Missing Links.

FOR students of Darwinism nothing could be more opportune than the appearance of such a work as that lately presented to us by Mr. Wallace.[1] No man now living has a better right than he to speak for the theory of which he is the joint, if not the original, author, while the space of time elapsed since Mr. Darwin's death has produced a mass of observations shedding a flood of light on almost every point of the question which has to be discussed. Therefore when Mr. Wallace sets himself to exhibit Darwinism for us in the clearest light, we may reasonably expect to be enabled at least to grasp the outlines of the system as a connected whole, and to perceive with some completeness the series of arguments by which its adherents believe it to be established.

And yet there must be some who rise from the perusal of the book bewildered rather than enlightened, and with less assurance even than before that they have got so far as to know what the Darwinian theory is. Such a state of mind would have a good deal to show in its own justification by raising various pleas on the evidence which Mr. Wallace affords, but for the present it will be enough to confine our attention to one.

From the fuller light which has now been cast on the facts bearing on the evolutionary theory, a result would appear to follow analogous to that which might conceivably ensue from a fuller examination of the geological record. Increased knowledge of that record might without doubt contradict the Darwinian theory of evolution. Darwinians have never pretended that we have direct evidence of the existence of all the

[1] *Darwinism: an Exposition of the Theory of Natural Selection, with some of its applications.* By Alfred Russel Wallace, LL.D., F.L.S., &c. Macmillan and Co, 1889.

forms of life in whose existence they believe. The species, whether living or extinct, which have been presented to actual observation, are but as a scattered group of islands, the relics of a vanished continent. Their contention is, that with means of observation more ample than we have, we should find the intervening chasms to have been once solidly bridged, by grades of life shaded by scarce perceptible gradations, from one to another of the species that we know. But, supposing that as our knowledge increased we were to find no trace of this—were to find the forms of life persistently grouping themselves around distinct centres, instead of arranging themselves in a linear chain—we should have a weighty argument against the hypothesis in whose favour the story of the rocks is invoked as a witness. Something like this it is which occurs in considering, with increased knowledge of facts, the various points of the argument whereon Darwinism rests.

It should not be forgotten that the various points of natural history which Mr. Darwin and other observers have established, are in themselves as separate and distinct one from another, as are the various species of animals and plants which we behold, and that their connexion in one whole, as Darwinians connect them, is as yet just as much a matter of hypothesis as is the connexion of those species by intermediate links. It has been shown, for instance, that there is a perpetual struggle for existence among the various inhabitants of the organic world: it has been shown that the individuals of a species tend to vary, more or less, from the normal type: also that man can avail himself of these variations to modify the qualities of the animals in his herds and the plants in his gardens. This has been proved. But that variation, trimmed and pruned by the struggle for existence, has modified species in a state of nature, as has man's conscious selection in a state of domestication—this is as yet but hypothesis, and hypothesis which needs confirmation from fuller inquiry into the facts of the case, just as much as the other hypothesis of the continuity of forms between one species and another. As we learn more about the struggle for existence, and about the variability of species, though more fully establishing these as separate varieties, we may possibly find that they do not play into each other's hands as they have been assumed to do, just as fresh observations of the path of a comet may

show it to be not an ellipse, but a parabola—not re-entrant but divergent.

Mr. Wallace has some important modifications to make in the statement of the observed facts with regard to variability, as known to Mr. Darwin. In the *Origin of Species*, the variations on which Natural Selection has had to work are always represented as *slight*. It is in "the accumulation of innumerable slight variations, each good for the individual possessor" that Mr. Darwin finds the means by which organs and instincts have been perfected:[1] all organs and instincts are, he tells us, "in ever so slight a degree, variable:"[2] there must have been "an interminable number of intermediate forms,"[3] an "infinitude of connecting links,"[4] between species and species. So undeniable, indeed, is this, that a frequent objection to the Darwinian theory, has been the impotence of variations so minute as was supposed, to benefit in any practical degree the creatures in which they occur.

