious belief as follows. 'The lowest savages have no idea of a Deity at all; those slightly more advanced regard him as an enemy to be dreaded, but who may be resisted with a fair prospect of success, who may be cheated by the cunning, and defied by the strong. Thus the natives of the Nicobar Islands endeavour to terrify their deity by scarecrows, and the negro beats his fetich if his prayers are not granted. As tribes advance in civilization their deities advance in dignity, but their power is still limited; one governs the sea, another the land; one reigns over the plains, another among the mountains. The most powerful are vindictive, cruel, and unjust. They require humiliating ceremonies and bloody sacrifices. But few races have arrived at the conception of an Omnipotent and Beneficent Deity.'

*'The gradual development of religious ideas among the lower races is a fair argument in opposition to the view that savages are degenerate descendants of civilized ancestors. It is very difficult to show any process of natural degradation and decay which could explain the quaint errors and opinions of the lower races of men, or to account for the lingering belief in witchcraft, and other absurdities, in civilized races.'

* 'Origin of Civilization,' p. 495.

'As to the Duke's position, "that man even in his most civilized condition is capable of degradation, that his knowledge may decay, and his religion be lost." This is, of course, true as regards individual men, but it does not hold good with the human race. Far more true, far more noble,' says Sir John Lubbock, 'are the concluding passages of Lord Dunraven's opening address to the Cambrian Archæological Association, "that if we look back through the entire period of the past history of man, we can scarcely fail to perceive that the whole exhibits one grand scheme of progression, which, notwithstanding partial periods of decline, has for its end the ever-increasing civilization of man and the gradual development of his higher faculties, and for its object the continual manifestation of the design, the power, the wisdom, and the goodness of Almighty God."'

Sir John Lubbock, in this paper, does not enter into the question of the origin of man, but only of his primitive state, and therefore does not notice the Duke of Argyle's very strong point that all deviations from the form of a brute towards that of man, if unaccompanied by the acquisition of reason, would be disadvantageous to him in the struggle of life, and therefore could not be the work of natural selection.

This subject was also considered by Sir John Lubbock in his 'Origin of Civilization' and in his 'Præhistoric Times,' and by Mr Tylor in his 'Early History of Mankind' and in his 'Primitive Culture.' We can notice only a few points, bearing in mind that our object is to ascertain whether there are any circumstances connected with savage life which may connect man with the brutes. Are there races of men who have no language, no moral sense, no religion?

* Sir John Lubbock does not suppose that any nation has ever been met with that had no language. In many of the lower races language is, indeed, very imperfect and eked out by signs, but this arises from the fact that in all countries inhabited by savages, the number of languages is very great (each tribe speaking a tongue unintelligible to its neighbours), and hence there is a great advantage in being able to communicate by

* 'Origin of Civilization,' p. 401.

signs. For the above reason savages are great adepts in the act of conversing by signs.

Here we may mention that the number of words in our modern languages which are in general use is much smaller than is usually supposed. It is said that the vocabulary of an agricultural labourer does not exceed three hundred words, and that a man of good education, brought up at a public school and the University, who reads the 'Times' and the books in Mudie's Library, does not employ in conversation more than three or four thousand words.*

And here we must note, as observed by Mr Tylor,† the difference between using gestures to facilitate the action of speech, and using gestures because there is no word in the language by which reference can be made to the object in question, because, in fact, that object is always referred to by a sign. In this latter case the language would evidently be very imperfect. Mr Tylor seems to question the sufficiency of the evidence brought in favour of the existence of any such language, and he

* Max Müller's 'Lectures,' p. 268.
† 'Early History of Mankind,' p. 79.

justly observes that it would require a very intimate acquaintance with a language before the fact could be ascertained, travellers being, of course, very likely to form erroneous opinions upon this point, as their ignorance of the language of the natives would naturally drive the latter to the use of signs.

Sir John Lubbock,* as we have seen, believes that many races exist, or have existed, which have no religion in one sense of the word. If a mere fear of the unknown, if a more or less vague belief in witchcraft, is to be regarded as a religion, no race is destitute of it; but if a higher estimate of religion is to be adopted, many, perhaps all, savage races are, according to the nearly universal testimony of travellers, destitute of religion, and Sir John quotes Spix and Martius, Bates, Wallace, and many other travellers in support of his view.

On the other hand, Mr Tylor,† though an evolutionist, says that the assertion that rude, non-religious tribes have been known in actual existence, though in theory possible,

* 'Præhistoric Times,' p. 575.
† 'Primitive Culture,' vol. i. p. 378.

and perhaps in fact true, does not at present rest on that sufficient proof which, for an exceptional state of things, we are entitled to demand. Savages often are inclined to conceal their religious ideas from strangers. In many cases in which no religion was supposed to exist, it has now been found that the people do believe in good and evil spirits.

Mr Tylor says, that in many of the instances in which Sir John Lubbock believes that races have no religion, further acquaintance with them has shown that they were not understood. It appears that the Australians believe in a spirit who makes the thunder, and who, as Mr Tylor observes, may be compared with the Zeus of the Greeks.

These degraded Australians have some customs which certainly imply considerable moral feeling. Sir John Lubbock, quoting Sir G. Grey's 'Australia,' says,* crimes may be compounded for by the criminal appearing and committing himself to the ordeal of having spears thrown at him by all such persons as conceive themselves to have been aggrieved, or by permitting spears to be

* 'Origin of Civilization,' p. 456.

thrust through certain parts of his body, such as through the thigh, or the calf of the leg, or under the arm. The part which is to be pierced by a spear is fixed for all common crimes, and a native who has incurred this penalty sometimes quietly holds out his leg for the injured party to thrust his spear through. So strictly, says Sir John Lubbock, is the amount of punishment limited, that if, in inflicting such spear-wounds, a man, either through carelessness or any other cause, exceeded the recognized limit, if, for instance, he wounded the femoral artery, he would in his turn be liable to punishment.

It is probable, as noticed by Sir John Lubbock, that these rules were originally intended rather to restrain the vengeance of the aggrieved party than to punish the offender.

In addition to the above points, we may mention that the degrees of affinity within which persons may intermarry is settled by law or custom in Australia.

Taking, then, the lowest races on the face of the globe, we still find them utterly removed from the state of brutes. No beast fears the unknown, or believes in witchcraft, connects thunder with the idea of a spirit, or lays down rules for the punishment of crime, or the regulation of revenge, or imposes any restraint on the pairing of the individuals of its race.

The reader will note that the skulls found in the caves of Engis and Neanderthal do not support either the theory of evolution or that of degradation, they seem to show that man has remained much the same for a vast period of time. We should, according to the evolution hypothesis, have expected to find a very inferior form of human being, only partially developed, while, on the theory of degradation, we ought to have had a form far more perfect than those of any existing savages, as being nearer to the fountain-head, nearer to the more perfect race of original man.

But we must remember that very little confidence can be placed in any deductions made from such very limited observations. Amongst ourselves there exists a very great difference between men as to the form of the skull, and it would be rash to assume that all the men of the time of the fossil-man of Neanderthal had skulls of an equally low form.

It has been suggested* 'that the Eskimo are the descendants of these dwellers in caves, and that they now represent them on the earth. In the caves were found rude stone cutters, awls, lance-heads, hammers, saws made of flint, with bone needles, sculptured reindeer antlers, engraven stones, arrow-heads, and harpoons, with the broken remains of animals which had been used as food. The most remarkable remains left in these caves are the sculptured reindeer antlers,—a well-defined figure of an ox stands out from one piece of antler, a second has been carved in a most tasteful manner; a reindeer is kneeling down in an easy attitude, with its head thrown up in the air so that the antlers rest on the shoulders, and the back of the animal forms a smooth surface for a handle which is too small to be grasped by an ordinary European. The most striking figure that has been found is that of a mammoth engraved on a fragment of fossil ivory. The peculiar spiral curvature of the tusks and the long mane have been most faithfully depicted, and prove that the original was familiar to the

* 'Edinburgh Review,' 1870, p. 452 vol. cxxxii.

eye of the artist. The discovery of the carcase of a mammoth in northern Siberia, preserved from decay by the intense cold of the frozen cliff in which it was imbedded, has made us acquainted with the long hairy mane; had not the mammoth in the flesh been thus handed down to us this most accurate drawing would have been treated as a mere artist's freak.'

'The weapons of the Eskimo are identical in shape with those of the cave men: the fowling spears are the same, and the method of fixing the bone heads of the spears into the shaft is the same in both cases. The Eskimo also engrave upon their drill bows the portraits of the animals which they hunt by sea or land. These animals were not the same amongst the cave men and the Eskimos, but in the case of the reindeer, which was common to them both, the carvings are precisely of the same character.'

'The habits of the two people were similar; both collected large quantities of the bones of animals round their abode, and both were in the habit of splitting the bones for the sake of the marrow, in the same way. The same stone-scrapers prove that both dressed their hides in the same way, while the needles prove that they were sewn together in a very similar fashion. A great many of the smaller implements of both people are absolutely the same in material and form. Both people were small of stature.'

There is another curious question—are the Bushmen of South Africa, and the pigmy race mentioned by Schweinfurth as inhabiting a portion of Central Africa, remnants of a race of men who were coeval with the cave men?

The Bushmen are described by Livingstone and Gordon Cumming as short in stature, very active, living almost entirely upon animal food, and frequently dwelling in caves. One of these caves is described by Gordon Cumming* as beautifully ornamented by its Lilliputian inhabitants with faithful portraits of all the animals of chase of the country.

This practice of representing the objects of chase seems common to the Bushmen and the ancient dwellers in the caves in France, and we may mention that similar figures

* 'The Lion Hunter,' vol. ii. p. 76.

have been found in a cave on the north-eastern coast of Australia.*

It is interesting to note the amount of intelligence possessed by these remnants of ancient races, if we may venture so to call them. The Bushmen seem to be quick in intelligence: they show a taste for ornament in their rude dwellings, and they have invented two kinds of poison for their arrows, which, in spite of their diminutive size, place all the beasts of the forest, not excepting the lion, at their mercy. They are described by Gordon Cumming as faithful and affectionate. The Bush-boy who accompanied him was faithful to him when deserted by all his native servants. Others, however, do not give so favourable an account of them,—they are described as untameable, as uninfluenced by presents of corn or cattle. They seem to the last degree attached to a roving life. We may mention that the poor natives of Tasmania, when taken from their native country, and their usual food and habits, soon dwindled away and became extinct, though well fed and otherwise cared for by our Government.

* Lubbock's 'Pre-historic Times,' p. 439.

Schweinfurth * gives us an account of a race of small men called the Akka, who occupy a district of Central Africa and exactly resemble the Bushmen. They are about the same height and are equally active: they are described as jumping about in the grass like grasshoppers; they are so nimble that they can shoot their arrows into an elephant's eye, and drive their lances into his belly. Schweinfurth believes that there is a series of dwarf races extending along the equator entirely across Africa, exhibiting all the characteristics of an aboriginal stock. Schweinfurth remarks that history has not shown that degeneracy in a nation has ever been attended by a general decrease in the people's stature.

Though the Akka are so agile they are described as bad walkers, unlike other Africans, who ordinarily walk with their feet straight: the Akka turn theirs somewhat inward—it is difficult to describe their waddling: every step they take is accompanied by a lurch that seems to affect all their limbs alike (this is somewhat like the gait of a gorilla). The Akka are a nation of hunters;

* Schweinfurth's 'Central Africa,' vol. ii. p. 128.

they are valued and protected by a neighbouring nation, the Monbuttoo, on account of their skill in hunting. The Monbuttoo breed no cattle: had they done so Schweinfurth seems to think they would have treated the Akka as the Boers of South Africa treat the Bushmen, for nothing could have prevented the Akka from spearing cattle, which they would have considered to be game.

