Difficulties of the Theory of Natural Selection.

[We need hardly say that the following interesting remarks on Mr. Darwin's theory as to the origin of species are not meant to discuss the question on theological grounds. The writer assumes the hypothesis that the theory in question does not of necessity contradict either the doctrine of Creation, or the Scriptural accounts which bear upon the fact of Creation. This being so, the theory may be discussed without reference to its advocates. Some of these may certainly not have spoken in a Catholic manner either as to Creation or the Scriptural narrative. But the theory need not be involved in the fault of its supporters. It is too often the case that the students of physical phenomena are prone to think that the generalisations at which they have arrived are such as to raise difficulties against received doctrines or interpretations of Scripture, and to use their discoveries as weapons against religion. Their great prevailing fault is their defect of logic. The best and most intelligent critics among men of their own class have often remarked on this, and it is evident to the whole world in the notorious fact of the rapidity with which theories based on premature generalisations have constantly to be abandoned before the force of subsequent discoveries. Akin to this want of precise logic is the impetuosity with which hastily-formed theories based upon observations of indisputable though exaggerated value are forced into collision with the venerable truths of faith. We do not now inquire whether the advocates of the theory of Natural Selection have not committed many faults of this last kind. But this question need not here be discussed, and it may fairly be put aside for the moment for the sake of examining the theory on its own ground, and testing its competency to explain the whole of the phenomena which it ought to explain. This is the best way of arriving at a proper estimate of its value, and it enables us gratefully to welcome whatever is of importance in the observations on which it is grounded, and to see their true bearing upon the advance of natural sciences. The theory may then be found to add greatly to our knowledge, without in any way conflicting with what is already certain and incontrovertible.]

MR. DARWIN'S theory of "Natural Selection" is perhaps the most interesting theory, in relation to natural science, which has been promulgated during the present century. Remarkable indeed is the way in which it groups together such a vast and varied series of biological* facts, and even paradoxes, which it appears more or less clearly to explain. By this theory of "Natural Selection" light is thrown on the more singular facts relating to the geographical distribution of animals and plants: for example, on the resemblance between the past and present inhabitants of different

* Biology is the science of life. It contains zoology, or the science of animals, and botany, or that of plants.

parts of the earth's surface, creatures closely allied to kangaroos having existed in the Australian region, where alone kangaroos are now found; and sloths and armadillos living now only in South America, where also we find the remains of extinct forms nearly related to them. Such coincidences are numerous. Again, it serves to explain the circumstance that often in adjacent islands we find animals closely resembling, and appearing to represent, each other; while if certain of these islands show signs (by depth of surrounding sea or what not) of more ancient separation, the animals inhabiting them exhibit a corresponding divergence.* "Rudimentary structures" also receive an explanation by means of this theory. These structures are parts which are apparently functionless and useless where they occur, but which represent similar parts of large size and functional importance in other animals. Examples of such "rudimentary structures" are the fœtal teeth of whales and of the front part of the jaw of ruminating quadrupeds. These are minute in size and never cut the gum, but are reabsorbed without ever coming into use, while no other teeth represent them in the adult condition of those animals. The mammary glands of all the male animals, and the minute wing-bones of the New Zealand apteryx, are other examples. Again, the curious fact that animals of very different form and habit (as, for example, the whale and the bat, or again the butterfly and the shrimp) are yet constructed on an essentially similar type is also readily explicable by "Natural Selection." That remarkable series of changes which animals undergo before they attain their adult condition, which is called their process of development, and in which they more or less closely resemble the early stages of the same process in other animals, has also great light thrown on it from the same source. The singularly complex resemblances borne by every adult animal and plant to a certain number of other animals and plants finds its solution in a similar manner. Finally, by this theory—and as yet by this alone—can any explanation be given of that extraordinary phenomenon termed *mimicry*. Mimicry is a close and striking, yet superficial resemblance borne by some animal or plant to some other very distinct animal or plant. The "walking leaf" (an insect belonging to the grasshopper order) is a well known but most striking instance of the assumption by an animal of the appearance of a vegetable structure, and the bee, fly, and spider orchids are familiar examples of a converse resemblance. Birds, butterflies, and even fish, seem to have in

* For very interesting examples see Wallace's *Malay Archipelago*, lately published.

certain instances a similarly striking external semblance to birds, butterflies, and fish of altogether distinct kinds.

Not only are all these diverse facts strung together, as it were, by the theory in question; not only does it explain the development of the complex instincts of the beaver, the cuckoo, the bee, and the ant, the song of the birds, the perfume of flowers, and the brilliant clothing of some of each; but it serves as a basis of future research and of inference from the known to the unknown. It guides the investigator to the discovery of new facts which, when ascertained, it seems also able to co-ordinate.* Nay, "Natural Selection" seems capable of application not only to the building up of the smallest and most insignificant organisms, but even of extension beyond the biological domain altogether, so as possibly to have relation to the stable equilibrium of the solar system itself and even of the whole sidereal universe.

Thus, whether this theory be true or false, all lovers of natural science should, on account of its practical utility, acknowledge a deep debt of gratitude to Messrs. Darwin and Wallace. With regard to the former gentleman (with whose name, on account of the noble self-abnegation of Mr. Wallace, the theory is, in general, exclusively associated) his friends may heartily congratulate him on the fact that he is one of the few exceptions to the rule respecting the non-appreciation of a prophet in his own country. It would be difficult to name another living labourer in the field of physical science who has excited an interest so widespread, and given rise to so much praise and animadversion, gathering round him, as he has done, a chorus of more or less completely acquiescing disciples, themselves masters in science and each the representative of a crowd of enthusiastic followers. But other causes have concurred to produce this interest in the theory besides the way in which it harmonises with biological facts. The latter could be only appreciated by men of science, while this theory, so novel and so startling, has found a cloud of advocates and opponents beyond and outside the scientific world.

In the first place, it was inevitable that a great crowd of half-educated men and shallow thinkers should accept with eagerness the theory of "Natural Selection," on account of a certain characteristic it has in common with other theories, which should

* See Müller's work, *Für Darwin*, lately translated into English. Mr. Wallace also predicts the discovery in Madagascar, of a hawk-moth with a certain length of proboscis, from the existence of a peculiarly elongated flower. See *Journal of Natural Science*. 1867.

not be mentioned in the same breath with it except, as now, with the accompaniment of protest and apology. We refer to its remarkable simplicity, and the ready way in which phenomena the most complex appear to be explained by a cause for the comprehension of which laborious and persevering efforts are not required, but which may be represented by the simple phrase "survival of the fittest."*

It is in great measure owing to this, and to a belief that it is yet easier and more simple than it is, that Darwinism, however imperfectly understood, has become a subject for general conversation in the way it has done, and has been able thus widely to increase a certain knowledge of biological matters; and this excitement of interest in quarters where otherwise it would have been entirely wanting, is an additional motive for gratitude on the part of naturalists to the authors of the new theory. At the same time it must be admitted that a similar "simplicity"—the apparently easy explanation of complex and difficult facts—also constitutes the charm of such matters as hydropathy, homœopathy, and phrenology, in the eyes of the unlearned or half-educated public. It is indeed, *the* charm of all those seeming "short cuts" to knowledge by which the labour of mastering scientific details is spared to those who yet believe that without such labour they can attain all the most valuable results of scientific research. It is not, of course, for a moment meant to imply that its "simplicity" tells in any way against "Natural Selection," but only that the possession of that quality is a strong reason for the wide and somewhat hasty acceptance of the theory, whether it be true or not.

In the second place, it was inevitable that a theory appearing to have very important relations with questions of the last importance and interest to man, that is, with questions of religious belief, should call up an army of assailants and defenders. Nor have the supporters of the theory much reason to blame the more or less unskilful and hasty attacks of adversaries, seeing that those attacks have been in part, if not mainly, due to the unskilful and perverted advocacy of the cause on the part of some of its adherents. If the *odium theologicum* has inspired some of the former, it is undeniable that the *odium antitheologicum* has possessed not a few of the latter. When we recollect the warmth with which what he thought was Darwinism was advocated by such a writer as Vogt, one cause for his zeal was not far to seek—a zeal, by the way,

* "Natural Selection" is happily so termed by Mr. Hebert Spencer in his *Principles of Biology*.

certainly not "according to knowledge," for few conceptions could have been more conflicting with true Darwinism than the theory he formerly maintained, but has now abandoned, viz., that the men of the Old World were descended from African and Asiatic apes, while, similarly, the American apes were the progenitors of the human beings of the New World. The cause of this palpable error in a too-eager disciple was not, we hope, anxiety to snatch all or any arms possibly available against Christianity, but the style of the author cannot but make us fear it, for he is a writer whose offensiveness is so gross that it is only surpassed by his amazing shallowness.

It is easy to complain of the one-sidedness of many of those who oppose Darwinism in the interest of orthodoxy; but hardly, if at all, less patent is the intolerance and narrow-mindness of some of those who advocate it, avowedly or covertly, in the interests of heterodoxy. This hastiness of rejection or acceptance determined by ulterior consequences believed to attach to "Natural Selection," is unfortunately in part to be accounted for by some expressions and a certain tone to be found in Mr. Darwin's writings. That his expressions are not always to be construed literally is manifest. The way in which he speaks figuratively of "purpose," for example, and "design," has occasioned, from the Duke of Argyll and others, criticisms which fail to tell against the theory, because such expressions are in Mr. Darwin's writings merely figurative. It may be hoped that a similar looseness of expression will account for passages of a directly opposite tendency, but it is nevertheless impossible to acquit Mr. Darwin of considerable rashness in appearing to oppose ideas which he gives no clear evidence of having ever understood. He is far from being alone in this, and probably merely assumes and reiterates, without much consideration, assertions and positions previously assumed by others. It has been the practise of too many first to misrepresent their adversary's view, and then elaborately refute it, in fact to erect a doll incapable of self-defence, and then, with a flourish of trumpets and many vigorous strokes, to overthrow the helpless dummy they had previously raised. Thus many who more or less distinctly oppose Theism in the interests, as they believe, of physical science, represent, amongst other things, a gross and narrow anthropomorphism as the necessary consequence of views opposed to those which they themselves advocate.

It is just in this way that Mr. Darwin assumes that the idea of "creation" necessitates a belief in an interference with, or dispensation of, natural laws, and that "creation" must be

accompanied by arbitrary or unorderly phenomena. None but the crudest conceptions are placed by him to the credit of supporters of the dogma of creation, and it is constantly asserted that they must offer "creative fiats" as explanation of physical phenomena, and be guilty of numerous absurdities. Mr. Darwin and others like him may be excused if they have not devoted much time to this study of Christian philosophy. But why assume as an undoubted fact that in that philosophy there is a necessary conflict between two such ideas as "creation" and "evolution?" Are there no Christian thinkers who accept both? We are not now speaking of theological questions, but we may say this much—that there are many as well versed in theology as Mr. Darwin in his own department of natural knowledge who would not be disturbed by witnessing the demonstration of his theory, and who are not affected at the idea even of what is called spontaneous generation and others like it, simply because they conceive that the possibility of such phenomena had been provided for in the old philosophy centuries before Darwin, or even before Bacon, and that, should all such possibilities even become realised facts they would take their place in the system without even disturbing its order, far less marring its harmony.

To return, however, to Mr. Darwin's theory of "Natural Selection." Whatever may have hitherto been the amount of acceptance it has met with, all anticipated that the appearance of his large and careful work on *Animals and Plants under Domestication*, could not but yet further increase that acceptance. We must, however, confess that we are now not without doubt as to how far such anticipations will be realised. The new book seems to us to add but little in support of the theory, and to leave most, if not all, its difficulties exactly where they where, while as to the hypothesis of "Pangenesis,"* it appears to us to be a question whether it may not be found rather to encumber than to support the theory it was invented to subserve. However, the work in question treats only of domestic animals, and probably the next instalment will address itself more vigorously and directly to the difficulties which seem to us yet to bar the way to a complete acceptance of the doctrine.

* "Pangenesis" is the name of a new theory promulgated by Mr. Darwin. It proposes to account for various facts, such as the occasional reproduction by individuals of lost parts, the development in offspring of parental or ancestral characters, &c., by the possession by every creature of countless indefinitely minute atoms termed "gemmules," which are supposed to be in constant circulation about the body.

As we have hinted, we are here going to admit the notion of organic and other evolution, but at the same time to suppose that new forms of animals and plants (new species, genera, &c.,) have from time to time been evolved from preceding animals and plants, not by the action of "Natural Selection" *alone*, but by that of certain laws, at present unknown, acting partly through powers and tendencies existing in each organism, partly through influences exerted on each by surrounding agencies, organic and inorganic, terrestial and cosmical, among which the "survival of the fittest" plays a certain but subordinate part.

The theory of "Natural Selection" may (though it need not) be taken in such a way as to lead men to regard the present organic world as formed, so to speak, *accidentally*, beautiful and and wonderful as is confessedly the hap-hazard result. A similar character attaches to the view advocated by Mr. Herbert Spencer, who however agrees with us in relegating "Natural Selection" to a subordinate *rôle*. We are convinced, on the other hand, that the whole organic world arises and goes forward in an harmonious development similar to that which displays itself in the growth and action of each separate organism, and that each such separate organism is the expression of powers and tendencies not to be accounted for by "Natural Selection" alone, or even by that together with merely the influence of surrounding conditions.

The difficulties which appear to us to oppose themselves to the reception of "Natural Selection," have in all probability been already carefully considered by Mr. Darwin, nevertheless it may not be altogether useless to enumerate them, and we are sure so candid and careful a naturalist as the author of the theory in question, will feel obliged by a suggestion of all the doubts and difficulties which can be brought against it.

