ART. IX. — *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, Linnæan, etc. Societies; Author of "Journal of Researches during H. M. S. Beagle's Voyage round the World." New York: D. Appleton & Co. 1860. 12mo. pp. 432.

THE author of this book endeavors to establish, though by a different theory and a somewhat different process of reasoning, the same conclusion which was arrived at by the French naturalist, Lamarck, and by the English author of the "Vestiges of Creation"; — namely, that all the species, genera, orders, and classes of animal and vegetable life are essentially of one blood and lineage, having been developed out of one another, without the intervention anywhere of any act of creative power; — developed by the slow but progressive accumulation, through what is practically an infinite lapse of ages, of differences and variations which were at first, and for a long period of time, so slight as to be wholly imperceptible. Mr. Darwin flatly denies, and labors to disprove, what has hitherto been received almost as an axiom in zoölogical and botanical science, — the doctrine of Permanence of Type. If his theory is correct, we may not, indeed, say of man, that he is literally "a brother to the insensate clod"; for he does not accept the hypothesis of "spontaneous generation," and even speaks in one place with unconcealed contempt of those who "believe that at innumerable periods in the earth's history certain elemental atoms have been commanded suddenly to flash into living tissues." But this is the whole extent of Mr. Darwin's concession. We may say of him what Pascal said of Descartes, — "It was his ambition, in his system of philosophy, to be able to do without God altogether; but he was obliged to suppose the Deity gave the world a fillip in order to set it in motion; after which there was nothing more for him to do." In like manner, on this theory, we must call in voluntary creative power to account for the primordial beginning of life in the lowest monad or germ of animal or vegetable being; every-

thing after this is produced by the orderly and necessary operation of secondary causes. Mr. Darwin boldly traces out the genealogy of man, and affirms that the monkey is his brother, and the horse his cousin, and the oyster his remote ancestor. The human body, in his view, is only a slowly developed zoöphyte, out of which it has grown by a process as natural and uniform as that by which a calf becomes a cow; and, by a parallel advancement, the human mind has become what it is out of a developed instinct.

Even this is not all. Mr. Darwin openly and almost scornfully repudiates the whole doctrine of Final Causes. He finds no indication of design or purpose anywhere in the animate or organic world. Like Geoffroy St. Hilaire, he takes good care "not to attribute any intention to the Almighty." The nicest and most complex adaptations do not to him prove design. The eye was not made to see with, or the ear to hear. The fact that these organs respectively do see and hear is accounted for, on this theory, by supposing that, through an accidental and purposeless variation, some one zoöphyte or other animal very low down in the scale happened to be born with a faint glimmering of vision,—with the poor rudiment of an eye, —"an optic nerve merely coated with pigment, and without any other mechanism"; that this "slight accidental variation" passed down by inheritance, giving to the possessors of it a great advantage over their fellows,—even so great that the former were preserved, while the latter died out; that in the lapse of years, another and yet another "slight accidental variation" successively supervened, and, if an improvement, was retained, while those not having it, and those variations which were not improvements, perished. "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?"

Still further: the order and symmetry which prevail throughout animated nature; the correspondence of the organic with the inorganic world; the prevalence of a few general forms of structure amid a countless number of beings, like everywhere

answering to like, and an exact balance of co-operating agents being always preserved, — all the facts which have appeared to most minds so significant of unity of plan, and thereby declarative of the unity of the Creator, — all these seem to Mr. Darwin to be merely the inevitable and unforeseen results of the blind working of nature's laws. "On my theory, unity of type is explained by unity of descent." Amid an infinite number of variations made at random, those only have been preserved which happened to be best fitted to one another, and to harmonize best with surrounding conditions of life, such fitness and harmony being the sole cause of their preservation.

> "Nam certe neque consilio primordia rerum
> Ordine se quæque atque sagaci mente locarunt,
> Nec, quos quæque darent motus, pepigere profecto."

We do not bring together these results merely as our own inferences from the new theory of the origin of species, for the purpose of making up an argument *ad invidiam* against it. We admit all that has been claimed for the proper independence of true physical science, — that its conclusions are to be tested by their own evidence, and not by their agreement or want of agreement with the teachings of Scripture, with received doctrines in theology or philosophy, or with any foreign standard whatsoever. We are ready to call out with the loudest of the anti-Mosaic geologists, *Fiat scientia, ruat cœlum.* But these doctrines are expressly accepted, expounded, and defended by Mr. Darwin himself, who is both a candid and intrepid reasoner, — accepted, not so much as inferences from his theory, but as part and parcel of the theory itself. The case, therefore, is not one of intrusion by theologians, moralists, or philosophers upon the proper domain of physical science. The intrusion, if any, comes from the other side. It is now the naturalist, the pure physicist, who, quitting his own territory, but, as he professes, still relying exclusively on physical evidence, seeks to build up metaphysical conclusions. We have a right, then, not merely as naturalists, but as students of the moral sciences, to examine the connection between his premises and his conclusions, to test his modes of reasoning, and to see whether he has made a legitimate application of the principles of inductive science to matters of fact, or has been only indulging in speculative and metaphysical dreams.

This theory, moreover, is entitled to all the advantage which it can derive from the high scientific reputation of its author. Mr. Darwin is one of the most eminent naturalists in England. The researches which he made in South America and the South Pacific, when he accompanied the Beagle in her surveying expedition round the world, and his speculations respecting the formation of coral reefs and *atolls*, somewhat daring and fanciful, but extremely ingenious and well-compacted, are large contributions to science, the merit of which is universally acknowledged. To the reputation which he has thus justly earned, as well as to the novel and startling character of the doctrines which he now promulgates, must be attributed the general curiosity and interest with which the work now before us was first received. The first edition of it is said to have been exhausted in London on the very day of its publication. It was republished as soon as it could be printed in New York; and it promises to occupy a large share of the attention of the scientific world for some time.

An outline of the theory may be given in a few words. It is matter of the commonest observation, that individual plants and animals are often found to vary by slight peculiarities from the general type of the race or breed to which they belong. Nature seldom, perhaps never, exactly repeats herself. While seeming to observe with much nicety the dividing lines which separate large groups or races from each other, she often appears inclined to a little sport with an individual member of one of those groups, even without going far enough to make a monster of it. The offspring is made a little bigger or a little smaller than its parent; or some organ or limb is abnormally repeated or deficient, or wrongly placed, or unusually developed, whether by excess or defect. Sometimes these peculiarities of structure pass down by inheritance, sometimes not. Mr. Darwin's theory is founded exclusively upon those which are inherited; "any variation," he says, "which is not inherited, is unimportant for us."

The success of the breeders of domestic animals is said to depend in a great degree upon their skill in noting these peculiarities, however slight, selecting those which are best suited for their purposes, multiplying them by allowing only the

selected animals to breed, and fostering them by careful attention to the external conditions upon which their points of excellence seem to depend. By a diligent and skilful use of such means, Mr. Bakewell, about a century ago, reformed the British breeds of sheep, cattle, and swine. By corresponding processes, though to a much greater extent, horticulturists have filled our gardens with so vast a number of cultivated varieties of flowers and plants, success being facilitated in this case by the greater quickness of reproduction, and by the mechanical facility with which all sorts of experiments in crossing the varieties can be conducted.