Schweinfurth had no opportunity of visiting the dwellings of the Akka, and he makes no mention of their possessing poisoned weapons. In disposition they are said to be engaging. But Schweinfurth describes them as delighting in wickedness from an inward impulse. His boy Nsewue * was fond of torturing animals, and his delight knew no bounds when his master, who was making a collection of skulls, boiled the heads of some people killed in battle; he went about the camp shouting that Bakinda was in the pot. Still this boy seems to have been a great pet. Schweinfurth gives a portrait of him which certainly has a low facial angle, and a simian aspect; perhaps this appearance might partly

* Vol. ii. p. 144.

be due to ill health, as he soon died, and portraits of young warriors of the race give us the idea of active, well-made men, with proper calves to their legs, and a firm upright carriage.

Dr Livingstone * gives us a description of two tribes inhabiting the same district, one of which, the Bushmen, he believes to be the aborigines of the region, and the other, the Bakalahari, to be the degraded remnants of the first immigration of Bechuanas. The Bushmen neither cultivate the soil nor rear herds. The Bakalahari retain in undying vigour the love for agriculture and domestic animals. They are a timid race, and in bodily development often resemble the aborigines of Australia. A few Bechuanas may go into a village of Bakalahari and domineer over the whole with impunity; but when these same adventurers meet the Bushmen they are fain to change their manners to fawning sycophancy; they know that if the request for tobacco is refused, these free sons of the desert may settle the point as to its possession by a poisoned arrow.†

* 'Missionary Travels,' p. 49.

† The reader will find an account of many of the most

And now what is to be our decision as to the question—are savages the degraded descendants of civilized man?

As to this point we must say, the balance of evidence seems to be in favour of Sir John Lubbock's views. The very remote period at which the earth was inhabited by men in a savage state, as shown by the remains of the cave men, and the great extent of the countries inhabited by them, are inconceivable on the hypothesis that they were the descendants of one tribe of comparatively civilized men; and this view is certainly confirmed by the use of stone knives in religious rites amongst those who are supposed to be the more immediate descendants of this tribe. But this is no proof whatever that these savage men were developed from any inferior form of animal life by simple accidental evolution and the survival of the fittest.

We will now look at the views entertained by Mr Wallace as to the action of natural selection on man, and (1) he meets the point

degraded races of savages in the appendix to Dr Büchner's 'Man in the Past, Present, and Future,' p. 313. English Translation.

that if man has been improved by natural selection from some ape-like form, the same instrument should improve him still further, and that we ought to see changes in man now in progress, by showing that after man became a rational being, he no longer required a change of body to fit him for changed conditions of life, for he could provide against their influence by his reason. It is in the mental and moral qualities of man that his future improvement by natural selection is to be expected.

But the most important of Mr Wallace's views upon this subject is his position that many of the peculiarities of human beings could not have been produced by natural selection. The mode of life of the lowest savages is not very different from that of animals, nor are they much superior to them in the use they make of their mental powers, yet the savage possesses a large and well-developed brain, quite disproportionate to his actual requirements, an organ that seems prepared in advance, only to be fully utilized as he progresses in civilization. A brain slightly larger than that of the gorilla would have sufficed for the limited mental development of the savage, and we must, therefore, admit that the large brain he actually possesses could never have been solely developed by any of those laws of evolution whose essence is, that they lead to a degree of organization exactly proportionate to the wants of each species (for the time being), and never beyond those wants. Mr Wallace refers to Mr Darwin's remark, that natural selection does not make creatures perfect, but only slightly more perfect than their neighbours, so as to survive them in the battle of life.* Natural selection could only have endowed savage man with a brain a little superior to that of an ape, whereas he actually possesses one very little inferior to that of a philosopher.†

Mr Wallace does not believe that man's naked skin could have been produced by natural selection. 'A hairy covering is general among animals, and, by the long persistence of this character, it must have acquired such a powerful hereditary tendency, that we should expect it to re-appear continually, even after ages of most rigid selection; and we may

* 'Natural Selection,' 2nd edit. p. 334. † p. 356.

feel sure that it never could have been completely abolished under the law of natural selection, unless it had become so positively injurious as to lead to the almost invariable extinction of the individuals possessing it.' We shall soon see that Mr Darwin supposes the bareness of the human skin to have arisen from the intentional denudation of their persons by the early progenitors of man for beauty's sake.

But, says Mr Wallace, 'the hairy covering of the body is useful to animals, and man is deficient in this covering on the part of the body where it would be most useful, namely, on the lower part of the back, the spinal region; this part of the body is free from hair in all the races of men. The want of this covering is felt, and man supplies its place artificially. All savages have cloaks or coverings of some kind for the back.'

'The hand of man contains latent capacities and powers which are unused by savages. Again, as to the musical powers of the human voice; the habits of savages give no indication of how this faculty could have been developed by natural selection, because it is never required or used by them; the singing of savages is a more or less monotonous howling, and the females seldom sing at all. Savages never choose their wives for their fine voices; sexual selection, therefore, could not have developed this wonderful power, which comes into play only amongst civilized people.

Again, the capacity to form ideal conceptions of space and time, the capacity for intense artistic feelings of pleasure, in form, colour, and composition; and for those abstract notions of form and number which render geometry and arithmetic possible. How were all or any of these faculties first developed, when they could have been of no possible use to man in his state of barbarism? How could 'natural selection,' or the survival of the fittest, in the struggle for existence at all favour the development of mental powers (perhaps we should say, the development of a brain capable of mental powers) so entirely removed from the material necessities of savage man, and which even now, with our comparatively high civilization, are, in their farthest developments, in advance of the age, and appear to have relation rather to the future of our race than to its actual status?'

Mr Wallace finds similar difficulties as to the origin of the moral sense, but we need pursue the subject no further; enough has been stated to enable us to form a judgment upon the point, which apparently must be in Mr Wallace's favour.

As to these points, Mr Darwin observes,* that man, in the rudest state in which he now exists, is the most dominant animal that has ever appeared on the earth. He has spread more widely than any other highly organized form, and all others have yielded before him. Through his powers of intellect articulate language has been evolved; he has invented, and is able to use, various weapons, tools, traps, &c.; he has made rafts or canoes; he has discovered the art of making fire. These several inventions, by which man in his rudest state has become so pre-eminent, are the direct result of the development of his powers of observation, memory, curiosity, imagination, and reason. Mr Darwin therefore says, he cannot understand how it is that Mr Wallace maintains, that 'natural selection could

* 'Descent of Man,' 2nd edit. p. 48.

only have endowed the savage with a brain a little superior to that of an ape.' *

As to this point, we have to remark that perhaps Mr Wallace may be wrong in estimating the brain power required by savage life as only a little greater than that of an ape; but his point does not depend upon the literal acceptance of these particular words. Mr Wallace means, in general terms, that the brain power of savages is greater than is required for their ordinary mode of life, and this Mr Darwin's account of what they have done does not disprove.

Some of Mr Darwin's observations certainly seem to support Mr Wallace's views. He says,† the Fuegians rank amongst the lowest barbarians; yet the three natives on board the 'Beagle,' who had lived some years in England, and could talk a little English, resembled us in disposition, and in most of our mental faculties.

It is said that the children of the native Australians, when taken into our schools, make rapid progress, quite equal to that of their white companions.

* 'Descent of Man,' 2nd edit. p. 49. † Ibid., p. 65.

The reader will note how important this point, that savages have a brain power beyond their present needs, is to the question whether savages are the degraded descendants of a superior form, or whether they are rising from a state of utter barbarism, or, indeed, from an ape-like ancestor. The great size of the brain is certainly strong evidence in favour of the former supposition.

Mr Wallace's inference from these facts is, that a superior intelligence has guided the development of man in a special direction, and for a special purpose. Mr Wallace seems to think that some 'higher intelligence' may have directed the process by which the human race was developed. Even if this position is not accepted, the difficulties, says Mr Wallace, which have been put forward remain, and prove that some more general or more fundamental law underlies that of natural selection.

This is certainly a remarkable conclusion for an author to arrive at, who started by stating how much he had done to prove the action of natural selection; and Mr Wallace has been ridiculed as suggesting, that God made the brain and natural selection the lungs. The proper deduction, of course, is, that natural selection, if it did not make the brain, did not make any part of the creature.

The reader will note, that we need not attempt to explain how man became possessed of brain power so much beyond his wants in a savage state. It is sufficient for us to inquire whether he could have obtained it in accordance with Mr Darwin's theory of the survival of the fittest: how a power which he did not require and could not use, could have given its possessor any advantage in the battle of life.

CHAPTER IX.

Mr Darwin—The bodily structure of man—The mental powers of brutes—Animals have some power of reasoning—Instances in monkeys of wonder, curiosity, and the like—Is man alone capable of progressive improvement?—Archbishop Sumner as to this point—Possession of property—Making tools—Imitative language—Humboldt on a nocturnal tumult in an American forest—Sense of beauty in men and animals—Religion and development of a moral sense—Instances of a moral sense amongst animals—Case of the Cercopithecus and the eagle—A savage's notion of morality compared with our own — Man differs from animals by his vices—Development of man's body from an ape-like ancestor—Is the gait of the Gorilla an intermediate link between that of man and beast?—How man's skin came to be bare of hair—Darwin's answer to the Duke of Argyle's point as to the bodily weakness of man's form—Development of the intellectual qualities—Form of our ape-like ancestor—Our ape-like ancestor not superior to existing monkeys—Sexual selection—Beauty which cannot be ascribed to sexual selection—Sexual selection impossible on the principle of natural selection—Fastidiousness of taste on the part of the female injurious to the species—Case of the spike-horn buck—Objections to it not met by Darwin.

We will now inquire in what manner Mr Darwin himself accounts for the appearance of man upon the earth.

In the first place, Mr Darwin argues that the bodily structure, the mental powers, and the moral sense of animals, are not so far removed from those of man as to make his descent from some form of the lower animals impossible, or even improbable.

'Man is notoriously constructed on the same general type as other mammals; all the bones in his skeleton can be compared with corresponding bones in a monkey, bat, or seal; so it is with his muscles, nerves, blood-vessels, and internal viscera.'

'Man is liable to receive from the lower animals, and to communicate to them, certain diseases, as hydrophobia, variola, the glanders, &c., and this fact proves the close similarity of their tissues and blood. Monkeys are fond of intoxicating liquors. Man is plagued with parasites of the same genera as those which infest animals.'

Monkeys are born in almost as helpless a condition as children. It is, in short, says Mr Darwin, scarcely possible to exaggerate 'the close correspondence in general structure, in the minute structures of the tissues, in chemical composition, and in constitution, between man and the higher animals, especially the anthropomorphous apes.'

On these points we shall probably be disposed to agree with Mr Darwin without hesitation. Man is an animal, and must have many points in common with other animals.

We now come to Mr Darwin's views as to the mental powers of animals.

'The lower animals, like man, feel happiness and misery — witness the gambols of kittens and the like; even insects (ants) have been observed to play together. The lower animals are excited by the same emotions as ourselves; terror acts upon them in the same manner, they tremble, and their hair stands on end; some dogs and horses are ill-tempered and easily turn sulky; others are good-tempered. Many anecdotes are told of the long-delayed and artful revenge of animals. Whewell has remarked, "Who that reads the touching instances of maternal affection, related so often of the women of all nations, and of the females of all animals, can doubt that the principle of action is the same in the two cases?" A monkey was seen driving away the flies which plagued her infant; another washed the faces of her young ones in a stream. Orphan-monkeys are always adopted and carefully guarded by the other monkeys, both males and females.'

'The principle of imitation is strong in man in a barbarous state, and monkeys are well known to be ridiculous imitators. Animals have excellent memories for persons and places. Imagination is one of the highest prerogatives of man, it is shared by animals, as is shown by the dreams of dogs.'