Mr. Wallace, however, shows that the differences which are constantly found to exist between individuals of the same species are by no means slight. In his own words,[5] "Individual variability is a general character of all common and widespread species of animals or plants: this variability extends, so far as we know, to every part and organ, whether external or internal, as well as to every mental faculty. Yet more important is the fact that each part or organ varies to a considerable extent independently of other parts. Again, the variation which occurs is very large in amount—*usually* reaching ten or twenty, and sometimes even twenty-five per cent. of the average size of the varying part; while not one or two only, but from five to ten per cent. of the specimens examined exhibit nearly as large an amount of variation." The proofs brought in support of these assertions are overwhelming. Among the lowest foraminifera, amongst sea-anemones, mollusks, insects, reptiles, birds, and mammals, abundant instances are quoted. It will perhaps be sufficient to take one or two examples.

Amongst fourteen specimens of the wall-lizard (*lacerta muralis*), examined by Mr. Milne Edwards, no single character except the scales on the head was found to be constant, the neck, trunk, tail, legs, and colour all "varying wonderfully," as shown by a diagram which Mr. Wallace appends.[6] Fifty-eight

[1] *Origin of Species*, c. xiv. p. 459 (Fifth Thousand). [2] *Ibid.* [3] *Ibid.* p. 460.
[4] *Ibid.* p. 461. [5] *Darwinism*, p. 81. Italics mine. [6] P. 65.

specimens of the cardinal bird (*cardinalis virginianus*) yielded scarcely a single one in which any of the more notable features corresponded exactly with the normal type of the species. In regard of the tail, for instance, three at most could be said to have it of about the regulation length, twenty-four having it shorter, and thirty having it longer: but the extremes of variation were in the direction of defect rather than of excess, four specimens having their tails very short and only one very long. In the total length of the birds themselves, the discrepancies were still more remarkable, no one individual making any pretence to conform exactly to the stock pattern. They generally inclined to be larger rather than smaller, but instances of excessive variation were again somewhat in the other direction. The same sort of thing is to be seen in the length of their wings, and the bill, the tarsus, the tors, are all found in this and other species to show an equal disregard of law. So amongst quadrupeds; one squirrel varies from another, within the limits of the same species,[1] as to the length of the head —somewhat, a great deal as to that of the feet, and extraordinarily as to the body, and especially as to the tail. In the same species of wolf and of bear,[2] extraordinary differences are found as to the several proportions of the skull—its length, its width, the sizes of the orbits, the palate, the nose, and the jaw-bone.

These are, I repeat, but specimens, taken from the mass of evidence produced by Mr. Wallace, and no one who examines that evidence as a whole can fail to see that he has established his case. The variations of form and structure which occur among wild animals—and the same is to be said for plants—are not occasional and minute, but incessant and important. There is clearly an end of the objection, above referred to, based on the supposed infinitesimal character of variations.

Very little reflection is, however, needed to show that if one difficulty is removed, it is only by introducing another vastly more formidable. If individuals are perpetually varying in such a fashion as we have seen, how comes it that species do not, like them, vary under our eyes? If every organ and function in each concrete specimen that we meet tends to depart from the normal type, how is it that the type remains normal, and that

[1] *Sciurus carolinensis* is Mr. Wallace's example, p. 67.
[2] *Canis lupus* and *ursus labiatus*, pp. 70—72.