Whatever may be the means employed in the process of artificial breeding, or however this process may be explained, it is a fact that man possesses many varieties of some kinds of domesticated animals. There are very many distinct breeds of dogs, horses, cattle, pigeons, and domestic fowls; on the other hand, there are but few of the cat, the donkey, or the goose. These breeds are called "varieties," because generally, if permitted, they interbreed freely with each other, and produce fertile offspring; while animals known to belong to distinct "species" can but seldom be crossed, and the progeny of such crossing is almost invariably sterile. How many of these varieties have originated under domestication, and as a consequence of it, is uncertain; there is little or no historical evidence on the point, and a balance of probabilities is no ground for a scientific conclusion. Many of them may be traced back to a very high antiquity. Mr. Darwin "believes" that our dogs have descended from several wild species, and he is "doubtfully inclined to believe" that all the horses have come from one wild stock. With respect to sheep and goats, he can "form no opinion." But he is "fully convinced" that of the breeds of pigeons, which are very numerous and very dissimilar structurally as well as in external appearance, "all have descended from the rock pigeon (*Columba livia*), including under this name several geographical races or sub-species, which differ from each other in the most trifling respects." Pigeons have been domesticated for thousands of years, and have been favored pets with their owners in all parts of the globe. The old Romans, we learn, were

distinguished "pigeon-fanciers," reckoning up with care the pedigrees of their favorites, and paying enormous prices for rare specimens.

Mr. Darwin assumes that many varieties have originated under domestication, solely through the care of the owners in *selecting* the peculiarities or variations which it was desirable to perpetuate, allowing only the individuals having these distinctive marks to propagate their kind, and so finally obtaining a breed invariably thus marked. By continuing this process, another and another variation is successively superinduced upon the one first obtained, and thus, *after a sufficient lapse of time*, a variety is produced which is found to have diverged very widely from the original stock. This process being a cumulative one, there being no natural limit to the number of variations which may in this way be successively superinduced upon one another, man might continue the work, *if he had time enough*, till he had produced, not merely varieties, but any number of distinct species, genera, or orders, — in short, till he had made the difference between the primitive stock and the cultivated race as wide as the interval which now exists between a zoöphyte and man himself. This mode of creating species would be by Voluntary or Methodical Selection.

Unluckily, man has not time enough; for the process is confessedly very slow. Mr. Darwin thinks the Egyptians began to "breed" pigeons about 3000 B. C.; nearly five thousand years, then, of Voluntary Selection have produced only some "varieties" of pigeons, which still freely propagate with one another. We want evidence, therefore, of some sort of "Natural Selection," which has been going on of its own accord, through mere natural laws, ever since the beginning of life upon this planet; and then, if *this* interval is long enough, — and geologists seem to think they have proved it to be virtually infinite, — the origin of all species, from a monad up to man, is fully accounted for.

According to Mr. Darwin's theory, Natural Selection is the means which Nature has provided whereby only her favored races are preserved in the struggle for life. His first step is the application of the Malthusian doctrine of population

to the whole animal and vegetable kingdom. This doctrine is, that the power of increase of any race of animals or plants, the human species included, is indefinite, or incapable of exhaustion; if it were exercised to the utmost, without any check from external circumstances, the earth would not be large enough for the beings of any one race which would claim a place upon it. This is undeniable, as any one may convince himself by trying the power of increase *by a geometrical progression* up only for a very limited number of terms. Then a struggle for life must constantly be going on, the stronger species — the one better adapted to the external and ever-varying conditions of life — always pushing out the weaker or the less adapted species, and usurping its place. By perpetually producing new variations, and then causing these to be preserved and multiplied by inheritance, till each additional quality or mark becomes the characteristic of a new variety or a new species, Nature is forever furnishing fresh combatants for this never-ending strife. The success, however insured, of any new-comer over its immediate competitor, is often attended with a train of consequences fatal to the continuance of a whole set of pre-existent species, and favorable to the ultimate introduction of new ones in their place. In the infinitely complex relations of every species to other organic beings and to external nature, any advantage, however slight, inherited by one variety, may give it the victory over the immediately allied varieties, and thus cause it to be preserved, while they perish. Each adaptation of an organ to a function must thus be perpetually improving; then why need we wonder that the present adaptations, after an almost infinite lapse of time, should have become so perfect? What marvel, to recur to an instance already quoted, that so complex and exquisite a machine as the human eye should have been developed out of the but-end of any nerve a little sharpened! since "several facts," argues Mr. Darwin, "make me suspect that *any* sensitive nerve may be rendered sensitive to light."

Some curious illustrations are given of the general fact, that "the structure of every organic being is related, in the most essential, yet often hidden manner, to that of all other organic beings, with which it comes into competition for food

or residence, or from which it has to escape, or on which it preys." Thus, who would have suspected, that the frequent occurrence, in any region or district, of two such plants as the heart's-ease and the common red-clover depended on the number of cats which the good housewives in that neighborhood should see fit to keep? Yet nothing is more certain; for the connection may readily be traced through the following *Sorites* in natural history. Clover and heart's-ease depend on humble-bees; humble-bees depend on rats and mice; rats and mice depend on cats; and we think Mr. Darwin might have added, cats depend on terriers and bull-dogs. The two flowers can be fertilized only by the visits of insects, and they are frequented by humble-bees alone, as the peculiar shape of their corollas prevents any other bee from reaching their nectar. But field-mice destroy the combs and nests of these bees, and thus keep down their numbers; while every one knows the state of the relations between mice, cats, and dogs.

"When we look at the plants and bushes clothing an entangled bank, we are tempted to attribute their proportional numbers and kinds to what we call chance. But how false a view is this! Every one has heard that when an American forest is cut down, a very different vegetation springs up; but it has been observed that the trees now growing on the ancient Indian mounds, in the Southern United States, display the same beautiful diversity and proportion of kinds as in the surrounding virgin forests. What a struggle between the several kinds of trees must here have gone on during long centuries, each annually scattering its seeds by the thousand; what war between insect and insect, — between insects, snails, and other animals, with birds and beasts of prey, — all striving to increase, and all feeding on each other or on the trees or their seeds and seedlings, or on the plants which first clothed the ground and thus checked the growth of the trees! Throw up a handful of feathers, and all must fall to the ground according to definite laws; but how simple is this problem compared to the action and reaction of the innumerable plants and animals which have determined, in the course of centuries, the proportional numbers and kinds of trees now growing on the old Indian ruins!" — pp. 72, 73.