'Animals even possess some power of reasoning. A wasp had been wrapped up in a piece of paper with some sugar, and given to a monkey, who was stung by the wasp; when another similar piece of paper containing sugar was offered to the same monkey he put it to his ear before opening it, so as to discover if there was anything moving about in it. A Retriever dog had to fetch two wounded wild ducks which fell on the opposite sides of a stream; she tried to bring both at once, but finding she could not do this, she killed one and left it, taking the other with her and returning for the one she had left dead.'

'The muleteers in South America say, I will not give you the mule which is easiest, but *la mas racional*,—the one that reasons best; and Humboldt adds, this popular expression, dictated by long experience, combats the system of animated machines (that animals are animated machines) better, perhaps, than all the arguments of speculative philosophy. Many of the more complex emotions are common to the higher animals and ourselves; a dog is jealous of his master's affection. Animals feel emulation, they love praise, a dog feels shame as distinct from fear, monkeys dislike being laughed at.'

'Animals enjoy excitement, and suffer from ennui, as may be seen with dogs; all animals feel wonder, and many exhibit curiosity. Monkeys have an instinctive dread of snakes, but some which were kept in confinement could not refrain from occasionally lifting the lid of a box in which snakes were kept, and thus satiating their horror.' Mr Darwin verified this account by trying an experiment in the Zoological Gardens. Taking there a living snake in a paper bag, one of the monkeys instantly approached the paper bag, but dashed away on finding the snake, and then monkey after monkey came to take momentary peeps into the bag at the dreadful object lying at the bottom of it.

'It has been asserted that man alone is capable of progressive improvement, that he alone makes use of tools or fire, domesticates other animals, possesses property, or employs language, that no other animal is self-conscious, comprehends itself, has the power of abstraction, or possesses general ideas; that man alone has a sense of beauty, is liable to caprice, has the feeling of gratitude, mystery, &c.; believes in God, or is endowed with a conscience.' Mr Darwin says he will hazard a few remarks on the more important and interesting of these points.

'As to the position that man alone is capable of progressive improvement, old animals are more wary and less easily caught than young ones, and the races of animals which are much hunted become more timid.'

Mr Darwin says 'our domestic dogs are descended from wolves and jackals, and though they may not have gained in cunning and may have lost in wariness and suspicion, yet they have progressed in certain moral qualities, such as affection, trustworthiness, temper, and probably in general intelligence. The common rat has conquered and beaten several other species throughout Europe, in parts of North America, New Zealand, and recently in Formosa and the mainland of China. In these latter cases, the victory of the common rat over the large Mus Coninga is attributed to its superior cunning, which latter quality had been gained by the habitual exercise of all its faculties in avoiding extirpation by man, as well as to nearly all the less cunning or weak-minded rats having been successively destroyed by him. To maintain, says Mr Darwin, independently of any direct evidence, that no animal during the course of ages has progressed in intellect or other mental faculties, is to beg the question of the evolution of species.'

Now here, again, is some tendency on Mr Darwin's part to miss the point in question. What is meant by progressive improvement?

Clearly a continuous advance, and this is not shown to have taken place because a dog has more general intelligence than a wolf or a jackal, or because one species of rat is more cunning than another. To meet the point, it must be shown that the wolves, dogs, and rats of to-day are more intelligent than the wolves, dogs, and rats of some thousand years ago. Every one knows the story of old Argus, who was the first to recognize his master Ulysses on his return from Troy, and died for joy on the occasion. The dog has been man's constant companion for a very long period, and has remained unchanged. And here we must remember that great part of the supposed increase of the intelligence of the dog as compared with that of a wolf or a jackal is due, not to innate spontaneous progress, but to the inherited effects of instruction received from man.

As to this point, we will quote a passage from Archbishop Sumner's 'Records of Creation.' 'If a comparison were to be drawn between man and the brute creation, it should be taken, not from the upright position, which is by no means confined to mankind, nor even from the vague term reason, which cannot always be accurately separated from instinct, but from that power of progressive and improvable reason which is man's peculiar and exclusive endowment.'

'It has often been alleged, and may be founded on fact, that there is less difference between the highest brute and the lowest savage than between the lowest savage and the most improved man. But, in order to warrant the pretended analogy, it ought to be also true that the lowest savage is no more capable of improvement than the Chimpanzee or the Orang-outan. Animals are born what they are intended to remain. Nature has bestowed on them a certain rank, and limited the extent of their capacity by an impassable decree. Man she has empowered and obliged to become the artificer of his own rank in the scale of beings by the peculiar gift of improvable reason.' *

Mr Darwin alludes to this passage, and allows that man is capable of incomparably greater and more rapid improvement than any animal, but this is mainly due to his

* 'Records of Creation,' Part II. Chap. ii.

power of speaking and handing down his acquired knowledge. Perhaps this is only removing the difficulty a step further back. How did man acquire language? Professor Max Müller makes the possession of language the fundamental difference between man and brutes.

Progression seems to be a constituent part of man's mental powers, but not of those of brutes. Can we then say that the mental power of brutes is the same as that of man, differing only in degree, when it wants this important element? Again, the ape-like ancestors of man when they branched off from the old world apes of that time could have been but very little superior to them in any way. How then, on the supposition that their mental powers and those of apes were the same in kind, have they made such great and the apes such small advances? According to Mr Darwin's own theory, as our ape-like ancestors and their contemporaries were produced by natural selection, that principle could not have given so great a power to advance to one branch and have left the other so incapable of progress, as this incapacity to vary would have been a disadvantage to the creature in which it occurred. In studying a theory of which change and development are the essence, we are startled by suggestions of persistence of form injurious to the creatures in which it occurs.

As to the point of possessing property, Mr Darwin mentions a monkey in the Zoological Gardens which had weak teeth, and used a stone to break open nuts. This stone it hid in the straw when not in use, and it would allow no other monkey to touch it. Here then, says Mr Darwin, we have an idea of property, but this idea, he says, is common to every dog with a bone, and to most or all birds with their nests. The reader will probably think that by the words, possesses property, something more is implied than a dog's tenure of the bone in its mouth, or even than a bird's possession of its nest; every animal must possess what it is actually eating or using at the time.

As to the position that man alone makes use of tools, Mr Darwin says the Chimpanzee in a state of nature cracks nuts with a stone, and an American monkey, which was taught to open hard palm-nuts with a stone, afterwards of its own accord used stones to open other nuts. Another monkey was taught to open the lid of a box with a stick, and it afterwards used the stick as a lever. Baboons, too, are said to roll down stones on their enemies from the tops of the hills which they inhabit. As to the Duke of Argyle's remark that the fashioning of an implement for a special purpose is absolutely peculiar to man, and that this forms an immeasurable gulf between man and brutes, Mr Darwin allows that it is a very important distinction, but seems to think it is explained by Sir J. Lubbock's suggestion, that man used accidentally split flint-stones as tools in the first instance, and that the transition would be easy to the purposely splintering of flints to be used as tools. Mr Darwin also approves of Sir John Lubbock's view, that probably fire was discovered during this process of splintering flints for tools.

Mr Darwin says * 'the anthropomorphous apes, guided probably by instinct, build for themselves temporary platforms; but, as

* 'The Descent of Man,' p. 82.

many instincts are largely controlled by reason, the simpler ones, such as this of building a platform, might readily pass into a voluntary and conscious act. The orang is known to cover itself at night with the leaves of the Pandanus, and Brehm states that one of his baboons used to protect itself from the heat of the sun by throwing a straw mat over its head. In these several habits, says Mr Darwin, we probably see the first steps towards some of the simpler arts, namely, rude architecture and dress as they arose amongst the early progenitors of man.' The reader can form his own opinion on these matters; we may observe that no simple arts have as yet been evolved from these instincts amongst the anthropomorphous apes, and they are at least as highly organized as the quadrumanous animals from whom Mr Darwin supposes that we are descended. These platforms, too, are very inferior productions to the nests of the tailor-bird or the squirrel, not to speak of the houses of the beavers; and as to monkeys covering themselves at night, every dog will make himself a bed in the straw of his kennel,—indeed, many animals make for themselves sleeping places.

With respect to the origin of articulate language, Mr Darwin says that, after having read the highly interesting works of Mr Hensleigh Wedgwood, the Rev. F. Farrar, and Professor Schleicher on the one side, and the celebrated lectures of Professor Max Müller on the other side, he cannot doubt that language owes its origin to the imitation and modification of various natural sounds, the voices of other animals, and man's own instinctive cries aided by signs and gestures.

It does not appear altogether incredible, says Mr Darwin, that some unusually wise ape-like animal should have thought of imitating the growl of a beast of prey, so as to indicate to his fellow-monkeys the nature of the expected danger, and this would have been a first step in the formation of language.

Now as to this question, we must allow that we are not competent to decide between rival theories of the origin of language, and any attempt to investigate them would lead us too far from our subject. But some points strike us as bearing upon the development hypothesis: (1) If language arises from the imitation and modification of natural sounds, the voices of other animals and man's instinctive cries, as these elements must be much the same all over the world, we should expect a greater similarity between the languages of different nations than that which now exists; (2) as Mr Darwin has told us that monkeys are great imitators, we should expect, according to his theory of the origin of language, to find some traces of language among them,—there would surely be now some ape having some form of imitative language; is this the case? We quote from Humboldt* an account of what may be called the conversation of an evening party in the wilderness: 'About eleven o'clock a noise so terrific arose in the neighbouring forest that it was impossible to close our eyes. Amid the cries of so many wild beasts, the Indians discriminated the little soft cries of the sapajous, the moans of the alonates, the howlings of the tiger, the congar, or American lion without mane, the pecari, and the sloth, and the voices of the curassoa, the parraka,

* 'Personal Narrative,' vol. iv. p. 436.

and some other gallinaceous birds. Sometimes the cry of the tiger came from the tops of the trees, and in this case it was followed by the sharp and long whistling of the monkeys, which appeared to flee from the danger that threatened them. The natives say these beasts of the forest are keeping the feast of the full moon.'

The reader will note that each of these creatures has its own peculiar cry, there is no appearance of any approach to the growl of the dreaded beast of prey.

Humboldt supposes this agitation among the beasts of the forest to be caused by some contest between the jaguars and their prey, and here we meet with a point of some significance; how, on the principle of utilitarian development, did these creatures acquire the habit of uttering these cries under such circumstances? we should have thought the tiger who hunts alone would be more likely to take his prey if he stole upon it in silence; so, on the other hand, the weaker beasts betray their situation by their cries, and lead their enemy to the place in which they are. The cries of the monkeys may be the result of social instinct and a warning to their fellows to fly, but why should the sloth, who is a solitary animal, and incapable of rapid motion, utter cries which can only serve to betray it to its enemies?

'A parrot can speak, but animals cannot use articulate language, because that depends upon man's large power of connecting definite sounds with definite ideas, and this obviously depends upon the development of the mental faculties. The higher apes possess organs which seem capable of speech, if only they had sufficient intelligence. The mental powers of the early progenitors of man must have been more highly developed than in any existing species of ape before even the lowest form of speech could have come into use.' We shall see that in all probability the ape-like ancestor from whom man is supposed to be descended, was not superior in intelligence to existing apes, and mankind, if they came into the world as Mr Darwin supposes, must have long remained speechless.

The reader will have remarked that Mr Darwin appears to argue in a circle, sometimes making articulate language a result of mental development, and sometimes supposing that mental development must precede the existence of language. Mr Darwin, however, appears to think that the body of the ape-like ancestor of man was modified when he branched off from the old world apes, and that such modification of form enabled him by degrees to improve his intellect, until language became possible, and that then language aided in the further development of the whole being.

