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ART. IV.—DARWIN ON THE ORIGIN OF SPECIES.

On the Origin of Species by means of Natural Selection ; or, the Preservation of Favored Races in the Struggle for Life. By CHARLES DARWIN, M.A., Fellow of the Royal, Geological, Linnean, etc., Societies, author of "Journal of Researches during H.M.S. Beagle's Voyage round the World." London: John Murray. 1859. New York: Appleton & Co. 1860.

THE author of this ingenious book is a grandson of Dr. Darwin, the celebrated author of "The Botanical Garden," "The Loves of the Plants," "Zoonomia," and other poetical and scientific works, full of fanciful theories and rather suspicious theology. Whatever, therefore, may be his speculative eccentricities, we may fairly presume that he has come honestly by them. He has, however, for years occupied a very respectable position as a naturalist, and is favorably known to the scientific world by his narrative of the voyage of the Beagle, which he accompanied as naturalist, as well as by a number of valuable contributions to the publications of the Ray Society on various departments of natural history. His attention, he tells us, was first directed to this "mystery of mysteries" in zoology, the Origin of Species, during the voyage of the Beagle. On its return, in 1837, he devoted himself to "patiently accumulating and reflecting upon all sorts of facts which could possibly have any bearing on it," and he has been steadily pursuing the same object ever since. (Page 9.) This work is the result of these years of laborious investigation. It is, however, as he informs us, but an abstract of what he has done, to be followed soon by a much fuller work containing "in detail all the facts, with references," on which his conclusions have been founded. Though it has been but little over a year since its first publication, this book has had quite an exciting, and, if we are to judge by the rapidity of its sale, we may say a successful career. Perhaps no scientific work has ever been at once so extensively read, not only by the scientific few, but by the reading masses generally; and certainly no one has ever produced such a commotion. It has set savans and learned societies by the ears, and has been the theme of ani-

mated discussion in all sorts of magazines—literary, religious, and scientific. We have room for but a hasty glance at this discussion. The *Edinburgh Review*, (April, 1860,) while it rejects Darwin's theory upon scientific grounds, still hints its belief in "a constantly operating secondary creational law, not yet discovered; or, as Prof. Owen calls it, 'the continuous operation of the ordained becoming of living things.'" The *North British* (May, 1860) condemns it both scientifically and theologically, and declares that "it is in direct antagonism to all the findings of a natural theology founded on legitimate inductions in the study of the works of God; and it does open violence to everything which the Creator himself has told us in the Scriptures of truth of the methods and results of his workings." The *Westminster*, (April, 1860,) on the other hand, in accordance with its infidel proclivities, rejoices over it, for the very reason that, as it believes, it is opposed to the teachings of revelation, and does not accord with the orthodox scientific theories on the subject. According to it, "every philosophical thinker hails it as a veritable Whitworth gun in the armory of liberalism," while at the same time it confesses that the theory is far from being proved, and is yet but a probable hypothesis. Among our own periodicals, the *North American Review* (April, 1860) and the *Christian Examiner* (May, 1860) pronounce the book, in effect, atheistical; while the popular *Atlantic Monthly* (July, August, and October, 1860) very magnanimously takes up the cudgels in its defense, for the reason that enough will be found to attack, and but few to defend it. But the opinions of the scientific journals may be of more importance on such a question as this. M. Pictet, who discusses the subject with a great deal of ability and candor in the *Bibliothèque Universelle*, (March, 1860,) thinks the theory may be true within certain limits, but that Mr. Darwin has carried it entirely too far. Prof. Asa Grey, in a very kindly tempered article in the *American Journal of Science*, (March, 1860,) while doing ample justice to the candor and industry of the author, and defending him against the charge of atheism, is compelled, with evident reluctance, to decide against him scientifically. And lastly, Prof. Agassiz comes to the defense of his own system, which is brought into question in this dispute. Of course he has far more at stake than all others concerned.

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This old theory of the transmutation of species, which he has so successfully opposed before, in its new form must expect no mercy from him. He can hold no parley whatever with it. Others may calmly discuss it, or coolly admit there may be some truth in it, but not so Agassiz. He must strangle it outright. Nothing short of annihilation will suit him. And most energetically does he set about the work, and most summarily does he finish it, winding up with the following sweeping condemnation: "Until the facts of nature are shown to have been mistaken by those who have collected them, and that they have a different meaning from that now generally assigned to them, I shall, therefore, consider the transmutation theory a scientific mistake, untrue in its facts, unscientific in its method, and mischievous in its tendency." His answer to Darwin is contained in the forthcoming volume of his great work, but has been published in advance in the *American Journal of Science*, (July, 1860.) This, whatever may be said of some of its arguments, is perhaps the strongest and most authoritative reply yet made to Darwin's book.

Such a strong array as this against the new doctrine would certainly discourage most modest men, but Mr. Darwin is prepared even for this reception. He says in his Conclusion:

I by no means expect to convince experienced naturalists, whose minds are stocked with a multitude of facts, all viewed during a long course of years from a point of view directly opposite to mine. . . . A few naturalists, endowed with much flexibility of mind, and who have already begun to doubt the immutability of species, may be influenced by this volume; but I look with confidence to the future, to the young and rising naturalists, who will be able to view both sides with impartiality.—P. 417.

