

SCIENCE.

IT has been long known to the friends of Mr. Darwin, that he had arrived at a mode of accounting for the diversity of the specific forms of organic life, as well past as present, which differed alike from the doctrine of Lamarck, (who made transmutation to depend mainly upon the efforts of the animal), and from the hypothesis of the author of the "Vestiges" (who found the solution of the problem in the idea of consecutive development). And it was not a little curious that about eighteen months since, Mr. Wallace, a gentleman engaged in studying the natural history of the Malay Archipelago, should have sent to Sir Charles Lyell, a memoir "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection," based on a principle identical with that at which Mr. Darwin had arrived some years previously. This has led the friends of Mr. Darwin, who knew that he has long had in preparation a large work on the subject, the completion of which will probably occupy him for two or three years, to urge him to bring his views before the public without further delay; and he has accordingly prepared what must be regarded as an abstract¹ of his larger treatise, containing a general exposition of his principles, but without either following them out into the details of their application, or doing more than indicate the nature of the evidence on which they are based. Mr. Darwin's mode of looking at the question is one which, if correct, will exert a most important influence on the future progress of natural history; and the appearance of this book will, perhaps, be felt hereafter to mark an era in the history of the science, analogous to that which has been established in geology by the "Principles" of Sir C. Lyell. The leading idea of the one as of the other is, that we need not go in search of any other causes than those which are at present in action, for an explanation of the phenomena exhibited to us in the present distribution and past succession of life upon the globe; a principle of change being still at work, the continuous operation of which, through the countless ages of geological time, is sufficient to account for the production, from a small number of original types, of a vast multiplicity of diversified forms, succeeding one another by natural descent, and undergoing progressive changes in accordance with the alterations progressively taking place in the external conditions of their existence. Of this principle, which is common to Mr. Darwin and Mr. Wallace (whose Memoir is published in the Proceedings of the Linnæan Society for July 1, 1858), we shall now give a concise account; following it, as far as our space permits, into the more extended development that has been given to it by the author of the treatise before us.

The origination and perpetuation of diversified breeds of our domes-

¹ "The Origin of Species by means of Natural Selection; or, the Preservation of the Favoured Races in the Struggle for Life." By Charles Darwin, M.A., F.R.S., &c. London. 1859. Post 8vo, pp. 502.

ticated species, depends upon the occasional occurrence of spontaneous departures from their ordinary type of conformation, the causation of which must be looked for in antecedents modifying the constitution of the parents, and operating especially on the reproductive function. Of these departures, if they are of a character which he considers to be useful to him, Man takes advantage; and by keeping apart the animals which present them, and causing these to breed with each other, he is able to procure their transmission through successive generations—modifying the form of the race, it may be, to one still more to his liking, by intercrossing it with some previous type. In this way it has been that so many new breeds of domesticated quadrupeds and birds have sprung up within the last century; and to the same process of *artificial selection* we are probably to attribute the origination of their ancestral forms from the wild species which were their remote progenitors. The new breeds thus produced sometimes (as in the case of the pigeon) differ so widely from their primordial stock, and from each other, that if their history were not known, they would rank not merely as distinct species, but even as belonging to several different genera. The breeds thus established, however, might not hold their ground if they were to return to their feral state; the general tendency being, for peculiarities such as they exhibit, to merge into the ordinary type, when free intermixture is permitted. But this, according to Mr. Darwin and Mr. Wallace, is only because these peculiarities are not of such a kind as would be useful to the animals in that struggle for existence which they have continually to maintain in a state of nature; this struggle being the necessary result of the fact, that the number of animals which arrive at maturity is many times exceeded by that of the animals which come into existence; a large proportion in species of ordinary fertility, and an immense preponderance in the most prolific, never reaching the adult condition, or propagating their kind. In this Struggle for Existence, it seems inevitable that those individuals should prevail, whose organization and powers are most in harmony with the conditions in which they are placed; the weaker or abnormally-constituted individuals being eliminated by the destructive agencies to which they will be early subjected. Thus a process of *natural selection* is always going on, whereby the vigour of each race and its adaptation to its conditions of existence are maintained at the highest point of which it is capable, so long as those conditions remain constant; and it is owing to the small amount of change which takes place in them within our limited observation, that specific types acquire that character of permanence which is commonly attributed to them. When, however, the range of the species is such, that it is subjected to a variety of influences as to climate, exposure, food, &c., we find it presenting modifications of form termed *varieties*, which are often as well marked and as regularly transmitted as the specific characters themselves. So if any considerable change should take place in one or more of these conditions, then that variety will gain ground, whose constitution is most in harmony with its new circumstances, whilst others less capable of adaptation will be crowded out; and thus any specific type may be replaced by a form more or less

remote from that of the original, of which it is, nevertheless, the legitimate descendant.

