NATURE

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STEUDEL'S NOMENCLATOR

ALL working systematic botanists use Steudel's "Nomenclator botanicus seu Synonymia plantarum universalis" as an indispensable book of reference. It is an alphabetical list arranged under genera of published names of plants, giving their native countries and the authors who published their descriptions. Synonyms are as far as possible given under the species to which they belong. The second volume of Steudel's work was published in 1841, and it is probably not far wrong to assume that the existing mass of described plants has since doubled.

Mr. Darwin has with equal kindness and generosity expressed the wish to aid in some way the scientific work carried on at the Royal Gardens, Kew. The attempt has been made for many years to keep up in the herbarium there a copy of Steudel with manuscript additions, for the use of persons engaged in the study of any particular group of flowering plants. By reference to the Kew Steudel it is possible to ascertain to a large extent what has been done, and so avoid the risk of describing and naming the same material twice over. But the Kew Steudel has only hitherto been posted up by the aid of funds privately supplied on intermittent occasions, and is not absolutely complete.

Mr. Darwin having had occasion to appreciate the usefulness of such a work in the botanical investigations which have of late years engaged his attention, has determined to supply the funds for preparing a new edition of Steudel's "Nomenclator," brought up to date. The work, which it is estimated will extend over about six years, will be carried on at Kew, and will be based on the limitations of genera laid down in Bentham and Hooker's "Genera Plantarum," to which it will in fact form a kind of complement. The editorial work has been entrusted to Mr. Daydon Jackson, Secretary of the Linnean Society. Mr. Darwin's munificent aid does not extend beyond supplying the means for preparing the work. The form and manner of publication will be reserved for consideration on its completion.

The Royal Gardens, Kew, have been very fortunate in from time to time receiving sympathetic aid from the outside world on behalf of the various branches of scientific work carried on in connection with them. The gifts of Mr. Bentham's library and herbarium, of the Jodrell Laboratory, of the North Gallery, and now of the means of preparing a new Steudel, are conspicuous examples.

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DARWIN'S NEW WORK.

Laws of Inheritance in the Animal and Vegetable Kingdoms.

THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION. By Charles Darwin, M. A., F. R. S., etc. Authorized edition. In two volumes, 12mo, pp. 496, 506. New York: Orange Judd & Co.

It is known that Mr. Darwin first grappled with the great problem of the origin and variation of organic life during the five years' voyage of the ship Beagle, of the British navy, 1831 to 1836; a voyage first made famous in the scientific world by the publication of his charming "Journal of Researches in Geology and Natural History," and since made far more memorable by the great results towards which these researches were the first steps. From the time of his return to England until now Mr. Darwin has steadily pursued the investigation of the subject. Eight years ago he gave to the world an outline of his theoretical conclusions, under the title of "The Origin of Species by means of Natural Selection;" and promised that it should be rapidly followed by full details of the facts and processes on which the theories were founded.

The volumes before us are the first instalment of this, the life-work of one of the greatest naturalists of any age. They have been delayed far beyond "the two or three years" which he thought in 1859 would suffice to complete the whole; chiefly as we now learn, by the author's ill health. They are devoted, as the title indicates, to the variation of animals in a domestic state, in the service and under the observation and control of man; and correspond, therefore, to the first chapter of "The Origin of Species." The next work is to treat of "The Variation of Organisms in a State of Nature, of the Struggle for Existence, and the Principle of Natural Selection," and to discuss the difficulties which are opposed to the theory; subjects which, in "The Origin of Species," occupied the eight chapters following the first.

