

fossils have been found; but Miocene lignites are abundant in Italy. At Sarzanello in Piedmont, six and a half feet of Miocene coal occurs. This is used in the Sardinian steam-navy. At Castiani, in the Maremma, good lignite, three feet four inches thick, is worked; and at Monte Bamboli, also in Tuscany, one bed four feet two inches, and another two feet thick, have long been in use.—[Abstract of paper by W. P. Jervis, Esq.]

REVIEWS.

8 p. of review

On the Origin of Species by Means of Natural Selection; or the Preservation of Favoured Species in the Struggle for Life. By CHARLES DARWIN, M.A. London: John Murray. 1860.

We could scarcely let this year pass away without some notice of a book which at least will make 1860 remarkable in the annals of natural history science. Whatever opinion may be entertained of the speculations on the origin of species sketched out by Mr. Darwin in his introductory work to the fuller and more explicit one he announces for some future day, there is no doubt that in its entirety his theory is one which for many years to come must receive the earnest attention of the scientific world; for whether the law of the necessity of organic variation and development as dependant on external circumstances attendant on the general "struggle for life" be universal in application or not, Mr. Darwin has at any rate opened out a new vein of reflection and investigation which must be followed out until the new theory be either disproved or proved from its first causes to its final results.

Nor must we be prevented from the true examination of its value and merit by any previous prejudices, nor deterred by the objections and abuse of those who are ever ready to attack new opinions on the old and ridiculous grounds of a real or pretended dread of an antagonism to Holy Scripture, as if the Word was not based on the sure foundations of truth. "I must express my detestation of the theory," says one opponent, "because of its unflinching materialism; because it denotes the demoralized understandings of its advocates. Look, too, at their credulity. Why Darwin actually believes that a white bear, by being confined to the slops of the Polar Sea might be turned into a whale; that a lemur might be turned into a bat; that a three-toed tapir might be the great-grandfather of a horse; or the progeny of an ass may have gone back to a buffalo." Such, however, are mere verbiages, baseless assertions, unwarranted attributions of irreligion and gross ironical misrepresentations of an author's writings, too transparent not to be seen through by the well-versed student of Nature. There is, however, a speciousness of appearance in the positiveness of diction of this style of attack which misleads the unreflecting as the flame allures unwary moths, and which often causes such inflated pomposities to be mistaken for acknowledged facts. Time was, and not so long since, either, when fossils were enigmas even to the learned; when thoughtful and sapient men discussed with heat of temper and with angry tones whether such organic remains of past creations embedded in the soil were

really shells, and bones, and plants, or whether they were plastic forms modelled in the dark recesses of the ground. Even now a-days some literary adventurers and crack-brained sages—and we are sorry to say, some men, too, of better note but mistaken views—now and then attempt to palm off this long ago exploded whim under a specious guise upon an intelligent world. The danger from such productions is small, and few indeed of those worth caring for would think a fossil bone or shell aught else than the treasured fragment of some ancient living being.

More dangerous, however, are the wilful pervertors who argue with a specious show of knowledge; and such detractors Darwin's theory, like every other, is sure to bring forward against itself. "Species have been constant," says one, "ever since they first existed; change the conditions, and the old species would disappear. New species would come in and flourish. But how? by what causation? By *creation*. What is meant by creation? The operation of a power quite beyond the power of a pigeon-fancier, a cross-breeder, or a hybridizer, in which one can believe by the legitimate conclusion of sound reason drawn from the laws and harmonies of nature, and, believing, can have no difficulty in the repetition of new species."