But he is far from being without disciples—disciples, too, whose names are not without weight and influence in science. Dr. Joseph Hooker has confessed himself a convert to the new doctrine, and in the *Introductory Essay to the Flora of New Zealand*, has attempted an application of it. He also claims another, who, if not converted, is at least among the anxious. In acknowledging "the fact that all the most eminent palæontologists, namely, Cuvier, Owen, Agassiz, Bassande, Falconer, E. Forbes, etc., and all our greatest geologists, as Lyell, Murchison, Sedgwick, etc., have unanimously, often vehemently, main-

tained the immutability of species," our author says: "But I have reason to believe that one great authority, Sir Charles Lyell, from further reflection, entertains grave doubts on this subject." (Page 271.) We may safely conclude that if this heresy has found advocates in such high places, it must be more widely disseminated among the lower ranks of scientific men. The Edinburgh reviewer, quoted above, says that "perhaps the majority of our younger naturalists have been seduced into the acceptance of the homœopathic form of the transmutative hypothesis now presented to them by Mr. Darwin under the phrase of 'natural selection.'"

After the statement of the names and influence arrayed for and against Darwin's theory, those who take their opinions on authority may be satisfied; others may desire to inquire further into the subject. We will try to gratify the latter class. Of course, at this stage of the discussion we cannot hope to advance anything new; nor do we expect to contribute anything toward the final settlement of the question one way or the other. We will simply aim, in this article, to present to our readers as brief and clear a view as we are able of the two opposing theories of the origin of species—the commonly received, or orthodox theory of special creation, supported by Agassiz and others, and the development or transmutation theory advocated by Darwin and his followers. We will then, if our space permit, briefly examine some of the principal arguments advanced by Mr. Darwin in support of the latter doctrine.

It will be well for us, before entering upon the discussion of the Origin of Species, to endeavor to obtain, if possible, a definite idea of what is understood by the term species; for it is by taking advantage of a diversity of opinion, more ideal than practical, among naturalists on this point, that our author attempts to befog—and, we may say, pettifog—the whole question. This will necessarily involve a brief discussion of the principles of classification in natural history, which, however, may also enable us the better to contrast the two opposite theories. The commonly received system of classification is based upon the idea that certain original and distinct organic forms were created, and that these forms consisted of a single individual or pair, as the representatives of each species, which have transmitted to all their descendants their specific characteristics

unchanged, or with such changes only as may be attributed to varying physical influence, accident, or the interference of man. The term species was therefore made to embrace all the individuals descended from each original stock. According to this idea, there was not only an intellectual, but a real, material connection, a blood-relationship, between all the individuals of a species. Thus it has been held "that while genera, families, orders, classes, and any other more or less comprehensive division, were artificial devices of science to facilitate our studies, species alone had a real existence in nature." It has also been commonly believed that there exists between all distinct species a natural repugnance to sexual intercourse, which was designed to prevent their intermingling, and thus to keep them apart, and preserve their specific identity. This belief is confirmed by the general law of the infertility of hybrids, the few exceptions to it being considered perversions of nature or monstrosities, and therefore entitled to but little weight.

Prof. J. D. Dana, in his "Thoughts on Species,"* has given us a more transcendental definition, endeavoring to throw light upon the subject by "reasoning from central principles to the circumferential." The germ cell which contains the individual, with all its possibilities, possesses certain inherent qualities or powers; and, when surrounded by its appropriate conditions, it develops a certain specific result; and, like the molecule of oxygen, it must correspond to a measured quota or specific law of force. Therefore "a species among living things, as well as inorganic, is based on a *specific amount or condition of concentrated force defined in the act or law of creation.*" He thus makes the fundamental distinction between species a *potential* one, depending on the difference of the value or law of force for each. By the same method he establishes the permanency of species. This he finds corroborated by the provisions of nature to guard their purity, as manifested by the law of hybridity mentioned above. It is perfectly consistent with this theory of the immutability of species that there should be a certain amount of variation under the varying conditions of life. But this variation is confined within fixed limits, beyond which it cannot pass. It is also temporary, and disappears with the causes which produced it. It is necessary, therefore, in studying the history of a spe-

* American Journal of Science, vol. xxiv, p. 305.

cies, not only to examine it in all the stages of the development of the individual, but to determine the precise amount of its variability under the varying physical influences to which it is exposed.