We may mention here that there is much dispute among the cultivators of the science of language as to whether thought, that is, mental conception as distinguished from feeling, can exist in the mind without language, or whether language is merely the means of communicating thoughts already conceived in the mind. Possibly mental conceptions, such as we now find them, are impossible without the aid of language, though to a certain extent they might exist independently of the faculty of articulate speech. This, however, is another question into which we cannot profitably enter, and which we must leave to those who, as Max Müller says, have devoted a life-time to the science of language.

'As to self-consciousness, individuality, abstraction, general ideas, and the like, which, according to several recent writers, make the sole and complete distinction between man and brutes. It is in vain, says Mr Darwin, to expect such faculties until man's mental powers had advanced to a high standard, and this implies the use of a perfect language. Perhaps an old dog in his dreams may reflect on his past pleasures in the chase; and, on the other hand, how little can the hard-worked wife of a degraded Australian savage, who uses hardly any abstract words and cannot count above four, exert her self-consciousness, or reflect on the nature of her own existence!'

'Men and animals have the same sense of beauty, witness the beautiful plumage of male birds, which charm the females, and with which women everywhere deck themselves. The same sounds also are agreeable to men and animals. Why certain sounds and colours excite pleasure, cannot, Mr Darwin says, be explained. In connection with this subject, Mr Darwin remarks that, judging from the hideous ornaments and equally hideous music admired by most savages, it might be urged that their æsthetic faculty was not so highly developed as in some animals, as, for instance, in birds.'

This is a most important remark. How can the higher animals have lost this sense of beauty if they are developed from the lower forms which possess it?

Mr Darwin says, obviously no animals could be capable of admiring such scenes as the heavens at night, a beautiful landscape, or refined music; such high tastes depend upon culture and complex associations, and are not enjoyed by barbarous or uneducated persons.

'If man was aboriginally endowed with the ennobling belief of an Omnipotent God, it would, of course, at once separate him from animals; but Mr Darwin says there is no evidence that he was so endowed. There is ample evidence, he says, that numerous savage nations have existed, and still exist, who have no idea of one or more Gods, and who have no words in their language to express such an idea.'

But, says Mr Darwin, if we include under the term religion the belief in unseen and spiritual agencies, the case is wholly different, for the belief seems almost universal with the less civilized races.

'The belief in spiritual agencies would readily pass into a belief in the existence of one or more Gods. The Fuegians seem to be in this respect in an intermediate stage; for when the surgeon on board the "Beagle" shot some youug ducklings as specimens, York Minster declared, in the most solemn manner, Oh, Mr Bynoe, much rain, much snow, blow much,—and this was evidently a retributive punishment for wasting human food. So, again, he related how, when his brother killed a wild man, storms long raged, much rain and snow fell.' The reader will perhaps think that these ideas of retributive justice are most extraordinary in a people so low in the scale of humanity as the Fuegians, and that they point to something more than a belief in the existence of a savage and vindictive spirit. Mr Darwin, however, says he could never discover that they believed in God, or practised any religious rites. As to this point we must remember what Mr Tylor has told as to the non-existence of religion amongst savages, in particular, their desire to conceal their views upon the matter from strangers.

The argument seems to be that we must not expect to find in brutes qualities which only highly-cultivated man can have, and which could not have existed in primitive man. These qualities are the result of development, and cannot therefore exist in the undeveloped.

'Of all the differences between man and the lower animals, the moral sense, or conscience, is by far the most important. Whence comes this sense? Any animal whatever endowed with well-marked social instincts would, says Mr Darwin, inevitably acquire a moral sense or conscience as soon as its intellectual powers had become so well developed as in man, for (1) the social instincts lead an animal to take pleasure in the society of its fellows, to feel a certain amount of sympathy with them, and to perform various services for them; (2) as soon as the mental powers have become highly developed images of all past actions would be incessantly passing through the brain of each individual; and that feeling of dissatisfaction which always results from any unsatisfied instinct, would arise in the mind of any individual who, in the gratification of some momentary desire, had lost sight of the great social instinct, the promotion of the general good; (3) after the power of using language had been acquired the common opinion, how each individual should act for the public good, would, to a large extent, become the guide of action; lastly, habit would play an important part in guiding the conduct of each member.'

Mr Darwin gives many instances in which animals render important services to each other. Wolves, and some other beasts of prey, hunt in packs, and aid each other in attacking their victims. Pelicans fish in concert, and have been known in one instance to feed an old blind companion.

'The Hamadryas baboons turn over stones to find insects, &c.; and when they come to a large one, as many as can stand round turn it over together and share the booty. Social animals mutually defend each other. A young baboon, being surrounded by dogs, climbed upon a rock, and loudly called for aid. One of the largest males in the troop, a true hero, says Mr Darwin, came down from the mountain, went to the young one, coaxed him, and triumphantly led him away, the dogs being too much astonished to make an attack. Mr Darwin says he cannot resist giving another scene: an eagle seized a young cercopithecus, which, by clinging to a branch, was not at once carried off; it cried loudly for assistance, upon which the other members of the troop rushed to the rescue, surrounded the eagle, and pulled out so many of his feathers, that he no longer thought of his prey, but only how to escape.' This is, indeed, a wonderful instance of gallantry and reason. It was a noble deed to attack so fierce a creature in defence of their companion, and they evinced great judgment in the manner of their assault; they could not hope to do any serious bodily harm to the eagle, but to pluck him was a great idea, and their nimble little hands would carry it well out. It would be painful to suggest, that the plucking might be only the consequence of their attempts to pull the eagle away from their companion.

Mr Darwin says it must have been sympathy which led the baboons and cercopithecus to defend their young comrades from the dogs and the eagle, and he gives an instance of sympathy and heroic conduct in a little American monkey. 'A keeper at the Zoological Gardens was attacked while kneeling on the floor by a fierce baboon. The little American monkey, who was a warm friend of the keeper, lived in the same large compartment as the baboon, and was dreadfully afraid of him. Nevertheless, as soon as he saw his friend, the keeper, in peril, he rushed to the rescue, and by screams and bites so distracted the baboon that the man was able to escape after running great risk of his life.'

The reader will remark how much the origin of the moral sense as here described is made to depend upon man's social habits, and will, perhaps, remember that in a savage state, men do not, indeed cannot, live together in large communities; they cannot do so until they have advanced so far in civilization as to possess flocks and herds, or to till the ground, and these social habits and feelings are not the necessary results of living together. Many animals live quite as much together as men; indeed, much more so than savage men, yet animals do not become social; they have not acquired the social habits and feelings of man, nor the resulting language, reason, or conscience. Granting all Mr Darwin asks from us, we have still the question before us—how did man, and man alone, acquire those social habits and feelings from which so much has been developed?

Mr Darwin remarks, 'that the strictly social virtues are those which are alone at first regarded. No tribe could hold together if murder, robbery, treachery, &c. were common; consequently, such circumstances within the limits of the same tribe are branded with infamy, but excite no such sentiment when perpetrated beyond those limits. A North American Indian is well pleased with himself, and is honoured by others, when he scalps a man of another tribe, and a Dyak cuts off the head of an unoffending person, and dries it as a trophy. It has been recorded that an Indian Thug conscientiously regretted that he had not robbed and strangled as many travellers as did his father before him. Mr Darwin implies that savages may have morality, though it is not the same as our own.'

We look down upon these savages, but are we much better than they? We protect life and property most carefully within our own bounds, but in spite of our boasted civilization, in spite of a religion whose essence is love of our fellow-creatures, we are ready, upon slight provocation, sometimes from mere lust of conquest or hope of glory, to slaughter our neighbours by wholesale, and inflict upon people who personally have never offended us all the horrors of war. We waste in warlike preparation, an amount of capital and labour which, employed on peaceful objects, would provide subsistence for millions, not to speak of the loss of so much valuable labour during the time the soldier is learning his drill. All Europe is now armed; we have almost reached again the state of the North American Indians, among whom each man was a warrior, and war the business of life. It is useless to speculate as to what will be the ultimate effect of this state of affairs upon mankind; and, indeed, it is beyond our province.

Man seems to possess some characteristics, which he can hardly have derived from a brute ancestor, or have developed as social virtues. Some of his vices seem peculiar to himself; many instances will occur to the reader, we may mention, pleasure in the contemplation of suffering. This is unknown among beasts. The cat, when playing with a mouse, does not enjoy the mouse's misery, but is pleased with the dexterity with which she catches it again and again. But the pleasure which the Romans had in the amphitheatre must have been pure enjoyment of the sight of suffering. Most savages delight in torturing their enemies, and even animals who have done them no harm. There are many points in which man does not compare favourably with animals; no animals behave so cruelly to each other as men, and male animals always show consideration for their females and defend them. Savages, as a rule, treat their women brutally.

Mr Mivart * seems to think that Mr Darwin misses the point as to the acquisition of the moral sense by mankind. Acts, he says, may be divided into materially moral acts, and acts which are formally moral. The first are

* Mivart, 'Genesis of Species,' p. 220.

acts good in themselves, as acts, apart from any intention of the agent, which may or may not have been directed towards 'right.' The second are acts which are good, not only in themselves, but also in the deliberate intention of the agent, who recognizes his actions as being 'right.'

'Actions of brutes, such as those of the bee, the ant, or the beaver, however materially good as regards their relation to the community to which such animals belong, are absolutely destitute of the most incipient degree of formal goodness, because unaccompanied by mental acts of conscious will, directed towards the fulfilment of duty.'

'No sign of moral reprobation is given by any brute, and yet had such existed in germ through Darwinian abysses of past time, some evidence of its existence must surely have been rendered perceptible through "survival of the fittest" in other forms besides man, if that "survival" has alone and exclusively produced it in him.'

'"Natural selection" would, of course, often lead to the prevalence of acts beneficial to a community, and to acts materially good; but unless they can be shown to be formally so, they are not in the least to the point; they do not offer any explanation of an altogether new and fundamentally different motive and conception.'

The reader will see that Mr Darwin belongs to the experiential school of philosophy, whose disciples maintain that moral conceptions have been evolved from original feelings of expediency, while Mr Mivart belongs to the opposite school, who argue that a sense of abstract right and wrong, and of duty, could never have been acquired in this manner, but must be intuitional. This, however, is a question into which we cannot enter; it could not be profitably considered except by those who have devoted their whole time to its study, and we can form a sufficiently accurate estimate of Mr Darwin's theory independently of it.

We will now turn to the manner in which Mr Darwin supposes man to have been developed.

'As soon as some ancient member of the great series of the primates, owing to a change in the manner of procuring subsistence, or to a change in its native country, came to live somewhat less in trees, and more on the ground, its manner of progression would have been modified. Man could not have attained his dominant position without the use of his hands, and his hands could not have acquired their delicate sense of touch while used as organs of locomotion. For many purposes it is necessary that both arms and the upper part of the body should be free, and for this end man must stand firmly on his feet. To gain this position, the feet have been rendered flat. It accords with the division of physiological labour which prevails throughout the animal kingdom, that as the hands became perfected for prehension, the feet should become perfected for locomotion.'

Mr Darwin goes on to say that 'if it be an advantage to a man to have his hands and arms free, and to stand firmly on his feet, of which there can be no doubt from his pre-eminent success in the battle of life, there can be no reason why it should not have been advantageous to the progenitors of man to have become more and more erect or bipedal, they would thus have been better able to have defended themselves with stones or clubs. The best constructed individuals would in the long run have succeeded best, and would have survived in the largest number. If the Gorilla and a few allied forms had become extinct, it might have been argued, with great force and apparent truth, that an animal could not have been gradually changed from a quadruped into a biped, as all the individuals in an intermediate condition would have been miserably ill-fitted for progression. But we know, and this, says Mr Darwin, is well worthy of reflection, that several kinds of apes are now actually in this intermediate condition, and no one doubts that they are on the whole well adapted for their conditions of life. We see in existing monkeys various gradations between a form of progression strictly like that of a quadruped, as in the baboons, whose gait is that of a dog, and that of a biped or man.'