these variations persistently arrange themselves about it? The deflections and nutations of a planet prove the existence of the force which in spite of them prescribes a fixed path and position, and unless the minor members of a solar system tended, of their own momentum, to fly off into space, we should not know that there was an overmastering power anchoring them to one centre. In the case which we are considering, the persistence of uniformity amid continual variation is far more remarkable. Each of these variations is a handle, and, as we have seen, a powerful one, for Natural Selection to grasp, and so to modify subsequent development. If the centrifugal tendency, which such variability indicates, were all—every varying climate and soil and circumstance on the face of the globe, should make its own species, or rather there should be no species at all, but a fleeting and evanescent succession of individual forms, like the shapes of clouds in a windy sky. It is idle to pretend that the features which any species constantly exhibits are specially adapted to existing circumstances, for in no two habitats are existing circumstances the same. To take examples familiar to every one; the house sparrow[1] flourishes in the north within the Arctic Circle, and on the Albert Nyanza, close to the Equator, in Siberia, and in Madeira, the Faröe Islands, and Moscow. Our common water crowfoot, whose white blossoms float on pools or sluggish streams, is to be found in all temperate regions, north and south, except New Zealand and the Pacific.[2] Now, who can say that in either of these instances, which might be reinforced by a host of others, the conditions of existence are so precisely the same for the species as a whole as to stereotype its characteristics, to perpetuate among sparrows, for instance, a white streak over each eye, a black lore, and a bar of white on the middle wing-coverts? It must be remembered that unless such absolute uniformity of type were everywhere visible, systematic naturalists would be only too glad to pronounce that the species were different: it is only the clearest evidence of continuous similarity, down to the minutest details, that can hinder them from doing so. And what is the force, we may ask once again, that preserves this uniformity, amid continual false starts along other paths? What hinders their varying surroundings from fashioning individual variations into permanent varieties?

[1] *Passer domesticus.* See Howard Saunder's *Manual of British Birds*, p. 171.

[2] See Sir J. D. Hooker, *Student's Flora of the British Isles*, p. 5.

It would therefore appear that the new crop of facts gathered by Mr. Wallace, while establishing on a broader basis than before the truth of variation, does not at the same time serve to establish the variability of species through natural selection, but, on the contrary, brings into more prominence than ever the idea of a controlling force strong enough to draw things together which circumstances would naturally drive apart. Instead of a fresh link being added to the chain of argument yoking together variability and struggle for existence as joint factors in the work of development, a link is snapped which we fancied to be forged. With infinitesimal variations, developments might be going on before our eyes, and yet be as invisible to us as the movements of the shadow on the dial. But with such variations as are now established, development, on Darwinian principles, should proceed at a rate at which we see that, in fact, it is not proceeding.

Therefore just as we might find from a fuller investigation of the rocks evidence for the isolation, and not for the concatenation, of the various forms under which life is known, so do we find like evidence from a more complete understanding of the state of the case with regard to variability. The forms tend persistently to group themselves round types, which yet remain ideals never, perhaps, actually realized, in any concrete instance, and whose continuance cannot therefore be well explained by what we are accustomed to call heredity.

And this suggests another consideration. If there has been development, it must, from analogy, have been rather by an alteration in the normal type itself, which thus controls a species, than in the individuals which compose it; they and their incessant variations being borne along the line of progression, as the members of our solar system career round the sun while it follows its own course through space. Supposing this to be the case, we have, on Darwinian principles, to face the inconvenience of supposing, that external circumstances succeed in creating and in modifying a type which they can scarcely ever, if ever at all, succeed in actually producing. This type is easily recognizable generation after generation, throughout a multitude of creatures, no one of which does yet exactly conform to it. A certain most definite condition of stature, of proportions, of hue, of form, is proved by the action of a creature's surrounding to be the best for that creature,

and this without those conditions having in all probability been ever united in any one case. Given a definite controlling force arranging the parts and organs on a certain pattern, it is easy enough to understand how external agencies should in some degree disturb that pattern without disarrangement, as the wind tosses the branches of a tree,—but how explain the production by mechanical forces of an ideal which as a fact they can never produce? Is it not like saying that a man could discover by mere measurement that the radii of a circle are equal without succeeding in drawing a circle in which they are so.