What we have now to bring forward may be summed up as follows :—

1. That though potent to explain the maintenance or further extension of favourable variations, the theory fails to account for the conservation and development of the first beginnings of such.

2. That on the theory of "Natural Selection" it is all but impossible, such are the probabilities against it, that identical structures should have arisen independently. Yet many structures undeniably exist which to all appearance must have so arisen.

3. That there are grounds for thinking that specific differences may be developed suddenly instead of gradually.

4. That the causes of variability in domestic animals have not

been proved to be of the same nature as those acting upon wild species.

5. That there is more reason to believe that species have definite though very different limits to their variability, than that all are capable of indefinite variation.

6. That some recent zoological and anatomical discoveries tend rather to diminish than to multiply the evidence in favour of minute and gradual modification.

7. That certain fossil transitional forms are absent which might have been expected to be present.

8. The great extent of geographical change required during the existence of the present fauna forms another objection.

9. That the objection drawn from the physiological difference between "species" and "races" still exists unrefuted.

10. That the phenomena of reversion still present a difficulty which has by no means been overcome.

11. That even if the origin of species by "Natural Selection" were proved, yet other phenomena not less remarkable would still remain unexplained, and that the explanation of such may possibly be at the same time the key to specific origination.

Besides these objections to the sufficiency of "Natural Selection," others may be brought against the hypothesis of "Pangenesis," which, professing as it does to explain great difficulties, seems to do so by presenting others not less great—almost, perhaps, to be the explanation of *obscurum per obscurius.*

Let us now dwell briefly on these difficulties one by one :—

1. *That though potent to explain the maintenance or further extension of favourable variations, the theory fails to account for the conservation and development of the first beginnings of such.*

It is distinctly enunciated by Mr. Darwin that the spontaneous variations are individually minute and insignificant. He says:* "Slight individual differences, however, suffice for the work, and are probably the sole differences which are effective in the production of new species." And again, after mentioning the frequent sudden appearances of domestic varieties, he speaks of "the false belief as to the similarity of natural species in this respect."†

Now the conservation and intensification of minute variations in many instances is of course plain and intelligible enough, such, *e.g.*, as those which tend to promote the destructive faculties of carnivorous beasts on the one hand, or to facilitate the flight or

* *Animals and Plants under Domestication*, vol. ii., p. 192.

† *Ibid.*, p. 414.

concealment of their prey on the other; provided always that these minute beginnings are of such a kind as really to have a certain efficiency, however small, in favour of individual conservation.

But some of the cases which have been brought forward, and which have met with very general acceptance, seem less satisfactory when carefully analysed than they at first appear to be. Amongst these we may mention the "neck of the giraffe." At first sight it would seem as though a better example in support of "Natural Selection" could hardly have been chosen. Let the hypothesis of an occurrence of occasional severe droughts in the country which that animal has inhabited be granted. In that case, when the ground vegetation has been consumed and the trees alone remain, it is plain that at such times only those individuals (of the nascent giraffe species) who were able to reach up very high would be preserved, and would become the parents of the following generation, some individuals of which would, of course, inherit that high-reaching power which alone preserved their parents. The issue only of these would again (*cæteris paribus*) be preserved at the next drought, and would again transmit to their offspring their still loftier stature; and so on from period to period through æons of time, all the individuals which tend to revert to the ancient shorter type being ruthlessly destroyed at the occurrence of each drought.

But against this it may be said: (1.) That the argument proves too much, for, on this supposition, many species must have tended to undergo a similar modification, and we ought to have a variety of forms similar to the giraffe developed from different leaf-eating ungulates.* A careful observer of animal life, who has long resided in South Africa, explored the interior, and lived in the giraffe country, assures us that the giraffe has powers of locomotion and endurance fully equal to those possessed by any of the other ungulates of that continent. Therefore some at least of these ought to have similarly developed, under pain of being exterminated by the overreaching of the giraffe when the long neck of the latter was in its incipient stage.

(2.) The power of reaching upwards acquired by the lengthening of the neck and legs must have necessitated a considerable increase in the entire size and mass of the body, and it is very problematical whether the disadvantages thence arising would not, in times of scarcity, more than counterbalance the advantages. For a considerable increase in the supply of food would

* Ungulates are hoofed beasts, *e.g.*, ox, horse, swine, &c.

be requisite on account of the increase in size, and, at the same time, a certain decrease in strength; for, as Mr. Herbert Spencer says,* "in similarly-shaped bodies the masses vary as the cubes of the dimensions, whereas the strengths vary as the squares of the dimensions." And in any animal, the height of which shall have been doubled, the bones and muscles will have been made but four times as strong, while the strain on the organism and the inertia to be overcome will be augmented eight times. However, allowing this favourable example to pass, many other instances present great difficulties.

Let us takes the cases of mimicry amongst lepidoptera, and suppose that a butterfly of a much-preyed-on species presents a very slight variation from the parent insects, and let it be conceded, for argument's sake, that a small deviation from the normal colouring or form will tend to make it escape destruction, by causing it more or less frequently to be passed over or mistaken by its persecutors. Yet the deviation must be in some definite direction, either towards some vegetable form, as in the leaf butterfly,† or towards another kind of butterfly, which escapes persecution from some offensive property, as in well-known South American forms. But as, according to Mr. Darwin's theory, there is a constant tendency to indefinite variation, and as the minute incipient variations will be in *all directions*, they must tend to neutralise each other, and at first to form such unstable modifications that it is difficult, if not impossible, to see how such indefinite oscillations of infinitesimal beginnings can ever build up a sufficiently appreciable resemblance to the leaf or other butterfly for "Natural Selection" to seize upon and perpetuate.

Again, at the other end of the process it is almost as difficult to account for the last touches of perfection in the mimicry. Some insects which imitate leaves extend the imitation even to the very injuries inflicted on those leaves by the attacks of insects or of fungi. How this double mimicry can importantly aid in the struggle for life seems a puzzling question, but much more so how the first faint beginnings of the imitation of such injuries in the leaf can be developed in the animal into such a complete representation of them.

Mr. Darwin explains the imitation of some species by others by the assured fact of the common origin of both the mimic and the mimicked species, and the consequent possession by both

* *Principles of Biology*, vol. i., p. 122,

† See Wallace's *Malay Archipelago*, vol. i., p. 204.

(according to the hypothesis of "Pangenesis") of gemmules tending to reproduce the ancestral colours, which colours the mimic must be assumed first to have lost and then to have again recovered. Mr. Darwin says:* "Varieties of one species frequently mock distinct species—a fact in perfect harmony with the foregoing cases, and explicable *only on the theory of descent.*" But this is but a partial and incomplete explanation, for we should have to go far back indeed to reach the common ancestor of the mimicking walking-leaf insect and the real leaf it mimics, or the original progenitor of both the bamboo insect and the bamboo itself.

In such cases no reason can be assigned why a variation tending in an *infinitesimal degree* in any special direction should be preserved. All variations would be preserved which tended to obscure the perception of an animal by its enemies, whatever direction those variations might take; and the common preservation of conflicting tendencies would necessitate their mutual neutralisation and obliteration, if we may at all rely on the many cases recently brought forward by our author with regard to domestic animals.

The theory of "Natural Selection" excludes the notion of a *sudden* resemblance to a leaf or a bamboo. Any spontaneous tendency in such direction is similarly and equally excluded, through the impossibility of explaining such cases by "community of descent." It is, to say the least, then, quite unwarrantable to use that explanation in the one case when its inapplicability in the other is manifest.

Another instance which may be cited is the symmetrical condition of the heads of the flat fishes (*pleuronectidæ*), such as the sole, flounder, brill, turbot, &c. In these both the eyes come to be placed, in the adult, on the same side of the head. If this condition had appeared at once, its perpetuation by "Natural Selection" is conceivable enough, but how the transit of one eye a minute fraction of the journey towards the other side of the head could benefit the individual is, indeed, far from clear, and it must always be recollected that "Natural Selection" only acknowledges minute variations. Moreover, these anomalous fishes seem to be probably of recent origin—*i.e.*, geologically speaking. We are not of course disposed to lay any great stress on the mere absence of their remains, nevertheless that absence is noteworthy, seeing that existing fish families—*e.g.*, the sharks (*squalidæ*)—have been found more or less abundantly in the carboniferous rocks.

* See Wallace's *Malay Archipelago*, vol. ii., p. 351.

Another difficulty seems to be the first formation of the limbs of the higher animals. The lowest vertebrata* are perfectly limbless, and if, as most Darwinians would probably assume, the primeval vertebrate creature was also apodal, how are the preservation and development of the first rudiments of limbs to be accounted for—such rudiments being, by the theory, infinitesimal and fractionless?

Again, a prehensile tail is undoubtedly a great assistance to an arboreal ape, but in the series of American monkeys some have this structure perfectly developed, some have it imperfectly, some scarcely at all, and in others it is absolutely wanting. It is impossible to believe that in any number of ages the first slight incipient tendency to grasp could preserve the lives of the individuals possessing it, or favour their chance of having and of rearing offspring.

The development of whalebone (*baleen*) in the mouth of whales is another difficulty. Once let it have grown to such a degree as to be at all useful, and then its preservation and augmentation within serviceable limits follows naturally. But how obtain the beginning of such useful development? Certain animals of exclusively aquatic habits, the dugong and manatee, also possess more or less horn on the palate, and at first sight this might be taken as a mitigation of the difficulty; but it is not so, and the fact does not help us one step further along the road, for in the first place these latter animals differ so importantly in structure from the whales and porpoises that they form an altogether distinct order, and in the second place the horny matter on their palate has not even initially the "strainer" action of the cetacean baleen.†

The sea urchins (*echinus*) have their spheroidal bodies furnished with certain very peculiar structures besides the spines and suckers which aid locomotion. The peculiar structures in question are termed *pedicellariæ*, and each consists of a long slender stalk, ending in three short limbs, the whole supported by a delicate

* The term "vertebrate" denotes that large group of the animal kingdom which contains all beasts, birds, reptiles, and fishes, and which is characterised by the possession of a spinal column, commonly known as the "back-bone."

† A whale-bone. A whale's mouth is furnished with numerous horny plates, which hang down from the upper jaw. They form two series, one on each side of the mouth, and the plates are placed transversely to the long axis of the body and very close together. On the inner edges of all the plates numerous fibres, as it were, fray out, and the multitude of fibres constitutes a sort of sieve, through which the water, taken into the mouth at each gulp, escapes, leaving behind the minute creatures on which these whales live.

internal skeleton. The three limbs (or jaws) which start from a common point at the end of the stalk are in the constant habit of opening and closing together with a snapping action, while the stalk itself sways about. The utility of these appendages is at present problematical; it may be that they remove from the surface of the animal's body foreign substances which would be prejudicial to it, and what it cannot otherwise get rid of. But granting this, what would be the utility of the *first rudimentary beginnings* of such structures, and how could such incipient buddings have ever preserved the life of a single echinus?

In that same echinus, as in many allied forms, and also in some sufficiently remote ones, a very peculiar mode of development exists. The adult is not formed from the egg directly, but the egg gives rise to a creature which freely swims about, feeds, and is even somewhat complexly organised. Soon a small lump appears on one side of its stomach, this enlarges, and having established a communication with the exterior, envelopes and appropriates the creature's stomach with which it swims away and developes into the complete adult form, while the dispossessed individual perishes.

Again, certain flies differ as to their mode of development from all other known animals, though they present a certain faint kind of resemblance to the echinus and their allies. In these flies, the grub is produced from the ovum, but this, instead of growing up into the adult in the ordinary way, contains certain patches of tissue, which patches respectively form certain parts of the adult animal and coalesce together. Now we confess our inability to conceive how either of these developmental processes could have *arisen* by the aid of "Natural Selection" alone.

There is an indefinite quantity of other structures or modes of being equally difficult to account for by Mr. Darwin's theory only. Such are, *e.g.*, the origin of such a part as a "mammary gland," and the *external* position in some animals of correlative glandular structures.

The projecting lumps of skin on the cheeks of the male orang-outan can hardly be supposed to tend to the preservation of the individual, nor can it aid (as the brilliant plumage of many birds is supposed to do) in the continuation of the race; as, in apes, the female is notoriously the weaker and less armed, and does not certainly *select*. On the other hand, the presence of this enlarged appendage must occasion a slight increase in the need of nutriment, and so far must be a detriment, although its detrimental effect would not be worth speaking of except in relation to

Darwinism, according to which "Selection" has acted through some millions of billions of ages, and has ever tended to suppress any useless development by the struggle for life. More or less similar difficulties attend certain sexual colours in the same group of animals.

Finally, such conditions as we find in some serpents are singularly puzzling to the Darwinian; such, *e.g.*, as the rattle of the rattlesnake, which tends to warn the intended victim by the ear as the expanding neck of the cobra warns the eye. As to any power of fascination exercised by means of these actions, the most distinguished naturalists, *certainly* the most distinguished erpetologists, entirely deny it, and it is opposed to the careful observations of those known to us; but, granting for argument's sake, that such an effect is occasionally produced, the opposite one must operate far more frequently, but even if the contrary effects merely balanced each other, "Natural Selection" would be unable to develope either.

A vast number of difficulties similar to those which have been mentioned might easily be cited, but for want of space those given must suffice.

2. *That on the theory of "Natural Selection" it is all but impossible, such are the probabilities against it, that identical structures should have arisen independently. Yet many structures undeniably exist which to all appearance must have so arisen.*

It is generally considered that the pouched beasts, or marsupial mammals (that is, the kangaroos, opossums, phalangers, &c.) are an ancient offshoot from the great mammalian class,* and although Professor Huxley has suggested another view,† yet this has not met with any notable acceptance, and has, we believe, been abandoned by its author, who, if we do not mistake, has returned to the older and more general notion.