'As the progenitors of man became more and more erect, with their hands and arms more and more modified for prehension and other purposes, and their feet and legs at the same time modified for firm support and progression, endless other changes of structure would have been necessary. The pelvis would have to be made broader. The spine peculiarly curved, and the head fixed in an altered position, and all these changes, says Mr Darwin, have been attained by man.'

Is Mr Darwin justified in treating the Gorilla as an intermediate link between man and apes in the matter of locomotion? Is upright walking customary with him? Does he make use of his advantages in any degree to use clubs or stones to defend himself? Is his form in the slightest degree modified by his habit, such as it is, of walking? We have seen from Professor Huxley's account of this animal that all these questions must be answered in the negative. We believe most naturalists deny that any animal of the ape tribe customarily uses an upright position in locomotion. Of all the quadrumana, baboons are the least arboreal in their habits, and their mode of locomotion on the ground is described by Mr Darwin as being almost like that of a dog. It certainly does not seem that walking erect is a necessary consequence of ceasing to climb.

Mr Darwin accounts for man's being destitute of a hairy covering common to apes even in the warmest countries by the supposition that man, or, as he says, primarily woman, became divested of hair for ornamental purposes, and this fashion we suppose in time introduced a constitutional bareness. We have already seen Mr Wallace's observations on this point, we shall meet with it again when examining Mr Darwin's theory of sexual selection.

Mr Darwin has to meet the objection that man as a mere animal is one of the most helpless and defenceless creatures in the world, and that during his early and less well-developed condition, he must have been more defenceless still. And he quotes the Duke of Argyle's observation, that the human form has diverged from the structure of brutes in the direction of greater physical helplessness and weakness, that is to say, it is a divergence which of all others it is impossible to ascribe to mere natural selection. The Duke, says Mr Darwin, adduces the naked and unprotected state of the body, the absence of great teeth or claws for defence, the little strength of man, his small speed in running, and his slight power of smell by which to discover his food or to avoid danger. Mr Darwin is not content with this series of difficulties to be answered, and says that to them might be added the still more serious one, the loss of the power of quickly climbing trees so as to escape from enemies.

Mr Darwin meets these difficulties (1) by stating that the Fuegians under their wretched climate can exist without a hairy covering and without clothing; (2) that the great canine teeth of apes are used by them chiefly in fighting with each other, and that the females, though destitute of these teeth, are able to exist. (We must remember that they are protected by the males.) (3) We do not know, says Mr Darwin, whether man is descended from a small anthropomorphous animal like the Chimpanzee, or from a powerful one like the Gorilla, so we cannot tell whether he is weaker or stronger than his ancestor. Does Mr Darwin mean that a mere increase in size from the ancestral form would be sufficient to make the change advantageous to man, apart from the acquisition of reason, and would alone be sufficient to compensate him for the loss of his bestial powers?

Mr Darwin says it may have been of advantage to man to have been descended from a weak form of a quadrumanous animal, as thus he would be necessarily more social, and from his social tendencies many of his greatest qualities have been developed. Here we think is another case in which Mr Darwin fails to meet the point made against his view. The question seems to be, not whether man has descended from a weak or a strong ancestor, but how, given the ancestor strong or weak, a deviation from that form to one of less bodily power could have been advantageous without the acquisition of reason?

As to the slight corporeal strength of man, his little speed, his want of natural weapons, &c., they are, Mr Darwin says, more than counterbalanced by his intellectual qualities, through which he has, whilst still remaining in a barbarous state, found for himself weaons, tools, &c.; and (2) by his social qualities, which lead him to give aid to his fellow-men and to seek it in return. 'No country in the world abounds in a greater degree with dangerous beasts than South Africa, no country presents more fearful hardship than the Arctic regions, yet one of the puniest races, namely, the Bushmen, maintains himself in Southern Africa, as do the dwarfed Esquimaux in the Arctic regions. The early progenitors of man were no doubt inferior in intellect, and probably in social disposition, to the lowest existing savages, but it is quite conceivable that they might have existed or even flourished, if, whilst they gradually lost their brute-like powers, such as climbing trees, &c., they at the same time advanced in intellect.'

The reader will be inclined to agree with Mr Darwin here. The difficulty is to account for the acquisition by the brute-like ancestors of man of the necessary intellectual powers. So far as we at present understand Mr Darwin, these intellectual powers seem to be the result, not the accompaniment, of evolution and bodily development.

We now turn with great interest to Mr Darwin's theory of the development of the intellectual and moral qualities of primeval man, and here we must say we are greatly disappointed.

Mr Darwin says the intellectual and moral faculties of man are variable, and we have every reason to believe that the variations tend to be inherited. Therefore, if they were formerly of high importance to primeval man and to his ape-like progenitors, they would have been perfected or advanced through natural selection. Is not Mr Darwin here begging the whole question? May we assume that our ape-like ancestor possessed a spark of reason like our own? if so, we can see how it might be improved by natural selection; but the point is, how was this spark acquired? how did it arise in our ape-like ancestors by the process of natural development from earlier forms which did not possess it? Mr Darwin then goes on to show the high importance of the intellectual faculties, of which, he says, there can be no doubt. In this the reader will at once agree with him. Mr Darwin says it would undoubtedly have been very interesting to have traced the development of each separate faculty from the state in which it exists in the lower animals to that in which it is found in man. Now this is exactly what we do want to know, how to account for what Sir C. Lyell has called the leap from the irrational to the rational, and as to this point Mr Darwin says neither his ability nor his knowledge permits the attempt at explanation.

Mr Darwin * traces the pedigree of man from a very humble form of marine animals, through a long series of creatures to the Simiadæ, who then branched off into two great stems, the new world and the old world monkeys, and from the latter at a remote period, man, the wonder and glory of the Universe, proceeded. Man is descended from an ape-like ancestor, but not, Mr Darwin says, from one similar to any form of ape now in existence. In his second volume Mr Darwin gives us a slight description of our ape-like ancestor; he was a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in his habits, and a native of the old world.

In his second volume † Mr Darwin approaches the subject of man's development again, and argues that though the interval between the mental power of one of the

* 'Descent of Man,' 1st edit. vol. i. p. 213; 2nd edit. p. 165.

† 'Descent of Man,' 1st edit. p. 390; 2nd edit. p. 609.

highest apes and of a fish (the reader will remember that mammalia are supposed to have had an aquatic creature for their ancestor) is immense, yet the mental power of the apes has been derived from that of fishes; why, then, should not the mental power of man be derived in like manner from his ape-like progenitor?

In considering this argument, we must remember that the ape-like ancestor from whom man descended at a remote period—the hairy, pointed-eared creature—could not have been superior if equal to the existing anthropomorphous apes; yet the development of these man-like apes is not sufficiently great to permit the existence among them of any dawn of language or reason. We cannot, therefore, conceive that any such beginning of reason could have taken place naturally in the supposed pointed-eared ancestor of man.

This is a very important consideration, for we could get over all those objections taken by the Duke of Argyle as to the modification of the ancestral form being towards increased weakness instead of strength, if we could suppose that the modification was not in the first instance of form, but of intellect, any improvement of which would clearly be a gain to the individual ape-like ancestor in whom it occurred, though his form was not changed at the same time, and the modification of form might have followed that of the intellect, as the improved individual endeavoured to avail itself of its increased powers, for which it would require, as Mr Darwin has suggested, the free use of its hands and arms, and a firm position on its feet.

In this work Mr Darwin enters at great length into the consideration of what he calls sexual selection, that is, the preference shown to particular mates. It is not easy to see how circumstances conducive to the union of two individuals of one species could tend to give rise to a new species. But Mr Darwin makes use of this principle to explain many phenomena which he cannot account for by the play of natural selection, and it is, as we have seen, of the greatest importance to his theory that he should be able to account for all the phenomena of organic nature by that theory; for if any case were left unexplained by it, we might be led to resort to the action of a

First Cause, a conclusion which would be fatal to Mr Darwin's theory.

As to beauty, which cannot be ascribed to the action of sexual selection, Mr Darwin attributes it to accidental chemical structure.

'The splendid tints of many of the lower animals are the direct result, either of the chemical nature or the minute structure of their tissues, independently of any benefit thus derived. Hardly any colour is finer than that of arterial blood, but there is no reason to suppose that the colour of the blood is of any advantage, and though it adds to the beauty of the maiden's check, no one will pretend that it was acquired for that purpose. So, again, with many of the lower animals the bile is richly coloured. The extreme beauty of the naked sea-slugs is chiefly due to the biliary glands seen through the translucent integuments, this beauty being probably of no service to these animals. The tints of the decaying leaves in an American forest are described by every one as gorgeous, yet no one supposes that these tints are of advantage to the trees. Bearing in mind, says Mr Darwin, how many substances closely analogous to natural organic compounds have been recently found by chemists, and which exhibit the most splendid colours, it would have been a strange fact if substances similarly coloured had not often originated independently of any useful end being thus gained in the complex laboratory of living organisms.'

Now upon this point we must observe, that all colours, that of the plumage of birds, as well as that of the leaves of trees, must depend upon structure, upon the manner in which the coloured object acts upon the rays of light; the question is, how organic objects acquired this peculiar structure? It is not a necessary incident to the decay of leaves, for many dying leaves are of a dirty brownish colour. How, then, are we to account for these beautiful colours? are they the result of accident? We are tempted to ask, what is an accident? and is there such a thing in the polity of nature? Are the colours, then, the result of some law of nature, giving rise to these beautiful objects for the sake of beauty and variety only?

To return to the question of sexual selection, amongst most animals the males are more highly adorned than the females, and Mr Darwin supposes that their beauty has been acquired by the females giving the preference to those males which showed the greatest approach from time to time to the forms and colours which we now see. Mr Darwin has evidently great difficulties to contend with as to this point. The males of birds are not always more brilliantly coloured than the females. The beautiful plumage does not appear till the bird becomes mature, and it is found only at particular seasons. Mr Darwin enters upon an examination of the laws of inheritance, from which he endeavours to meet these and other similar points, but adds, these laws from unknown causes are very liable to change, hence the successive steps in the modification of a species might readily be transmitted in different ways, some of the steps being transmitted to one sex and some to both, some to the offspring at one age and some at all ages; not only are those laws of inheritance extremely complex, but so are the causes which induce and govern variability. The variations thus caused are preserved and accumulated by sexual selection, which is in itself an extremely complex affair, depending as it does on ardour in love, courage, and the rivalry of the males, and on the powers of perception, taste, and will in the females. Sexual selection will also be dominated by natural selection, for the general welfare of the species. Hence the manner in which the individuals of either sex, or of both sexes, are affected through sexual selection cannot fail to be complex in the highest degree.

We can agree with Mr Darwin as to this point, there is no doubt as to the difficulty of the question. It is not, however, necessary for us to follow him in detail in the discussion of it, for we think that his position, that sexual selection would be dominated by natural selection for the general good of the species, is fatal to the whole theory of sexual selection. Mr Darwin allows 'that many characters proper to the adult male would be of no service, or actually injurious, to the young, as bright colours from making them conspicuous, or horns of a large size from expending much vital force; such variations in the young would be promptly eliminated through natural selection. The adult and experienced males, on the other hand, though exposed to nearly the same dangers as the young animals, would find a compensation for these disadvantages in the preference shown them by the females.'