The above considerations may assist us to a clearer conception of what we mean by a *species*. Every one uses the term, and every one knows what is meant; yet none ever succeeds in a satisfactory definition. Mr. Darwin seems to imply[1] that no definition can be framed without including "the unknown element of a distinct act of creation." De Candolle[2] defines it as a collection of individuals which resemble one another more than they resemble anything else, which hand on their peculiarities from generation to generation, and which, from analogy, we suppose to have sprung from one individual. Swainson,[3] still more awkwardly, defines a species as an animal which, in a state of nature, is distinguished by certain peculiarities from another animal, and propagates after its kind; whose peculiarities, therefore, are permanent. It would seem to be simpler and plainer to say, that a species is a permanent group of plants or animals framed in all particulars after a single type. This emphasizes the most remarkable fact about species, the fact, namely, that in all cases, man alone excepted, we can describe a species very much as an individual. Not only as to bodily qualities can we say that the cock-sparrows born next season will have narrow white streaks over their eyes, but we can securely beforehand set down the whole brood, cocks and hens alike, as impudent, quarrelsome and thievish, and addicted, despite all experience, to building nests in water-pipes. We can describe the fox as cunning, the booby as stupid, the robin as familiar, the tom-tit as plucky. We may set traps openly on the tops of bare poles knowing that hawks will infallibly perch upon them, and circumvent the more astute crow by

[1] *Origin of Species*, p. 44. [2] Quoted by Mr. Wallace. *Darwinism*, p. 1.
[3] *Ibid.* p. 2.

poisoning eggs which he will with equal certainty eat. We know exactly the habits of mind which will induce the wild-duck to enter our decoys, and the wheat-ear our traps. We know that a trout when hooked will behave in one way and a salmon in another; we talk of one fish as game, and of another as faint-hearted. Red ants, we prophesy, will make slaves, and black ants submit to slavery; moths will fly into candles; jackdaws will run off with anything that glitters; dogs will attach themselves to masters. The characteristics of each race may vary in what seems the most arbitrary manner, and yet be obviously for that race the rule which they follow by no independent volition of their own; in spite of the argument by which the cat in the fairy-tale proved its own madness. "A dog isn't mad, is he? Well, he growls when he is angry, and wags his tail when he is pleased: but I growl when I am pleased, and wag my tail when I am angry."

The description which naturalists give of species descend to particulars still more minute than these; and generation after generation we find these descriptions verified. The component individuals are all obviously made after one pattern, like the uniforms of the same regiment. Species are thus the ultimate moulds in which nature casts her organic products; the terminal buds on her genealogical tree. It is extraordinary how near one species may run to another, remaining at the same time fundamentally distinct. An excellent example is afforded by two of our commonest summer migrants, the willow-wren and the chiff-chaff. When once they open their mouths to sing there is no mistaking them; but till they do that it is almost impossible to distinguish them. Even when we hold them in our hands, except for a slight difference in their size, and in the colour of their legs,[1] we find no apparent distinction. The surest test is found in the quill feathers of the wing. In the willow-wren the second quill is equal in length to the sixth, in the chiff-chaff to the seventh; in the former only six quills and in the latter seven have the outer webs sloped off or emarginated. In habits the two species are as like each other as in form. They live on the same food, build most similar nests, and lay eggs similarly marked though with slightly different colours. Yet running so very close to each other

[1] The length of the willow-wren is 4·9 inches, and of the chiff-chaff 4·75: the legs of the former are light brown, of the latter dark brown.

they are as distinct as species can be. As already said their song is utterly distinct, the one emitting a cheerful though very simple strain from a bush; while the other seated aloft in a tree hammers away persistently at a couple of notes, or as it seems to all but the most delicate ears, at one note only. The points of difference which we can specify between the two are slight and seemingly trivial, but for all that it is perfectly clear that a willow-wren is one thing and a chiff-chaff quite another; they go each their own way in absolute independence, and very often do not inhabit the same districts. There is something which discriminates them, beyond any point of difference on which we can put our finger; they rally round different standards, and obey different watchwords.

From what has been said it would appear that the most striking characteristic presented by species, as we know them, is their isolation one from another. It is most important to bear this constantly in mind when considering any theory which professes to explain how they are linked together. On Darwinian principles we have to hold that any two species may ultimately be traced back to a common form, from which both have sprung, just as the buds of a tree, whereto I have compared them, may be traced back to the same bough, or at least to the same stem. But, more than that, we have to maintain, that these buds, fraught with the potency of yet further developments, have come to be where they are, not through any innate laws of growth within the tree which bears them, but simply through the mechanical operation of external forces. According to this view, Nature's genealogical tree differs from other trees in having no predisposition stamping its growth with any particular character; it will be an oak, a palm, or a bramble, as circumstances choose. Therefore when we lay down that one species, or genus, or family, has sprung from another, not only must we assume that every form intermediate between the two has once existed, we must also postulate that the conditions of the earth have been such that each intermediate form has in its own time been the most advantageous in the struggle for existence. Birds, for example, we are told have descended from reptiles, whose fore-legs have been developed into wings, and their scales into feathers. If we are good Darwinians, not only must we hold that the bird-form is the best for one set of conditions, and the reptilian for another; we must suppose