Dickens, in one of his novels, very shrewdly remarks that the advice given to street-boys about to fight "to go in and win" is very excellent if they only knew how to follow it; and when one naturally asks how new species which geology shows us appearing from time to time *first* began, the answer, by *creation* is as easy to give and about as useless as the advice offered to the street-boys. It is, after all, a mere assertion, an evasion of the question, a cloak for ignorance. We see different races from time to time leaving their relics entombed in the solid rocks of the earth, we see the remains, however, only of the *perished* race; we have no proof, no trace, no evidence whatever in those great entombments of the origin or *first* appearance of the *progenitors* of those races. Those races might have sprung from single pairs, or the primitive individuals might have been *created* in hundreds. Few, we think, would incline to the opinion of the direct creation of hundreds of the like animals or plants at one time; but if, on the other hand, we incline to the *direct creation* of a single pair, we must admit that that pair must have been created ages before its race could be useful or necessary on the face of the earth; must have been created in fact in advance of those changes of physical conditions of our planet, which all admit to have been brought about in the lapse of time by natural operations, in order to provide for the necessary propagation of their descendants in sufficient numbers at the period when they should *usefully* abound. We should incline to think that a theory which proposed to view the development of the required races or species as concurrent with the physical changes rendering necessary their presence,—and as consequently necessarily developed by natural laws, like we see everywhere else around us so wisely and immutably pre-ordained, apparently from the beginning of all things, by the Almighty Designer,—would be preferable to the idea of direct creations, and affording a more reasonable reply than the mere assertions of the miraculous agency with which our query is so commonly met.

But "the assumption of the *direct creation* of species is an hypothesis," says another, "which does not suspend or interrupt any established law of nature. It does not suppose the introduction of new phenomena unaccounted for by the operation of any known law; and it appears to be a power *above* established laws, and yet acting in conformity with them." It may be due to the astuteness of our intellect, but we cannot see how a power can be *above* and not be necessarily *antagonistic* to established laws, and consequently how it can be possible for such a power to be in conformity with such established laws.

"The pretended physic and philosophy of modern days," says a third,

"strips man of all his moral attributes, and holds as of no account his origin and place in the created world. A cold atheistical materialism pervades the sentiments of modern philosophy. The new doctrine is untrue and mischievous. It is opposed to the obvious course of nature, and the very opposite of inductive truth."

Why should it be considered atheistical to believe the laws of the Great Perfection to be *perfect*. The inscrutable Eternal cannot err; why then should His laws be so defective and imperfect as to require repeated efforts of creative energy? Is this world like an old watch so much out of order as to require continual oilings and repeated repairs? Why, too, should it be objectionable to consider the laws He has given to nature as worthily and incessantly subservient to His will? Or why should it be thought irreligious to believe the Maker of all things in His *first* designs should have foreseen the necessity of future modifications to future altered conditions, and have provided accordingly in His *first type-plans* for their future illimitable adaptations to the ever-changing scenes presented in the progress of our earth's ever-altering conditions? Why, indeed, may we not look around us and believe in the universal bowing of all nature hourly, daily, unceasingly to the unerring laws and sustaining power of God? Why should we not see in every change His presence and His will? Why should the high position of man be brought in on all occasions in our natural history researches when we do not at present know of any link which binds him to the brute creation?

If these remarks on our part seem strong, let it however be known that we are not professedly defending Mr. Darwin's doctrines, but attempting to pourtray as forcibly as we can the unjustness and uncharitableness of such attacks upon a new and well-studied theory. Let a new doctrine be always well and impartially examined, and justly accepted or rejected according to our honest opinions of its merits or failings. Mr. Darwin's theory briefly resolves itself into this.

First.—*There is a natural struggle for existence.*—"Look," he says, "at a plant in the midst of its range; why does it not double or quadruple its numbers? We know that it can perfectly well withstand a little more heat or cold, dampness or dryness, for else it ranges into slightly hotter or colder, damper or drier districts. In this case we can clearly see that if we wished in imagination to give the plant the power of increasing its number, we should give it some advantage over its competitors, or over the animals which preyed on it. On the confines of its geographical range, a change of constitution with respect to climate would clearly be an advantage to the plant: but we have reason to believe that only a few plants or animals range so far that they are destroyed by the rigour of the climate alone. Not until we reach the extreme confines of life in the Arctic regions or on the borders of an utter desert will competition cease. The land may be extremely cold or dry, yet there will be competition between some species, or between the individuals of the same species, for the warmest or dampest spots. Hence, also, we can see that when a plant or animal is placed in a new country, among new competitors, though the climate may be exactly the same as in its former home, yet the conditions of its life will gradually be changed in an essential manner. If we wished to increase its average numbers in its new home, we should have to modify it in a different way to what we should have done in its native country; for we should have to give it some advantage over a different set of competitors or enemies. It is good thus to try in our imagination to give any form some advantage over another. Probably in no single instance should we know what to do so as to succeed. It will convince us of our ignorance on the mutual relations of all organic beings; a conviction as necessary as it seems difficult to acquire. All that we can do is to keep steadily in mind that each organic being is striving to increase at a geometrical ratio; that at some period of its life, during some

season of the year, during each generation or at intervals it has to struggle for life, and to suffer great destruction. When we reflect on this struggle we may console ourselves with the full belief, that the war of nature is not incessant—that no fear is felt—that death is generally prompt,—and that the vigorous, the healthy and the happy, survive and multiply.