We think there is a fatal flaw in this argument. Mr Darwin does not appear to distinguish between the struggle for mates amongst the individuals of a species and the struggle for existence between species. The acquisition of ornament might be an advantage to its possessor in the rivalry of the males of a given species, but it could never give strength to a species, and assist it in the great and general struggle which goes on in nature, unless the acquired ornament increased the prolificness of the species to so great a degree as to more than compensate it for the increased destruction of individuals which would take place through their being more conspicuously coloured, and Mr Darwin does not attempt to show that the fecundity of a species is increased by the acquisition of ornament; the utmost that can be said upon this point is, that the most highly adorned males are probably the healthiest, and, therefore, the first to breed, but this does not prove that the healthiest males in unadorned races are not also the first to breed. Let us take our common wild rabbit as an example, and suppose the males to be obliged, in order to please the females, to assume a more conspicuous colour, to become whitish, for instance. Is it conceivable that, because some rabbits were whiter than others, and were thus more agreeable to the females, the race of rabbits would thereby be benefited to such a degree as to compensate it for the greater danger to which its more conspicuous colour exposed it, or, indeed, to any degree whatever?

This point is a most important one, for the existence of ornament is fatal to Mr Darwin's theory, and to all theories of simple utilitarian evolution, unless it can be shown that the adornment increases the vigour of a race, and its chance of survival in the battle of life.

Mr Darwin allows, that it is an astonishing fact that the females of birds, of reptiles, of fishes, and even of insects, should have the same sense of beauty as to colour as highly cultivated man, while the ornaments of savages are hideous in our eyes. As to this point, Mr Darwin contents himself with saying, 'we really know very little about the minds of the lower animals. It cannot be supposed that male birds of paradise and peacocks, for instance, should take so much pains in erecting, spreading, and vibrating their beautiful plumes before the females for no purpose. Nevertheless, says Mr Darwin,* I know of no fact in natural history more wonderful than that the female argus pheasant should be able to appreciate the exquisite shading of the ball and socket ornaments and the elegant pattern on the wing feathers of the male.' We may add, that she should have appreciated the first dawnings of these beauties, have foreseen their future excellence, and so have perfected them. These facts are, indeed, astonishing. We may remark, that though Mr Darwin gives instances in which particular female birds have preferred particular males, he has not shown that the preference was due to any particularly distinct excellence in the special kind of beauty for which the species is remarkable.

* 1st edit. vol. ii. p. 400; 2nd edit. p. 616.

We may note, that the fact that the peacock vibrates his beautiful feathers in the presence of the pea-hen, is not necessarily a proof of their origin by sexual selection, he might equally do so on the principle of special creation.

The reader will remember the remark by the author of the paper on 'Darwinism' in 'The Quarterly Journal of Science,' that mammalia are less brilliantly coloured than the lower animals, and Mr Darwin's observation that the æsthetic faculty of savage man is not so highly developed as in some animals. It is a curious fact, that as we advance in the scale of nature, there should be found a growing tendency to disregard what is considered of so much importance among the lower forms, and that the taste should re-appear in cultivated man; the fact seems difficult of explanation on any principle of evolution.

And, again, there is the usual question, how does it happen that sexual selection is not universal? that while the female argus pheasant has such a keen perception of beauty, the hen partridge and many other birds have been content with such comparatively plain mates. We cannot suppose that no occasional variations occurred in these latter cases on which sexual selection could act, for, on the supposition that these birds and all others were formed by natural selection, they ought, as we have seen, to have acquired the same, or very nearly the same, degree of variability. Again, why, as a general rule, are the birds of tropical countries more adorned than those of the temperate zones? how is this fact to be accounted for by sexual selection? It cannot be because the passions are stronger in warm than in cold climates, for the effect of this greater strength would be a less regard to refinement in beauty.

And this brings us to the general question which lies beneath all these points, how did the females acquire a taste for beauty which compels the males to assume a garb which is positively injurious to them? How could the taste be acquired in a course of simple utilitarian evolution by the survival of the fittest in the battle of life? we are not now speaking of how the beautiful plumes themselves have been acquired, but how some females obtained such extreme fastidiousness of taste as to make them decline any less beautiful mate.

It is evident that this fastidiousness, like the limitation of the fertilization of red clover and the orchids to the instrumentality of peculiar insects only, is a disadvantage to its possessor, and could, therefore, never have been acquired in the battle of life. Clearly, a bird which had not this peculiar taste, which, on the other hand, preferred a plain mate, would be most likely to leave offspring which would survive in the struggle of life.

Finally, as to this question, we must call the reader's attention to the point, that if sexual selection cannot be maintained, the numerous instances of beauty in birds and other creatures which Mr Darwin places before his readers, are, in fact, only so many arguments against the principle of natural selection.

As to the position that mankind acquired bareness of skin through sexual selection, we have already seen Mr Wallace's observations upon it, and the strong arguments which he brings against it; we will here call the reader's attention to a few points: (1) The fur of a monkey—and such we suppose must have been the covering of our ape-like ancestor—is very unlike the hair found on the human body, it is a real fur, and would be extremely difficult to remove; we may fancy the task of constantly plucking or shaving such a creature.

As to the point that the loss of his hairy covering would have been injurious to early man, Mr Darwin says,* that it is not surprising that a slightly injurious character should have been acquired by sexual selection, for we know that the plumes of some birds and the horns of some stags have been thus acquired. We have, however, already seen cause to think Mr Darwin wrong on this point. Does he suppose that the fertility of the human race was increased by the loss of their covering?

Again, the admiration of a bare skin must have been universal throughout the world in order to give rise to the general bareness of man's skin, and we know how different are the views of different races of men as to what constitutes beauty in other respects. We cannot suppose that a change so great, and which Mr Wallace has shown to be so difficult, could have taken place before mankind separated into races.

* 1st edit. vol. ii. p. 377; 2nd edit. p. 601.

Is not the whole idea of this origin of man's bare skin simply a supposition, quite unsupported by evidence, and eminently improbable? how could such a caprice have arisen in such creatures as our ape-like ancestors, who, we must remember, were in all probability inferior to existing apes, who show no trace of such preference?

In this work, when speaking of the law of battle amongst animals, Mr Darwin gives us a case in which he considers that the horns of a species of deer are now actually in the process of being modified by natural and sexual selection. A hunter, who for twenty years had hunted in a district of America where a particular species of deer abounds, first heard of spike-horn bucks about fourteen years ago; these became from year to year more common. About five years ago this hunter shot one, and subsequently another, and now they are frequently killed. The spike-horn differs *greatly* from the common antler: it consists of a single spike more slender than the common antler and scarcely half so long, projecting forward from the brow and terminating in a very sharp point; it gives a considerable advantage to its possessor over the common buck. Besides enabling the animal to run more swiftly through the thick wood and underbrush, the spike-horn is also a more effective weapon than the common antler. With this advantage the spike-horn bucks are gaining upon the common bucks, and may in time entirely supersede them. 'Undoubtedly,' says the hunter, 'the first spike-horn buck was merely an accidental freak of nature, but his spike-horn gave him an advantage, and enabled him to propagate his peculiarity.' The reader will note here that this certainly is not a case in point for Mr Darwin, who distinctly states in other places that he founds his system upon observed facts amongst domestic animals, that large sudden variations such as this of the spike-horn do not occur amongst domestic animals, and that, if they did occur, they would be eliminated by intercrossing, and not transmitted entire and in a perfect state to the offspring. These references to circumstances which are not to the point are very hurtful to Mr Darwin's theories, and they are by no means infrequent, as we have seen, with him and his followers.

In the second edition of 'The Descent of Man,' Mr Darwin says,* a critic has well objected to this account (of the appearance of the spike-horn buck) by asking, why, if the simple horns are now so advantageous, were the branched antlers of the parent form ever developed? To this objection Mr Darwin says he can only answer by remarking that a new mode of attack with new weapons might be a great advantage. This may be the case, but it is no answer to the criticism; the spike-horns are superior in themselves, independently of all advantage from novelty; they are described as more effective weapons, and they are less cumbersome, and require a less expenditure of vital power.

In the last edition of 'The Descent of Man,' Mr Darwin † quotes an observation by Mr Belt, that the want of hair may be an advantage to man, as he is thus enabled to free himself from the multitude of ticks with which he is often infested, and which sometimes cause ulceration. Mr Darwin does not think this evil of sufficient magnitude to have led to the denudation of the body through

* p. 513. † p. 57.

natural selection, since none of the many quadrupeds inhabiting the tropics have acquired any specialized means of relief. Mr Darwin adheres to his former view, that the bareness of the human skin is due to sexual selection, and, as we have seen, supposes that the custom of depriving the skin of hair arose originally among women. This is the reverse of the usual phase of sexual selection, as in general it is the males that are modified to please the females. Is this another distinguishing mark between man and beasts?

CHAPTER X.

Mivart's 'Man and Apes'—No evidence from analogy of a common origin—The affinity rather a network than a ladder—M. Lecomte—Ape imitating the growl of a wild beast—Darwin's answer to the Duke of Argyle's position a mere evasion of the point—Natural selection cannot give a weak form and add compensation—As to mental qualities of men and beasts—M. Claparède as to bareness of man's skin—Intelligence of higher apes compared with that of other animals—Crawfurd's account of the views of the Hindûs as to this point—Humboldt—Intelligence of the Titi—Intelligence of a dog in the like case—Le Vaillant's ape—Lyell's 'Antiquity of Man'—Quotes Professor Rolleston's idea that the improvement in man's ancestor began in the mind—Seems to take Dr Asa Gray's view of evolution—Conclusion—Man is not descended from an ape-like ancestor—The gulf between man and apes another argument against natural selection.

In an essay on 'Man and Apes,' which appeared in 'The Popular Science Review' for April and July, 1873, Mr Mivart argues, that though it is certainly true that, on the whole, the anatomical characters of man's body have much more resemblance to those common to the man-like apes than to those presented by any other section of the order Primates, this community of structure is not such as affords satisfactory evidence of a common origin.

The human structural characters are shared by so many and such diverse forms, that it is impossible to arrange even groups of genera in a single ascending series from the Aye-aye to man, if all the structural resemblances are taken into account.

If the number of wrist bones be deemed a special mark of affinity between the Gorilla, Chimpanzee, and man, why are we not to consider it also as a special mark of affinity between the Indris (a low form of half-ape) and man. That it should be so considered, Mr Mivart says, would be deemed an absurdity by every evolutionist.

'If the proportions of the arms speak in favour of the Chimpanzee, why do not the proportions of the legs serve to promote the rank of the Gibbons?'

'If the bridging convolutions (in the brain) of the Orang go to sustain its claim to supremacy, they also go far to sustain a similar claim on the part of the long-tailed, thumbless Spider Monkeys.'

'If the obliquely-ridged teeth of Simia and

Troglodytes point to community of origin, how can we deny a similar community of origin to the Howling Monkeys?'

'The liver of the Gibbons proclaims them almost human; that of the Gorilla declares him comparatively brutal, and so on the lines of affinity between different Primates forming, as remarked by the Dutch naturalists, Messrs Schroeder, Van der Kolk, and Vrolik, rather a network than a ladder.'

We need not enter more fully into Mr Mivart's views; it is, we think, apparent that anatomy alone will not show the identity, or even the relationship, of man and brutes.

M. Lecomte* refers to the opinions of several foreign anatomists, who deny Professor Huxley's position, that the extremities of the hind limbs of the Gorilla are in reality at all like feet, and he maintains that all the quadrumana from the Gorilla downwards are really climbing animals.

As to Mr Darwin's point, that it does not appear altogether incredible that some unusually wise ape-like creature imitated the growl of a beast of prey so as to indicate to

* Le Darwinisme et l'Origine de l'Homme.

his fellows the nature of the danger that was approaching, and that this was the first step in the formation of language, M. Lecomte says,* that to establish a system, we ought to have facts which are altogether credible, and that no actual monkey, even the noisiest, has ever afforded the least indication that he thought of imitating the voice of a beast of prey. The cry of every monkey when in danger is peculiar to it, and is always the same. The reader will remember that we have seen that it is probable that the mental powers of our supposed ape-like ancestors were not superior to those of existing apes.