Such natural selection obviously tends to produce *divergence of character* amongst the forms which are thus preserved, and also to extinguish the less improvable and intermediate varieties. And on this principle, Mr. Darwin maintains that the nature of the mutual affinities of organized beings is to be explained. It is, as he justly remarks, "a truly wonderful fact—the wonder of which we are apt to overlook from familiarity—that all animals and all plants throughout all time and space, should be related to each other in group subordinated to group, in the manner which we everywhere behold." And it is not only more accordant with our notions of the philosophy of causation to believe that this subordination of plan, like the adaptation between each species and the conditions of its existence, should be the result of the continuity of one mode of operation through the whole period that has elapsed since life was first introduced into our planet; but it also harmonizes better with our highest ideas of Divine foresight to believe that the scheme of evolution was originally made so perfect as to require no subsequent interference to keep it in order, or to bring its working into accordance with unforeseen contingencies. Though this consideration has been before urged, especially by Professor Baden Powell, yet it derives increased force from the new aspect in which the question is presented by Mr. Darwin; since, instead of endeavouring to account for existing phenomena by a hypothesis, in support of which not a particle of positive evidence can be adduced, he points to a *vera causa* in actual operation, and simply asks for an unlimited period of geological time for its antecedent action. So, again, if the real affinities of all organic beings are due to inheritance or community of descent, we have a satisfactory explanation of the existence of parts so rudimentary as to be of no possible use to the individual: "Nature," as Mr. Darwin remarks, "having taken pains to reveal, by rudimentary organs and by homologous structures, her scheme of modification, which it seems that we wilfully will not understand."

If the idea of progressive variation by a natural selection arising out of the universal conditions of the existence of organized beings, be once admitted, it does not seem possible to set any definite limits to its operation. If what is good as regards varieties be good also as regards species, and if what is good in respect to species be good also in regard to genera, we have only to ask for a greater lapse of time and a greater variation of external conditions, to account for the derivation, not only of new genera but of new families, orders, and even classes, from types of form originally very dissimilar. Mr. Darwin does not hesitate to go even to the extent of claiming a common origin for all organized beings; and, though he freely admits it as a grave objection to such a doctrine, that the study of fossil remains does not afford us such a series of connexions between our existing forms and those of anterior epochs as would be required to complete the genealogical tree, yet he greatly weakens (if he does not altogether remove) the force of this objection, by dwelling on *the extreme incompleteness of the geological record*. He is undoubtedly entitled to urge it as an important fact in

his favour, that where there is continuity of stratification, there we find the greatest continuity in the general type of life; many species passing unchanged through a long succession of formations, and many other types presenting such slight modifications that their hereditary continuity cannot be reasonably questioned. And it is further to be noticed that many fossil types do really fill up wide intervals between existing orders; the existing families of Pachyderms, for example, which seem to have little relation to each other, and still less to the Ruminants, being brought into such close connexion, not merely with one another, but with ruminants, by the multitude of their extinct forms, that all these large herbivorous quadrupeds now in Professor Owen's estimation rank but as a single order.

If we examine into the popular notion of the *permanence of species*, we find that it doubtless has its chief basis on the ordinary cosmogony, and on the short period of time that is commonly supposed to have elapsed since the present order of things came in. But it is now known that we may date back the introduction of many of our existing forms not only to the commencement of the tertiary period, but to the latter part of the secondary. And whilst these have maintained their ground with little change during the long succession of ages that has since elapsed, it cannot be reasonably questioned that other specific forms, originally associated with them, may have undergone progressive modification.

"The chief cause," observes Mr. Darwin, "of our natural unwillingness to admit that one species has given birth to another and distinct species, is that we are always slow in admitting any great change of which we do not see the intermediate steps. The difficulty is the same as that felt by so many geologists, when Lyell first insisted that long lines of inland cliffs had been formed, and great valleys excavated, by the slow action of the coast waves. The mind cannot possibly grasp the full meaning of the term of a hundred million years; it cannot add up and perceive the full effects of many slight variations accumulated during an almost infinite number of generations."