Perhaps Agassiz, in his essay on classification, has given the fullest and best expression to the prevailing opinions of philosophic naturalists on this subject. His views accord so completely with the most theistic opinions in natural theology, and the generally received interpretation of the utterances of the Bible on the subject, that while they claim the assent of men of science, they must be hailed by all enlightened Christians as an important contribution toward the establishment of the complete harmony of the teachings of science and revelation. In his system he admits, to its fullest extent, the doctrine of final causes. He "looks upon an intelligent and intelligible connection between the facts of nature as a direct proof of the existence of a thinking God, as certainly as man exhibits the power of thinking when he recognizes their relations." (*Cont. to Nat. Hist.*, vol. i, p. 11.) In attempting a system of classification of natural objects, therefore, we should endeavor to discover the plan or conception which existed in the mind of the Creator, and which has been embodied or expressed in the creation. The Author of nature is the author of the true system of classification, so that in tracing it the human mind is but translating into human language the divine thought expressed in nature in living realities. In opposition to the notion of species, stated above, he contends that species have no more real existence in nature than genera, families, orders, classes, and branches have; that they all exist only as categories of thought, founded upon separate and distinct categories of characters; that these categories of thought existed primarily in the mind of the Creator, and have been embodied in living forms. He finds among animals six categories of relationship based upon structure, and states them thus:

Branches, or types, are characterized by the plan of their structure;

Classes, by the manner in which that plan is executed, as far as ways and means are concerned;

Orders, by the degrees of complication of that structure;

Families, by their form, as far as determined by structure;

Genera, by the details of the execution in special parts; and

Species, by the relations of individuals to one another and to the

world in which they live, as well as by the proportions of their parts, their ornamentation, etc.—*Cont. to Nat. Hist.*, vol. i, p. 170.

He elsewhere, in describing species more fully, enumerates their relations under nine distinct heads, as embracing all their characteristics, and says: "As soon as all the facts bearing upon these points are fully ascertained, there can remain no doubt respecting the natural limitation of species." (*Cont. to Nat. Hist.*, vol. i, p. 169.) He utterly rejects "as an unailing criterion of specific identity" the law of hybridity, or, as he calls it, "the sexual connection which so naturally brings together the individuals of the same species in the function of reproduction." In this he agrees with Darwin.

It will be seen that the distinctions enumerated above, between the divisions recognized by all naturalists, are differences of *kind*, not of *degree*. It is, therefore, impossible that by variation one class of differences should pass into another; that is, specific differences become generic, or the reverse. From this, Agassiz infers the immutability of species, considering "that all organized beings are created, that is, endowed from the beginning with all their characteristics," and that these characteristics have been transmitted unchanged, except within certain limits, to all their descendants. Not only were species supernaturally created, but their geographical distribution he considers also primordial. Instead of originating in a single locality, they have been created in the localities where they now exist, not in a single individual or pair, but in a multitude of individuals, as many, probably, as have represented the species at any period of its history. This last is also opposed to the popular idea of the community of descent among all the individuals of a species. According to him, the connection, instead of being a material, is only an intellectual or ideal one. He sums up his opinion on this point in few words: "Species, genera, etc., exist as thoughts, individuals as facts." (*Am. Jour. of Sci.*, xxx, p. 143.)

Darwin and the transmutationists, on the other hand, consider a system of classification nothing but a convenient arrangement of natural objects into groups, differing from each other not in kind, but only in degree. His theory admits the orthodox doctrine of a community of descent for all the individ-

uals of a species, and their distribution by natural agencies from a single locality. But he carries the doctrine of community of descent to a most unorthodox extent. He believes that species have not been independently created, but have descended like varieties from other species. He thus states his theory at the end of his Introduction: "I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species." (Page 13.) This is quite a moderate statement of the theory; and in reading the book we are led to believe that he extends it no further. His whole argument is really intended to establish no more than this. It is not until he has reached the Conclusion that he seems to have ventured to the full extent to which it was manifest his doctrine must carry him. Here he is led to apply the theory of descent with modification to members of the same class. Then he launches out still more boldly and says: "I believe that animals have descended from at most only four or five progenitors, and plants from an equal or less number." (Page 419.) He seems inclined to stop again at this point, but a little thought soon satisfies him that there is no resting-place here. He then makes the final plunge: "Therefore, I should infer from analogy that probably all the organic beings which have ever lived on this earth have descended from one primordial form, into which life was first breathed." (Page 419.) Here at last we find the germ out of which all the diversified forms of plants and animals have been developed by the operation of secondary causes. As to the precise nature of this "primordial form," he very prudently avoids giving us any information. Had he gone one step further, and made this form the result of the action of physical forces on inorganic matter, his development theory would have been more complete; and then, by acknowledging the omnipotence of matter, he could have dispensed with a primary or efficient cause altogether. But he has not taken these last two steps, and has therefore escaped the bottomless pit of atheism which opened just ahead of him.

Starting, then, from this originally created form, the first slight modifications would give us varieties; as these became

more distinct, species would result ; as these differences became greater, we would divide species into distinct groups called genera ; and as they separated still wider, into families, and so on, until we reached the greatest divergence expressed by branches or types. Thus, according to Darwin, varieties are but incipient species, species incipient genera, and so on through the whole series. Agassiz has compared his system of classifying animals to the grouping of the stars ; the stem and branches of a tree better illustrate Darwin's idea.