that a form half-way between the two, with legs half-wings and scales half-feathers, was once upon a time better for those creatures who fell in for it, than the old reptile-form which they had left. According to this theory no advance is made along the path of development in view of any point to be gained beyond. If any single step is taken, it is because the position gained is good in itself, better for those who occupy it than the situation they have left, and enabling them to fight for life on better terms than those who have stayed behind. It is like saying that the only way in which men could have got from London to York was by building a town all the way; each fresh suburb and street and house being added, merely because it was good for man to be *there*, because the situation afforded advantages unknown before. And just as in the map of England there are wide tracts where no trace of a hamlet or a hut speaks of human occupancy, and where no feature of the district suggests any motive that could make men dwell there, so in the scheme of organic life, as known to us, there are wide gaps, which it baffles our very imagination to fill. We can fancy, easily enough, that all the conditions of the globe, that we witness, have been changed for their contraries—tropic heat for arctic cold, land for water, loam for rock. We know what other changes would be involved by these in the world of life, for in our flora and fauna we have abundant instances of forms adapted to all. But for such creatures as those which we have to suppose, it would seem that another sort of world was needed, and other rules of the game of life, of the existence of which we have no evidence at all beyond our own speculations. It is not merely that links are missing in the chain of life-forms; they are missing just where they ought to be found, if we are to be justified in talking of the evidence afforded by observation in favour of the Darwinian theory.

The difficulty thus arising has, it is true, been to some extent anticipated by Mr. Darwin himself, who attempts to supply an answer. It would, however, seem that there are important factors in the problem which his solution does not consider. His contention is that if we do not find link-species actually existing, it is because they have been beaten in the race of life by their more developed descendants; and if we have not found them in the rocks, it is because of the extreme imperfection of our geological record. As to the first point of

this argument, he bids us remember that we must not look to find forms indicating the direct descent of one of our existing species from another. The birds, for example, of the present day, are not to be traced to any of our living lizards, but bird and lizard alike to a common ancestor, more lizard-like than bird-like. From this unknown progenitor the fowls of the air have branched off in one direction, utterly modifying the ancestral organs, and our creeping things in another, still applying the organs to their original purposes, but improving their structure variously for the same. Therefore, he argues, the more modified species, in whatever direction their modifications may have lain, have improved their position in life, relatively to the original, which they have consequently exterminated; just as the rifle-man has extinguished the arquebusier and the arquebusier the crossbow-man. "Hence," in his own words,[1] "if we look at each species as descended from some other unknown form, both the parent and the transitional varieties will generally have been exterminated by the very process of formation and perfection of the new form."

The existence of intermediate forms as living species being thus accounted for, it remains to explain why they are not found as fossils. As Mr. Darwin puts it,[2] "Why is not every geological formation and every stratum full of such intermediate links? Geology assuredly does not reveal any such finely graduated organic chain; and this, perhaps, is the most obvious and gravest objection which can be urged against my theory. The explanation lies, as I believe, in the extreme imperfection of the geological record." How imperfect our knowledge of that record is, he proceeds to show. Only here and there on the earth's surface have we the opportunity of getting a glimpse into the volume whose pages are the rocks. A water-worn cliff, a mine, a quarry, a railway-cutting, show us here and there the fragment of a leaf; but how insignificant a portion of the globe's face is scanned by any of these. What we know of the geological record must, from the nature of the case, be to what we do not know, as a minute and altogether insignificant fraction. The fact, therefore, that we know little or nothing of intermediate links, is not surprising but natural, and till our knowledge of the whole be vastly greater than it is, we can found no argument upon our ignorance of a part.