Now assuming that the marsupials are such an ancient offshoot,

* The class mammalia contains all warm-blooded animals which suckle their young, such as apes, bats, hoofed beasts, lions, and other beasts of prey, whales, marsupials, &c.

† In his Hunterian course for 1866, the Professor promulgated the opinion that a great and widely-diffused marsupial fauna may have existed anterior to the development of the ordinary or non-pouched beasts, and that the carnivorous, insectivorous, and herbivorous non-pouched forms may have descended respectively from anterior carnivorous, insectivorous, and herbivorous pouched forms. If this view could be substantiated, we should have a common, simultaneous modification of very distinct forms, so that the difficulty raised would be rather augmented than diminished by such an interpretation of zoological facts.

nothing can be more remarkable than the identity of structure between certain of the teeth of the large predatory marsupial called the thylacine, or Tasmanian wolf, and those of the common dog. The resemblance is so complete that community of descent is at once most forcibly suggested, and yet on the assumption adopted, the thylacine may be closely related genetically to the kangaroo and its allies, but must be separated from the dog by an abyss. In the same way a quite remarkable resemblance obtains between the back teeth of beasts of insectivorous habits, whether pouched or not (as may be seen in Dr. Curvier's *Dents des Mammifères*); while, *à priori*, we might have expected that all the pouched beasts would have shown an essentially similar type of dental structure parallel to that existing in so many other points of their organisation.

On Darwinian principles, according to which zoological relationship are those of blood and descent, we should expect that each class would only possess such characters in common as they might obtain through their assumed common origin, together with such analogical resemblances as similarity of habit might occasion; yet the great mammalia of the ocean (*cetacea*), and the prodigious extinct marine reptiles (*ichthyosauri*), show striking resemblances not referable to similarity of habit, and in the same way the bats and those aerial reptiles of the secondary epoch—the pterodactyles—present in their back-bone, breast-bone, and hind limbs, curious and singular resemblances over and above the remarkable common principle of wing.

Again, bivalve shell-fish (*i.e.*, creatures of the mussel, cockle, and oyster class) have the two shells united by powerful muscles, which pass directly across from one shell to the other, and as by their contraction they close the shell, they are termed adductor muscles. Now, certain animals which belong to the crab and lobster class (viz., *ostracod crustacea*), which have their hard outer coat so modified as to look quite like a bivalve shell, though perfectly different in nature and composition, have, strange to say, the two sides also connected by adductor muscles. It is quite impossible to suppose that this identity of structure between a *crustacean* and a mussel can be due to community of descent.

We have already spoken of those very bizarre organs, the pedicellariæ of the echinus. Well, structures essentially similar (called "Bird's Head Processes") are developed from the surface of the compound masses of certain of the highest of the polyp-like animals (viz., the polyzoa, or, as they are sometimes called, the bryozoa). Yet these latter, and the echinus, can have none

but the most distant genetic relationship. We have, therefore, singularly complex and similar organs of diverse and independent origin.

In the highest class of animals (the mammalia) we have a placental mode of reproduction, no trace of which exists in any bird or reptile, yet it crops out again in certain sharks; and there it might well be supposed to end, but, marvellous to relate, it reappears in very lowly creatures—namely, certain of the ascidians, sometimes called tunicaries or sea-squirts.

In birds (the essentially aerial class of vertebrates) we have air-sacks extending from the air-passages of the body. In some insects (the essentially aerial class of invertebrates) we have also air-sacks extending from the air-passages of the body—dilatations of the tracheæ. But birds present us with another difficulty as to the independent origin of similar structures. For birds and reptiles have such and so many points in common that Darwinians must regard the former as modified descendants of ancient reptiles. But on Darwinian principles it is impossible that the class of birds so uniform and homogeneous should have had a double reptilian origin. If one set of birds sprang from one set of reptiles, and another set of birds from another set of reptiles, the two sets of birds could never by "Natural Selection" have grown into such a perfect similarity. To admit such a circumstance would be equivalent to abandoning the theory of "Natural Selection" as the sole origin of species.

Now it has generally been supposed that these ancient flying reptiles (the pterodactyles) were the progenitors of this class of birds, and one part of their structure especially supports this view. We allude to the bladebone (*scapula*), and the bone which passes down from the shoulder-joint to the breastbone (viz., the coracoid). These bones, but especially the latter, are such exact anticipations of the same parts in ordinary birds, that it is impossible for a Darwinian not to regard the resemblance as owing to community of origin. Yet, strange to say, the view has now been put forward, and very ably maintained,* by Professor Huxley, that the line of descent from reptiles to birds has not been through the pterodactyles to ordinary birds, but through the dinosauria† to the struthionidæ.‡ Now, in the dinosauria we find skeletal characters, unlike those of ordinary birds, but most

* In a lecture before the Royal Institution.

† The dinosauria are such fossil reptiles as the iguanodon and its allies.

‡ The struthionidæ is a family including the ostrich, emeu, phea, cassowary, &c.

closely resembling the osseous structure of the struthionidæ. How then is it possible at once to explain on the theory of "Natural Selection" the three following simultaneous resemblances, or rather identities, of structure—(1.) That of the pterodactyles with ordinary birds; (2.) that of the dinosauria with the struthious birds; (3.) that of the ordinary and struthious birds with each other?

Either birds must have had the distinct origins whence they grew to their present uniformity, or the very same skeletal characters must have spontaneously and independently arisen. Here is a dilemma, either form of which bears a threatening aspect to the exclusive supporter of "Natural Selection," and between which it is somewhat difficult to choose.

But so great is the number of similar, but apparently independent, structures, that we suffer from a perfect *embarras de richesse.* For example, the prehensile-tailed apes, carnivores,* rodents,† edentates,‡ and marsupials. The twisting of the windpipe of the sloth into folds reminding us of birds, as also the horny gizzard of the stomach of the great ant-eater. Again, the similar form of the crowns of the teeth in some seals, certain sharks, and some extinct cetacea; but we have quoted more than enough for our purpose.

Other reasons for believing that similarity of structure is produced by other causes than merely "Natural Selection," are furnished by certain facts of zoological geography, and by similarity in mode of variation being sometimes extended to several species of a genus, or even to widely different groups, while its restriction and limitation are often not less remarkable. Mr. Wallace, in his very instructive and interesting work on the Malay Archipelago,§ describes a remarkable case discovered by him of mimicry among birds, and which was the first example of the existence of this phenomena among the higher animals. A certain oriole of the island of Bouru has come to imitate a honey-sucker of the same island so exactly that the one is constantly mistaken for the other, in spite of their very distinct family relationship. Mr. Wallace offers a satisfactory explanation of this phenomenon in that the weak orioles find their profit in being mistaken by the certain birds of prey for the strong, active, and gregarious honey-suckers. So far so good, but "in the

* Carnivores are lions, dogs, bears, weasels, &c.

† Rodents are rats, squirrels, hares, guinea-pigs, &c.

‡ Edentates are sloths, armadillos, ant-eaters, &c.

§ See vol. ii., p. 150.

adjacent island of Ceram we find a very distinct species of both these genera, and, strange to say, these resemble each other quite as closely as do those of Bouru." Now, it is hardly credible that "Natural Selection" alone should, on the one hand, have limited this mode of protection to the one genus of orioles, and, on the other, should have enabled various of its component species to copy exactly various species of the honey-sucker, sifting out the conflicting tendencies of the incipient minute variations in all directions in each case.

Again, in describing the fauna of Celebes (the great interest of which the author so well points out), Mr. Wallace notices a remarkable common character possessed by butterflies of different families—"a peculiarity of outline which distinguishes them at a glance from those of any other part of the world;"* it consists "in the fore-wings being either strongly curved or abruptly bent near the base, or in the extremity being elongated and often somewhat hooked." The only explanation offered by Mr. Wallace is that "it seems probable that it is the result of a former condition of things, when the island possessed a much richer fauna, the relics of which we see [?] in the isolated birds and mammalia now inhabiting it; and when the abundance of insectivorous creatures rendered some unusual means of escape a necessity for the large-winged and showy butterflies." He adds—"It is some confirmation of this view, that neither the very small nor the very obscurely-coloured groups of butterflies have elongated wings, nor is any modification perceptible in those strong-winged groups which already possess great strength and rapidity of flight." Now, every opinion or conjecture of Mr. Wallace is worthy of respectful and attentive consideration, but we must confess this explanation appears to us to be extremely unsatisfactory. What the past fauna of Celebes may have been is as yet conjectural. Mr. Wallace confesses that now, at any rate, "there seems to be no unusual abundance of insectivorous birds;" and, even if there ever has been an abundance of such, it is by no means certain that they would have even tended to produce the conformation in question, for Mr. Wallace himself says, "It is not at all clear *what effect* the peculiar curvature of the wings has in modifying flight." We have here then a structure explained by a hypothetical property induced by a hypothetical cause!

But surely it is not unreasonable to class this instance with others in which a similarity of form or colour coexists with

* Vol. i., p. 439.

a certain geographical distribution quite independently of the destructive agencies of animals. Such a case is the gradual increase in brilliancy of colour of both birds and butterflies, as we pass from Tasmania to the northern part of Australia. It can hardly be that the insectivorous birds uniformly decrease as we reach the warmer Australian latitudes so as to allow of the existence of more conspicuous insect forms; but if it were so, this would in no way explain the greater brilliancy of the birds themselves.

Again, though certain South American butterflies mimic others which are protected by an offensive odour, yet other species mimic forms which are quite destitute of such protection, and which do not lend themselves, as far as we yet know, to any similar explanation. Then, why are these peculiar mimicking modes of variation, though spread among different species of certain, yet confined as they are to such groups? How many birds would be benefited by mimicry besides the eastern orioles? How many insects also other than those which exhibit the peculiarity? No! some other influence than "Natural Selection" has had a share in determining such phenomena—an influence similar to that which induces certain shells when removed to strange waters to assume characters possessed by the species in the second locality; but of this in our next section. We do not here allude to any influence higher than is indicated in every part of nature. We allude merely to a secondary cause; but we are strongly impressed with the conviction that that cause is not "Natural Selection," pure and simple. Here, however, we must pause for the present.

Difficulties of the Theory of Natural Selection.

II.

We continue, in the following pages, to discuss some of the heads of objections which we have already indicated to Mr. Darwin's theory.

3. *That there are grounds for thinking that specific differences may be developed suddenly instead of gradually.*

The difficulty of comprehending the preservation of infinitesimally small beginnings of useful structures (considered in the first part of this paper), together with the absence of certain fossil forms (to be considered later), appear to us to point in this direction. Some facts however brought forward in Mr. Darwin's last work appear decidedly to harmonise with a rapid development of specific differences. Such facts are—1. "That climate to a certain extent directly modifies the form of dogs." * (The Rev. R. Everett found that setters at Delhi, though most carefully pa ed, yet had young with "nostrils more contracted, noses more pointed, size inferior, and limbs more slender;") 2 that cats at Monbas, on the coast of Africa, have short stiff hairs instead of fur, and that a cat at Algoa Bay when left only eight weeks at Monbas "underwent a complete metamorphosis, having parted with its sandy coloured fur;"† 3. that the conditions of life seem to produce a considerable effect on horses, and instances are given of pony breeds ‡ having independently arisen in different parts of the world, possessing a certain similarity in their physical conditions; 4. that—as to pigs, so Nathusius § states positively as the result of common experience and of his experiments—rich and abundant food, given during youth, tends by some direct action to make the head broader and shorter, and *vice versâ;* 5. that curious jaw appendages often characterise Normandy pigs, according to M. Eudes Deslongchamps. Richardson figures them on the old "Irish greyhound pig," and they are said by Nathusius to appear occasionally in

* *Animals and Plants under Domestication*, vol. i., p. 37.
† *Ibid.*, p. 47. ‡ *Ibid.*, p. 52. § *Ibid.*, p. 72.

all the long-cared races. Mr. Darwin observes,* "As no wild pigs are known to have analogous appendages, we have at present no reason to suppose that their appearance is due to reversion; and if this be so, we are forced to admit that somewhat complex, though apparently useless, structures may be suddenly developed without the aid of "Selection;" 6. that "climate directly affects the thickness of the skin and hair" † of cattle; 7. that in the English climate an individual Porto Santo rabbit ‡ recovered the proper colour of its fur in rather less than four years; 8. that the effect of the climate of India on the turkey is considerable. Mr. Blyth § describes it as being much degenerate in size, "utterly incapable of rising on the wing," of a black colour, and "with long pendulous appendages over the beak enormously developed;" 9. that among other curious instances of the direct effect of conditions on individual animals may be selected that given by Mr. Darwin from M. Costa, || who has recorded of oysters, "that young shells, taken from the shores of England and placed in the Mediterranean, at once altered their manner of growth, and formed prominent diverging rays, *like those on the shells of the proper Mediterranean oyster;*" 10. that, as Mr. Meehan,¶ quoted by Mr. Darwin** tells us, twenty-nine kinds of American trees all differ from their nearest European allies in *a similar manner*—"leaves less toothed, buds and seeds smaller, fewer branchlets," &c.; 11. that there has suddenly appeared in a bed of common broccoli a peculiar variety faithfully transmitting its newly acquired and remarkable characters;†† 12. that there has been a rapid transformation and transplantation of American varieties of maize into a European variety;‡‡ 13. that certainty "the Ancon and Manchamp breeds of sheep," and that all but certainly "Niata cattle, turnspit and pug-dogs, jumper and frizzled fowls, short-faced tumbler pigeons, hooked-billed ducks, &c., and a multitude of vegetable varieties, have suddenly appeared in nearly the same state as we now see them."§§ Lastly—a most significant fact—that there has been an occasional development (in five distinct cases) in England of the "japanned" or "black-shouldered peacock." *Pavo nigri-*

* *Animals and Plants under Domestication*, vol. i., p. 76.
† *Ibid.*, p. 91. ‡ *Ibid.*, p. 114. § Quoted *Ibid.*, p. 294.
|| *Bull. de la Soc. Imp. d'Acclimat*, tom. viii., p. 351. Quoted by Mr. Darwin in vol. ii., p. 280.
¶ *Pro Acad. Nat. Sc. of Philad.*, Jan. 28, 1862. ** *Ibid.*, p. 281.
†† *Animals and Plants under Domestication*, vol. i., p. 324.
‡‡ *Ibid.*, vol. i., p. 322. §§ *Ibid.*, vol. ii., p. 414.

pennis, a distinct species, according to Dr. Sclater,* yet arising in Sir J. Trevelyan's flock, composed entirely of the common kind, and increasing, "*to the extinction of the previously existing breed.*" † Mr. Darwin's only explanation of the phenomenon (on the supposition of the species being distinct) is by reversion, owing to a supposed ancestral cross. But he candidly admits: "I have heard of no other such case in the animal or vegetable kingdom." On the supposition of its being only a variety he observes: "The case is the most remarkable ever recorded of the abrupt appearance of a new form, which so closely resembles the true species, that it has deceived one of the most experienced of living ornithologists."