The green and budding twigs may represent existing species ; and those produced during each former year may represent the long succession of extinct species. At each period of growth all the growing twigs have tried to branch out on all sides, and to overtop and kill surrounding twigs and branches, in the same manner as species and groups of species have tried to overmaster other species in the great battle for life. The limbs divided into great branches, and these into lesser and lesser branches, were themselves once, when the tree was small, budding twigs ; and this connection of the former and present buds by ramifying branches may well represent the classification of all extinct and living species into groups subordinate to groups. Of the many twigs which flourished when the tree was a mere bush, only two or three, now grown into great branches, yet survive and bear all the other branches ; so with the species which have lived during long-past geological periods, very few now have living and modified descendants. From the first growth of the tree, many a limb and branch has decayed and dropped off ; and these lost branches of various sizes may represent those whole orders, families, and genera which have now no living representatives, and which are known to us only from having been found in a fossil state. As we here and there see a thin, straggling branch springing from a fork low down in a tree, and which by some chance has been favored, and is still alive on its summit, so we occasionally see an animal like the ornithorhynchus or lepidosiren, which in some degree connects by its affinities two large branches of life, and which has apparently been saved from fatal competition by having inhabited a protected station. As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch, so by generation, I believe it has been with the great tree of life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever-branching and beautiful ramifications.—Pp. 118, 119.

It will occur to the reader at once that this is no new doctrine. Passing by the crude speculations of the ancient philosophers on this subject, we find that it has been repeatedly

advanced under different forms in more modern times, to be just as often rejected by naturalists as unworthy a place among scientific theories. Now we find the same old doctrine renovated by Mr. Darwin, "furnished with a new hat and stick," and started with a great flourish of trumpets on its travels again and again, we fear, to fall by the wayside like its predecessors, though it is likely to last longer and go further than they.

The advocates of this doctrine contend that "when the mind has once admitted the conception of the gradual production of the present physical state of the globe by natural causes operating through long ages of time, it will be little disposed to allow that living beings have made their appearance in any other way." (*West. Rev.*, April, 1860, p. 306.) This argument from analogy seems to have had some influence with Sir Charles Lyell, for after so ably combating the transmutation theory, he is now inclined to adopt it as a necessary complement to his geological doctrines. But "analogy may be a deceitful guide," Mr. Darwin says. Here, we think, it certainly leads us astray. We cannot see the parallelism between the changes of form in inorganic matter and the production of living beings with all their existing diversity. Science has determined pretty clearly all the properties of inorganic matter and the nature of all the physical forces. The law of these forces has been reduced to strict mathematical expression, and their effects have all been calculated. In the phenomena of inorganic nature all the elements are known, but what do we know of the causes of vital phenomena? The transmutation of inorganic matter into a living form has not yet been accounted for by any of the natural agencies which produce physical phenomena. In organic matter we find an entirely new element introduced, which controls and subjects all the others, and which, for want of a better name, we call vitality, or the vital force. The exact value or law of this force has not yet been calculated and reduced to a numerical expression, as the other forces of matter have been. Therefore, until this link in the chain is supplied, until we are able to account for the first production of vital phenomena by the operation of physical forces previously existing, and until we have determined the law of this vital force, as we have that of gravitation, we are not prepared to form any consistent hypothesis to explain the origin of the

present diversified forms of living beings, which shall be a complement, as its supporters pretend this one is, to the theory which "accounts for the physical changes of the globe by the operation of natural causes." If they ask us to admit an act of special creation at this point, though they limit it to merely breathing life into one "primordial form," the chain of secondary causes is broken, and the analogy no longer exists. Lamark was more consistent. He supposed his monads or "rough draughts" of animal and vegetable existence to be produced by spontaneous generation. The author of the "Vestiges of Creation" also, in order to fill up this gap, declares that "the first step in the creation of life on this planet was a *chemico-electric operation by which simple germinal vesicles were produced.*" (Vestiges of Creation, page 106.) Mr. Darwin sneeringly asks the advocates of special creation if "they really believe that at innumerable periods of the earth's history certain elemental atoms have been commanded suddenly to flash into living tissues!" (Page 418.) We certainly cannot see any insuperable difficulty in admitting a supernatural agency for the production of each new form introduced, after admitting it for the first one, or as Mr. Darwin prefers, the first four or more; especially until some secondary cause has been proved sufficient to account for their origin, and thus dispense with the further necessity for a primary one.

To satisfy ourselves of the difficulty the transmutationists have found in discovering or inventing a cause sufficient to produce the present variety of forms, it is only necessary to look at the various attempts that have been made within the last two centuries. Each one has been confidently advanced as the *vera causa*, in a short time to give place to another, which likewise has soon become fossilized with the other extinct theories of the stratum of thought which produced them.

The theories of the ancients, and also that of Buffon, were theories of degradation, while those of the moderns are theories of progression. By the former the most perfect animals were created, but had a constant tendency to degenerate; according to the latter, the lowest forms are constantly improving or developing. By the first the orang-outang is a fallen or degenerate man; by the second, man is but a developed monkey.