The process whereby Nature develops any number of divergent varieties, species, and genera out of a very few primitive stocks is illustrated by a diagram closely resembling in shape

an open fan, though most of the sticks are broken off at different lengths. At many points on each stick, little secondary fans branch out, and from these, again, a third set radiate, and so on indefinitely. Millions of developing stocks are thus constantly aiming to push out their divergent lines of offspring over the same ground, and wherever they cross each other, a battle for life ensues, in which the stronger, the better armed, or the more prolific combatant, or the one better adapted to the locality, necessarily triumphs, and its rival perishes. In this way, sooner or later, each of the radiating arms of the primitive fan is broken off, and the species of a secondary, tertiary, or still lower formation occupy the whole of the now greatly widened field. From her exhaustless lap Nature constantly showers forth "varieties," most of which perish almost as soon as formed; others survive long enough to push out their always divergent lines till they become distinct "species"; others, more favored still, take rank as "genera," "orders," or "classes," because from their vigorous loins have sprung a wholly new set of varieties and species. However isolated the species at the tip ends of widely divergent lines may now seem to be, and however broadly separated from one another, could we trace back the genealogy of each, we should find the lines approximating by imperceptible gradations, and at one point or another the whole broad interval between them would be spanned by an endless number of intermediate forms, varying from each other by differences almost too slight to be recognized. A break is nowhere possible; *Natura non facit saltum.*

The theory is certainly ingenious and captivating; and the great store of curious facts, from the whole range of natural history, with which it is illustrated and seemingly buttressed, renders the whole exposition of it very delightful. It seems almost ungrateful, in return for the entertainment which the work has afforded, to proceed doggedly to weigh the evidence, and to ascertain if the foundation is firm enough to support the broad and lofty superstructure. But fascinating as the system is, — and every scheme of cosmogony must be of that sweeping and imaginative character which tickles the fancy and partially blinds the judgment, — the obstinate question will at last recur, *Is it true?*

The first difficulty that we encounter is the vast lapse of time requisite, according to the theory, for the development of the numerous and widely divergent species and genera that now people the earth, out of the poor and solitary germ of life that was first flung into its bosom. But this consideration, which till very recently seemed to oppose a fatal obstacle to the airy hypotheses of the cosmogonists, has now become their strong-hold and chief defence against all the assaults of their opponents. The speculations of Sir Charles Lyell and other "uniformitarian" geologists upon the long roll of ages, "the millions on millions of years," needed for the explanation of geological phenomena according to their mode of reading them, have so excited the imaginations and stupefied the intellects of ordinary thinkers, that it is now rather a recommendation of a theory that the operations contemplated in it could be fully carried out only in an eternity. Mr. Darwin quotes a few of the more striking facts and conclusions of this class of geologists; and having thus accustomed the mind to reflection upon such stupendous periods of time, it seems a trifling matter for him to ask us to admit, that ages of equal or even greater length may have elapsed of which we have no record in the rocks; — that, besides the eternity of which we have some sort of geologic evidence, we should acknowledge the probable lapse of another eternity that has left no legible traces behind it, but which happens to be necessary for the purposes of his theory.

For instance: taking the rate at which the sea now eats into and wears away cliffs five hundred feet high, Mr. Darwin calculates that more than three hundred millions of years were required for the denudation of the great dome of rocks which must once have covered up the district in England now called the Weald. But this estimate goes upon the supposition that the action of the sea was incessant; whereas it is thought that the area during this period must have undergone many oscillations of level, — must have been alternately elevated and depressed, — and therefore, during long ages, must have been raised above or sunk below the action of the coast-waves; so that this period of three hundred millions of years can have been only a fraction of the time that must have elapsed since

the denudation of those rocks began, — that is, since the latter part of the Secondary period. But if we go back to a vastly earlier period than this, to the primary fossiliferous rocks, we come to the Silurian formations, abounding in remains of nearly all classes of animal life, and so enormous in thickness, that, when compared with the length of the epoch required for the deposition of them, the period needed for the denudation of the Weald shrinks into insignificance.

Thus far we have proceeded on what is thought to be good geological evidence; and our readers may think that we have attained a period which ought to be long enough for the requisitions of any cosmogonic theory, — that we have got even a fair instalment of eternity, so that the addition of a few thousand millions of years would be a matter of no importance. Mr. Darwin evidently thinks so, for he finds that even this *quasi* eternity is not enough for his wants; that he must double it, or nearly double it, though there is no paleontological evidence whatever in favor of such addition. There is only the stubborn fact, that his theory needs it, so that the addition must be made. He finds the lowest Silurian strata, as we have just said, abounding in animal remains of the most diversified character, and some of them of a very advanced type. Of course, according to his theory, all these Silurian animals must have been developed with almost inconceivable slowness, through very slight gradations, out of lower and lower types, the improved offspring slowly supplanting and exterminating their predecessors, who "died and left no sign." "Consequently," he says, "if my theory be true, it is indisputable that, before the lowest Silurian stratum was deposited, long periods elapsed, as long as, or probably far longer than, the whole interval from the Silurian age to the present day; and that during these vast, yet quite unknown, periods of time, the world swarmed with living creatures."

It is to the credit of Mr. Darwin's candor that he confesses himself staggered by this difficulty, and even seems for a moment to admit that it is insuperable. "To the question why we do not find records of these vast primordial periods, I can give no satisfactory answer." But he soon plucks up heart, and suggests a possible solution of the problem. The geologi-

cal record is imperfect. Metamorphic rocks abound in many regions where they are visible, and vastly greater quantities of them are probably buried under the Atlantic and Pacific oceans. In these rocks, though called azoic, because yielding no fossils, it is thought that phosphatic nodules and bituminous matter have been discovered; that is, though presenting no remains of fishes, they may be said to exhale "a very ancient and fish-like smell." For instance, there are immense areas of bare metamorphic rock in South America; and in these "we *may perhaps believe* that we see" the only remains of the immense number of animal forms which peopled the earth during an ante-Silurian eternity.

We have dwelt at some length on these geological speculations respecting the time, or rather the eternity, of the earth's history. They play a prominent part in Mr. Darwin's theory, as indeed they have done in every other recent scheme of cosmogony. The author of the "Vestiges" made as much use of them as his far abler and more scientific successor. These supposed immeasurable periods afford scope for the scientific imagination to expand, and broad hypotheses to spring up, and evidence to be multiplied, and all difficulties to be explained away. Grant to the speculatist an eternity, or a *quasi* eternity, for the action and development of his hypothesis, and he can prove anything; that is, he can show how anything *is possible;* and this is all that is expected of any cosmogonist. Neither Mr. Darwin, nor any one else, hopes to prove directly that species *actually were developed* out of each other; he only aims to show *how it is possible that they may have been so developed.* And this he cannot fail to do with the advantage in question. Give him infinity, or a number that is virtually infinite, for a multiplier, and he cares not how small the multiplicand may be; he can make the product large enough to answer the requisitions of any hypothesis, — large enough to bridge over the interval between an oyster and a man. If he has but a shadow of evidence, — a mere *suspicion* that the thing is so, because he is *unable to prove that it is not so*, — still, if he is allowed to multiply this shadow, this suspicion, by an eternity of years, the result will be imposing enough to stagger the convictions of all careless thinkers.

Mr. Darwin does not pretend to have any *direct evidence* that a species, or even a variety, ever *did* originate by the process of Natural Selection, — that is, by successive accidental variations passing down by inheritance, and thus creating an advantage in the struggle for life. He only *believes* that certain "varieties" have originated under a very different though analogous process, — Voluntary Selection, or the care of man; and he has *imagined*, — for that is the word rather than *discovered*, — he has imagined a corresponding though dissimilar method, through which "varieties" *might be* established by natural means alone. Then he borrows an eternity from the geologists for the carrying out of his process, and finds it will thus suffice, not merely for the establishment of new varieties, but for developing anything out of anything, — a man out of a zoöphyte. All the evidence collected in his book goes to prove only this minor point; — that the phenomena of zoölogy and geology, so far as they are known, are not inconsistent with such a carrying out of his imaginary process. Even assuming his geological eternity, he has only shown that *the thing may be so for all that we know to the contrary.* As a logical thinker, he ought to know that this is no proof at all.