It has been commonly supposed that a fundamental difference exists between varieties and true species, in regard to their *fertility when caused to breed together*. But this test is not only founded upon a very limited induction, but, as Mr. Darwin shows, is so far from yielding results of any tolerable constancy, that the two most careful experimentalists who have applied themselves to this inquiry have come to conclusions diametrically opposed as to the rank which they are led by this test to assign to particular forms. The fact seems rather to be, that the reproductive system is the part of the organism most liable to be influenced in its action by causes which we are not yet able to appreciate; and that as any disturbance in the natural conditions of life tends to produce sterility, so any decided difference in the constitution of the types brought together in the generative act will tend to render its results imperfect (just as it is known to do in the operation of grafting), whether those types rank as species or as varieties.

The influence of Mr. Darwin's views upon the study of natural history, even if they should gain acceptance to only a very limited

extent, must be most important. The moment that systematists give up the notion that species have originated by distinct acts of creation, and that their forms have been permanently transmitted, they will cease to be haunted by the shadowy doubts whether this or that form be in essence a species, or be a mere variety; and the only question with them will be, whether any form be sufficiently constant and distinct from other forms to be capable of definition, and, if definable, whether the differences be sufficiently important to deserve a specific name. Instead of vainly searching for the undiscovered and undiscoverable essence of the term species, they will be led to regard species merely as combinations of individuals that are capable of being grouped together by a common description—in fact, to treat them as those naturalists at present treat genera, who admit that they are merely artificial combinations of species. But if the principle of Modification by Natural Selection should be admitted to anything like the extent to which Mr. Darwin would carry it, then it is obvious that a new set of ideas will be introduced into the other and more general departments of natural history. The terms used by naturalists of affinity, relationship, community of type, paternity, morphology, adaptive characters, rudimentary and aborted organs, &c., will cease to be metaphorical and will have a plain signification. A grand and almost untrodden field of inquiry will be opened, on the causes and laws of variation, on correlation of growth, on the effects of use and disuse, on the direct action of external conditions, and the like. Our classifications will come to be, as far as they can be so made, genealogies; and will then truly give what may be called the plan of creation. Even Psychology will acquire a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. And just as, in the past history of our globe, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving—namely, the production of the higher animals—directly follows, so in Man's future we are encouraged to look to the same principle as tending, on the whole, notwithstanding many apparent pauses and even retrogressions, to the progressive elevation of his nature towards the highest perfection of which created beings are susceptible.

We have thus endeavoured to set before our readers the fundamental ideas contained in the remarkable work before us. On some other occasion we may enter upon a critical examination of them, and attempt to determine the extent to which we are justified by analogy and by inherent probability in carrying the principle of divergent modification by natural selection from the lower or more restricted into the higher or more comprehensive groups of organized beings. At present we shall only point out that the question of the truth of the principle is one altogether distinct from that of the extent of its applicability; and that nothing can be more unfair than to decide upon its validity by the judgment we may form as to Mr. Darwin's inferences from it. He has established so high a claim by his previous works, to a respectful consideration of anything that he may put forth, that we cannot doubt that he will meet this at least on the part of every

reader who may possess sufficient capacity to comprehend his reasoning, and sufficient freedom from prejudice to be able to appreciate it.

Mr. Van Voorst's series of small volumes on the "Outlines of the Natural History of Europe," has received an interesting addition by the publication of a treatise on the Natural History of the European Seas,² which had been commenced by the man of all others most competent to execute it, Professor Edward Forbes, but of which, unfortunately, only a small portion had been actually executed at the time of his lamented death. In that portion, however, the general plan had been traced; and in accordance with the dying request of his friend, Mr. Godwin-Austen has done his best to carry it out, in order that a fragment too valuable to be withheld, and yet too slight to stand by itself, might not be lost to the public. The treatise is essentially one on the Geographical Distribution of Marine Life; its purpose being mainly to show that the European seas are divisible into a number of "provinces," each characterized by a group of forms peculiar to itself, though with these are mingled immigrants from other provinces, which sometimes exceed in number the aboriginal forms. After an Introduction in which the subject is discussed in its general outlines, successive chapters are devoted to the Arctic province, the Boreal province, the Celtic province, the Lusitanian province (with which Professor E. Forbes's portion of the work concludes), the Mediterranean province (treated by Mr. Godwin-Austen with peculiar felicity), the Black Sea, and the Caspian; to which are appended two most interesting chapters "On the Distribution of Marine Animals," and on the "Early History of the European Seas," with a Concluding Summary, and Lists of the species believed to constitute the proper Faunæ of the respective provinces. The whole work is an admirable sample of that improved mode of looking at the phenomena of geographical distribution, in connexion with antecedent geological changes, which Professor E. Forbes probably did more than any other man to introduce; and though some of his views might perhaps have undergone modification if he had lived to become acquainted with the results of subsequent research, yet, as in the case of the work we have last noticed, it is the *method of investigation* indicated, rather than its actual results, which gives to this little book its peculiar value.