The speculations of Demaillet, (Tellamed,) published in

1748, were so entirely unsupported by facts that they made but little headway against the prevailing opinion of that time. He supposed that when, in the process of the formation of the globe, the dry land was upheaved, some of the marine animals, leaving the water, took to the land, and during a long period they gradually became adapted to their new conditions of life; others in like manner, by constant efforts, became enabled to fly in the air.

Lamarck, in the beginning of the present century, presented nearly the same doctrine again, and supported it with much more ingenuity. (*Philosophie Zoologique.*) He develops the lower forces into the higher by the tendency to progressive advancement in organization and intelligence, and by the force of external circumstances, or of variations in the physical condition of the earth, or the mutual relations of plants and animals. According to his theory, the habits of an animal are not determined by its organs, but that organs are developed, or become obsolete in the course of time by the habits of an animal, or those of its progenitors. For instance, ducks and other water-fowl were not made web-footed to enable them to swim, but by making constant efforts to swim, in searching for food, the skin gradually expanded between the outstretched toes until in course of time the membrane grew and filled the whole space. Again, by the repeated efforts of a fish to fly in the air, the fins gradually developed into wings, and the fish became a bird. The insufficiency or worthlessness of the facts adduced by Lamarck in support of his theory was enough of itself to cause its rejection by scientific men; but when he attempted to show its practical operation in developing an orang-outang, who had been brought up through all the regular stages from an oyster, into a man, the ridicule with which it was met was so overwhelming that but few ever had courage to advocate it.

The author of the *Vestiges of Creation* next attempted to solve this "mystery of mysteries." His idea is, that the lower forms of animals represent by a regular series all the stages in the embryological development of the higher; "*that the simplest and most primitive type, under a law to which that of like production is subordinate, gave birth to the type next above it, that this again produced the next higher, and so on to the*

very highest, the stages of advance being in all cases very small, namely, from one species only to another; so that the phenomenon has always been of a simple and modest character." (*Vestiges*, p. 115.) In order to bring about this generation of any species by the next one below it, he thinks it is only necessary "to protract the straightforward part of the gestation over a small space." He supposes this may be accomplished "by the force of certain external conditions operating on the parturient system." (*Vestiges*, p. 110.) The nature of these conditions, he says, we can only conjecture. But, as conjecture was not deemed quite substantial enough for the basis of a scientific theory, this flimsy fabric did not long withstand the tempest of argument and ridicule let loose upon it.

This last attempt to discover a secondary cause sufficient to meet the wants of the development hypothesis proved such a miserable failure that for years no one ventured to make another. So completely did this heresy appear to have been crushed out, that the advocates of special creation, having the field all to themselves, had begun to look upon their position as impregnable against any force that could be brought to bear upon it. Such was the state of affairs when Messrs. Darwin and Wallace startled the scientific world by a communication to the Linnæan Society, professing to be a restatement of the Lamarkian hypothesis in an improved and truly scientific form. Out of this paper Mr. Darwin's book has grown. When we consider the circumstances under which this work is produced, the respectability of the source from which it emanates, and the great pretension it makes, we are not surprised at the stir it has made, nor at the rigid account to which it has been held by the advocates of the opposing doctrine.

What, then, is this great discovery of Mr. Darwin—this new natural agent sufficient to develop all the diversity of living things from the "one primordial form into which life was first breathed?" What is this great secret kept hidden from the world to be revealed to us in these latter times through Mr. Darwin? He calls it "Natural Selection, or the preservation of favored races in the struggle for existence." This "struggle for existence," upon which he bases his whole theory, he states thus :

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being which, during its natural lifetime, produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food and no prudential restraints of marriage.—P. 63.

We will, just here, in passing, for we have no time to discuss this point, say that we do not believe in this struggle for existence, as Mr. Darwin states it. In spite of his array of facts, we are not yet convinced that such is the law of any part of God's creation. As Carey and other political economists have conclusively proved the doctrine of Malthus to be false in its application to human society, so we believe science will yet prove it as false and wicked when applied to the organization of the animal kingdom. But having, as he thinks, established this struggle for existence, he next considers its influence on the variation of species. That each organism begets its like, but with some slight difference, is a law universally admitted. Now it is not improbable that, in the course of "thousands of generations," some modification, however slight, may occur which may be of advantage to its possessor in this ever-recurring struggle for existence. The individuals possessing this advantage would, therefore, have the best chance of surviving and procreating their kind. This profitable variation would also, after "thousands of generations," under the same law of variability, be improved and perpetuated. Thus, by a slow process, varieties would be produced. The same tendency to vary still existing, these varieties would, in the course of ages, become true species. After a still longer time these species would be divided into genera, classes, etc. "This, of course, is only applicable to the profitable variations, for those that were injurious would be rigidly destroyed." This preservation and accumulation of infinitesimally small and inherited profitable variations, and the destruction of injurious

ones, he calls "Natural Selection." This, then, is the new secondary creational agent which is to do the work mostly assigned to a primary one. To see how it works, let us take the example quoted above. According to Darwin's theory, when food became scarce on land, a portion of the birds in certain localities would be compelled to seek it in the water. Here, then, would commence a new struggle. In the course of time it would happen, how we do not know, that a bird would be born with a slight expansion between the toes. This would give him a slight advantage over his fellows, and be transmitted to his offspring. This would thus be preserved until, in the course of ages, by the same law of variation, another fowl would be born with the membrane somewhat larger. This, in the same manner, would be transmitted and gradually enlarged until the perfect web-foot would be produced by natural selection. He admits the influence of habit, it is true, but only as a subordinate agency in effecting changes of structure. How much more satisfactory this explanation is than that of Lamarck our readers can decide for themselves.