After these facts it is somewhat startling to meet with the dogmatic assertion, that it is a *false belief* that natural species have often originated in the same abrupt manner. ‡

4. *That the causes of variability in domestic animals have not been proved to be of the same nature as those acting upon wild species.*

The much greater degree of variation among domestic animals than among wild ones is asserted over and over again by Mr. Darwin, and the assertions are supported by an overwhelming mass of facts and instances.

These remarkable variations extend to instincts and propensities as well as to ascertainable points of structure. No individual wild animal has ever been found living under sexual relations opposed to those adopted by the rest of its species. Nevertheless, the wild drake is monogamous while the domestic one has a polygamous habit. §

Again it is demonstrated by Mr. Darwin's careful weighings and measurements, that, though little used parts in domestic animals get reduced in weight and somewhat in size, yet that they show no inclination to become truly "rudimentary structures." Accordingly he asserts ‖ that such rudimentary parts are formed "suddenly, by arrest of development" in domesticated animals, but in wild animals slowly. The latter assertion,

* *Proc. Zoo. So. of London.*, Ap. 24, 1860.

† *Animals and Plants under Domestication*, vol. i., p. 291.

‡ We may remind our readers that certain axolotls (large Mexican efts with permanent gills) have quite unexpectedly put on what is believed to be the normal adult form of the species. Only a few have done so, but these have done it completely and *suddenly*.

§ *Animals and Plants under Domestication*, vol. ii., p. 304.

‖ *Ibid.*, p. 318.

however, is a *mere assertion;* necessary indeed for the theory of "Natural Selection," but in no other way.

Of course it may be asserted that a tendency to indefinite variability exists equally in all cases, and that it is the circumstances and conditions of life alone, which cause the effects of this common tendency to differ so much in the two cases. But assertion is not proof, and this assertion cannot be proved. Indeed it may equally be asserted (and we think it is a statement more consonant with the above facts) that domestication in certain animals induces and occasions a tendency to vary which is absolutely wanting in wild animals—the introduction of new causes occasioning new effects. For, though a certain minute variability (or rather oscillation) exists in all organisms, yet domesticated ones are exposed to new and different causes of variability, resulting in such striking divergencies as have been observed. Not even in this latter case however is it necessary to believe that the variability is indefinite, but only that the small oscillations become in certain instances intensified into large and conspicuous ones, Moreover, it is possible that our domestic animals have in part been chosen and domesticated through possessing a capacity for variation in an eminent degree; and this brings us to the fifth consideration.

5. *That there is more reason to believe that species have definite limits to their variability, than that all are capable of indefinite variation.*

This proposition is largely supported by facts brought forward by the zealous industry of Mr. Darwin himself. It is unquestionable that the degrees of variation which have been arrived at in domestic animals have been attained more or less readily in a moderate amount of time, but that further development in certain desired directions is in some a matter of extreme difficulty, and in others of absolute impossibility. It is also unquestionable that the degree of divergence attained in one domestic species is no criterion of the amount of divergence which may be produced in another. It has been contended on the other hand—(1.) That we have no evidence of any limits to variation other than what are imposed by physical conditions, such, *e.g.*, as those which determine the greatest degree of speed possible to any animal (of a given size) moving over the earth's surface; (2.) that the differences in degree of variation presented by different domestic animals are due to the varying direction and amount of attention in man's selection, combined with abundance or scarcity of individuals; (3.) and finally, that

the "variations" found in nature are within the limits to which the variation of domestic animals extend.

The fact of the rapidly increasing difficulty found in producing, by ever such careful selection, any further extreme in some variation already carried very far (such as the tail of the "fantailed pigeon," or the crop of the "pouter"), is certainly on the side of the existence of definite limits to variability. It is asserted in reply, that physiological conditions of health and life may bar such further development. But it is difficult to see how the addition of the two more feathers to the present breed of fantailed pigeons could be so detrimental. And even if that be the nature of the barrier, the admission of an internal barrier in the structure and nature of each organism is indeed all that is required. Mr. Darwin evidently thinks that those are right who hold that the limits of variability in pigeons have not been reached; and it is probable that those limits, in certain (perhaps many) directions, have not. But it is all but certain that in some other directions *they have*. On the hypothesis of *indefinite* variability, it is difficult to say what barrier there is to the production of completely web-footed pigeons or pigeons with certain tail feathers lengthened beyond the other ones, like those of Trogons, or indefinite monstrosities of other kinds. Of course for the complete development of such, a very long period of time might be required, but not for the *beginnings* of such variations. Now, all the variations which have ever taken place in pigeons are, after all, of a few definite kinds only; such as may be well conceived to be compatible with a species possessed of a certain inherent capacity for considerable yet definite variation. And such a capacity harmonises with the ready production of certain degrees of abnormality, which then cannot be further increased.

That different species have not only very definite but very different degrees of capacity for variation is much supported by facts given in Mr. Darwin's recent publication. Thus the great degree of variability presented by dogs, cats, horses, fowls, and pigeons, is abundantly enforced, but the *very small* extent to which the goose, the peacock, or the Guinea fowl are shown to have varied is none the less worthy of note.*

Mr. Darwin attempts to explain this fact as regards the goose, by the assertion that it has not been much the object of careful selection; but if this is the case, it is at least as probable that its fixity of character is the cause of the neglect,

* *Animals and Plants under Domestication*, vol. i., p. 289—295.

as the reverse. It may fairly be assumed that *had* the goose shown a tendency to vary similar in degree to that of the fowl or pigeon, it would have received attention at once on that account.

As to the peacock, Mr. Darwin excuses it on the plea that the individuals have been too few in number. But they have *not been too few* for the independent origin of the black-shouldered form, or for the supplanting of the commoner one by it. As to any neglect in selection, it would be monstrous to imagine that with regard to this bird (kept as it is all but exclusively for its beauty), any spontaneous variation in colour or form would have been neglected. On the contrary, it would have been sure to have been seized upon with avidity and preserved with anxious care. Yet, apart from the black-shouldered form and white varieties, no tendency whatever to variation has, we believe, ever been known to manifest itself. The Guinea fowl again is a very noteworthy instance of constancy under very varied conditions. These instances alone (and there are yet others) seem sufficient to establish the assertion, that the degree of variability of one kind of domestic animal is no index to the degree of variability of another kind. It is then quite unwarrantable to assume that *all* wild animals have a capacity for variation similar to that existing in *some* of the domestic ones; while, on the other hand, if the degree of capacity for variation be different in different domestic animals, it must surely be limited in those which vary least, and *a fortiori* limited in wild animals.

That "the variations found in nature are within the limit to which the variations of domestic animals extend" may be understood to mean that no two species of the same genus differ more than do two extreme varieties of certain domestic animals. And this we have no wish to deny. But under domestication we have new conditions; and it must not be assumed that the causes of variation are only the same as in wild animals. *A priori* we might expect a greater variability in domestic animals, and it is unfair to argue, as Mr. Darwin does,* that because certain domestic animals have varied, therefore all natural species must be capable of a similar extent of variation.

That each species exhibits certain oscillations of structure is admitted on all hands. Mr. Darwin asserts that this is the exhibition of a tendency to vary which is perfectly indefinite.

* *Animals and Plants under Domestication*, vol. ii., p. 406.

If this indefinite variability *does* exist, of course no more need be said. But the occurrence of variations in certain domestic animals greater in degree than the differences between many wild species, is no argument in favour of its existence, until it can be shown that the causes of variability in action in the one case are the same as in the other. But a most important argument against it may be drawn from the fact, that certain animals though placed under the influence of those extraordinary causes of variability to which domestic animals are subject, have nevertheless never been known to vary even in a degree equal to that in which certain wild kinds have been ascertained to vary. And in addition to this we shall presently see that the domestic varieties have little stability and much tendency to reversion, whatever be the true explanation of such phenomena. The parallel variations, before referred to,* also harmonise with the existence of definite kinds and degrees of variation as contrasted with unlimited variability.

6. *That some recent zoological and anatomical discoveries tend rather to diminish than to augment the evidence in favour of minute and gradual modification.*

All naturalists now admit that certain animals, which were at one time supposed to be connecting links between groups, belong altogether to one group and not at all to the other. For example, the Aye-aye (*Chiromys Madagascariensis*),† was till quite lately considered to be closely allied to the squirrels, and was often classed with them in the rodent order, at the same time that its affinities to the lemurs and apes were admitted. The thorough investigation into its anatomy that has now been made, demonstrates that it is a completely lemuroid animal, and that it has no more essential affinity to rodents than any other lemur-like creature has.

Bats were by the earliest observers naturally supposed to have a close relationship to birds, and cetaceans to fishes. It is almost superfluous to observe that all now agree, that these creatures make not even an approach to either one or other of the inferior classes.

The *amphibia* (*i.e.*, frogs, toads, and efts) were long considered (and are so still by some) to be reptiles, showing an affinity to fishes. It now appears that they form with the latter

* *Animals and Plants under Domestication*, vol. ii., p. 348.

† A lemur, or low kind of ape. The Aye-aye is one that differs singularly from all other apes, or indeed lemurs.

one great group,* which differs widely from reptiles, while its two component classes are very difficult to separate from each other in a thoroughly satisfactory manner.

On the hypothesis of gradual and minute modification the succession of organisms on this planet must have been a progress from the more general to the more special. Yet some of the most recently discovered fossils show a structure singularly more generalised than any exhibited by older forms; while others are more special than are any allied creatures of the existing creation.

A notable example of the former circumstance is offered by Macrauchenia—a hoofed animal, which was at first supposed to be a kind of llama. Hoofed animals are divisible into two very distinct series, according as the number of functional toes on each hind foot are odd or even. And many other characters are found to go with this obvious one. Now the very earliest ungulata show this distinction, which is completely developed and marked in the eocene Palœotherium and Anoplotherium found in Paris by Cuvier. The former of these has the toes odd (perissodactyle), the other has them even (artiodactyle).

Now the Macrauchenia, from the first relics of it which were found, was thought to belong plainly to the even-toed division. But subsequent discoveries seemed to give it an equal claim to rank amongst the perissodactyle forms. Others again inclined the balance of probability towards the artiodactyles. Finally it appears probable that this very recently extinct beast presents a highly generalised type of structure, uniting in one living form both artiodactyle and perissodactyle characters in a way not found in any other known creature living or fossil. At the same time, as has been said, this differentiation of artiodactyle and perissodactyle existed in the oldest known forms of ungulata.

Again, no armadillo *now living* presents nearly such a remarkable speciality of structure, as was possessed by the *extinct* Glyptodon. Nor does any predacious beast of the *present day* show such a highly differentiated and specially carnivorous dentition, as that which characterises the *extinct* Machairodus or sabre-toothed tiger. It is not pretended that these instances are irreconcilable with "Natural Selection." Nevertheless they point in an opposite direction.

7. *That certain fossil transitional forms are absent, which might have been expected to be present.*

Some of the facts already enumerated tend more or less to

* Ichthyopsida of Professor Huxley.

support the above proposition. The only notable instance in which discoveries recently made appear to fill up an important hiatus is the interpretation lately given by Professor Huxley* to the remains of the dinosauria, and which we noticed in the first part of this paper. The learned Professor has, as before said, shown that in very important and significant points the skeletons of the Iguanodon and of its allies approximate very closely to that existing in the Ostrich, Emeu, Rhea, &c. He has given weighty reasons for thinking that the line of affinity between birds and reptiles passes rather to the birds last named from the dinosauria, than from the pterodactyles through the Archæopteryx to the ordinary birds. Finally, he has thrown out the suggestion that the celebrated footsteps left by some extinct three-toed creatures on the very ancient sandstone of Connecticut were made, not, as hitherto supposed, by true birds, but by more or less ornithic reptiles. But even if all this were conceded, it would not approach to a demonstration of specific origin by *minute* modification. And though it harmonises well with "Natural Selection," it is equally consistent with the rapid and sudden development of new specific forms of life. Indeed, the Professor, with laudable caution and a moderation too little observed by some Teutonic Darwinians, guarded himself from any imputation of asserting dogmatically the theory of "Natural Selection," while upholding fully the doctrine of evolution.