A writer of ordinary powers might have been content to make a collection of facts illustrating the former work, and linked together only by reference to its discussions and explanations. That work may fairly be regarded as an era in science. Since its appearance, the debates, inquiries and observations of natural history have grouped themselves around it, and their relative importance is fairly tested by the closeness of their relation to its theory. Not that naturalists generally are prepared to accept that theory as an established law, in the full extent to which its author would apply it; the majority of them, perhaps, would still prefer to regard natural selection as a cause of variation only within the boundaries of the several species, and would ascribe to each species of animals and plants a distinct type of structure and an independent origin. But, even if they are altogether right in so narrowly limiting the application of the principle, no one can now deny its truth within certain limits, as yet undefined; and this alone would entitle it to a high rank as a scientific discovery, second, perhaps, to none since the Undulatory Theory of Light. In fact, it is a discovery which, to many minds, has first vindicated the right of the student of natural history to a seat in the councils of positive science. It has been but a few years since it was fashionable among those who aspired to imitate Bacon, in taking "all knowledge to be their province," to express a low estimate, almost a contempt, of the so-called "sciences of classification," and to deny them any place in the great system of universal law which scientific thought forever strives to build. The arbitrary assumptions which every scheme of organic life was compelled to make, before the first steps toward arranging its materials could be taken, and the vagueness and want of generality in the characteristics which test classification, not only in the crude system of Linnæus, but in all those which have followed it, offended minds trained to demand everywhere principles which could be expressed by exact formulæ and rigidly verified by experiment. Men are even yet in their prime, who, as youths, were taught that botany and zoology on the one hand, and mineralogy and geology on the other, were vast aggregates of observed facts, arranged for convenience under arbitrary heads, but not capable of reduction to general laws; that they were rather regions of curious observation than of scientific thought; and that all that they had or ever could have to teach was but related to the laws revealed by the exact sciences, as description is to analysis, or as play to work. How is it that such notions have so rapidly disappeared? How is it that the general reader of common intelligence understands the real nature and value of these "descriptive sciences," to use a term already becoming antiquated, better than philosophers who settled their "hierarchies of the sciences" a short generation ago? The question might be answered more fully; but the short of it is, first, that Lyell has since taught the world that the forces now at work upon the earth are sufficient to account for all its past changes of which we have any evidence, and has thus first set geology on a science on its feet; and, secondly, that Darwin has first led the way to an intelligent study of the whole universe of organisms, by methods which assume nothing but the ascertained results of the older sciences, and with the aim, already justified by important successes, of comprehending all organic life under one scientific conception. As we believe, he has done still more than this; he has arrived at a glimpse of the substance, if not of the final form, of the universal laws by which life is evolved, reproduced and varied.

Mr. Darwin is not an ordinary writer, and has not been content to expand his earlier and more general statements. His mind is one of that very small class to which Bichat, Virchow and Faraday belonged—the brilliant theorists, who are also distinguished as accurate observers. His recital of curious facts is enlivened and illustrated throughout by thought; his principles and arguments everywhere rest solidly upon observed fact. This constant attention to the great issues of law, to decide which is the aim of the work, enables him to bring into view always the essential points in his statements of fact—the "crucial" or test facts, so to speak. These have been selected, and are presented with such skill and clearness as to lead the reader's mind inevitably to the problem in hand, and to furnish him with all the existing means for its solution; and, at the same time, with such candor that all the objections to which the author's own views are open, are suggested as fairly as any adversary could desire. Add to this that Mr. Darwin is familiar with the whole literature of his subject, that for every statement which does not rest upon his own observations the authority is given, and where any doubt is possible, or where testimonies differ, the author's means of deciding are given to the reader; and that the style of the work is essentially the same by which his former books have charmed so many thousands; simple, direct, easy, devoid of artifice, almost without ornament, but suggesting rather than expressing an enthusiasm for his great purpose, as full as is consistent with a wise moderation of statement.

The work begins by pointing out the bearing of the changes in animals and plants under domestication upon the origin of species by natural selection. All life tends to multiply with extreme rapidity; nature cannot support all that she produces, and "of many seeds she often brings but one to bear."

But the progeny of an animal or a plant are not all alike; and of those produced to his hand man often selects the best to survive and continue the species.

ARTIFICIAL SELECTION.

"Selection may be followed either methodically and intentionally, or unconsciously and unintentionally. Man may select and preserve each successive variation, with the distinct intention of improving and altering a breed in accordance with a preconceived idea, and by thus adding up variations, often so slight as to be imperceptible by an uneducated eye, he has effected wonderful changes and improvements. It can, also, be clearly shown that man, without any intention or thought of improving the breed, by preserving in each successive generation the individuals which he prizes most, and by destroying the worthless individuals, slowly, though surely, induces great changes." (i., 16.)

These facts are sufficient to show that variations may be accumulated by inheritance; and it to some extent, why not to any imaginable extent? Who shall set limits to the changes which may thus be wrought in the lapse of countless generations? But, it will be asked, how can this accumulation take place in a state of nature? Where man selects the fittest to survive, from age to age, fitness will steadily increase; but what takes the place of this intelligent selection, where there is no supervision to effect it?

MALTHUS AMPLIFIED.

Here is the point where the argument of this work bears upon natural selection:

"All organic beings, without exception, tend to increase to so high a ratio, that no district, no station, not even the whole surface of the land or the whole ocean, would hold the progeny of a single pair after a certain number of generations. The inevitable result is an ever-recurrent struggle for existence. It has truly been said that all nature is at war; the strongest ultimately prevail, the weakest fail. * * The severe and oft recurrent struggle for existence will determine that those variations, however slight, which are favorable, shall be preserved or selected, and those which are unfavorable, shall be destroyed." (i. 16, 17.)