M. Lecomte quotes with great approbation the Duke of Argyle's point, that natural selection could never have caused man to have varied towards a state of greater weakness and inaptitude to struggle successfully in the battle of life. M. Lecomte speaks of Mr Darwin's answer to the Duke as a mere evasion of the point, and says 'it is not sufficient to show, as Mr Darwin has attempted to do, that the divergence is not attended with any great inconvenience, or even with no incon-

* 'Le Darwinisme,' p. 249.

venience at all. It is necessary to show that the weakness and the nakedness of man, are an absolute advantage to him in overcoming the difficulties of life. No doubt all this is compensated for by our mental faculties, but how came natural selection to act in such a manner as to require compensation? All the world knows that the Esquimaux and the Boschimans live, but would they not live better if they were stronger and better armed?'

As to the point that the mental qualities of man and brutes are the same in nature, and differ only in degree, M. Lecomte says,* 'instead of improving the means of providing for their necessities all animals remain stationary. Between this sleeping intelligence, which nothing can waken or excite, and the progressive intelligence of man, there is an impassable abyss. If the intellect of animals is the same in nature as that of man, why do not our domestic animals, by reflecting and reasoning upon what they see amongst civilized men, acquire a certain amount of civilization?'

'The monkeys which were contemporary

* p. 313.

with our Simian ancestors could not have been very inferior to them in intellectual powers, for Mr Darwin's theory requires that the advantageous variations should be small; such, therefore, must have been the change which occurred in our Simian ancestors. How does it happen, if the intellect of man and brutes is the same in quality, that the monkeys were left so far behind in the race for improvement? that between them, as they now exist, and man, there is a great gulf?'

As to the nakedness of man's body being acquired by sexual selection, M. Lecomte says, this is merely offering to prove one hypothesis by another equally gratuitous. As to this point, M. Lecomte quotes M. Claparède's answer to Mr Wallace's objections to the productions of man's naked skin by natural selection, to which Mr Darwin referred, only without quoting it: 'That perhaps man found it necessary to protect his back by the fleece of some animal, and who knows, says M. Claparède, if the continual rubbing of this garment on that part of the body for a long series of ages may not have produced a comparative thinness of hair upon the human back?' 'Here,' says M. Lecomte, 'is a strange way of establishing a theory; this hypothesis is as gratuitous as any of the others.'

Much has been said as to the intelligence and mental powers of the monkey tribe. Is this intelligence greater than that of some other races of animals?

In the first place, we must remember that the form of monkeys is somewhat like that of man, and this gives in our eyes, at least, an appearance of great intelligence to acts done by them, as they are done in some measure in the same manner as we should ourselves perform them. A monkey takes a stone in its hand, and cracks a nut with it as we should do, and this act appears the result of reason. A thrush dashes a snail against a large stone to break its shell. No doubt if the thrush had hands it might take up the stone to break the snail open; there is really no difference in the mental power displayed in the two cases.

The higher apes show no forethought; they do not, like the squirrel, build nests in the trees, and lay up a store of food, so that the abundance of one season may supply the needs of another; they must have a daily supply of fruit found for them during the whole year round, and this, perhaps, is one reason why so very small a portion of the earth is available to them.

And what do any monkeys do, which is comparable to the performances of beavers, who build dams across rivers to raise the water to a proper depth in front of their houses, making these dams in a straight line across the river when the current is gentle, but of a curved form with the convex side presented to the stream when that is more rapid, and who are said to plaster the outside of the roof of their houses (which roof is six or seven feet in thickness) with mud just before the commencement of severe weather, that it may be frozen hard, and thus prove impenetrable to their great enemy the wolverine?

We should expect to find that animals advanced regularly in intelligence as they approached the ape family in form; yet what is the case? The elephant and the dog, which, probably, are at least equal to the apes in intelligence, are of totally distinct species, as unlike monkeys as possible. The elephant, indeed, is perhaps the most reasoning of animals, seems to make most use of a mind. It was said of the large elephant which was brought to the Zoological Gardens many years ago, that it could not for some time be persuaded to step upon the platform, which had been placed for it to walk upon from the ship to the shore, it seemed aware of its own great weight, and repeatedly felt the fastenings of the planks with its trunk.

Mundy, in his pen-and-pencil sketches of India, mentions a case in which a sportsman was thrown from his houdah almost into the jaws of a lion, which would have destroyed him had not his elephant seized a sapling in his trunk, and bent it so tightly down over the loins of the lion, that he was crushed down to the ground and held fast until the hunter escaped, an instance of readiness of resource and of skilful application of a tool almost human.

In the last edition of 'The Descent of Man' Mr Darwin states that elephants, when sinking in boggy ground, seize any solid object, and place it under their knees to prevent them from sinking deeper. On such occasions they never seize their drivers, but they are very apt to take hold of their riders. Dr Hooker's elephant, under such circumstances, did not attempt to seize him, and Mr Darwin gives this as an instance of noble fidelity on the part of the elephant.

We should also expect to find that amongst the Quadrumana themselves there was an advance in intelligence as we approach the higher apes ; yet this is not so. The gorilla is a fearful brute, and we must remember that it was one of the smaller and less advanced monkeys that is so highly praised by Mr Darwin for attacking the baboon in defence of his keeper ; and what this monkey is admired for doing would be done, as a matter of course, by almost every dog. Again, the monkeys which are carried about the streets by the Italian boys, and which are taught to perform various tricks, are of the American type of monkey, which differs in many respects from the old world form, approaches less nearly to man in its structure, and is not the branch of the Simiadæ from which Mr Darwin supposes man to have been derived. It is certainly a significant fact that these monkeys should show a greater capacity for receiving instruction than the man-like apes.

Mr Crawfurd says, the Hindûs, who ought from long experience to be competent judges, give the superiority of intelligence among monkeys, not to the anthropoid gibbon, but to a baboon with a very long tail, called the Hanuman, the Semnopithecus Entellus of naturalists. So satisfied are they of his superiority that, in one of the most celebrated of their fantastic epics, they make him the commander-in-chief of the army of its hero, a demi-god, while they give details of the tricky expedients of the general.*

Humboldt says,† no other monkey has so much the physiognomy of a child as the Titi (a small American monkey); there are the same expression of innocence, the same playful smile, the same rapidity in the transition from joy to sorrow. Its large eyes are instantly filled with tears when it is seized with fear. The sagacity of this little animal is so great, that one which Humboldt possessed recognized engravings of insects, though not

* 'A few notes on the Antiquity of Man,' &c., p. 21.

† 'Personal Narrative,' vol. iv. p. 527.

coloured, and reached out its little hand every time a plate was shown to him representing a grasshopper, or a wasp, in the hope of catching these insects. Humboldt observes that he had never heard of a picture in which horses or deer were represented of their natural size, and in the greatest perfection, having made the least impression even upon hunting-dogs. As to this point, the author of these pages has seen a dog attracted by the moving picture of a rat in a magic lantern, but only once; as soon as he discovered the cheat he could not be induced to care for it again, in this respect showing superiority over the Titi, which appears to have attempted to seize the insect every time the plate was shown to it. The same dog, when a looking-glass was placed on the ground before him, ran eagerly to meet the dog which he thought he saw advancing towards him; but having once satisfied himself that what he saw was not a real dog, he took no further notice of the image. This dog is now blind. When he has to go down a flight of stairs, with which he is familiar, he feels his way to the first step, and then descends without hesitation, and lands quietly at the bottom; does he count the steps?

We do not often find dogs and monkeys placed together under circumstances which enable us to compare their intelligence. Le Vaillant, however, carried an ape with him in his first journey into the interior of Africa, along with his pack of dogs. We will quote a passage from his account of his expedition:* 'In our marches, when Kees found himself tired, he got upon the back of one of my dogs which had the complaisance to carry him for whole hours together; one only, which was larger and stronger than the rest, ought to have served him for this purpose; but the cunning animal well knew how to avoid this drudgery. The moment he perceived Kees on his shoulders he remained motionless, and suffered the caravan to pass on without ever stirring from the spot. The timorous Kees still persisted; but as soon as he began to lose sight of us, he was obliged to dismount; and both he and the dog ran with all their might to overtake us. For fear of being surprised,

* 'Travels into the Interior of Africa,' Part I. p. 124. English Translation.

the dog dexterously suffered Kees to get before him, and watched him with great attention.' Here we see the dog and ape were about equal. We must, however, add that Le Vaillant states that Kees had acquired an ascendancy over the pack, apparently from the superiority of his instinct.

We will notice an instance of fidelity in a dog mentioned by the same author, as it occurred while Kees was one of the party. A favourite dog, Rosetta, was missing. After a long search, she was found about two leagues from the camp, sitting beside a chair and a large pannier which had fallen from one of the waggons. Here we have an instance of a sense of duty which the ape did not seem to possess, or at least did not exercise.

Le Vaillant gives a most graphic account of the signs by which danger is announced by different animals in a night encampment in the wilds of Africa. 'If it be a lion which approaches the dog begins to howl in a most melancholy tone, and keeps close to his master; the oxen bellow in a plaintive manner, but with a low voice; horses beat the earth and caper about in all directions; goats express their fear by peculiar signs; and sheep, with their heads hung down, collect themselves into a body, and press as closely against one another as they can. On such occasions the terror of Kees was still more apparent; he moaned like a sick person, and dragged himself along at my side in a most languid condition.'* The reader will note that there is no hint here of any imitation by any of the animals, even by the ape, of the growl of the wild beast which is approaching; if there had been the least trace of anything of the kind it could not have escaped the notice of so keen an observer of nature as Le Vaillant.

And what do any of these animals do which is comparable to the performances of ants, who have regular government and division of labour? But even among these wonderful creatures we have no evidence that there is any advance going on towards greater perfection; they have, so far as we know, always been the same that they are now.

The last chapter of Sir C. Lyell's 'Antiquity of Man' is devoted to the 'Bearing of the

* p. 338.

doctrine of transmutation on the origin of man, and his place in the creation.' Sir C. Lyell passes in review most of the speculations on this subject, many of which we have already noticed. After quoting a passage from Mr Darwin's 'Descent of Man,' pointing to the conclusion that man is the co-descendant with other mammals of a common progenitor, Sir C. Lyell says, we certainly cannot escape from such a conclusion without abandoning many of the weightiest arguments which have been urged in favour of variation and natural selection. Many of the gaps which separate the most nearly allied genera and orders of mammalia are, in a physical point of view, as wide as those which divide man from the mammalia most nearly akin to him; and the extent of his isolation must be considered before we can discuss the bearing of transmutation upon his origin and place in creation.

Sir C. Lyell notices a suggestion of Professor Rolleston, that we ought not always to take for granted, as some advocates of the development theory seem to do, that each advance of physical power (ought it not to be psychical power ?) depends on an improvement in bodily structure; for why may not the soul, or higher intellectual and moral faculties, play the first instead of the second part in a progressive scheme? As to this point, the difficulty is, as we have seen, that the ape-like ancestor from whom man and apes are supposed to have descended was, in all probability, not superior, if equal in intelligence, to existing apes; and as their intelligence has not taken any step towards reason, it is not likely that that of their ancestor did so. The spontaneous acquisition of reason by such a creature is inconceivable.