But, after all, it is by no means certain that the Connecticut footsteps were made by very ornithic reptiles, or extremely sauroid birds. And it must not be forgotten that a completely carinate† bird (the Archæopteryx) existed at a time, when as yet we have no evidence of some of the dinosauria having come into being.

Again, the pterodactyles, though a numerous group, are all true and perfect pterodactyles, though surely some of the many incipient forms would have had at least as good a chance of preservation.

The group of whales is a very marked one, and apparently of recent origin, geologically speaking. It is curious then that so few instances tending to indicate their line of descent should have presented themselves. The bat again is a form which, on the Darwinian hypothesis, we might surely expect to have left behind some relics of the incipient stages of its development.

But not only is it the case that we fail to find any traces of

* See also the *Popular Science Review* for July, 1868.

† A bird with a keeled breast-bone, such as almost all existing birds possess.

the incipient stages of numerous very peculiar groups of animals, but it is undeniable that there are instances in which a *gradual transition* appeared to be all but demonstrated, but which instances have been upset and refuted by further investigation. At one time the remains of the labyrinthodonts which up till then had been discovered, justified the opinion that as time went on, forms had successively appeared with more and more complete segmentation and ossification of the back-bone, which in the earliest forms was a soft continuous rod or notochord. Now, however, it is considered probable that the Archegosaurus was a larval* form, while labyrinthodonts with completely developed vertebræ have now been found to exist amongst the very earliest forms yet discovered. The same may be said regarding the eyes of the trilobites, some of the oldest forms having been found as well furnished in that respect as the very last of the group, which has left its remains accessible to observation.

Such instances however, as well as the way in which marked and special forms (as the pterodactyles, &c., before referred to), appear at once in, and similarly disappear from, the geological record, are, we well know, explicable on the Darwinian hypothesis. Of course the alleged extreme, and probably great, imperfection of that record may be pleaded validly in excuse. But it *is* an excuse.† Nor is it possible to deny the *à priori* probability of the preservation of at least a few minutely transitional forms in one or other instance, if every species without exception has arisen exclusively by such minute transitions.

8. *The great extent of geographical change, required during the existence of the present fauna, forms another objection.*

Many facts as to the present distribution of animal life on the earth's surface are readily explicable by the hypothesis of slight elevations and depressions of larger and smaller parts of that surface. But there are others, the existence of which it is very difficult, if not altogether impossible, so to explain. Thus, with regard to existing fresh-water fishes, pleurodont‡ lizards, and insectivorous mammals, it is necessary to assume (on the Darwinian theory) that Africa and India were intimately con-

* A larva is an immature individual. Thus a tadpole is the larval form of a frog.

† As Professor Huxley, with his characteristic candour, fully admits in the paper on the dinosauria, before referred to.

‡ Those in which the teeth are attached by their sides within the margin of the jaw. Those in which the teeth are attached to the summit of the margin are termed acrodont.

nected, on account of the resemblance between the fresh-water fishes of the two regions. For the same reason we must consider Northern Africa and South America to have been similarly continuous; although the latter combination must have been distinct from the former one. Since, though Africa has forms of fresh-water fish like those of India on the one hand and South America on the other, yet the Indian-like forms are different from the American-like ones; and no forms extended from India to South America.

Land in the place of Southern Africa must (on the same theory) have been continuous with South America on the one hand and with Madagascar on the other. This is shown by the existence of pleurodont iguanian lizards in both these extremes, and nowhere else on the earth's surface, certainly not on the present continent of Africa as yet known; while the previous land in its place must have been distinct from the Africa connected with India, or that which originally had its streams continuous with those of South America. For the fresh-water fishes, like those common to Africa and South America, are not, as far as yet known, found in Madagascar.

The last-named island and the West Indies were (on the same theory) also once continuous, as is shown by the existence of the insectivorous genera Centetes, Ericulus, and Echinops in Madagascar, while the only other member of the group to which they belong is a resident in Cuba and Hayti—the genus Solenodon. But this union must have been at a period when the great lemurine group was absent. For it is difficult to understand the spread of such a form as Solenodon and the non-extension of the active lemurs, or their utter extirpation, in such a congenial locality as the West Indian Archipelago.

Again, the very close connection of South America and Australia is evidenced (always on the Darwinian theory) not only from the marsupial fauna of both, but also from the frogs and toads which respectively inhabit those regions, and a truly remarkable similarity and parallelism exists between certain of the same animals inhabiting South-western America and Europe.*

Now all these facts refer to *existing animals only;* and we think many geologists will demur to the introduction of such vast geographical changes, amounting to the sinking and re-emergence of Africa and an Atlantis some three, if not four, times since the development of the present fauna on the earth's surface.

* See a paper read by Dr. Günther before the Zoological Society, on June 25, 1868.

These difficulties are evaded, if we concede the possibility of the independent origin of similar forms under similar conditions. Certainly the independent building up of such definite resemblances in different species of pleurodont lizards is at first sight startling. But we have already seen that it is impossible to escape independent origins of similar forms upon any hypothesis. Nor are the teeth of the dog and the thylacine, or any of the other instances before enumerated in the first part of this paper, really less wonderful instances of independent origination, than are similar lizards, fishes, frogs, or toads.

9. *That the objection drawn from the physiological difference between "species" and "races" still exists unrefuted.*

Mr. Darwin candidly admits difficulties regarding the sterility of different species when crossed, and demonstrates satisfactorily that it could never have arisen from the action of "Natural Selection." He remarks,* also "With some few exceptions in the case of plants, domesticated varieties—such as those of the dog, fowl, pigeon, several fruit-trees, and culinary vegetables, which differ from each other in external characters more than many species—are perfectly fertile when crossed, or even fertile in excess, whilst closely allied species are almost invariably in some degree sterile." It is true he adds, "that we can, to a certain extent, give a satisfactory answer," but to our mind at least the answer is *not* satisfactory, or, indeed, clear.

Mr. Darwin says, as to the sterility of species, that "the cause lies exclusively in differences in their sexual constitution." But the problem is, what *is* this "difference," the existence of which all must, of course, admit; and as to this, he adds, "we are far from precisely knowing the cause."† He, however, attempts to account for it by the exposure of species "to more uniform conditions during long periods of time" than those to which varieties are exposed; and that as wild animals, when captured, are often rendered sterile by captivity, so the influence of union with another species may produce a similar effect. It seems to us a most unwarrantably strong presumption that a cross with what on the Darwinian theory can only be a slightly diverging descendant of a common parent, should produce an effect equal to that of captivity and consequent change of habit, as well as at least considerable modification of food.

No clear case has been given by Mr. Darwin in which mongrel animals, descended from the same undoubted species, have been

* *Animals and Plants under Domestication*, vol. ii., p. 189.

† *Ibid.*, p. 190.

infertile *inter se;* nor any clear case in which hybrids, between two generally admitted distinct species of animals, have been fertile *inter se.*

It is true that facts are brought forward tending to establish the probability of the doctrines of Pallas, that species may sometimes be rendered fertile by domestication. But even if this were proved—which it is *not*—it would be no approximation towards proving the converse, that races and varieties may become sterile when crossed. And whatever may be the preference occasionally shown by certain breeds to mate with their own variety, no sterility is recorded as resulting from unions with other varieties. Indeed, Mr. Darwin remarks:* "With respect to sterility from the crossing of domestic races, I know of no well-ascertained case with animals. This fact (seeing the great difference in structure between some breeds of pigeons, fowls, pigs, dogs, &c.) is extraordinary, when contrasted with the sterility of many closely-allied natural species when crossed."

It has been asserted that three species of pheasants produce fertile hybrids. It would be highly interesting to know whether they are subject to variations, bearing in mind the remarkable phenomenon of the sudden production of the black-shouldered peacock before alluded to.

10. *That the phenomena of reversion still present a difficulty, which has been by no means overcome.*

In controverting the generally-received opinion as to "reversion," Mr. Darwin has shown that it is not all breeds which in a few years revert to the original form. But he has shown no more.

Thus the feral rabbits of Porto Santo, Jamaica, and the Falkland Islands, have not yet so reverted† in those several localities. Nevertheless, a Porto Santo rabbit brought to England reverted in a manner the most striking, recovering the proper colour of its fur "in rather less than four years."‡

Again, the white silk fowl in our climate "reverts to the ordinary colour of the common fowl in its skin and bones, due care having been taken to prevent any cross."§ This reversion taking place in spite of careful selection is very remarkable.

Numerous instances of reversion are given by Mr. Darwin, both as regards plants and animals; amongst others the singular fact of bud reversion,‖ and the curiously recurring development of black sheep, in spite of the most careful selection.¶ It is true

* *Animals and Plants under Domestication*, vol. ii., p. 104.
† *Ibid.*, vol. i., p. 115. ‡ *Ibid.*, vol. i., p. 114.
§ *Ibid.*, vol. i., p. 243. ‖ *Ibid.*, vol. ii., p. 361. ¶ *Ibid.*, vol. ii., p. 30.

these instances are explicable by means of other hypotheses than that which assumes a limit to specific variation. Nevertheless it cannot be denied that the phenomena of reversion tend to favour the limitation hypothesis, while the cases of non-reversion do not contradict it. Besides, it is not contended that all species have the same amount of variability, but on the contrary, that the differences between their capacities in this respect are very marked, as shown, *e.g.*, by the fowl and duck on the one hand, and the peacock and goose on the other. Similarly the tendency of reversion may produce its effect at an indefinitely longer period in some species, and under some circumstances, than in others.

Some of the instances given as cases of reversion are quite untenable; as, for example, where Mr. Darwin regards the occasional presence of supernumerary digits in man as a retention of an embryonic condition.* For this error, however, the author is not responsible, as he reposes on the authority of Professor Owen, and quotes that naturalist's remark that in the ichthyopterygia "the digits may be seven, eight, or nine in number, a significant mark of piscine affinity." The fact is, that in the *ichthyopterygia*, as in all known vertebrates, there are nominally never more than five digits. The appearance of a greater number is due to the development of certain marginal ossicles around the terminal limb-segment, sometimes even extending as far as the proximal limb-segment; while, as to "piscine affinity," no fish can be said to have even a single digit, no relation of homology whatever being really traceable between the fin-rays of fishes and the true digits of higher animals, though such a relation has commonly been assumed to exist.

Again Mr. Darwin observes,† "The greater frequency of a monster kind of proboscis in the pig than in any other animal, considering the position of the pig in the mammalian series, has likewise been attributed, perhaps truly, to reversion." He refers to Isid. Geoffroy St. Hilaire, *Des Anomalies*, t. iii., p. 353. It is very difficult, however, to see in what way this can be a case of *reversion*, as the only known proboscidian ungulates are the elephants and tapirs, and to neither of these has the pig any close affinity. On the Darwinian theory, such a structure should rather appear in the horse than in any form of pig; as the horse, like the tapir, belongs to the perissodactyle, or odd-toed group of hoofed beasts.

* *Animals and Plants under Domestication*, vol. ii., p. 16, and also p. 57.
† *Ibid.*, vol. ii., p. 57.

As before hinted, the element of time must be taken into account in judging of the phenomena of "reversion." Considering the inconceivably vast series of ages required by "Natural Selection" for the development of species, no nearly sufficient period has yet elapsed since man's action to justify the assertion that any given breed will not ultimately revert.

11. *That even if the origin of species by "Natural Selection" were proved, yet other phenomena not less remarkable would still remain unexplained, and that the explanation of such may possibly be at the same time the key to specific origination.*

The phenomena in question are those indicated by the terms serial, bilateral, and vertical homology.*

The facts of serial homology† seem hardly to have excited the amount of interest they undoubtedly merit. Many writers have occupied themselves with investigations and speculations as to what portions of the leg and foot answer to what parts of the arm and hand. But comparatively few have devoted much time and thought to the question of serial homology in general. Mr. Herbert Spencer, however, in his charming work, entitled *First Principles of Biology*, has given forth ideas on the subject, which deserve careful perusal and consideration, and which apply to all the three kinds of homology mentioned above. These ideas we will notice a little further on.

Serial homology is most strikingly manifested in such a creature as the hundred-legs, or centipede. There the body consists (except at its two ends) of a longitudinal series of externally quite similar segments. Each segment supports a pair of limbs, and the appendages of all the segments (except as before) are completely alike.

* "Homology" means such a relation between different parts that the parts in question may be said in some sense to be "essentially the same," or, at least, "of similar nature." The term homologous may be applied to different parts of the same individual, as to "the right and left hands," or to "joints of the backbone," or to "the teeth of the two jaws." The homology here spoken of is of this kind, and applies only to different parts of the same individual. The term homologous is, however, also applied to similar parts of different species, as to the arm of man and to the foreleg of the horse, or to the paddle of the whale and the wing of the bat. This latter kind of homology may be further distinguished into (1.) a relationship which—on Darwinian principles—would be due to direct descent, and (2.) a relationship induced, not derived—*e.g.*, the relationship of the tooth of the thylacine to that of the dog, spoken of in the first part of this paper.

† Serial homology is the relation of resemblance and affinity existing between parts placed in series one behind the other in the same individual—*e.g.*, the limbs of the centipede, the ribs or joints of the backbone of a horse.

A less complete case of serial homology is presented by *crustacea* (animals of the crab class), notably by the Squilla and by the common lobster. In the last case, great as are the apparent differences between the appendages of different parts (*e.g.*, between the antennæ,* the mandibles,† the great claws, the swimmerets‡), yet these differences do not exist at first; for in development they all make their appearance similar in form.