There is nothing new in this conception of a cosmogony worked out by speculating upon what is possible in an infinite lapse of years. It is at least as old as Democritus and Epicurus, and has never been presented with more poetic beauty than by Lucretius. According to their scheme, a chaos of atoms or primary molecules of matter, moving fortuitously from eternity in infinite space, crossing and jostling one another, and forming themselves successively into every imaginable compound and aggregation, happened at last to settle into the present system of earth, sun, moon, and stars, — of plants, animals, and men. For the chance of order and mutual fitness is at least one out of an infinite number of chances of disorder and confusion; and in an infinite series of years, this solitary chance must sooner or later be realized.

> "Sed quia multa modis multis primordia rerum
> Ex infinito jam tempore percita plagis,
> Ponderibusque suis consuerunt concita ferri,
> Omni modisque coire, atque omnia pertentare,

Quæcunque inter se possent congressa creare;
Proptera fit, uti magnum volgata per ævum,
Omnigenos cœtus et motus experiundo,
Tandem ea conveniant, quæ ut convenere, repente
Magnarum rerum fiant exordia sæpe,
Terrai, maris, et cœli, generisque animantum."

Every one must acknowledge that of such a theory no direct confutation is possible; for being essentially and completely metaphysical in character, resting altogether upon that idea of "the infinite" which the human mind can neither put aside nor comprehend, it can be met only by metaphysical arguments drawn from this same bewildering conception, — arguments which can again be opposed by others of the same character and equal weight, leaving to the intellect no possible escape from an endless conflict, and no mode of arriving at any conclusion. Kant and Hamilton have proved, *ex abundanti*, that the conception either of the infinite or the absolute "can have no objective reality, that it conveys no knowledge, and that it involves the most insoluble contradictions." But the difficulty, whatever it may be, is wholly metaphysical; till recently, no one ever dreamed of beholding it transported to the province of physical science.

But Mr. Darwin will object, that, however vast may be the lapse of years which is needed, according to his system, for the natural evolution of a universe of animate beings out of a monad, — and he admits it "to be utterly inappreciable by the human intellect," — still he has not avowed that it must be strictly *infinite*. We answer, that he is obliged to claim an *indefinite* succession of ages, so vast that the mind can neither comprehend it in itself, nor in its relations with any period of time which it is accustomed to measure; and the difference between such a conception and that of the strictly *infinite*, if any, is not appreciable. If it were appreciable, the difference would be fatal to his theory, which needs a period so vast as to be out of relation to any finite time which we can comprehend.

This can be easily shown. He must admit that the individual variations on which his whole theory is based, "slight" and "accidental" in character because produced by no intel-

ligent cause, can take place in any one out of all possible directions. The one useful variation is no more likely to appear early, or to become inheritable, than an indefinite number of useless or injurious departures from the primitive type; the very function of his principle of Natural Selection is to eliminate the many unprofitable varieties, — and it is only after trial of them that their unprofitableness can become so far manifest as to cause their elimination, — and to preserve for a limited time the single advantageous deviation. It is only

"Omnigenos cœtus et motus experiundo"

that Nature is able to select a favored race through a manifest reason for such preference. A half-formed eye, for instance, varying at random, must beget an indefinite number of varieties inferior to itself, before it happens to hit on the one new form which is really an improvement; and this indefinite interval must be followed by another of equal length, before the race with vision very slightly improved can kill out, in the struggle for life, the vast number of those previously existing, who cannot see quite so well. Improvements which proceed by almost imperceptible gradations must be slow to manifest their superiority. If we add that, according to the Darwinian theory, this process, thus consisting of two steps, must have been repeated an indefinite number of times, in order to bridge over by very fine degrees the immense interval which now separates the highest from the lowest order of being, it must be confessed that the period needed for the evolution of this system lacks no characteristic of eternity except its name.

Here it may be remarked, that, formidable as Mr. Darwin admits the objection to his theory to be, that geological research has discovered so very few of "the interminable number of *intermediate* forms which must have existed" as "*connecting links* between the living and extinct inhabitants of the world," still he does not half appreciate its magnitude. The objection is really insuperable; for it is not merely the "intermediate forms," the "connecting links" between the living and the dead, which should have been discovered, but an infinite number of other varieties not intermediate, — gross, rude, and purposeless, — the unmeaning creations of an un-

conscious cause, — wholly out of line with such as succeeded in founding a permanent family.

But the large drafts which this theory makes upon our credulity may be more clearly shown by looking at its application to a special case, that of instinct. Mr. Darwin maintains that the most complex and wonderful instincts, such as that of the hive-bee in constructing its cells, and that of certain ants in becoming slaveholders, and thus having all their wants supplied by borrowed labor, have originated in the gradual accumulation of slight but profitable variations of instinct, through the Natural Selection of these out of a vastly larger number of unmeaning, useless, or injurious variations which have accidentally arisen during an unlimited lapse of years. Herein it is assumed that instincts do vary, that the variations are inherited, and that there is no check upon the indefinite accumulation of them; so that we may believe human reason itself to have been thus gradually built up out of the faintest manifestations of instinct which we now witness in the lowest forms of animal life. Each of these points, we believe, admits of the gravest doubt, and is here asserted on wholly insufficient evidence.

If there is any one quality of instinct which, more than any other, has attracted the attention of observers as its characteristic, it is its absolute invariableness, its incapacity of improvement or deterioration. The very little evidence which Mr. Darwin here adduces to the contrary leads us to suspect that he has confounded the *variability* with what may be called the *pliability* of instinct, though the latter quality is one that is not at all available for the purposes of his theory. Every one knows that the instincts of many animals, perhaps of all, are slightly *pliable;* that is, they may be bent so as to accomplish their purpose in any one out of several slightly different ways, choosing one or another according as circumstances may render necessary. Though walking in a narrow path, the animal can still turn aside a little to the right or left, so as to avoid an obstruction in the way. Honey-bees can alter their work just enough to answer the *ordinary* exigencies, to avoid the common casualities or difficulties, of their occupation; when extraordinary difficulties arise, they

pull down the whole structure, and begin anew. But this limited pliability of the instinct, being possessed in an equal degree by all, parents as well as offspring, affords no ground of any possible change or improvement in the habits of the race. The same power reappears in any number of successive generations, manifesting just the same degree of pliability as at first. The instinct, we may fairly say, is *invariably* pliable to the same, and that a very limited, extent.

A true *variation*, such as the Darwinian theory requires, would be the manifestation by an individual in the wild state, or undomesticated, of some feat, quality, or degree of instinct, however slight, totally unlike anything that had been manifested by any of its progenitors or its fellows. Of such variation, as it seems to us, Mr. Darwin has failed to adduce a single instance. That the same species of birds should build slightly different nests in different localities, accommodating the structure somewhat to the climate or the nature of the ground; that migratory birds should not always remove to the same distance or in the same direction, or, in the face of new and extraordinary difficulties, such as may be interposed by man, should not migrate at all; that upland geese should still survive, though they seldom have a chance to swim; or that woodpeckers might stray out upon the Pampas and find a livelihood there, though there are no trees for them to climb; — all such cases, as it seems to us, evince only the *pliability* of instinct, or the possibility that the animal may still live, though circumstances have rendered exercise of some one of its instincts for a time impossible.