[1] *Origin of Species*, p. 172. [2] *Ibid.* p. 280.

Rightly to understand the complex bearings of a line of reasoning such as this is no easy task, and he would be a bold man who could pretend with any confidence to grasp them all; but assuredly there are some obvious considerations, not indicated by Mr. Darwin, whereof account must be taken, before we can draw from his premisses the conclusion he would have us adopt.

In the first place, it must not be forgotten that in any direct line of descent, such as he supposes, amongst successive species of plants or animals, although each generation is better fitted for the struggle of life than its predecessor, it does not therefore follow that the tide of life on earth has continuously increased in volume, as do the waters of a river from its head to its mouth. The less developed had to contend with less developed antagonists, and were just as capable of establishing a firm and durable empire, as were the ancient Romans, though they knew nothing of gunpowder. Life must, at all times, have been co-extensive with the capability of the earth to support life, and there is no reason whatever to suppose that this has developed as time went on, for while one class of creatures have been modifying themselves more effectually to consume others, those others have, by the same rule, been guarding themselves against being too easily consumed. The stream of life must therefore be taken as constant at all periods and in all stages of development, on the border lines between our present forms, just as much as within the tracts that include them.

It must, moreover, be remembered that the Darwinian theory, though commonly spoken of as dealing with the origin of *species*, claims equally to deal with the origin of more primary and fundamental divisions in the organic world, of genera, orders, classes, and even kingdoms.[1] On its principles we have to assume that the procession of life-forms has been continuous, from the least organized jellies of the primitive world, to the most complex structures of our own. As has

[1] The organic world is divided into the *vegetable* and *animal* KINGDOMS. The latter is divided into two SUB-KINGDOMS, *vertebrates* (back-boned animals) and *invertebrates*. *Vertebrates* have five CLASSES, *fish*, *amphibians*, *reptiles*, *birds*, and *mammals*. Each of these has various ORDERS, as, amongst birds, *swimmers*, *waders*, *runners*, *scratchers*, *climbers*, *perchers*, *birds of prey*. Within each ORDER are FAMILIES, as the *sparrow family*, among the *perchers*. The GENUS passer, a subdivision of this, includes various SPECIES, as the House sparrow and the Tree sparrow.

been said, every step of the road must once upon a time have been occupied in force, one as much as another, and occupied during the enormous periods of time needed for development to be wrought. All the border-lands between our existing forms must once have been thronged with life, if one class of creatures has grown out of another. It should therefore seem that the classification of extinct organisms ought not in any degree to coincide with that of those which are living. Granting that the latter have been developed into strongly-marked differences, yet in the series which led up to these we should find such differences melt away. The diagram of extinct life should be to that of existing life as a continent to an archipelago. More than this: we have actually good reasons for anticipating that, if Darwinian principles were true, we should find more traces of those forms which have no near counterpart in actual life, than of others. The more fundamental a development has been, the more time must have been needed to work it. Any species, therefore, in which such development has been operated, must have been long-lived and multitudinous, in exact proportion to the importance of differences which separate those between which it constitutes a link. For example, whatever space of time may have been required to evolve the features which distinguish one bird from another, a goose from a humming-bird, an immeasurably larger space must have been needed to make a true bird out of a true reptile, and countless myriads of creatures must have lived and died in a condition between the two. But the most notable fact about the record, as we know it, of geology, is its harmony with the broader features of the existing order of things. Mammals we find, and birds, reptiles, fishes, insects, mollusks. They do not fit in, it is true, with our actual genera and species, but there is no doubt as to where to place them in our larger classes. Instead of manifesting a character completely at variance with our present classification, with its broad intersecting gulfs separating forms from forms, the geological record adopts that classification, lending itself with singular facility to that classification—gulfs and all. Therefore, although it be true that we know but little of that record, yet what we do know points all in one direction.