A very beautifully illustrated description has appeared of new forms of Turbellaria, Rotatoria, and Annelida, collected by Herr Schmarda in Ceylon, Australia, South America, Central America, the West Indies, and other localities which he visited between 1853 and 1857.³ The admirable representations, however, which he gives of their external

² "The Natural History of the European Seas." By the late Professor Edward Forbes, F.R.S., &c. Edited and continued by Robert Godwin-Austen, F.R.S. London. 1859. Fcap. 8vo, pp. 306.

³ "Neue Wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde, 1853 bis 1857." Von Ludwig K. Schmarda. Erster Band. Turbellarien, Rotatorien, und Anneliden. Erste Hälfte, mit 15 illuminierten Kupfertafeln und Holzschnitten. Leipzig. 1859. 4to, pp. 66.

configuration, are not accompanied by any corresponding elucidation of their anatomical structure; and this omission is to be specially regretted in the case of animals of which so much yet remains to be learned.

From the indefatigable Professor Ehrenberg we have a description of various forms of microscopic life brought by the Brothers Schlagintweit from an altitude of 20,000 feet on the Himalayan Alps.⁴ Amongst these it is interesting to find some new forms of that curious tribe of *Tardigrades*, which, although doubtless aberrant forms of Annelida, agree with certain Wheel-Animalcules in being able to endure complete desiccation; and it is partly, no doubt, in virtue of this tenacity of life, that they are enabled to maintain their existence under circumstances so extremely unfavourable.

We have before us the first six parts of a general description of the Classes and Orders of the Animal Kingdom, by Professor Bronn,⁵ the eminent Palæontologist, which is likely to prove a very useful work. The account of each class and order is based on the latest scientific researches into its structure, and is illustrated by figures taken from approved sources; and the references to the works and memoirs which furnish the best information upon each department are both copious and discriminating. Any of our younger naturalists possessing a good knowledge of German would be doing service to their countrymen by reproducing this work in an English dress; such a summary of the most important results of modern investigations, especially as regards the lower tribes of animals, being just what is most needed at the present time by those who desire to gain a general acquaintance with the animal kingdom before proceeding to the study of any particular department of it. The only work to which it bears any resemblance is the "Animal Kingdom" of Professor Rymer Jones, which is so far behind the present state of science that a reliance on it can only mislead the student who has no other sources of information.

Professor Stein, whose researches on the Infusoria are among the most important of recent contributions to the study of that group, has issued the first part of a systematic treatise upon it,⁶ which contains a much fuller and more critical inquiry into the value of the previous observations of other microscopists, especially Professor Ehrenberg, than is included in the work of MM. Claparède and Lachmann recently noticed by us. These authors have called in question

⁴ "Beitrag zur Bestimmung des stationären mikroskopischen Lebens in bis 20,000 Fuss Alpenhöhe." Von C. G. Ehrenberg. Aus den Abhandlungen der Königl. Akademie der Wissenschaften zu Berlin. 1858. Mit drei Kupfertafeln. 4to. pp. 43.

⁵ "Die Klassen und Ordnungen des Thierreichs wissenschaftlich dargestellt in Wort und Bild." Von Dr. H. G. Bronn, Professor an der Universität Heidelberg. Mit auf Stein gezeichneten Abbildungen. Bände I.—VI. Leipzig und Heidelberg: 1859. 8vo. pp. 176.

⁶ "Der Organismus der Infusionsthier, nach einigen Forschungen in Systematischer Reihenfolge bearbeitet." Von Dr. Friedrich Stein, Professor der Zoologie an der Universität zu Prag. 1. Abtheilung. Allgemeiner Theil und Naturgeschichte der Hypotrichen Infusionsthier. Mit 14 Kupfertafeln. Leipzig. 1859. 4to., pp. 206.

some of the doctrines previously advanced by Professor Stein in regard to the reproduction of Infusoria and the succession of forms presented by the same organism; but there can be no doubt that on which ever side the right may lie, the truth will only be established by free discussion; and we are glad, therefore, that an observer who has devoted much careful attention to the inquiry should publish his results in a form so complete, and thus bring them fairly before the view of the scientific public.

From America we have a continuation of Dr. Lea's great work on the Unionidæ,⁷ which is highly creditable not only to his zeal and industry, but also to his liberality. The work has improved as it has proceeded, both in matter and form; and the part before us may challenge comparison in both respects with any monographs of the day. Dr. Lea has made a great advance in the study of this group, since he has insisted upon the necessity of attending to their soft parts as well as to their shells, and to the early as well as the adult forms of the latter.