Mr. Darwin, having given us no direct proof of the *variability* of instinct in the wild state, has of course failed to show that variations are ever inherited, so as to become the characteristic of a breed or race, instead of being only the peculiarity of an individual. And of cases under domestication, though he alludes to "authentic instances" of inherited habits or tricks, he publishes but one, and that the very familiar, though disputed one, of a young pointer dog beginning to "point" before any pains had been bestowed on his education. "I have myself seen," he says, "a striking instance." So far, so good; but we are not informed whether the animal pointed

perfectly and invariably, or whether he had been so sequestered that he could have taken nothing from older and well-trained dogs by unconscious imitation. But without descending to such particulars, why did it not occur to Mr. Darwin to observe if the habit was inherited for more than one generation? Why not seek to know if the puppies of this young dog would also "point" without any training? Failing of evidence on this point, he ought to see that an isolated instance avails but little for the interests of his theory. English country gentlemen have been breeding and training these dogs with great care and skill for some centuries; and the number of pointers now living in England must amount to several thousands. By the doctrine of chances, if but one out of five thousand contemporaries is found not to need training, very many generations must elapse before we can expect to find another case, even among the descendants of this one "infant phenomenon." A variation inherited through only one generation is little better for Mr. Darwin's purposes than one which is not inherited at all. Yet here he should find evidence, if anywhere, since tame animals can be more thoroughly observed than their wild brethren; and domestication removes the chief obstacle to multiplying peculiarities by descent, man taking great pains to preserve the purity of the breed. Wild varieties cannot be prevented from "crossing" or interbreeding with each other; and in the mongrel progeny, the peculiarities of the thorough-bred parents quickly disappear.

Again, instinct and structure are nicely correlated to each other, and must be so correlated, or the animal would perish. As Müller remarks, the animal "wills to do nothing which its organs do not enable it to do; and its organs are not such as to prompt to any act to which it is not impelled by an instinct." But, according to the Darwinian theory, there is no ground to expect that the *variations* of structure and instinct should be even simultaneous, much less nicely correlated to each other; and our author has adduced no evidence that they are so. The aimless and accidental character of the variations, together with their admitted infrequency as inheritable peculiarities, renders it in the highest degree im-

probable, not to say impossible, that an inheritable peculiarity of structure should happen to occur at the same time with a corresponding one of instinct nicely adapted to it; that, for instance, the apparatus in a bee's abdomen for secreting wax should first appear on the very day when the insect was first incited and taught to build a comb. Such a correspondence and adaptation would compel even Mr. Darwin to renounce chance and believe in design.

We must remember, also, that the highest and most complex instincts are found in very low structural forms. For the most marvellous cases we must descend to the *Articulata*, — to bees, ants, spiders, and the like. No instinct even comparable to theirs can be found in the two higher classes of Mollusks and Vertebrates; and even in this last class, few will dispute that the instincts of birds are more intricate, far-reaching, and wonderful than those of mammals. Dr. Holland was led to notice this fact when speaking of the inverse perfection of the two faculties of reason and instinct; he remarks of the instincts, that "they multiply continually, and become more distinct in character, as we descend in the scale." It is impossible, then, for Mr. Darwin to maintain that the development, through variation and natural selection, of instinct and structure has gone on *pari passu*, each improvement in the one being accompanied by a simultaneous and perfectly correlated improvement in the other. The process of advancement, in the one case, stopped long ago; from insects upward, instincts have only diminished or deteriorated; while the organic structure has been developed from the spider's up to man's.

The bearing of this fact upon the Darwinian theory is very serious; it is even fatal. If instinct and structure have not varied *pari passu*, and by gradations nicely adapted to each other, *neither can have varied at all.* An isolated variation in either would be fatal to the animal's chance in the struggle for life. A persistent instinct would correct a structural variation; a persistent structure would correct a varying instinct. The bee could not have received an instinct to build its cell before its abdomen had begun to secrete wax. The dugs of mammals could not have been developed before

their offspring were urged by instinct to apply to them for food.

And here it may be remarked, that Mr. Darwin argues throughout his book as if, for the purposes of his theory, there were no difference between plants and animals; as if whatever conclusions were established for the vegetable, would hold good also for the animal kingdom. Of course, this is a very convenient assumption for him, as evidence of variation is much more easily collected in the case of plants than in that of animals. And yet the assumption seems a rash one on many accounts, and especially for a consideration derived from what has just been stated. Plants differ from one another only as organisms, or in structure alone; animals differ not only structurally, but in their instincts. Now, as the instincts, being more permanent, being permanency itself, correct and efface variations of structure, or kill out monsters, it follows that the Darwinian theory is by no means as applicable or plausible in reference to animals as to plants. And here we have an explanation of the paradoxical remark that has been made in reference to the geographical distribution of plants and animals. It is said that "powers of locomotion seem to have been given to animals in order to enable them to stay at home." This is true. Their structure, indeed, enables them to wander; but the steady instinct confines them to their proper locality. On the other hand, the locomotive apparatus of plants, or of their seeds, is far less perfect; but not being corrected by any instinct, it still enables them to wander and to distribute themselves very widely.

The reasons now adduced seem conclusive against the theory of the gradual building up of a complex instinct through casual inherited variations and natural selection. As there are no indications of evidence, however faint, to serve as a multiplicand, even the great advantage of having eternity as a multiplier will not avail. Zero multiplied by infinity is still zero. In fact, the argument is strong the other way. The necessary correlation of instinct and structure makes the cumulative inherited variation of either impossible. But it will be instructive to witness, in a single example, how broad and lofty a superstructure may be built up by a lively scientific

imagination on assumed data. Let a clever theorist once get fairly mounted on his hobby, and he will ride in imagination to the world's end, before he has fairly shown the possibility of advancing an inch. We will take, as the example, a case which Mr. Darwin has considered at length, which has always been a favorite one in the argument from design, and which he admits to present difficulties so formidable to his speculation that he could not at first reflect on them without being staggered. We mean the construction of the comb by a hive of bees.

He first endeavors to divest the phenomenon, as far as possible, of its marvellous character, by making it appear that the construction, by these insects, of two opposite and parallel layers of cells, — each cell being a symmetrical hexagonal prism, closed by a trihedral pyramid composed of three rhombi, the obtuse angles of each rhombus measuring precisely 109° 28′ and its acute angles 70° 32′, — is no very wonderful thing after all; — even when it is added, that precisely this form and these dimensions, and no other, will give the utmost possible capacity with the least possible expenditure of material. "The difficulty" of making such cells, he says, "is not nearly so great as it at first appears."