When Lamarck and others pretended to have discovered a *natural* explanation for all the diversity of organic forms, the burden of proof was naturally and properly thrown upon them. They were required to show that the causes brought forward were really sufficient to produce the present diversity of species, or, if that was not possible, that the whole mass of facts were more conformable to their theories, and better explained by them than by any other. But they utterly failed to establish either point. The burden of proof laid on them was more than they were able to carry. The same demand is now made of Mr. Darwin. He must prove that his new doctrine of natural selection is either a "true physical theory, or a sufficient hypothesis," or both, else it will soon be put in the same category with its predecessors.

We have already devoted much the larger portion of the space allowed us to an exposition of Mr. Darwin's theory, and to an effort to determine its true position in relation to the derivative hypotheses which have preceded it, and to the prevailing doctrine of special creation, thinking this course more consistent with the character of this journal, and more adapted to the wants of our readers, than the discussion in detail of all

the scientific questions involved. We shall endeavor, however, in the space that remains, to examine briefly some of the principal arguments advanced by our author in support of his new doctrine.

His first argument is from variation under domestication, where the natural tendency to vary is controlled and modified by the interference of man. He thinks that the conditions of life, as food, climate, etc., by acting upon the reproductive system, have great influence in causing variability, though he does "not believe that variability is an inherent and necessary contingency under all circumstances, with all organic beings, as some authors have thought." Variation is also modified, to some extent, by "various degrees of inheritance and reversion," by "correlation of growth," by "the direct action of the conditions of life," and by "use and disuse." Over all these causes of change, however, man's power of accumulative selection predominates. (Pp. 44, 45.) "Nature gives successive variations; man adds them up in certain directions useful to him. In this sense, he may be said to make for himself useful breeds." (P. 34.) In this manner new races or varieties are produced within a short period, owing to the wonderful plasticity of some of our domestic animals under the hand of man. These varieties, according to Mr. Darwin's theory, are but incipient species, some of them being more clearly defined than many recognized species in a state of nature. If, then, such marked varieties are thus produced in so short a time, may they not, if the process be continued long enough, be converted into good and reliable species? The aim of this argument, therefore, is to prove that, under man's selection, the production of new species is possible. Under this head he gives us many very curious and interesting facts to illustrate the great power of man in moulding the forms of some of our domestic animals. His favorite illustration is that of our domestic pigeons. These he seems to have studied very thoroughly, having for this purpose joined two of the London pigeon clubs. He is satisfied that all the varieties of our pigeons, of which more than one hundred are well marked, are descended from the wild rock pigeon, (*columba livia*.) Some of these differ so much in size, color, habits, and even structure, that Mr. Darwin declares:

Altogether, at least a score of pigeons might be chosen, which, if shown to an ornithologist, and he were told that they were wild birds, would certainly, I think, be ranked by him as well-defined species. Moreover, I do not believe that any ornithologist would place the English carrier, the short-faced tumbler, the runt, the barb, pouter, and fantail in the same genus, more especially as in each of these breeds several truly inherited sub-breeds, or species as he might have called them, could be shown him.—P. 27.

Yet even here, however strong the appearances may be in his favor, he does not venture to claim the formation of a single new species. The morphological evidences here paraded so confidently are more apparent than real, not being sufficiently reliable or permanent for the establishment of specific difference. The boasted difference in the number of vertebræ is found, upon examination, to be confined to the small ankylosed bones in the region of the tail, which vary so much, even in individuals, that they are never depended on to determine species. In fact, he seems to ignore all variation which belongs to individuality. He forgets that in nature, within the limits of well-defined species, there are instances of much more wonderful variation than any of those boasted of in our domestic breeds; and that the determination of the limits of this variability, and the circumstances which affect it, is an essential part of the study of the history of each species. Now whatever peculiarity belongs to the individual is transient, and disappears or changes with the influences which produced it. These distinct breeds or races are only produced by the careful and constant selection by man of certain variable peculiarities, and by close breeding in and in. But let this perversion of nature be removed, and allow the different breeds to have free intercourse, and see how soon your boasted varieties disappear. Mr. Darwin acknowledges this to be the case with the races of pigeons. There is really no resemblance between the distinctions of the best marked breeds, and the differences of natural species. Besides, there is none of that repugnance to intercourse to keep them distinct, such as we find existing between natural species. Even Mr. Darwin, though with Agassiz he rejects the law of hybridity as a test of specific difference, admits that no instance has ever been known of distinct species producing fertile hybrids. If, then, there be no real dif-