Secondly,—There is in nature a principle of natural selection.—“How will the struggle for existence,” says Mr. Darwin, “discussed too briefly in the last chapter, act with regard to variation? Can the principles of selection, which we have seen so potent in the hands of man, apply in nature? I think that we shall see that it can most effectually. Let it be borne in mind in what endless number of strange peculiarities our domestic productions, and in a lesser degree, those under nature vary; and how strong the hereditary tendency is. Under domestication, it may be truly said that the whole organization becomes in some degree plastic. Let it be borne in mind how infinitely complex and close-fitting are the mutual relations of all organic beings to each other and to their physical conditions of life. Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred that other variations useful in some way to each being in the great and complex battle of life should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive), that individuals having advantages however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable variations and the rejection of injurious variations I call natural selection. Variations neither useful nor injurious would not be affected by natural selection and would be left a fluctuating element, as perhaps we see in the species called polymorphic. We shall best understand the probable course of natural selection by taking the case of a country undergoing some physical change, for instance, of climate. The proportional numbers of its inhabitants would almost immediately undergo a change, and some species might become extinct. We may conclude from what we have seen of the intimate and complex manner in which the inhabitants of each country are bound together, that any change in the numerical proportions of some of the inhabitants, independently of the change of climate itself, would seriously affect the others. If the country were open at its borders, new forms would certainly immigrate, and this also would seriously disturb the relations of some of the former inhabitants. Let it be remembered how powerful the influence of a single introduced tree or mammal has been shewn to be. But in the case of an island, or of a country partly surrounded by barriers, into which new and better adapted forms could not freely enter, we should then have places in the economy of nature which would decidedly be better filled up, if some of the original inhabitants were in some manner modified; and had the area been open to immigration, these same places would have been seized on by intruders. In such case, every slight modification, which, in the course of ages chanced to arise, and which in any way favoured the individuals of any species, by better adapting them to their altered conditions, would tend to be preserved, and natural selection would thus have free scope for the work of improvement. We have reason to believe, that a change in the conditions of life by specially acting on the reproductive system, causes or increases variability; and in the foregoing case the conditions of life are supposed to have undergone a change and this would manifestly be favourable to natural selection, by giving a better chance of profitable variations occurring, and unless profitable variations do occur, natural selection can do nothing. Not that, as I believe, any extreme amount of variability is necessary; as man can certainly produce great results by adding up in any given direction mere individual differences—so could

nature, but far more easily, from having incomparably longer time at her disposal. Nor do I believe that any great physical change, as of climate or of any unusual degree of isolation to check immigration, is actually necessary to produce new and unoccupied places for natural selection to fill up by modifying and improving some of the varying inhabitants. For as all the inhabitants of each country are struggling together with nicely balanced forces, extremely slight modifications in the structure and habits of one inhabitant would often give it an advantage over others; and still further modifications of the same kind would often still further increase the advantage. No country can be named in which all the natural inhabitants are now so perfectly adapted to each other, and to the physical conditions under which they live that none of them could any how be improved; for in all countries the natives have been so far conquered by naturalized productions, that they have allowed foreigners to take firm possession of the land. And as foreigners have thus everywhere beaten some of the natives, we may safely conclude that the natives might have been modified with some advantage, so as to have better resisted such intruders. As man can produce, and certainly has produced, a great result by his methodical and unconscious means of selection, what may not nature effect? Man can act only on external and visible characters; nature cares nothing for appearances, except in so far as they are useful to any being. She can act on every internal organ—on every shade of constitutional difference—on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. Every selected character is fully exercised by her: and the being placed under well-suited conditions of life. Man keeps the natives of many climates in the same country; he seldom exercises each selected character in some peculiar and fitting manner; he feeds a long- and short-backed pigeon on the same food; he does not exercise a long-backed, or a long-legged quadruped in any peculiar manner; he exposes sheep with long- and short-wool to the same climate. He does not allow the most vigorous males to struggle for the females. He does not destroy all inferior animals, but protects during each varying season, as far as lies in his power all his productions. He often begins his selection with some half-monstrous form; or at least by some modification prominent enough to catch his eye, or to be plain and useful to him. Under nature the slightest difference of structure, or constitution, may well turn the nicely-balanced scale in the struggle for life, and so be preserved. How fleeting are the wishes and efforts of man! how short his time! and, consequently, how poor his products will be compared with those accumulated by nature during whole geological periods! Can we wonder, then, that nature's productions should be far "truer" in character than man's productions—that they should be infinitely better adapted to the most complex conditions of life, and should plainly bear the stamp of far higher workmanship? It may be metaphorically said that natural selection is daily, hourly scrutinizing throughout the world every variation, even the slightest; rejecting that which is bad, preserving that which is good; silently and invisibly 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 lapse of ages, and then so imperfect is our view into long past geological ages, that we only see forms of life are now different from what they formerly were. * * * Slow though the process of selection may be, if feeble man can do much by his powers of artificial selection, I can see no limit to the amount of change, to the beauty and infinite complexity of the co-adaptations between all organic beings, one with another, and with their physical conditions of life, which may be effected in the long course of time by nature's power of selection.