Such an obvious serial repetition of parts does not obtain in the highest, or back-boned animals—vertebrata. In man, *e.g.*, nothing of the kind is externally visible, and we have to penetrate to his skeleton to find such. There, indeed, we discover a number of pairs of bones, each pair so obviously resembling the others, that they all receive a common name—the ribs. There also we find a still more remarkable series of similar parts, the *vertebræ* (or joints of the back-bone), which are admitted by all to possess a certain community of structure.

It is in their limbs, however, that the vertebrata present the most obvious and striking serial homology—the only serial homology externally visible. And, as has been said, this fact has excited much attention and inquiry, for though striking, this correspondence is never complete.

Mr. Darwin recognises§ this homology, which enters into his laws of correlation. To say, however, that any parts resemble each other by "a law of correlation" is no very satisfactory explanation, nor one specially favourable to "Natural Selection."

The resemblance between the fore and hind limbs seems sometimes to have been strongly educed in creatures which, on the Darwinian hypothesis, are the descendants of others in which it was far less marked. The common parent of efts on the one hand, and of sharks and rays on the other, cannot be conceived to have possessed that remarkable correspondence between the bones and cartilages of the fore and hind limbs recently pointed out by Gegenbaur as existing in the former.‖

Now it is not conceivable that indefinite variation and "Natural Selection" could ever build up this serial symmetry without some special innate tendency so to build up possessed by the organism itself. By special tendency we mean one, the laws and conditions of which are as yet unknown, and analogous

* The long filamentary processes projecting from the head.
† The first pair of jaws.
‡ The paddle-like limbs placed beneath the so-called tail.
§ *Animals and Plants under Domestication*, vol. ii., p. 322.
‖ See his *Carpus and Tarsus.*

to the innate powers possessed by crystals similarly to build up certain peculiar and very definite forms.

That there *is* some such special and peculiar influence seems to us clear, not only from facts of comparative anatomy, but also from those of teratology* and pathology.

Whatever may be said regarding efts or newts, yet tortoises on the one hand and plesiosauria† on the other must be admitted by all to be highly differentiated organisms, and far enough removed from what, on Mr. Darwin's theory, must have been the earliest limbed vertebrate type. Yet they exhibit such a remarkable uniformity in fore and hind limb structure that it is impossible to doubt its independent appearance in these two widely-different types of animal life.

Mr. Darwin cites‡ a remarkable instance of what he is inclined to regard as the development in the foot of birds of a sort of representation of the wing feathers of its hand. He says: "In several distinct breeds of the pigeon and fowl the legs and the two outer toes are heavily feathered, so that, in the trumpeter pigeon, they appear like little wings. In the feather-legged bantam, the 'boots' or feathers which grow from the outside of the leg and generally from the two outer toes, have, according to the excellent authority of Mr. Hewitt, been seen to exceed the wing feathers in length, and in one case were actually nine-and-a-half inches in length! As Mr. Blyth has remarked to me, these leg-feathers resemble the primary wing-feathers, and are totally unlike the fine down which naturally grows on the legs of some birds, such as grouse and owls. Hence it may be suspected that excess of food has first given redundancy to the plumage, and then that the law of homologous variation has led to the development of feathers on the legs, in a position corresponding with those on the wing, namely, on the outside of the tarsi and toes. I am strengthened in this belief by the following curious case of correlation, which for a long time seemed to me utterly inexplicable, namely, that in pigeons of any breeds, if the legs are feathered, the two outer toes are partially connected by skin. These two outer toes correspond with our third and fourth toes. Now, in the wing of the pigeon or any other bird, the first and fifth digits are wholly aborted; the second is rudimentary, and carries the so-called 'bastard-wing;' whilst the third and fourth digits are completely united

* The science of abnormal forms.

† Large extinct marine reptiles, with long necks, small heads, and paddle-like limbs.

‡ *Animals and Plants under Domestication*, vol. ii., p. 322.

and enclosed by skin, together forming the extremity of the wing. So that in feather-footed pigeons, not only does the exterior surface support a row of long feathers, like wing-feathers, but the very same feathers which in the wing are completely united by skin become partially united by skin in the feet; and thus, by the law of the correlated variation of homologous parts, we can understand the curious connection of feathered legs and membrane between the two outer toes." This notion may of course be erroneous, but it is well worthy much consideration.

As to teratology, it is notorious that similar abnormalities are often found to co-exist in both the fore and hind extremities—"l'Anomalie se répète d'un membre thoracique au membre abdominal du même côté.* And he afterwards quotes from Weitbrecht,† who had "observé dans un cas l'absence simultanée aux deux mains et aux deux pieds, de quelques doigts, de quelques métacarpiens et métatarsiens, enfin de quelques os du carpe et du tarse."

As to pathology, those interested in the subject may consult Budd, in the *Medico-Chirurgical Transactions*, vol. xxv., London, 1852; James Paget's *Surgical Pathology*, p. 27, Philadelphia, 1860; and Burt G. Wilder's "Pathological Polarities," in the *Boston Medical and Surgical Journal* of April 5, 1866.

Vertical homology‡ is much less marked than is serial homology, nevertheless it is plainly to be seen in the tail region of most fishes, and in the far-extending dorsal (back) and ventral (belly) fins of such kinds as the sole and flounder.

Lateral homology§ (or bilateral symmetry), on the other hand, is much more marked, and indeed exists at one or other time of life in all animals except some very lowly organised creatures, like the star fishes, which, when adult, seem to possess a radial symmetry, having a distinct bilateral symmetry at an earlier stage of existence. In the highest animals this symmetry is laid down at the very dawn of life, the first trace of the future creature being a longitudinal streak—the embryonic "primitive groove." Now the resemblance between the right and left sides of the body is stated by Herbert Spencer‖ to be simply due to the similarity of the conditions which affect the two sides respectively. And indeed he explains in the same manner the occasional presence of

* *Hist. Générale des Anomalies*, t. i., p. 228, Bruxelles, 1837.

† *Nov. Comment. Petrop.*, t. ix., p. 269.

‡ The homological resemblance of parts placed one above the other beneath.

§ That of the right hand or foot with the left hand or foot, &c.

‖ *First Principles of Biology.*

vertical homology, and, in an analogous way, the serial homology of vertebrate animals. The serial repetitions of such creatures as the lobster he attributes to quite another cause, namely, the coalescence of organisms of a lower degree of aggregation in one longitudinal series, through survival of the fittest aggregation.

The general absence of symmetry between the dorsal and ventral surfaces of animals he explains by the different conditions to which these surfaces are exposed, as also the occasional bilateral asymmetry, as in the flat fishes (*pleuronectidæ*), snails, &c. But it is, to say the least, open to grave doubt, whether the action of similar conditions could ever build up such detailed and striking repetitions, were there no *internal tendency* in these animals to develope in the way they do. It appears more probable that the inclination of each organism is to develope in a symmetrical manner, and that this tendency is controlled and subordinated by the action of external conditions, than that symmetry is superinduced *ab externo*. That there is some tendency of this kind—which has been spoken of as a polarity*—seems to us to be demonstrated by those numerous cases in which similar additional digits or other deformities are found in both hands or in both feet. But perhaps one of the most remarkable and striking cases is given by Mr. Darwin himself. He says:† "Near approach to identity is curiously shown in many diseases in which the same exact points on the right and left side of the body are similarly affected. Thus Mr. Paget (*Surgical Pathology*, vol. i., p. 19, 1853) gives a drawing of a diseased pelvis, in which the bone has grown into a most complicated pattern, but 'there is not one spot or line on one side which is not represented, as exactly as it would be in a mirror, on the other.'" No action of external conditions could possibly have determined this phenomenon.

We may here notice a remark made by Mr. Darwin. He says, after speaking of Julia Pastrana‡ and a man of the Burmese Court: "These cases and those of the hairless dogs forcibly call to mind the fact that the two orders of mammals—namely, the edentata and cetacea—which are the most abnormal in their dermal covering, are likewise the most abnormal either by deficiency or redundancy of teeth."§ The fact is incontestable. But the armadillos are more abnormal than the American ant-eaters as

* As by Dr. Wyman, in his paper *On Symmetry and Homology in Limbs*, Boston, 1867.

† *Animals and Plants under Domestication*, vol. ii., p. 369.

‡ A remarkable woman exhibited in London some years ago.

§ *Animals and Plants under Domestication*, vol. ii., p. 328.

regards their dermal covering, yet in their dentition they are less so; while the Cape ant-eater (or aard-vark, orycteropus) has teeth such as exist in no other mammal, though its hairy coat exhibits no marked peculiarity. Again, the pangolins* stand alone amongst mammals as regards their scaly covering, yet their mouth is like that of the hairy ant-eaters, *i.e.*, edentulous. Again, the dugong and manatee are dermally alike, yet extremely different as regards the structure and number of their teeth. The porcupine also, in spite of its enormous armature of quills, is supplied with as good a mouthful of teeth as are the hairy members of the same family; and in spite of the deficiency of teeth in the hairless dogs, no converse redundancy of teeth has been remarked, so far as we know, in Angora cats and rabbits.

Leaving, however, on one side these latter points, it is, we think, evident from the facts of homology—especially when considered in its relations to pathology — that some innate and substantial cause exists in each organism, which may at the same time account for both specific resemblance and specific divergence. In obedience to the law of parsimony, it is more desirable to make use of one such conception than to imagine a number of, to all appearance, separate and independent "laws of correlation" between different parts of each animal. We think that enough has been said to show that what we believe to be the complex results of this tendency cannot have been produced by "Natural Selection" alone.

If, then, in spite of Mr. Darwin's theory, it is still necessary to conceive a substantial form moulding each organic being, and directing its development as a crystal is built up, only in an indefinitely more complex manner, then the claim of "Natural Selection" to explain by itself the evolution of each animal form, or the "origin of species" must fall to the ground. Many phenomena have been shown to exist, for which the Darwinian theory is quite unable satisfactorily to account. And a principle regulating the successive evolution of different organic forms, such as we believe exists, is not one whit more mysterious than is this innate tendency which, as we have seen reason to think, each several form possesses, while the existence of the latter favours the probability of the existence of the former. The rest of our observations we must reserve for a third and last article.

* Scaly ant-eaters of the Old World.

Difficulties of the Theory of Natural Selection.

III.

BEFORE concluding our remarks on Mr. Darwin's theory, we may as well perhaps just glance at a certain very wide subject connected with it. We say "connected with it," because Mr. Darwin, in his book on the origin of species, does not pretend to explain the genesis of the higher psychical phenomena of man. Nevertheless, some of his disciples are not equally prudent; and, indeed, the report has reached us that Mr. Darwin himself is engaged in the preparation of a work in which this question can hardly fail to be considered. It may be well then to glance at (for our space allows no more) the subject alluded to, which is the origin of the notion of "morality." As is no doubt known to most of our readers, it is asserted by some, that in spite of the great *present* difference between the ideas "useful" and "right," yet they are nevertheless one in *origin*.

They say that "Natural Selection," has through long ages preserved those individuals who had a liking for practices and habits of mind useful to the race, and has destroyed those of an extremely contrary tendency. The descendants of individuals so preserved have, they say, come to inherit such a liking, and finding this inherited tendency thus existing in themselves, have become apt to regard it as *innate*, and independent of all experience, whereas really it is only the result of the gradual accretion of useful predilections which from time to time arose in a series of ancestors naturally selected. This is the notion of some of our contemporaries, according to whom "morality" is, as it were, the congealed past experience of the race, and "virtue" is no more than a sort of "retrieving."

Some remarks made by Mr. Darwin appear to show his disposition to sympathise with this view. Thus, in his book on *Animals and Plants under Domestication*,* he asserts that "the savages of Australia and South America hold the crime of incest in abhorrence;" but he considers that the abhorrence has probably arisen by "Natural Selection," the ill effects of close inter-breeding causing the less numerous and less healthy off-

* Vol. ii., p. 122.

spring of incestuous unions to disappear by degrees in favour of the descendants (greater both in number and strength) of individuals who naturally, from some cause or other, as he suggests, preferred to mate with strangers rather than with close blood-relations; this preference being transmitted, and becoming thus instinctive in remote descendants.

But to meet Mr. Darwin merely on his own ground, it may be objected that this notion fails to account for "abhorrence" and "moral reprobation," for, as no stream can rise higher than its source, the original "slight feeling" which was *useful* would have been perpetuated, but would never have been augmented beyond the degree requisite to ensure the beneficial preference, and therefore would not certainly have become magnified into "abhorrence." It will not do to assume that the union of males and females each possessing the required "slight feeling" must give rise to offspring with an intensified feeling of the same kind, for, apart from reversion, Mr. Darwin has called attention to the unexpected modifications which sometimes results from the union of *similarly* constituted parents. He says,* "If two top-knotted canaries are matched, the young, instead of having very fine top-knots, are generally bald." In the same way, the union of parents with a similar aversion might result in phenomena quite other than the augmentation of such aversion, even if the two aversions should be altogether similar; while very probably they might be so different in their nature as to tend to neutralise each other. Besides, the union of parents so similarly emotional would be rare amongst such savages, where marriages would be owing to almost anything rather than to congeniality of mind between the spouses.

Again, care of, and tenderness towards the aged and infirm, are actions on all hands admitted to be "right," but it is difficult to see how such could ever have been so useful to a community as to have been seized on and developed by the exclusive action of the law of the "survival of the fittest." On the contrary, we are inclined to think that on strict utilitarian principles the rigid political economy of Tierra del Fuego† would have

* *Animals and Plants under Domestication*, vol. i., p. 295.