Sir C. Lyell considers the power of progressive and improvable reason brought out in strong relief by Archbishop Sumner fifty years ago an 'essential character,' and as to this point he remarks—'it has sometimes happened that one nation has been conquered by another less civilized, though more warlike; or that during social and political revolutions, people have retrograded in knowledge. In such cases the tradition of earlier or of some higher, more educated, caste, which has been destroyed, may give rise to the notion of degeneracy from a primeval state of superior intelligence. But had the original stock of mankind been really endowed with such superior intellectual powers, and with inspired knowledge, and possessed the same improvable nature as their posterity, the point of advancement which they would have reached ere this would have been immeasurably higher.'*

Sir C. Lyell quotes a passage from Agassiz,† 'in favour of the existence in every animal of an immaterial principle, similar to that which, by its excellence and superior endowment, places man so much above animals. The principle unquestionably exists, and whether it be called soul, reason, or instinct, it presents, in the whole range of organized beings, a series of phenomena closely linked together, and upon it are based, not only the higher manifestations of the mind, but the very permanence of the specific differences which characterize every organ. Most of the arguments of philosophy in favour of the immortality of man apply equally to the permanency of this principle in other living

* p. 422. † p. 531.

beings.' Without pretending, says Sir C. Lyell, to offer a decided opinion on the transcendental questions raised in this citation, they cannot be lost sight of when comparing man with the inferior animals.

In another place Sir C. Lyell says,* 'that if some of the arguments in favour of a future state are applicable in common to man and the lower animals, they are by no means the weightiest and most relied on. We cannot imagine this world to be a place of trial and moral discipline for any of the inferior animals, nor can any of them derive comfort and happiness from faith in a hereafter.'

Sir C. Lyell also quotes a remark by the late Mr Hopkins of Cambridge,† 'that if we embrace the doctrine of the continuous variation of all organic forms from the lowest to the highest, including man as the last link of the chain of being, there must have been a transition from the instinct of the brute to the noble mind of man; and in that case, where are the missing links, and at what point of his progressive improvement did man acquire the spiritual part of his being, and

* p. 537. † p. 544.

become endowed with the awful attribute of immortality?'

In commenting upon this passage, Sir C. Lyell says, 'before we raise objections of this kind to a scientific hypothesis, it would be well to inquire whether there are no analogous enigmas in the constitution of the world around us, some of which present even greater difficulties than that here stated. When we contemplate the many hundred millions of human beings who now people the earth, we behold thousands who are doomed to helpless imbecility, and we may trace an insensible gradation between them and the half-witted, and from these again to individuals of perfect understanding, so that tens of thousands must have existed in the course of ages, who, in their moral and intellectual condition, have exhibited a passage from the irrational to the rational; moreover, nearly one-tenth of the human race die before they are a month old; many millions perish in every century in the first few hours of their existence. To assign to such individuals their appropriate psychological place in the creation is one of the unprofitable themes on which theologians and metaphysicians have expended much ingenious speculation.'

Now as to these points, we must note that the instances brought forward by Sir C. Lyell are simply cases of disease and death in a particular species; there is nothing in them at all analogous to a change in an entire species, in a healthy state, from one to another degree of rationality.

Sir C. Lyell says, 'I cannot better conclude this volume than by reminding the reader that Dr Asa Gray, in his excellent essay ("Natural Selection not inconsistent with Natural Theology"), has pointed out that there is no tendency in the doctrine of Variation to weaken the foundations of Natural Theology; for, consistently with the derivative hypothesis of species, we may hold any of the popular views respecting the manner in which the changes of the natural world are brought about. We may imagine that events and operations in general go on in virtue simply of forces communicated at the first; or we may hold that now and then, and only now and then, there is a direct interposition of the Deity; or, lastly, we may suppose that all the changes are carried on by the immediate, orderly, and constant, however infinitely diversified, action of an Intelligent, efficient Cause.' Sir C. Lyell adds, 'They who maintain that the origin of an individual, as well as the origin of a species or a genus, can be explained only by the direct action of the creative cause, may retain their favourite theory compatibly with the doctrine of transmutation.' (This position, of course, implies that the variations on which natural selection is to act are directly regulated by the first Cause, which is not Mr Darwin's theory, being, in fact, simply a form of direct creation. 'The whole course of nature may be the material embodiment of a preconcerted arrangement, and if the succession of events be explained by transmutation, the perpetual adaptation of the organic world to new conditions leaves the argument in favour of design, and therefore of a designer, as valid as ever, for (quoting Dr Asa Gray) to do any work by an instrument must require, and therefore presuppose, the exertion rather of more than of less power than to do it directly.'

We need make no apology for stating Sir

Charles Lyell's views thus at some length, every one must wish to know the feelings with which he ultimately regarded Mr Darwin's theory, and these passages, like some others we have quoted in a previous chapter, seem to show that he, though approving Mr Darwin's views to some extent, was by no means entirely satisfied with them, and felt, as he has himself stated, the want of some higher law of which we are ignorant.

And now, what is the conclusion to which we are to come as to the origin of man. We have seen great reason to believe that natural selection, or the survival of the fittest, cannot have given rise to the forms of organic life below man. Are there any special circumstances connected with his appearance in the world which show that his origin is due to that principle, or which in any way tend to support it?

And first, as to the question, are savages the degraded descendants of civilized man? As to this point, the balance of argument and evidence seems to be against the degradation theory. Apart from all other considerations, the very great length of time during which savage man has existed, the extent to which he had spread over the globe, and the general appearance of progress by him, are inconsistent with that theory.

No doubt some tribes may be the degraded descendants of more highly civilized races, but we can hardly believe this to be the case of the cave men who existed so long ago, and who occupied so large an area. To take this view would throw back the epoch at which the original civilized race appeared, to an enormous distance of time. And we must bear in mind Sir C. Lyell's remark, that if man was originally civilized and endowed with the power of progressive improvement, which appears to be his special attribute, the mass of mankind could hardly have degenerated. As to Mr Wallace's point, that the brain power of savages is above their wants, which, as we have seen, is an argument in favour of the degradation theory, that brain power may be the form in which the power to make progressive advance has been given to man. On this point we can only make suppositions, we cannot at present bring forward direct evidence. There is nothing, however, in this view of the progress of man which shows that he has descended from an ape-like ancestor; in fact, the general diffusion of man over the earth (and many evolutionists suppose that this diffusion took place before man had acquired language) is quite inconsistent with a development from an ape-like creature, as all existing man-like apes are, we have seen, extremely local, capable of existing in a few spots only.

To turn to Mr Darwin's own views as to the descent of man, we find him apparently suggesting, that man's ape-like ancestor began his progress towards humanity by acquiring a more upright posture, and a freer use of his hands and arms, and that by the gradual progress of the body in this direction the present form of man was produced. Mr Darwin also seems to think, that during this progress of man's body, his mind was gradually improved, as the body became more and more like what it now is, and therefore more and more capable of giving effect to mental conceptions.

Now, has Mr Darwin met the Duke of Argyle's point, that the deviation from the form of a brute towards that of a man is, apart from the acquisition of reason, a step from a strong to a weak form? Does Mr Darwin account for the bareness of man's skin? does he refute Mr Wallace's position, that the brain power of a savage is much above his requirements, and therefore could not be the result of natural selection, as the superfluous power would not be felt to be an advantage, and would not be preserved? Has he shown that the man-like apes are markedly more intelligent, and approach man's reason decidedly more closely, than any other animal? These, and other questions of a like nature, we must say Mr Darwin has not answered satisfactorily. Had he done so, he would have only taken away special objections to the origin of man by natural selection, leaving all those still in force which we have seen militate so strongly against our acceptance of that principle, as the means by which the lower organisms are formed.

Can we suppose, following up the hint given by Professor Rolleston, that the change in our ape-like ancestor was at first an improvement of the intellectual powers which was followed by bodily adaptations, the mind always keeping in advance of the body? This supposition would meet the difficulty of the weakness of man's body, but not that of the large size of his brain, unless indeed we allow that savage man is the degraded descendant of civilized man.

This supposition would also seem to meet the point raised in 'The North British Review,' as to the elimination of an improved variety by intercrossing, as we might suppose that creatures, in which there was any dawn of reason, would keep apart from mere brutes. But the appearance of this amount of reason in such a creature as our ape-like ancestor, the hairy, pointed-eared creature, not superior if equal to existing monkeys, is simply a miracle; it is not the development of a quality already possessed by him or his ancestors, but the imparting of a new quality; it is putting the rational in place of the irrational; it is supposing the occurrence of the power of indefinite improvement and progress in creatures whose equals and contemporaries have shown no trace of it.

It is impossible to deny that animals have many feelings in common with man, but if their mental attributes differed only in degree from those of man, there ought to be some considerable amount of progressive improvement among them, such movement being one attribute of the intelligence in question.

Nor shall we get over the difficulties by supposing that man's form and man's mental powers varied advantageously, *pari passu.* It is quite impossible that each successive small increment of bodily advance should be accompanied by a corresponding small increment of mind independently developed, and that this should go on time after time through the long series of changes which transformed our ape-like ancestors into man; impossible, we say, because the chances against the occurrence independently of such contemporary changes are almost infinite.

What may be the place in nature of intelligent and faithful animals, is another question, with which we are not concerned, our business being simply to ascertain whether their mental attributes are a part of the general scale of nature from a monad to man, or whether they are peculiar to themselves. If the chasm between the mental powers of men and brutes be enormous, so, according to the evolution hypothesis, must have been the difference between the variability of their mental powers. How did man's ape-like ancestor alone obtain this great amount of variability? or rather, how did other brutes acquire their incapacity to vary?

It is no answer to this question to say that man's power of language helped him; the question is, why, on the principle of simple evolution, were all the means of progress monopolized by incipient man alone?

Mr Darwin does attempt to meet this point. In the sixth edition of the 'Origin of Species,' * he says, 'Various causes could be assigned why apes have not acquired the intelligence of man, but as these causes are conjectural only, it would be useless to give them. A definite answer to the question ought not to be expected, seeing that no one can solve the simpler problem, why of two races of savages one has risen higher in the scale of civilization than the other? This apparently implies increased brain power.'

* 'Origin of Species,' 6th edit. p. 181.

Mr Darwin evidently considers the point of little importance; he is quite satisfied of the truth of his system; he believes that he has successfully met all the objections which have been urged against it, and he naturally considers this point as equally capable of explanation. To us who, on the contrary, believe that Mr Darwin's theory has broken down in many points, it is only another instance of failure.

There is no analogy between the comparative rate of progress by two races of savages, and the non-existence of any power of progressive improvement in apes; the point is, how the power to progress was obtained, not the rate at which it worked.

We must, then, come to the conclusion that Mr Darwin has not satisfactorily proved that man is the descendant, through a process of natural selection, of an ape-like ancestor. Indeed we think Mr Darwin has by his 'Descent of Man' weakened the position of the general principle of natural selection. The point which we have just noticed of the non-progression of apes, is another argument against the existence of any general system of variation and progress, and the array of instances of peculiar form and colour which he has given us as the results of sexual selection, is sufficient to destroy his theory altogether should sexual selection fail him, and we have seen reason to believe that it is but a broken reed.

Though we have come to the conclusion that there is not sufficient evidence to support Mr Darwin's theory, we cannot feel surprised that it has taken such complete possession of its author and made such progress in public estimation, for there no doubt is 'grandeur in the view that life with its several powers has been originally breathed by the Creator into a few forms or into one; and that from so simple a beginning endless forms most beautiful and most wonderful have been and are being evolved;'* and the theory of the struggle for life and the survival of the fittest, does seem at first sight to give us an explanation of the manner in which this result is brought about, for all Nature seems to be regulated on the prin-

* The last words of the last edition of 'The Origin of Species.'

ciple of exuberant production kept in check by great destruction, thus offering a wide field for the play of natural selection in picking out the fittest, if only, some organisms are produced more fit for their surroundings than their neighbours.

THE END.

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