"If a number of equal spheres be described with their centres placed in two parallel layers; with the centre of each sphere at the distance of radius $\times \sqrt{2}$, or radius $\times$ 1.41421 (or at some lesser distance), from the centres of the six surrounding spheres in the same layer; and at the same distance from the centres of the adjoining spheres in the other and parallel layer; then, if planes of intersection between the several spheres in both layers be formed, there will result a double layer of hexagonal prisms united together by pyramidal bases formed of three rhombs; and the rhombs and the sides of the hexagonal prisms will have every angle identically the same with the best measurements which have been made of the cells of the hive-bee." — pp. 201, 202.

He tested this theory by observation. He found that the bees did begin by excavating hemispherical cavities and building up cylinders on them, of the proper size, and *always at the specified distance from each other*, stopping when the rims would intersect or break in upon each other, and then economically biting away all the superfluous wax, till the partitions

between the adjacent cells became planes of a uniform and minimum thickness. Thus the cylinders terminated by hemispherical cavities became the required hexagonal prisms ending in trihedral pyramids, the three rhombi of each pyramid entering into, and forming a part of, the pyramidal ends of three distinct cells in the opposite and parallel layer. The construction, then, according to Mr. Darwin, is very simple. We have only to suppose that several hundred or thousand bees, beginning work on the opposite faces of a thin plate of wax, excavate at once many hemispheres, with the centre of each at the distance of radius $\times$ 1.41421 from the centres of all the adjacent spheres both in the same layer and in the other and parallel layer. It is only necessary to add, that the bees then economize their precious wax by biting away every particle of it which is not absolutely needed, and the work is practically done. The problem of constructing the marvellous cells is solved.

As it seems to us, Mr. Darwin's explanation only makes the work of the bees appear more wonderful than ever. Not only do they build cells having the marvellous properties first described, but the *modus operandi* — the process of building them — what geometers would call the "solution of the problem by a practical construction" — rivals in beauty and simplicity any solution that mathematicians ever effected. Now that we understand *how* the work is done, the only question that remains is, How do the bees succeed in sweeping their hemispherical cavities always at the exact distance which is required? and that, too, though half of them must work on the opposite side of the comb, — the centre of each cell being measured off from the centres of six others in the same layer, and of three others on the opposite side? How do hundreds and thousands of bees, working together without confusion, always make these nine distances of the same required amount? This requisition, being a mathematical one, must of course be rigorously enforced. The quantity by which radius should be multiplied for each distance is not 1.416 or 1.415; it should not be anything, and with the bee *it never is anything, but* 1.41421. How are the working bees enabled to measure off so nicely this distance nine times for each one of the many

thousand cells which they construct in every hive every season?

Mr. Darwin's answer is ready; he says they have been prompted and enabled to do this BY CHANCE, — that many accidental modifications of instinct having accidentally become inheritable, this one modification was picked out from them by natural selection, because it is more conducive than any other to the preservation of the bee's existence. But to be more particular: the architectural instinct of the bee has varied at random through a past eternity; and a vast number of the variations thus produced have happened to be perpetuated by inheritance, as characteristics of so many distinct species of bees. If we admit the number of distinct species thus formed, each with its peculiar architectural instinct, to have been *infinite*, one of them *must* have been prompted to measure off this prescribed distance, and no other, between its cells. If the number of species was only *very great*, but not infinite, then one of them *happened* to possess an instinct for this precise distance. Now, as this distance causes the smallest expenditure of wax, and as "the saving of wax, by largely saving honey, must be a most important element of success in any family of bees," the species of bees having an instinct for this distance must have had a better chance than any other in the struggle for life, and so must have been preserved, while all others perished. Among these others must have been some who built at the distance 1.416 or 1.415; but the difference between these numbers and the prescribed 1.41421, though small, was yet fatal to the builders, who died out because they thereby used more wax than was necessary. And yet the humble-bees, who construct "very irregular rounded cells of wax," and thereby waste a prodigious amount of the precious material, together with a Mexican species of bee, which is nearly, though not quite, as prodigal of wax, have survived to the present day very comfortably, and in great numbers. Why the rule of saving wax as a condition of existence should have been so much less rigidly enforced in their case than in that of the hive-bee, we are not informed.

It is a characteristic of Mr. Darwin's theory, — an excellence of it as a work of fancy and imagination, but a misfortune for

it considered as a speculation in science, — that it is universal in its application, and that all its parts are so nicely compacted and mutually dependent, that it must either be accepted or rejected as a whole. A failure in any part, an insurmountable difficulty in the application of it to any phenomenon, is destructive of all its claims to belief. "All or nothing," must be the motto of its author. Hence he more than once alludes to some "one special difficulty, which at first appeared to me insuperable, and actually fatal to my whole theory." If it were not for this consideration, we think Mr. Darwin would never have meddled with the subject of instinct, but would have contented himself with a theoretical explanation of the origin of species, considered, as they may be in the case of plants, merely as so many distinct or varying structures. He seems hardly satisfied with his own account of the development of instinct, as he admits that the cases of it which he has considered do not strengthen his theory, but he also thinks that they do not annihilate it. The necessary correlation of this faculty with the structure of every animal in which it appears, prevented him from leaving it out of view altogether; yet he has passed over some of its most puzzling manifestations, and some of those which it is most difficult to reconcile with his theory of its origin.

For instance; — in the infinite number of variations which he requires us to believe this faculty to have undergone, why has it never overstepped the clearly marked line which still divides it from reason? As he is obliged to believe that reason at some period was developed out of instinct, why should there still be such an interval between them? They seem to differ, not in degree only, but in kind. If it were not so, if the difference were only in degree, we should be obliged to admit, in many cases, that instinct is superior, that its power quite transcends that of reason.

> "But honest instinct comes, a volunteer,
> Sure never to o'ershoot, but just to hit;
> While still too wide, or short, is human wit."

It is thus manifestly pre-eminent, however, only within its own narrow sphere. The several classes of brutes do one thing in only one way. Following their own narrow path,

they appear like prodigies of wisdom; remove them ever so little from it, and they again become brutes. We can understand this inconsistency on the supposition that instinct has always remained invariable, — that it has never changed; for it may then be compared to a machine, which performs its one task very perfectly, — more perfectly than the human fingers could. But it can do nothing else; its function is single and unchangeable. Mr. Darwin would have us believe that instinct has varied infinitely in every one of its manifestations; that its process of development has been tentative, every conceivable modification of it being subjected to trial, as in the attempts of the bee to construct its cell, and only that form of it being finally preserved which is absolutely the most profitable. These infinitely numerous variations, we cannot too often repeat, are first made entirely at random. Why did one of them never approach that characteristic of reason, now never found in instinct, which enables man to profit by experience, and thus renders him almost equally competent for all emergencies? Experience is thrown away upon mere instinct, which never profits by it. It cannot be denied, that it would be a far surer means of preservation in the struggle for life, to possess even a thousandth part of man's power of adapting his conduct to circumstances, of observing the causes of error or failure in one trial and of avoiding them in the subsequent endeavor, rather than to enjoy in perfection the capacity of doing one thing with unerring success, but at the same time to be unable to change the mode of action so as to accommodate it to the ever-changing conditions and exigencies of existence. The bee constructs its combs with admirable art; but it cannot build a hive or house for these combs. It cannot fashion a paper house, like the wasp, or dig subterranean chambers for its home, like the ant. The range of primitive variation was wide enough to include a power superior to reason, though of very inferior use in the battle for life, — the power, we mean, of building just one kind of home with the utmost possible economy of the one building-material. Why did it not, then, include one of the lower but far more profitable manifestations of reason, — the ability to use some other material when wax was deficient, even if it were thereby com-

pelled to build circular instead of hexagonal cells? "*Si seulement*," says Bonnet, when speaking of the faculty to which the works of the beaver are to be referred, — "*si seulement ils élevoient une fois des cabanes quarrées! Mais ce sont eternellement des cabanes rondes ou ovales.*"