† See the highly interesting *Journal of Researches* of Mr. Darwin (second edition), vol. i., p. 214, where he describes the habits of the natives of that part: "It is certainly true, that when pressed in winter by hunger they kill and devour their old women before they kill their dogs. The boy being asked why they did this, answered, 'Doggies catch otters, old women no.' They often run away into the mountains, but they are pursued by the men and brought back to the slaughter-house at their own firesides!"

been eminently favoured and diffused by the impartial action of "Natural Selection" alone. Similarly, admiration of acts of great self-denial done for the good of others, and tending even to the destruction of the actor, could hardly be accounted for on Darwinian principles alone; for self-immolators must but rarely leave direct descendants, while the community they benefit must by their destruction tend, so far, to morally deteriorate. But devotion to others of the same community is by no means *all* that has to be accounted for. Devotion to the whole human race, and devotion to God—in the form of asceticism—have been, and are, very generally recognised as "good," and (on the principle once more that a stream cannot ascend) it is to us simply impossible to conceive that such ideas and sanctions could have been developed by "Natural Selection" alone, from only that degree of unselfishness necessary for the preservation of brutally barbarous communities in the struggle for life. That degree of unselfishness once attained, further improvement would be checked by the mutual opposition of diverging moral tendencies and spontaneous variations in all directions, added to which we have the principle of reversion and atavism tending powerfully to restore the more degraded anterior condition, and, indeed, requiring the continued action of "Natural Selection" to prevent positive retrogression. It is certainly difficult to see how, through the action of "Natural Selection" alone, the maxim, *Fiat justitia ruat cælum*, could ever have been excogitated, still less have found a widespread acceptance.

But no one disputes the complete distinctness, here and now, of the ideas of "duty" and "expediency," whatever may have been the origin of those ideas. No one pretends that ingratitude may in any past abyss of time have been a virtue, or that it may be such now in Arcturus or the Pleiades. Indeed, a certain eminent writer of the utilitarian school of ethics has amusingly and very instructively shown* how radically distinct are the two ideas he endeavours to identify. Now, these ideas being so distinct *now*, the same difficulty meets us with regard to their origin that we met with before in considering the first beginnings of useful bodily structures. Darwinians would probably assert that the germs of morality exist in apes, especially as Mr. Darwin speculates as to whether the gorillas or ourang-outans in effecting

* We allude to Mr. John Stuart Mill, a writer quite remarkable for the charming *naiveté* with which he every now and then, by a simple remark, takes the ground from under his own feet, and demonstrates the futility of his very argument. See *Discussions on Sir William Hamilton*, p. 103.

their matrimonial relations, show any tendency to respect the table of prohibited degrees of affinity.* No tittle of evidence has yet been adduced pointing in such a direction, but surely if it were of such importance and efficiency as to result (through the aid of "Natural Selection" alone) in that "abhorrence" before spoken of, we might expect to be able to detect unmistakable evidence of its incipient stages. But in fact, did the most undeviating instinct guide apes and other brutes, in such matters, it would not indicate even the faintest germ of morality; moral reprobation is absolutely absent from every brute, however highly organised. It is interesting, on the other hand, to note Mr. Darwin's statement as to the existence of this feeling even in the very lowest and most degraded of all the human races known to us.† As to the *first beginning* of the idea of "right," "Natural Selection" is impotent to suggest even an approach towards its explanation. For we need hardly remind our readers that acts may be *materially* moral to a high degree without being in the least *formally* so. Actions like those of the bee, the beaver, or the dog, however good as regards their effect on the community to which they belong, are absolutely destitute of the most incipient degree of real goodness, because unaccompanied by consciousness and will directed towards the fulfilment of duty as an end. The confusion of thought resulting from confounding together these very distinct things is far from uncommon,‡ and its effects are disastrous indeed! Were virtue *a mere kind of "retrieving,"* then certainly we should have to view with apprehension the spread of intellectual development which might lead the human "retrievers" to regard from a new point of view their fetching and carrying! But here we enter upon a theme foreign to the immediate matter in hand, though a very tempting one, and one which we may, perhaps, before very long be able to treat directly and at some length.

* *Animals and Plants under Domestication*, vol. ii.

† Again Mr. Darwin bears witness to the existence of moral reprobation on the part of the Fuegians (*Journal of Researches*, vol. i., p. 215): "The nearest approach to religious feeling which I heard of was shown by York Minster (a Fuegian) who, when Mr. Bynoe shot some very young ducklings as specimens, declared in the most solemn manner, 'Oh, Mr. Bynoe, much rain, snow, blow much.' This was evidently a retributive punishment for wasting human food."

‡ Professor Huxley asks: "Is mother-love vile because a hen shows it; or fidelity base, because dogs possess it?" (*Man's place in Nature*, p. 111). It is only metaphorically that "maternal love" can be attributed to the hen, or "fidelity" to the dog.

Mr. Darwin's theory of *Pangenesis* must, finally, receive a passing notice, though our limits forbid us to enter into much detail on the subject. This theory appears to be as follows: That each living organism is ultimately made up of an almost infinite number of minute particles termed "gemmules," each of which has power to reproduce its kind. Moreover, that these particles circulate freely about the organism, and are derived from all the parts of all the organs of the less remote ancestors of each such organism during all the states and stages of such several ancestor's existence; and therefore of the several states of such ancestor's organs. That such a complete collection of gemmules is aggregated in each ovum and spermatozoon in most animals, and in each part capable of reproducing by gemmation (budding) in the lowest animals and in plants. Therefore in many of such lower organisms such a congeries of ancestral gemmules must exist in every part of its body, since in them every part is capable of reproducing by gemmation. "It has often been said by naturalists that each cell of a plant has the actual or potential capacity of reproducing the whole plant; but it has this power only in virtue of containing gemmules *derived from every part.*"*

Moreover, these gemmules tend to aggregate themselves, and reproduce in certain definite relations. Thus, when the foot of a newt is cut off, its reproduction is explained by Mr. Darwin as the aggregation of those floating gemmules which come next in order to those of the cut surface, and the successive aggregations of the other kind of gemmules coming after in regular order. Also, the most ordinary processes of repair are similarly accounted for, and the successive development of similar parts and organs in creatures in which such complex evolutions occur is explained in the same way, by the independent action of separate gemmules.

In order that each living creature may be thus furnished, the number of such gemmules in each must be inconceivable. Mr. Darwin says:† "In a highly organised and complex animal, the gemmules thrown off from each different cell or unit throughout the body must be inconceivably numerous and minute. Each unit of each part, as it changes during development, and we know that some insects undergo at least twenty metamorphoses, must throw off its gemmules. All organic beings, moreover, include many dormant gemmules derived from their grandparents and more remote progenitors, but not from all their progenitors. These *almost infinitely numerous* and minute gem-

* *Animals and Plants under Domestication*, vol. ii., p. 403.

† See *Animals and Plants under Domestication*, vol. ii., p. 366.

mules must be included in each bud, ovule, spermatozoon, and pollen grain." We have seen also that in certain cases such must be included also in every part of the whole body of each organism! But where are we to stop? There must be gemmules not only from every organ, but from every part of such, from every cell, thread, or fibre entering into the composition of such part, from every nucleus of every cell, from every nucleolus found in each such nucleus, and from every component part of each such nucleolus. Moreover, not only from all these, but from each and every successive stage of the evolution and development of such successively more and more elementary parts. At the first glance this new atomic theory has charms from its apparent simplicity, but the attempt thus to follow it out to its limits appears to us to indicate its essential insufficiency and cumbrousness. Mr. Darwin himself is fully aware that there must be *some* limit to this aggregation of gemmules. He says:* "Excessively minute and numerous as they are believed to be, an infinite number derived, during a long course of modification and descent, from each cell of each progenitor, could not be supported or nourished by the organism."

But waiving all this, the theory does not even then, as far as we yet see, account in the least for certain phenomena. For example, how is the simple reproduction of certain marine worms —*e.g.*, *Nais*—explicable by it? In such creatures we see that a certain segment of the body gradually becomes modified till it assumes the condition of a head, and this remarkable phenomenon is repeated again and again, the body of each worm thus dividing into new individuals. The development of such a mode of reproduction seems to us not to be accounted for either by "Natural Selection" nor by the supplementary theory of *Pangenesis*. Similarly with the secondary larva of certain Echinoderms (spoken of in the first part of this article) which swims away with the stomach of the primary larva.

This conception of Mr. Darwin seems to us to be little, if at all, superior to the hypothesis put forward by Mr. Herbert Spencer.† The former author, as we have seen, makes use of imaginary "gemmules;" according to the latter writer, each organism consists of certain so-called "physiological units," each unit having an innate power and capacity, by which it tends to reproduce the entire organism of which it forms a part, unless, in the meantime, its force is exhausted by its taking part in the

* *Animals and Plants under Domestication*, vol. ii., p. 402.

† In his *Principles of Biology*.

production of some definite tissue. This conception much resembles that suggested by Professor Owen in his treatise on *Parthenogenesis*,* where the cells resulting from the subdivision of the germinal vesicle were represented as conserving their developmental force, unless employed in building up definite organic structures.

None of these conceptions, however, give any real explanation. In each case the facts of biology are restated, and certain names and epithets imposed, but Mr. Darwin's atomic theory appears at first sight to be more simple, and so lends itself more to the delusion that all mysteries can be readily cleared away, and the most recondite biological phenomena made an affair of A, B, C.

Mr. Herbert Spencer's hypothesis, on the other hand, requires the assumption of an innate tendency in each physiological unit, which tendency might perhaps be represented by the symbol of a complex series of vibrations forming a most intricate harmony (analogous to one of sound or colour), in the whole organism, of which each such unit is a component part. In this way the reparation of local injuries might be symbolised as a filling up and completion of an interrupted rhythm. Thus also monstrous aberrations from typical structure might correspond to a discord, and sterility from crossing be compared to the darkness resulting from the interference of waves of light.

Such symbolism will harmonise with the peculiar reproduction of the *Nais* before mentioned, with the facts of serial homology, and with those of bilateral and vertical symmetry, &c. Also, as the atoms of a wine-glass may be made to give out sound by the action of those of an adjacent tuning-fork, so it may be conceived that physiological units of one organism may be influenced by surrounding organisms and other conditions, and that influences by accumulation may upset the original rhythm and produce a modification of it—a fresh chord in the harmony of nature—a new species!

But leaving these *fancies*, we must return to our subject—namely, to the theory of "Natural Selection." As we have already said, we cordially acknowledge our debt of gratitude to Messrs. Darwin and Wallace for propounding it, however little we think it capable of the great work its more zealous advocates have attributed to it. The hypothesis of *Pangenesis* is also highly interesting and suggestive, and we receive its publication with thanks. There is, however, a portion of Mr. Darwin's last work which we have perused with surprise and sadness; surprise,

* Published by Van Voorst in 1849.

because we were far from expecting from a naturalist and an observer of Mr. Darwin's eminence such trivial remarks, and what we cannot refrain from terming such a pitiable manifestation of one-sidedness and shallowness; sadness, because the remarks referred to appear to us to indicate (we need not say how much we hope the appearance is false) a strong antitheistic bias. We regret the passage also because the completeness of the work is rather marred than enhanced by its insertion.

We here allude to the last two pages of the second volume of *Animals and Plants under Domestication*, where Mr. Darwin, after treating at such great length, and even with a sometimes perplexing fulness, the question of domestic varieties, suddenly plunges into the most immense and important of subjects, in order to dispose of it, or to seem to do so, in a few concluding paragraphs. It is with nothing less than amazement that we notice here the apparent utter inability of Mr. Darwin to enter, even for a moment, into the ideas or to conceive the position of a Theistic philosopher. He says,* alluding to an illustration given by him in a former chapter: "The shape of the fragments of stone at the base of our precipice may be called accidental, but this is not strictly correct, for the shape of each depends on a long sequence of events, all obeying natural laws, on the nature of the rock, on the lines of definition or cleavage, on the form of the mountain which depends on its upheaval and subsequent denudation, and lastly, on the storm and earthquake which threw down the fragments. But in regard to the use to which the fragments may be put, their shape may strictly be said to be accidental. And here we are led to face a great difficulty, in alluding to which I am aware that I am travelling beyond my proper province. An omniscient Creator must have foreseen every consequence which results from the laws imposed by Him, but can it be reasonably maintained that the Creator intentionally ordered, if we use the words in any ordinary sense, that certain fragments of rock should assume certain shapes, so that the builder might erect his edifice? If the various laws which have determined the shape of each fragment were not predetermined for the builder's sake, can it with any greater probability be maintained that He 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-

* *Animals and Plants under Domestication*, vol. ii., p. 431.

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—if we do not admit that the variations of the primeval dog were intentionally guided, in order that the greyhound, for instance, that perfect image of symmetry and vigour, might be formed—no shadow of reason can be assigned for the belief that the variations, alike in nature and the result of the same general laws, which have been the groundwork through Natural Selection of the formation of the most perfectly adapted animals in the world, man included, 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.' If we assume that each particular variation was from the beginning of all time preordained, the plasticity of the organisation, which leads to many injurious deviations of structure, as well as that redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to the Natural Selection or survival of the fittest, must appear to us superfluous laws of nature. On the other hand, an omnipotent and omniscient Creator ordains everything and foresees everything. Thus we are brought face to face with a difficulty as insoluble as is that of freewill and predestination."