The evident modifications of primitive type-plans, which indisputably we see

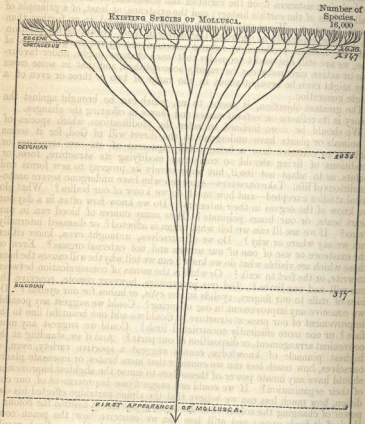
in past and present forms of life, are undoubtedly the strongest arguments in favour of Darwin's theory of progressive development by natural selection. But as geology alone must be the sole source of knowledge for testing or learning the effects of great periods of time in the gradual transmutation of species, so will our efforts be resultant of efficient proof only in proportion to the perfection or imperfection of the geological record. This record Darwin justly says is defective. No doubt, it is; no doubt there are great gaps in the earth's past history of which no trace remains—and many, and far more numerous gaps which scientific investigations have not yet filled up. Still, we may hope to find, and by patience and research no doubt we ultimately shall mark out, the great points in the picture around which the details may reliably be filled in by correctly drawn inferences. If we tabulate the number of known species of any particular class of animals or plants, we find the numbers invariably in the aggregate ranging higher until we attain a maximum in the present creation, notwithstanding there are occasional deficiencies of individual genera between certain geological formations which shows that we have not yet a perfect knowledge of all the forms living during those eras in which such deficiencies occur. Such results, however, are important in their bearing on the doctrine of the natural development of species. Taking for example the totals of known mollusca, we commence in the Silurian period with 317, and close in the recent with 16,000. It follows, then, that if in the pre-Silurian age life began on our planet with the same number of definite type-plans, such as the globular, the radiate, soft-bodied, the vertebrate, &c., which we see so prominently defined in the existing races; and taking the mollusca, for example, of that pre-Silurian period at unity, or as the first commencement of their special or direct creation; and regarding such special or direct creations as the miraculous interference of the Deity, then we have as a result an ever increasing ratio of miraculous interferences, and we must also regard creative energy as sixteen thousand times more active in our time than in the pre-Silurian period. A condition of things few of us would be inclined to admit. On the other hand, this natural radiation of numbers—let us put it down by a diverging figure (*see woodcut, p. 470*) each line of which is representative of hundreds—is so representative of the natural radiation of life-forms by the splitting up of species by natural variations into new species,—one species first naturally divided into two species, these two into four, these four into eight, and so on, as would naturally result by the operation of natural laws carrying on gradually and incessantly the transmutation and subdivision of old into new species,—as to incline the mind at first sight to faith in the past operations of such natural laws in the production of the very numerous species now living around us.

The proportions of the level lines indicating the horizons of the various periods which the tree of increase of species does not cover, represents, of course, also the successively available spaces for the geographical spread of the species existant at those dates, for the earth's surface cannot exceed a definite limited area, the maximum of which may be considered to be represented by the border lines of the diagram.