Still more notable is it that what might seem at first sight to be possible links, present us with some of the most perplexing problems. For instance, to keep to our example, there have

been flying reptiles,[1] and there has at about the same period of the world's history, been a bird with sundry reptilian features.[2] Some writers have hastened to declare that this at once proves the case for the descent of the one from the other. But in the first place the pterodactyle, although he could fly, was as clearly a reptile as the bat is a mammal; and although the archæopteryx had lizard-like teeth, a long tail, and free digits on his wing, no one can read Professor Owen's account[3] without seeing that he was as true a bird as the canary. But, moreover, whatever else these species may be, they cannot be links in the same chain of development. The pterodactyle had a wing, to be sure, but it was a wing constructed on utterly different principles from that of a bird. In it the little finger of the hand[4] is abnormally developed, and, with the aid of a membrane, performs all the work of flight. In the bird this digit is suppressed altogether, and a totally different modification of parts exhibited. The archæopteryx has a bird's wing, and a completely developed wing too; the proportions of some of the more important parts are, according to Professor Owen, like those of the peregrine falcon; while as a whole he compares it to the wing of a grouse. And yet it is not even this member which, on the same authority, most evidently stamps the creature with the character of a bird, but its breast-bone, and especially its feet.

Instead, therefore, of filling the void, such an instance as this does but serve to emphasize its existence. Reptiles we see might have come to fly as well as birds, and yet be as far from being birds as the crocodile, or rather still further, for it would be easier to make a bird's wing out of a crocodile's fore-foot than from the wing of a pterodactyle.

Once more then, by another road, we are brought back to the consideration with which we started, that the most striking feature presented to us by these various tribes of organic creatures which we know, is their isolation one from another, far more than their intercommunion. Everywhere we seem to

[1] Pterodactyles.

[2] The archæopteryx of the oolite.

[3] *Phil. Journ.* Royal Society for 1863, pp. 33, seq.

[4] It is scarcely necessary to observe that in the skeleton of all vertebrate animals the same fundamental parts are to be traced: thus the hand of man, the wing of the bat or the bird, the flipper of the whale, the paw of the lion, the fore-foot of the lizard, all contain the same ultimate elements, variously modified according to the creature's various needs.

find evidence of forces working actively from within, and determining the fundamental character of each class, and not of a mere passive plasticity ready to assume any form which surrounding circumstances may impress. Yet it is for this colourless passivity that Darwinians argue. In Mr. Wallace's words, "In this way [by preservation of variations happening to prove useful] every possible modification of an animal or plant, whether in colour, form, structure, or habits, which would be serviceable to it or to its progeny at any period of its existence, may be readily brought about."[1] More noteworthy still are his words that follow: "There are some curious organs which are used only once in a creature's life, but which are yet essential to its existence, and thus *have very much the appearance of design by an intelligent designer.*" An appearance which he clearly holds to be illusory, for he proceeds to explain how natural selection can sufficiently account for all the facts. Hence we may clearly see the distinction to be drawn between a theory which teaches merely that there has been development in the history of the organic world, and that which lays down that the development has been operated by the agency of Natural Selection alone. For those who hold development to have proceeded on a plan and along fixed lines, the difficulties urged above are not formidable. A man intending to reach a distant spot does not embark on a railway with the intention of spending his life thereon, but as a means to his destination. The idea of a foreknown end once introduced, there is no necessity of holding that every step along the road was once a terminus. But take such an end away, and it is hard to understand how the ground-plan of nature, as it has in fact resulted, should be distinctly traceable in every phase of its past history.

To recapitulate. The constant variability of individuals within the same species, while the specific type endures unvaryingly, points to an energetic intrinsic force, as the operative agency by which species are moulded, and discredits the idea that their forms are the sport of extrinsic conditions. On the latter supposition there would be required, in order to account for the development of one class of creatures from another, a chain of conditions rendering each intermediate form, in its season, the most advantageous hitherto acquired by any organism in that line of development. Some of the conditions,

[1] *Darwinism*, p. 113. Italics mine.

thus postulated, must have been so alien to all now existing upon earth, that the advent of the present state of things has utterly obliterated the races which existed therein, as effectually as an atmosphere of choke-damp would extinguish our present fauna. Moreover the creatures thus exterminated, though they must have been once found in as large numbers as those of other periods, have melted away like a wreath of mist leaving no trace behind, and thus enabling the series of life-forms exhibited by the rocks to tally with our own, as to both its contents and its gaps.