There is another difficulty in the theory, which Mr. Darwin seems either to have overlooked or under-estimated. He supposes that organs and instincts have been developed by the accumulation of innumerable slight variations, every one of which, however, must have been important enough to afford an additional chance in the struggle for life. The varieties which have appeared under domestication he supposes to have been very gradually formed, through "individual differences so slight as to be quite inappreciable by an uneducated eye." Man's care and foresight can preserve and accumulate these shades of difference, by keeping the breed pure and providing all the conditions of healthy growth. But in the wild state, Nature seems to have furnished no adequate means of preserving, each by itself, these minute gradations. If the variation is important enough to preserve those who have it, while others must die out because they have it not, then it cannot be so slight in character as to form one of a series of almost imperceptible steps. It must be of grave importance; not a slight variation, but a jump; not natural, but supernatural. For, as Mr. Darwin is fond of reminding us, *Natura non facit saltum.*

We will take, for instance, one of his own examples, — the commencement of vision, or the rudimentary formation of an eye. If such a rudiment could see at all, — and it must see well enough to give its possessor a decided advantage in the struggle for life, — then its formation was a step of transcendent magnitude; for there is all the difference in the world between *seeing*, however imperfectly, and *not seeing at all.* And as the theory will not allow any variations to be transmitted and preserved but those which are immediately and directly useful in the competition for the ground, the way could not have been prepared, through millions of years, for the formation of an eye which could see, by accumulating variations on an eye which could not see. From a creature, then, which had not even an infinitesimal rudiment of an optic nerve, there must

have been a sudden jump to another having an entirely new sense.

In respect to the variability of species, there is another Latin adage, borrowed with a little change from the law, which, as we believe, rests on as good a foundation of fact as the one which our author is so fond of quoting, — *De minimis non curat Natura.* Variations, if slight, do not injure or improve the animal's chance of life, are seldom transmitted by inheritance, and so cannot act by accumulation, and cannot, therefore, affect permanency of type. Take, for instance, the various breeds of pigeons, of which this book gives an amusing account. They, indeed, have long been domesticated; but if they were turned loose, it is difficult to imagine how far their chance of escaping the unlucky accidents of a feral condition would be affected, either by the erect position of their tail-feathers, or by reversed feathers on their necks, or by trumpeting instead of cooing, or by a ludicrous habit of tumbling in the air head over heels once or twice in the course of every flight. And even these peculiarities, trifling as they now appear in reference to the animal's chance of life, are complex according to the Darwinian theory; that is, they are the accumulated result of variations which probably did not affect the position of more than one feather at a time.

On the other hand, variations, if great, either die out by sterility as monsters, or are rapidly effaced by crossing the breed. According to this theory, sterility is only a relative or proportionate effect of hybridism, since the distinction between species and varieties exists not in kind, but only in degree. Therefore, while hybrids, produced by crossing species, are almost invariably sterile, mongrels, produced by crossing varieties, only tend to sterility. "Mongrel offspring are very generally, but not quite universally, fertile." Now this tendency to sterility, which must be distinctly appreciable when the difference between the parent varieties is great, must diminish the chance of the mongrels in the struggle for life much more rapidly than the variations themselves, from which the sterility springs, can increase it. So also, as has been before observed, the very act of crossing the varieties tends, by splitting the difference, to diminish the distance between them; in

other words, the offspring will bear a closer resemblance to either parent, than the parents do to each other. Under domestication, indeed, the varieties will be kept apart; but in the wild state, Nature has no means of preventing them from pairing. They will interbreed if not prevented, and will thereby kill out, instead of multiplying, their variations. Here, perhaps, we perceive the reason of a fact observed by Dr. Hooker, that the varieties are chiefly found on the outskirts of the area tenanted by the species to which they belong. Only those varieties are preserved which chance to spring up in localities less exposed to the influences that would bring them back by reversion.

Perhaps it was not to be expected, in this preliminary work, which is avowedly a mere abstract of a more detailed and elaborate publication, that Mr. Darwin should consider at length the application of his theory to extreme cases, like that of the origin of man, which present the greatest difficulty. Some reticence even of allusion to this branch of his subject leads us to suspect that the author was unwilling to create alarm or shock prejudices in a mere preparatory sketch, the brevity of which would necessarily exclude most of the evidence or arguments that would show the alarm to be unfounded. It would therefore be hardly fair to comment at length upon a portion of the matter in controversy, in respect to which, as the lawyers would say, the plaintiff has not yet presented his case. Still we are not to forget, that the theory, if accepted at all, must be accepted as a whole, that it must explain all the phenomena or none, and hence that Mr. Darwin is bound to account for the origin of the human species just as much as for that of the lowest insect. He confesses as much, when he says that, after the general reception of his system, "psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation"; and that "light will be thrown on the origin of man and his history." He is bound, therefore, to find the means of bridging over, by imperceptibly fine gradations, the immense gap which now separates man from the animals most nearly allied to him, — a gap not only between the two structural forms, which, however unlike, may still be affirmed to be of the same kind, but between reason and instinct, where nearly all psy-

chologists are agreed that the difference is in kind, and not in degree. Here surely, as we remarked in the outset, it is the student of physical science who, instead of protesting against intrusion by others, is himself intruding upon psychological and metaphysical ground, and aiming to break up the previously well-established division of the sciences.

This objection to the development theory, moreover, is immeasurably increased when we consider that all the evidence thus far obtained goes to show that man is a very late comer upon the earth, and consequently, that the interval of time, within which far the broadest chasm which we have to contemplate in zoölogy is to be filled up by innumerable transitional forms, is certainly the shortest which geology has revealed. Notwithstanding the very questionable evidence recently obtained by the discovery of some flint knives and arrow-heads in localities where their presence is difficult to be accounted for, he must be a bold geologist who would carry back the duration of the human race on the earth far beyond what is called the historic period, much less as far back as the very latest stage of the Tertiary formation. The few fossil monkeys that have been discovered are not so near approximations to the human structure as several anthropoid species that are still living. Within the comparatively brief epoch to which we are here confined, how can man have been developed, by the indefinitely slow process of variation and selection, out of a monkey, and where are the countless extinct types that should mark the steps of his progress? How many varieties must have existed as strict transitional forms to fill up this broad gap, to say nothing of the greater — infinitely greater — number of variations which were not improvements, but which must also have appeared and died out under a liability to change having no direction or purpose but that of chance! Geology can find no traces of them. The latest chapter of the Stone Book, which is far the best preserved, and which ought to be nearly filled with variations upon this single theme, does not record a single form intermediate between man and the chimpanzee.