Mr. Page has added to the elementary and advanced text-books of Geology, which we have noticed on former occasions, a sort of explanatory Dictionary of Geological Terms, which will doubtless prove very useful not merely to beginners, but also to such as have made considerable progress in the science.⁸ For the nomenclature of Geology is drawn from so many sources, that no one can be expected to possess a familiarity with the import of all the terms which are used in its different departments; thus a palæontologist and a mineralogist may each have made great attainments in his own subject, and yet may know but very little of the other; and a man may have studied the great problems of physical geology, and be familiar with its language, who has very little acquaintance with either palæontology or mineralogy. We have no doubt, therefore, of the existence of a demand for a work like the present; and for a first attempt of the kind, Mr. Page's Handbook deserves credit. We have, however, observed not a few serious defects in it, as well as some mistakes; and we would suggest to him that, when it reaches a new edition, he should endeavour to obtain the assistance of experts in the principal departments of the subject, instead of trusting to his own general knowledge of the whole range of it; and that he should introduce illustrative figures of the great variety of objects of which no short descriptions can possibly convey any adequate idea. A really good Dictionary of Geology by some half-dozen competent writers, with a sufficient number of well-executed illustrations, would be, we are strongly inclined to believe, not merely a most useful but also a profitable work.

At an interval of more than a quarter of a century from the publi-

⁷ "Observations on the Genus *Unio*, together with Descriptions of New Species, their Soft Parts, and Embryonic Forms, in the Family Unionidæ." By Isaac Lea, LL.D., President of the Academy of Natural Sciences of Philadelphia. Vol. VII. Part I. With 12 Plates. Philadelphia. 1859. 4to, pp. 51.

⁸ "Handbook of Geological Terms and Geology." By David Page, F.G.S. Edinburgh. 1859. Post 8vo, pp. 416.

cation of the first volume of the Life of Cullen by Dr. John Thomson, the work has been completed by the publication of the second, but a small part of which, however, is from the same pen.⁹ When prevented by advancing age and infirmity from making use of the large collection of materials which he had brought together for the purpose, Dr. Thomson, some time before his own death, transferred them to his son, Dr. William Thomson, the late Professor of Physic at Glasgow; and some progress had been made in the work by him, when it was again interrupted by the malady which proved fatal to him. Anxious that the labours of his father and his brother should not be left incomplete, Dr. Allen Thomson, the present distinguished Professor of Anatomy in Glasgow, sought the assistance of Dr. Craigie, whose knowledge of the history of medicine, and especially of that period in which Dr. Cullen was one of its most prominent actors, peculiarly qualified him for the task; and this has been at last accomplished, the delay being chiefly due to the *embarras des richesses* arising out of the large accumulations which Dr. Thomson had made, with reference to the Brunonian and other controversies in which Dr. Cullen was engaged, and to the influence of his teachings upon the subsequent progress of Medicine. The long postponement of the appearance of the second volume, which has resulted from the foregoing circumstances, has unfortunately prevented any considerable addition being made to that knowledge of personal details which it had been hoped that it was not too late to obtain from Dr. Cullen's descendants; but the work is one which no well-educated physician should fail to read, for the instruction it affords as to that period of medical history in which the foundation of the science and art as it now exists was unquestionably laid.

HISTORY AND BIOGRAPHY.

HISTORY becomes more local and inquisitive as political and social changes impart an interest to districts comparatively unimportant. The three sister provinces of Livonia, Esthonia, and Courland serve to exemplify this position. In the second decade of our century, Alexander I., says Otto von Rutenberg, in the preface to his history of these provinces,¹ conferred on their serf population the first and holiest of human rights. The abolition of serfage destroyed an incipient patriarchal system. The new and legal order which sup-

⁹ "An Account of the Life, Lectures, and Writings of William Cullen, M.D., Professor of the Practice of Physic in the University of Edinburgh." Commenced by John Thomson, M.D., F.R.S.L. and E., Professor of Medicine and General Pathology; and by William Thomson, M.D., Professor of the Practice of Physic in the University of Glasgow; and concluded by David Craigie, M.D., F.R.S.E., &c. In Two Volumes 8vo. Edinburgh. 1832 and 1859.

¹ "Geschichte der Ostseeprovinzen Liv-Esth-und Kurland von der ältesten Zeit bis zum Untergange ihrer Selbständigkeit." Von Otto Von Rutenberg. London: Williams and Norgate.