The illustration referred to was that of a man building an edifice from fragments of rock at the base of a precipice, by selecting for various parts of the building the pieces most suitable, through the form they had assumed, to help in the construction of such various parts, and Mr. Darwin says we should "regard him as the paramount power."* But an intelligent and philosophic theist would *not* regard him as the paramount power, and could not do so. Mr. Darwin, and many like him, appear to find it unreasonable and absurd that men should regard phenomena in a light not furnished by or deducible from the very phenomena themselves, although the men so regarding them avow that their mode of viewing those phenomena in question comes from quite another source. It is as if a man, A., coming into B.'s room and finding there a butterfly, should insist that B. had no right to believe that the butterfly had not flown in at the open window, inasmuch as there was nothing about the room or insect to lead

* *Animals and Plants under Domestication*, vol. ii., p. 430.

to any other belief, while B. stoutly maintained the contrary, he having met C., who had told him that he, C., had brought to B.'s room a ripe chrysalis, and that having watched the perfect insect emerge he had left it behind, while bringing away with him the skin of the insect. In the same way, the assertion that certain important conceptions of mankind are ideas in the mind of God, *e.g.*, the vertebrate idea, is often ridiculed, as if the assertors either pretended to some prodigious acuteness of mind or genius on the one hand, or as if they detected evidences of divine imaginings in the phenomena furnishing the special conception on the other. One would think that it would be, though unhappily it is not, superfluous to say that such assertors need pretend nothing of the kind, but the remark may be simply the necessary consequence of their being *theists at all.* For let the idea of God according to the highest conceptions of Christianity be once accepted, and then it becomes simply a truism to say that the mind of the Deity contains all that is *good* and *positive* in the mind of man, plus, of course, an absolutely inconceivable infinity beyond, and that thus such human conceptions may be, nay, *must* be, asserted to be ideas in the divine mind also. It is unfair in the objectors to try to ridicule certain conceptions in the name of physical science, when their objection comes in reality not from *physical* science at all, but solely from a strong *metaphysical* anti-theistic bias or conviction.

The theist having arrived at his theistic convictions from quite other sources than a consideration of zoological or botanical phenomena, returns to the consideration of such phenomena, and views them in a theistic light, without, of course, asserting that such light* has been derived from them, or that there is an obligation for others so to view them who decline to enter upon or to accept the other considerations which have produced the theistic conviction in the theist. It is in this way that our theist would altogether decline to regard the builder spoken of in the illustration quoted as really the "paramount power."

What little apparent force there may be in the concluding objections made by Mr. Darwin to the divine agency results almost entirely from the low anthropomorphism which alone he seems able to understand as theism. It is again the dummy of his own construction set up to be knocked down.

Now the theist, having got his idea of God, is compelled indeed to conceive of the Deity in terms which are only strictly applicable to the finite, *i.e.*, to all that is positive and all that is

* Of course this is not from a theological point of view.

best in man, but he at the same time declares the *utter inadequacy* of all such terms; that, after all, they are but accommodations to human infirmity; that they are in a sense objectively false (because of their inadequacy), though subjectively and very practically true; that they should be prefaced by "so to speak," and the theist, of course, vehemently rejects from his divine idea all that distinctly expresses or implies human infirmity or limitation.

Now Mr. Darwin (and others are like him), speaks as if all who believe in Almighty God were compelled to accept, as really applicable to the Deity, terms and ideas distinctly expressing human *infirmity* and *limitation*. Thus he asks whether God can have ordered the rock-splitting and the race variations referred to in the passage above quoted, for the considerations mentioned in the same passage. Why, even man may have several distinct intentions and motives for a single action, and the theist has no difficulty in supposing that, out of an infinite number of motives, the motive mentioned in each case may have been an exceedingly subordinate one. The theist, though properly attributing to God what, for want of a better term, he calls "purpose" and "design," yet affirms that the limitations of human purposes and motives are by no means applicable to the divine "purposes." Out of many, say a thousand million, reasons for the institution of the laws of the physical universe, some few are, to a certain extent, conceivable by us, and amongst these the benefits, material and moral, accruing from them to men and to each individual man in every circumstance of his life, play a certain, perhaps a very subordinate, part.*

The objection to the bull-dog's ferocity and "men's brutal sport" opens up the familiar and vast question of the existence of evil, a problem which cannot be treated here, but the great stress laid on animal suffering in the present day induces us to make one or two remarks. To those who accept the belief in God, the soul, and moral responsibility, physical suffering and moral evil are simply incommensurable. To such, the placing of non-moral beings in the same scale with moral agents will be

* In the same way Mr. Lewes, in criticising the Duke of Argyll's *Reign of Law* (*Fortnightly Review*, July, 1867, p. 100), asks whether we should consider that man wise who spilt a gallon of wine in order to fill a wine-glass? But because we should not do so, it by no means follows that we can argue from such an action to the action of God in the visible universe. For the man's object is, by the hypothesis, to fill the wine-glass only, and the wine spilt is so much loss. With Almighty God it is entirely different in both respects.

utterly insufferable. But considering physical pain only, all must admit that this depends greatly on the mental condition of the sufferer. Only during consciousness can it be said truly to exist, and only in the most highly-organised men does it reach its extreme. It is generally admitted that lower or less cultivated human beings are less keenly sensitive than are the more refined. But only in man can there be any really great degree of suffering, because only in man is there that intellectual recollection of past moments and that anticipation of future ones which constitute in great part the bitterness of suffering. The momentary pang, the present pain, which beasts endure, though real enough, is simply not to be compared as to intensity with suffering induced in man by his high prerogative of self-consciousness. As to the "beneficial lines" (of Dr. Asa Gray, before referred to), some of the facts before noticed seem to us to point very decidedly in that direction, but all must admit that the actual existing outcome is more "beneficial" than the reverse. The natural universe has resulted in the development of an unmistakable harmony and beauty, and in a decided preponderance of good and of happiness over their opposites.

If laws of nature did "appear superfluous" on the theistic hypothesis (which we do not for one moment admit), it would surely be nothing less than puerile to prefer rejecting that hypothesis to conceiving that the appearance of superfluity was probably due to human ignorance. This notion seems to be closely connected with that habit of mind which, in such a shallow way, regards "creation" and "evolution," as necessarily antithetical. As before remarked, many Christian thinkers find no difficulty in accepting the idea of "evolution" as well as that of "creation." Mr. Darwin distinctly declines to enter upon the question of the first origin of organised being, still less the question as to the origin of the whole phenomenal universe. On the face of it, therefore, his theory in no way conflicts with the idea of creation which is conceived to be the very institution, the *fons et origo* of that universe, with all its various natural laws and complex processes, not a miraculous interference with them. Having, as before said, once got, from whatever source, the idea of God, the theistic way of looking at the universe, naturally results in the acceptance of the dogma of creation, though, of course, for those who unhappily do not accept the idea of Deity there is and can be no such way of accounting for its origin. But the theist finds no need to conceive "creation" as a divine action, taking place now and then at

irregular intervals, or as arbitrary and capricious, or, in a word, as in any way inconsistent with harmonious and orderly development; so that neither evolution, nor that form of it termed Natural Selection, need necessarily conflict with it. Thus our criticisms of "Natural Selection" rest upon natural phenomena alone, and are not occasioned by any hostility arising from a conviction of an incompatability between that theory itself and orthodoxy, much as we object to the last passage quoted from Mr. Darwin, as well as to some other of his remarks, and to his general tone.

As we have before observed, it is undeniable that a somewhat eager acceptance of Natural Selection has sometimes accompanied a rejection of religious belief, and it is very probable that the latter state of mind has by some been honestly deemed a necessary consequence of the reception of the theory. For it may well be that some minds, exceptionally powerful in other respects, have been rendered peculiarly feeble and obtuse as regards theological questions, from an absence of mental exercise in that direction. The one-sidedness resulting from a merely partial exercise of the mind is notorious, as is also the considerable degree of opposition which, on the whole, exists between the "scientific" frame of mind and the "philosophical." Mr. Darwin is unquestionably a first-rate observer, and a most patient and careful thinker as regards biological phenomena; but his philosophical ability remains to be proved, and, we are inclined to think, will permanently remain in that undemonstrated condition.

Before leaving this subject, we may as well call attention to an instance of one amongst many of the extremely shallow objections made by modern writers of the highest repute to primary religious belief. Thus it has actually been urged, as an objection to theism, that were an intelligent clock to speculate as to its maker, it would necessarily conceive him in terms of clock-being, and figure him, at the best, as furnished with cogged wheels, escapements, &c., his motions facilitated by oil—in a word, like itself. Further, it is urged that this necessary clock conception would be completely false, and that the illustration thus exhibits the absurdity and unreasonableness of those men who figure the incomprehensible cause of all phenomena as a Being in some way comparable to man. Now, putting aside for the moment all other considerations, and accepting the illustration, surely the example demonstrates the absurdity of the *objector himself!* It is true, indeed, that a man is an organism indefinitely more complex and perfect than any clock, but if the clock could only

conceive of its maker in clock terms, or else in terms altogether inferior, the clock would plainly be quite right in speaking of its maker as a, to it, inconceivably perfect kind of clock, acknowledging, at the same time, that this, its conception of him, was *utterly inadequate*, although the best its inferior nature allowed it to form. For if, instead of so conceiving of its maker, it thought of him as a piece of amorphous metal, or as mere oil, or by any other inferior conception which a clock might be imagined capable of entertaining, the clock would be wrong to a degree absurd indeed. For man can much more properly be compared with, and has much more affinity to, a perfect clock in full activity than to a mere piece of metal or drop of oil. Nor is this all. The clock is more in the right still, for its maker, man, actually *has* the very cogged wheels, escapements, oil, &c., which the clock's conception has been supposed to attribute to him; inasmuch as all these parts must have existed as distinct ideas in the human clockmaker's mind before he could actually construct the clock formed by him. Unquestionably, then, on the mere ground taken by the objector quoted, if we are compelled to think of the First Cause either in human terms (but with human imperfections abstracted and human perfections carried to infinity), or, on the other hand, in terms decidedly inferior (such as those are driven to who decline to accept the term "personality"), there can be no question but that the first conception is vastly nearer the truth than is the second. Yet the latter is the one put forward by such writers, and this in spite not only of its intellectual absurdity, but in spite, also, of the way it conflicts with the whole moral nature of man and all his noblest aspirations. But there is something more to be said about this very shallow sophism. If the clock in question had the power of knowing God from His works, it would of course have a soul with faculties of sensibility, intellect, consciousness, reason. In short, it would have essentially a human soul. The philosophical conception which it would form of God would be therefore like that of a human philosopher. Now, though we conceive of God through the ideas formed from the external, and those formed from the internal, world, or, in other words, from the world within and without us, yet we do not stay here, but of these conceptions we build up our idea of God, so to speak, by a triple process. We get to know, imperfectly if you will, yet truly, the essential nature of God, first, by *the way of causality*, for we know that all the perfection of the effect must be precontained in the cause, at least equivalently; secondly, by *the way of excess*, for

we know that all perfection, whether of the *ego* or the *non-ego*, must be in the infinite Being in infinite excess; thirdly, by *way of negation*, for we know that no imperfection of being can possibly be in the uncreated. Therefore He is uncomposed, unchanging, immortal, uncaused, &c. Now, it is impossible to consider these three methods without perceiving that, on the one hand, we do not confine the perfections of God to those we perceive in ourselves—we perceive that all perfection of *all* being is in Him; and that, on the other, we exclude from our idea of God much that is essential to us, and a portion of our *relative* perfection. We deny that He is corporeal; we deny that He has faculties *as such*, for He is one eternal unchanging act of life, which is Himself. Neither, therefore, would the clock confine its ideas of God to what is analogical with its own being. It would include in that idea much which is not derived from self, and exclude, on the other hand, much that is so derived. These non-theistic speculators have confounded the material out of which human thought is evolved with human thought itself. They have superciliously surveyed the heaps of stones, unchiselled, unordered, ready for the builder, and then, pointing in triumph to the unsightly mass, have asked their admiring listeners: "Where is your temple of order and symmetry here?"

A lamentable sign of our present intellectual decrepitude is the way in which even the so-called educated public is ready to fall down at the feet of any teacher of physical science who has attained a certain degree of fame or even notoriety. Two or three such, with as many soi-disant philosophers, reign, at the present moment, in English public opinion in a way which would be ridiculous were not the consequences so serious. Inverting the true order, we have unbounded submission, as to mere matters of opinion, where reason and not authority should be the sole arbiter. In the name of truth, then, we cry out for more "free thought," and a greater exercise of "private judgment," in this, its legitimate field!

We owe some apology to our readers for our later observations, which have little enough in the shape of novelty to recommend them. But after all, it is remarkable how little is really new under the sun, how the same or similar conceptions crop up again and again. Some speculators appear now inclined to return once more to the fortuitous concourse of atoms of Democritus—for that each animal is merely the result of the physically selected aggregation of his component atoms, is the most recent (pangenetic) development of the Darwinian hypo-

thesis. However this may be, the gemmules of Mr. Darwin are singularly like the molecules of Bonnet and of Buffon ; and even certain mediæval authors have almost anticipated the doctrine of Pangenesis. Again, the "physiological units" invented by Herbert Spencer are, as we before said, very similar to the direct descendants of the primitive germ-cell made use of by Professor Owen in his theory of parthenogenesis.

But even the very hypothesis of "Natural Selection" (or the "survival of the fittest") itself was in great part thought out not hundreds but thousands of years ago. For Aristotle notices the opinion that by the accidental occurrence of combinations, organisms have been preserved and perpetuated such as final causes, did they exist, would have brought about, disadvantageous combinations or variations being speedily exterminated. The Epicureans afterwards, according to Simplicius, held a similar opinion. We may be pardoned, then, if in our objections there is also some want of novelty.

In conclusion we once more tender our thanks to Mr. Darwin for his recent contribution to science, and earnestly hope that he may long be spared to carry on his zealous labours. We also hope that, before long, we may be able to benefit by studying his observations on the variations of animals *in a state of nature.*