The only answer which Mr. Darwin is wont to make to objections of this class, "that the geological record is far more imperfect than most geologists believe," though less applicable

to this particular case than to any other, because the period in question is so recent and its history is so well known, still deserves comment, for it is an instructive specimen of the kind of reasoning with which such speculatists as Mr. Darwin are satisfied. Their mode of argument seems to be, to admit any evidence from paleontology *in favor* of any theory or speculation, but to deny the competency of the same science to bear testimony *against* it. Geology is a witness that will not submit to be cross-examined; the record admits only affirmative proof. If asked to account for any chasm or inconsistency in the narrative, the witness will only answer, as Majocchi did at the trial of Queen Caroline, — *Non mi ricordo;* "The geological record is imperfect." To a certain extent, we are willing to admit the validity of this excuse. The record *is* imperfect, though not to so great a degree as Mr. Darwin, for the sake of preserving his theory, would fain have us believe. For no geological reason whatever, but only to support the foregone conclusion that this theory respecting the origin of species is true, he maintains that "successive formations are separated from each other by enormous blank intervals of time," and that, before the lowest Silurian bed was deposited, there was a period longer than the whole interval from the Silurian age to the present day, during which the world swarmed with living creatures, though not a trace of them now remains. We submit, moreover, as a reasonable principle in the law of evidence, that this unwillingness of the geological witness to be cross-examined, or his incapacity to bear negative evidence, ought to detract largely from the weight of his positive testimony. If his memory is so imperfect that he cannot explain deficiencies or reconcile inconsistencies in his story, what he does say ought to go for little or nothing.

We have no space left to consider the probability of the development of instinct into human reason. We can only advert very briefly to a large class of facts which tend to prove that what Mr. Darwin would call "variations" in mind, or strongly marked peculiarities of intellect or character, are very seldom transmitted by inheritance at all, and can never be traced beyond the second or third generation. Genius is the least heritable of all qualities. We might parody the lines of our great poet so far as to say,

"*Sons* of great men oft remind us
They *can't* make their lives sublime."

Great polyglots, such as Rossi and Mezzofanti, (who, indeed, as priests, were bound to celibacy,) great arithmeticians, like Jedediah Buxton or Zerah Colburn, have left no children who inherited their peculiar talent. No great poet, we believe, was ever the son or the father of a poet. Even marked peculiarities of vision, which are partly structural and partly mental in origin, are seldom continued by descent, and never beyond two or three generations. Myopy or near-sightedness, which is often congenital, and color-blindness, which is always so, seem to appear and disappear with little or no dependence on hereditary causation. Now if variations are not hereditary in the case of human reason, which is the most flexible of all endowments, the history and phenomena of which are the best known, and which is the characteristic attribute of what Mr. Darwin calls a "dominant" species, — that is, one which has a wide range and is very broadly diffused, — there is surely little reason to expect that they are inherited in the case of instinct, which is opposed to reason in every one of these particulars.

After all, for the defence of the great truths of philosophy and natural theology, it is hardly necessary to spend much time in the refutation of such fanciful theories of cosmogony as this by Mr. Darwin. A proper view of the nature of causation, a clear recognition of the great truth that the natural no less than the supernatural, the continuance no less than the creation of existence, the origin of an individual as well as the origin of a species or a genus, can be explained only by the direct action of an intelligent creative cause, — places the vital doctrine of the being and the providence of a God on ground that can never be shaken. We gladly borrow from Mr. Darwin the quotation from Bishop Butler which he has affixed as a motto to the second edition of his work: "The only distinct meaning of the word 'natural' is *stated*, *fixed*, or *settled;* since what is natural as much requires and presupposes an intelligent mind to render it so, — that is, to effect it continually or at stated times, — as what is supernatural does to effect it for once." It is only for the advocate of Revealed Religion, drawing his premises alike from the history of the human race

and the fully established conclusions of physical science, to vindicate the additional truth, that the Divine action has not been limited to "the natural," — that is, to the stated repetition of uniform events, — but has extended to "the supernatural," or to a break in the regularity of the succession, whenever some great purpose could thereby be more directly attained. It is both unphilosophical and presumptuous for the finite to undertake to set bounds to the infinite by declaring *a priori*, that either of these modes of action has any more claim to be considered as necessary than the other.

In one respect, indeed, this speculation respecting the origin of species is more unfavorable than most other schemes of cosmogony to the doctrine that the Deity acts through secondary causes alone, having thereby set in motion a mechanical universe, which ever afterwards continues and repeats itself. The necessary consequence of such a doctrine is the absolute universality of natural law, or the entire exclusion of the contingent, the variable, or the unprecedented from the scheme of creation. But we are not obliged to go far towards the limits of the universe or towards the boundaries of human knowledge, in order to find large classes of phenomena which show no traces of mechanical repetition or adherence to a fixed pattern, in respect to which science has made no progress and can hope for no progress, for the only *law* which they exhibit is that of boundless variety and unceasing change. We allude to the external differences, marked and obvious in character, which enable us to distinguish different individuals of the same race, different offspring of the same parents, and different members performing the same function in one organism. No two human faces, no two leaves of the same tree or bush, no two whelps of the same litter, no two roses on the same stalk, are exactly alike, or are in any danger of being confounded even by the careless observer. Now these countless differences which distinguish all living forms from each other, and which are left unstudied by the physical inquirer solely because they are countless and wholly irregular, and so flatly refuse to submit themselves to order, system, or mechanism, are yet just as much a part of creation — a part, so to speak, of the Divine plan — as the general laws themselves which

underlie them, and which alone come within the scope and power of human science. Admitting, for the nonce, that law and order can be ascribed to the blind action of secondary or mechanical causes, these endless diversities still remain inexplicable except upon the supposition of the constant action of a free personal cause.

Now the tendency of Mr. Darwin's theory, or rather of the facts upon which it is founded, is to enlarge the domain of what is thus, in one sense, arbitrary and contingent, or dependent on free volition, in nature, and to limit the action of secondary causes to a comparatively subordinate part in the economy of the universe. Our author denies that the same physical antecedents are always followed by the same consequents; he affirms that irregular and unexpected variations are perpetually interrupting the chain of orderly succession, and compelling us to seek for a cause *ab extra*, or out of the phenomena themselves, — a free, or, as he would call it, a capricious cause, to account for the aberrant results. While seeking with so much zeal to disprove the necessity of any fresh exertion of creative power to explain the origin of a new species, he traces back that origin to countless "variations," departures from law, divergences from type, every one of which, on his own principles, is just as much an act of creation as the primary calling forth of light out of darkness. Variations of this sort, not mechanical, but contingent, — not resulting necessarily from the old order of things, but arbitrarily engrafted upon it, — not pointing backward in an endless cycle, but forward to a continued progress and improvement, — have been taking place ever since the first appearance of life upon the earth, and are even now constantly occurring around us. Thus indeed, — to adopt the doctrine propounded in another of the mottoes affixed to this book, though not, we fear, in the sense in which either its author or Mr. Darwin understood it, — thus, indeed, "we can perceive that events are brought about, not by *insulated* interpositions of Divine power," but by exertions of it so frequent and beneficent, that we come to regard them as the ordinary action of Him who laid the foundations of the earth, and without whom not a sparrow falleth to the ground.