ference between well-marked varieties and species, and if these breeds have diverged so far as to be liable to be mistaken for distinct species, and genera even, why has he not been able to produce an instance of even a slight obstacle to a perfectly fruitful intercourse having been established between them? If these modifications of structure are so important and essential as he would have us believe, why have they not in a single instance been accompanied by change enough in the reproductive system to keep the races apart? This we think a serious difficulty, nor has Mr. Darwin with all his ingenuity attempted to explain it. Besides, if some of our existing races of domestic animals were established many thousand years ago, as we have abundant evidence they were, why is it, if they are incipient species, they have not, under the same influences, gone on diverging, and in time become good species? If, as we are told, the period of a single life has been sufficient to establish a distinct breed, surely the six thousand years of human history might have developed a single species at least out of some one of them.

This whole argument from variation under domestication to establish the probability of specific variation in nature, we consider a complete fallacy which proves nothing. But having, as he thinks, succeeded in proving that man's selection is capable of producing new species, our author next looks for some agency in nature which operates in the same way. Here is the original part of his book. His discovery of natural selection, which has been at work from the beginning, producing the most astonishing results, without being suspected by the closest students of nature, certainly entitles him to a place in the first rank of discoverers—provided, however, his discovery does not in the end prove to be but an invention, and a useless one at that. When we tell him that in domestication all the variations are produced and controlled by the intelligence of man, while his newly discovered agency is entirely fortuitous and unreasoning, and cannot be depended on for the production of such results as we see, his ingenuity and imagination are ready for even this emergency. Haphazard and accidental as his natural selection seems to others, to him it appears endowed with the highest attributes of wisdom and omnipotence. Here is its apotheosis:

It may be said that natural selection is daily and hourly scrutinizing throughout the world every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. We see nothing of these slow changes in progress until the hand of time has marked the long lapse of ages, and then so imperfect is our view into long past geological ages that we only see that the forms of life are now different from what they formerly were.—P. 80.

Surely the imagination that is capable of such a creation ought to be equal to the explanation of any difficulty that might present itself. The admission made in the last sentence quoted above is certainly a damaging one, especially when we consider that this theory pretends to be but a complement to Lyell's doctrine, that all the changes in the earth's crust have been produced by the same natural causes which we now see in operation. Lyell's whole argument is based upon the fact that we can and do see these forces at work, and by measuring the effects we see them producing we are able to calculate all the results of their operation in past ages. But Darwin admits that "we see nothing of these slow changes in progress;" nor, after the lapse of ages, do we see any evidence of them, except that "the forms of life are now different from what they formerly were." We humbly suggest that even modern geologists might be allowed to ask for a little proof before being compelled to adopt such a theory as a necessary consequence of what they have all along believed. But where is the proof? Has Mr. Darwin furnished one instance of a new species produced by natural selection? After his great display of his facts and his promise of more to come, we are surprised to find that they prove so little to the point. Some are unreliable, some prove nothing, (that we can see,) others can be made to prove just as much on one side as the other. When we demand some example of transmutation brought about by natural selection, though he is not able to produce one from his list in reserve, his imagination helps him out of the difficulty. "Instead of facts we are treated with marvelous bear, cuckoo, and other stories. *Credat Judæus Apella.*" Here is a specimen:

In North America the black bear was seen by Hearne swimming for hours with widely open mouth, thus catching, like a whale, insects in the water. Even in so extreme a case as this, if the supply of insects were constant, and if better adapted competitors did not already exist in the country, I can see no difficulty in a race of bears being rendered, by natural selection, more and more aquatic in their structure and habits, with larger and larger mouths, till a creature was produced as monstrous as a whale.—P. 165.

We should like to know how much credulity is necessary to enable one to adopt such stories as proofs of a scientific theory. Lamark's most absurd fictions never called for more. But the capacity of the theory is not fully developed until he comes to apply it to the production of special organs of great perfection. Even he himself is staggered when asked to explain the development of the eye by natural selection. He says :

To suppose that the eye, with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest possible degree.—P. 167.

Yet he screws up his courage to face the difficulty. Here is the whole process :

If we must compare the eye to an optical instrument, we ought, in imagination, to take a thick layer of transparent tissue, with a nerve sensitive to light beneath, and then suppose every part of this layer to be continually changing slowly in density, so as to separate into layers of different densities and thicknesses, placed at different distances from each other, and with the surfaces of each layer slowly changing in form. Further, we must suppose that there is a power always intently watching each slight accidental alteration in the transparent layers, and carefully selecting each alteration which, under varied circumstances, may in any way or in any degree tend to produce a distincter image. We must suppose each new state of the instrument to be multiplied by the million, and each to be preserved till a better be produced, and then the old ones to be destroyed. In living bodies variation will cause the slight alterations, generation will multiply them almost infinitely, natural selection will pick out with unerring skill each improvement. Let this process go on for millions on millions of years, and during each year on millions of individuals of many kinds, and may we not believe that a living optical instrument might thus be formed as superior to one of glass as the works of the Creator are to those of man?—P. 169.