The struggle for existence by the multiplied species seems thus to be continuously increased by a continuous and rapid decrease of available terrestrial space by the ever increasing sub-division and restriction of the geographical area.

It should also be borne in mind that the diagram shows only the increase of specific forms of one class of the animal kingdom—the mollusca. Taking these as having increased from unity to sixteen thousand; and taking the increase of all the other classes—the Radiata, Crustacea and Insects, the Vertebrates terrestrial, aerial, or aquatic, &c.,—as equal only to this sum in the aggregate of their similar specific increase, we have for the animal kingdom an assumed total of

thirty-two thousand. Taking the like sum as representative of a similar increase of species in the vegetable kingdom; and we obtain then, as a final result, the conclusion that the creative action as exerted in the direct creation of species, commencing in the pre-Silurian period at unity, has been successively and continuously intensified ever since, until now it has obtained an intensity sixty-four



Diagrammatic View of the Actual Increase of Species of Mollusca, illustrating the increasing intensities of creative action at the periods stated, if the theory of the direct creations of species be admitted.

[Each line of the Tree of Numerical Increase of Specific Forms represents 100 species.]

thousand times greater than when it commenced; or upwards of twenty-one thousand times greater than it was at that point in past time—the Silurian era—to which we can trace back the records of its action.

The radiata, the vertebrata, or any other class, exhibit the like results with the mollusca, confirming the impression of the prolificness of existing species as due to the natural sub-division by natural transmutating

eternal and ever enduring force the vast clouds of vapours that have in the roll of ages collapsed into the myriads of worlds and suns that swarm in the heavens above and around us—of which we can neither see the limits nor conceive the expanse—but which may yet be the smallest and least wonderful of all the myriads of world-clusters with which the same great Creator has star-dusted His course through the realms of boundless and interminable space.

Reynolds' Geological Atlas of Great Britain. London: James Reynolds, 174, Strand.

This is a series of thirty-three small quarto maps folded and bound into an ordinary octavo book—a very convenient and useful size. These maps are very neatly and cleanly executed; and on them the principal roads and railways, both those constructed and those constructing, are laid down, and the geological features intelligibly and neatly coloured in, but not always quite so carefully as to areas as ought to pass out to the world under the authority of Professor Morris, whose assistance the editor acknowledges. The maps, however, offering a really good foundation for every essential detail, there is no reason why, under the direction of so able a geologist, all such errors should not be instantly corrected before the issue is made to the public. For example, in our copy the district from Hythe to Folkestone is coloured in as Upper Greensand and Gault, instead of as Lower Greensand, as every geologist knows it is from the memorable paper of Dr. Fitton "On the Strata below the Chalk," and which work is quoted as one of the authorities on which the geological information of the present series is based. Again, the tongue of land outside the river Stour, in front of Sandwich, and between Deal and Pegwell Bay is coloured down as Chalk, while every antiquary, and we thought everybody else, knew that tract was open water to the old Roman port of Richborough, and formed the mouth of the estuary which, passing between the Isle of Thanet and the mainland, was up to mediæval times, indeed, used as a passage by ships voyaging to London.

This map was sent to us in time for review last month; but Mr. Reynolds having found out some errors in his map of Scotland, requested us to withhold our criticism until that map had been amended, which has now been done. As far, however, as the execution of the maps, and the size, style, and small cost of the work are concerned, Mr. Reynolds has done well his duty as publisher; and if he will pass his maps under the careful inspection of his friend Professor Morris, we have no doubt that the atlas will be relieved of such slight blemishes as those which have caught our scrutinizing eye, and be justly entitled to a general favoritism with students and travellers, as well as for use in schools.

We sincerely wish success to all such efforts, but we are nevertheless bound to look for defects in all new publications of this class, as in their general accuracy consists their chief value; we desire at the same time to give honest criticisms, both for the guidance of those of our readers who rely on our judgment, and for the just encouragement of producers, an encouragement we are the more pleased to give when we see a desire manifested, as in the present case, to attain correctness, by retaining the services of gentlemen who, by their knowledge and talent, are able to secure it.

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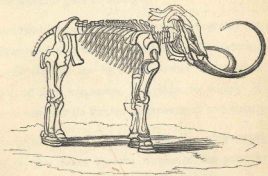
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