Travellers tell us of hosts of ants which in their migrations overcome all obstacles by lavish sacrifice of lives, filling up pits and damming streams and even extinguishing fires by the sheer force of numbers, willing to perish that others may find a path over their remains. Were we to track their course to confirm such an account, we should look to find their remains most plentiful where their difficulties have been greatest. So should it be, on Natural Selection principles, with the march of life. There, too, there are chasms to be filled on the way, if that way is to be continuous from end to end. The passage from invertebrate to vertebrate, from fish to reptile, from reptile to bird or to mammal, demands changes so fundamental that the earth should be laden with the failures. But it is just where the dead should be lying thickest that we find them not at all.

There is yet another quarter where our missing links may be sought. The history of the development of each individual animal, as we are often told by Darwinians, is a summary of the history of the race to which that individual belongs. A mollusk, for instance, a reptile, a bird, and a mammal, have their origin in primitive cells absolutely similar, and in the course of its progress towards what is to be its final form, the reptile is at one period indistinguishable from a fish, and the mammal from a reptile. "A better proof of this," says Mr. Darwin,[1] "cannot be given than a circumstance mentioned by Agassiz, namely, that having forgotten to ticket the embryo of some vertebrate animal, he cannot now tell whether it be that of a mammal, bird, or reptile."

The fact is certainly important and significant, but it is hard to see in it a proof of what Darwinians would have it prove.

[1] *Origin of Species*, p. 439.

In the first place, as has been well pointed out by Mr. Mivart,[2] though, in such cases of individual development, there be progress from one form to another, that progress is ruled by a force intrinsic to the developing creature, and not by extrinsic circumstances. The future dog may for a time be indistinguishable from a lizard, but a lizard it is not, and nothing on earth can make it one, or can even change it to a wolf. A dog it must be or nothing. "If then," argues this able writer, "the development of the individual is an epitome of that of the species, the latter must, like the former, be due to the action of definite innate laws, unconsciously carrying out definite pre-ordained ends and purposes."

For our present object it is still more noteworthy that the abridgement of evolutionary history thus presented by the embryo, is as silent on the subject of the link-forms whereof we are in search, as are the voluminous tomes of the rocks. We obtain no hint at all as to how one class or order of beings can have been changed to another, but again seem to recognize life in all its stages as being attached to one or other of the typical forms to which we are accustomed.

But more than this. In some of the lower animals the processes of individual development are displayed nakedly before our eyes, like the works of a skeleton clock. In the class of insects, for example, we see in the larva a totally different life-form from that of a perfect insect. A caterpillar differs from a butterfly, not so much indeed as a lizard from a bird, but yet sufficiently to make it instructive to observe by what kind of form he links these two phases of his existence. He does so by becoming a chrysalis. Did any caterpillar ever go into the chrysalis unless with the purpose of coming out as a butterfly? If the intermediate form were ever his final stage he might as well, so far as his individual development was concerned, have gone into his coffin or into the crop of a sparrow. Here then, at least, is a form such as we have sought, connecting conditions of existence altogether different, but it is a form which can never have been the terminus of development, for in that case the terminus would have been final.

However, therefore, we approach the problem, the solution offered by Darwinianism appears less satisfactory the more it be

[2] Articles in the *Tablet* newspaper, March to June, 1888.

examined. Intrinsic forces working definitely towards one plan, not indeterminate forces swept hither and thither by external agencies like a cloud of dust, are suggested by the phenomena of nature, whithersoever our eyes are turned. It would be strange were it otherwise. Organic nature in all its parts we find to be inexorably ruled by law. How then shall we expect that with the whole it should be otherwise? Lawless or really random variation, says Dr. Asa Gray,[1] would be a strange anomaly in this world of law, and a singular conclusion to be reached by those who insist upon the universality of law in Nature.

J. G.

[1] *Contemporary Review*, April 1882, p. 609.