Let any one who has been able to bring his mind to adopt this explanation try how much harder it would be to believe the doctrine of special creation. Surely the transmutationists, above all others, ought to have charity for those who are still weak enough to hold to the belief in the doctrine of final causes.

These must serve as specimens of the direct arguments by which our author would establish his theory. But his genius for special pleading does not fully display itself until he comes to explain away the facts which oppose his hypothesis. Even when he admits the objection to be a serious and damaging one, he gradually brings himself to the belief that the difficulty may not be so serious after all; and finally ends by convincing himself, if not others, that instead of being squarely against him, as they have all along been supposed, the facts are really on his side. A good sample of this kind of reasoning is his chapter on the geological record. Most of our readers will probably recollect how utterly this same development hypothesis was demolished by the geologists when the author of the *Vestiges of Creation* was rash enough to appeal to the testimony of the rocks to establish it. It was then clearly shown, and every succeeding discovery has but added confirmation to the fact, that instead of the successive formations containing the regular graduated series of organisms, from the lowest and simplest cell up to man, the highest and most perfect of created forms, which this theory demands, the chain is broken and fragmentary, the first and many of the intermediate links being entirely wanting. In the very lowest fossiliferous strata we find representatives of all four of the different branches of the animal kingdom, showing a degree of divergence which, according to Darwin, it must have required countless generations to produce. Nor do we find a gradual increase of the number of individuals of a species as we proceed from the bottom to the top of a formation, nor a gradual dying out; but each new species is represented, on its first appearance, by as many individuals as at any period of its history. Species appear suddenly, and as suddenly disappear, to be succeeded in the next formation by forms entirely distinct from any that existed before. Such is the most undoubted testimony of the rocks, which even Mr. Darwin is compelled to admit. He says: "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." (P. 246.) He would account for the absence of the first link of the chain on the supposition that in consequence of the delicacy of their organization all traces of the forms existing before the Silurian period were obliterated by metamorphic or other influences. But it is fair to presume that these destructive agencies, whatever they were, must have subsided gradually, and left some traces, however imperfect, of the immediate progenitors of such well-preserved animals as are found in the lowest fossiliferous strata, if any such progenitors ever existed. To account for the absence of the intermediate links, he contends that the "geological formations in any region are almost invariably intermittent," and separated by long intervals of time. This he explains on the theory that "all the ancient formations which are rich in fossils have been formed during subsidence," and the fossils thus preserved; while "the littoral and sub-littoral deposits are continually worn away as soon as they are brought up, by the slow and gradual rising of the land, within the grinding action of the coast waves." (P. 254.) We cannot resist the temptation to give entire Agassiz's reply to this ingenious argument:

He would have us believe that geological deposits took place during the periods of subsidence, when it can be proved that the whole continent of North America is formed of beds which were deposited during a series of successive upheavals. I quote North America in preference to any other part of the world because the evidence is so complete here that it can only be overlooked by those who may mistake subsidence for the general shrinkage of the earth's surface in consequence of the cooling of its mass. In this part of the globe fossils are as common along the successive shores of the rising deposits of the Silurian system as anywhere along our beaches; and each of these successive shores extends from the Atlantic states to the foot of the Rocky Mountains. The evidence goes even further. Each of these successive sets of beds of the Silurian system contains peculiar fossils, neither found in the beds above nor in the beds below, and between them there are no intermediate forms."—*Am. Jour. Sci.*, vol. xxx, p. 146.

His wonderful theory of the gradual perfection of the organs of vision by natural selection through countless ages is also

somewhat robbed of its fair proportions by the evidence which geology furnishes of the existence of such complex and perfect eyes as those of trilobites among the very oldest fossils.

These are but a few of the facts which the geological record, imperfect as it is, presents in opposition to this theory; and Mr. Darwin, with all his ingenuity and special pleading, has not been able to weaken their force or pervert their meaning. We contend that they are absolutely fatal to it, and must be disproved before it can even be admitted as a *possible* hypothesis, much less a probable one. His chapters on Geographical Distribution, Classification, Embryology, etc., in spite of their interest, we must pass over entirely. The arguments we have given bear upon the most essential points, and they must serve as specimens of the whole.

We have discussed this as a scientific question only, to be decided upon its merits without reference to its theological bearings. It will be time enough to consider it from this latter point of view when it appears likely to become established as a true scientific theory, of which there seems now to be but little need of apprehension. In conclusion we must say that, with all the ingenuity displayed by Mr. Darwin in the discussion of the many curious facts his industry has collected, and whatever may be the benefit to science from the new impulse given to investigation by his book, he has, in our opinion, entirely failed to re-establish on a scientific basis the often rejected theory of the transmutation of species. We are satisfied that, as an explanation of the origin of species, "natural selection" will prove a delusion, and that science will soon consign it to its appropriate place in the museum of curious and fanciful speculations.

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