Mr. Darwin, in the "Origin of Species," already boldly rejected, as worthless, the objection from the inconceivable time required to produce great changes by accumulating insignificant variations, for is not infinite time at Nature's disposal? He has of course lost none of this boldness in the interval, during which human fossils and human work have been discovered among the remains of extinct mammals, and in graves that have been closed for centuries of centuries, and during which so much has been done by geology to raise its scale of measuring time to the proportions indicated by astronomy for the sidereal heavens. In short, grant to Mr. Darwin the proposition illustrated in these volumes, that modifications may be accumulated by inheritance, and it certainly follows that his entire theory may be true. There is nothing in the laws of thought to prevent its adoption. If the lapse of time required to accomplish the result defies figures to express it, he may still say that the earth and life upon it have endured so long, and ask for proof of the contrary. We live on an earth where the minute coral insect has built continents, and look up into a sky where rays of light that have travelled ten millions of years to tell the story reveal to us the existence of other worlds. Is it for us to question any statement Nature may make to us of the length of her days?

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THE REAL NATURE OF PROGRESS.

One of the most beautiful uses of this theory is the analysis which it enables the author to make of the conception of progressive development. He seems to accept Herbert Spencer's definition of organic progress as the specialization of organs and functions, and denies that there is any innate tendency in each being to advance in organization. But "as natural selection acts exclusively through the preservation of profitable modifications of structure, and as the conditions of life in each area generally become more and more complex from the increasing number of different forms which inhabit it, and from most of these forms acquiring a more and more perfect structure, we may confidently believe that, on the whole, organization advances." (i. 19.)

The reader is frequently led up, in thought, within sight and hearing, as it were, of the very workshop of Nature. Glimpses are given of wonderful prospects, passing suggestions of thoughts almost too bold for expression, or profound analogies are embodied in illustrations which might be expanded into theories. A brief example is this introduction to the chapter on changed conditions of life.

HOW RACES GET A CHANGE OF AIR.

"In considering whether any facts were known which might throw light on the conclusion arrived at in the last chapter, namely, that benefits ensue from crossing, and that it is a law of nature that all organic beings should occasionally cross, it appeared to me probable that the good derived from slight changes in the conditions of life, from being an analagous phenomenon, might serve this purpose. No two individuals, and still less no two varieties, are absolutely alike in constitution and structure; and when the germ of one is fertilized by the male element of another, we may believe that it is acted on in a somewhat similar manner as an individual when exposed to slightly changed conditions. Now, every one must have observed the remarkable influence on convalescents of a change of residence, and no medical man doubts the truth of this fact. Small farmers who hold but little land are convinced that their cattle derive great benefit from a change of pasture. In the case of plants the evidence is strong that a great advantage is derived from exchanging seeds, tubers, bulbs and cuttings from one soil or place to another as different as possible." (ii., 178, 179.)

A NATURAL MULTUM IN PARVO.

Nor is the following suggestion less admirable of its kind.

"The fertilized germ of one of the higher animals, subjected as it is to so vast a series of changes from the germinal cell to old age, is perhaps the most wonderful object in nature. It is probable that hardly a change of any kind affects either parent without some mark being left on the germ. But on the doctrine of reversion, as given in this chapter, the germ becomes a far more marvellous object, for, besides the visible changes to which it is subjected, we must believe that it is crowded with invisible characters, proper to both sexes, to both the right and left sides of the body, and to a long line of male and female ancestors separated by hundreds or even thousands of generations from the present time; and these characters, like those written on paper with invisible ink, all lie ready to be evolved under certain known or unknown conditions." (ii., 80.)

It seems scarcely fair to the author to select samples of his compact, forcible and unbiassed statements of curious and important facts, illustrating his doctrines. Every chapter is full of them. They are the substance of the whole work. No room is lost by the theories. They serve as a system for arranging the facts, of which the book seems to contain more than could possibly be compressed into the same space if it contained nothing else. Mr. Darwin's volumes compare with a loose recital of unclassified facts just as a well-packed trunk compares with a heap of promiscuous linen. Here are a few curiosities, taken almost at random:

FINE WOOL SPOILED BY CROSSING.

"The most remarkable statement which I have met with of the persistent endurance of the effects of a single cross is given by Fleischmann, who, in reference to German sheep, says 'that the original coarse sheep have 5,500 fibres of wool on a square inch; grades of the third or fourth merino cross produced about 8,000, the twentieth cross 27,000, the perfect pure merino blood 40,000 to 48,000.' So that in this case common German sheep crossed twenty times successively with merinos have not by any means acquired wool as fine as that of the pure breed." (ii. 112.)

FOWLS MODIFIED TO ORDER.

On the astonishing power of systematic selection to modify forms:

"Our pigs, as Mr. Corringham remarks, during the last twenty years have undergone, through rigorous selection, together with crossing, a complete metamorphosis. The first exhibition for poultry was held in the Zoological Gardens in 1845, and the improvement effected since that time has been great. As Mr. Bailey, the great judge, remarked to me, it was formerly ordered that the comb of the Spanish cock should be upright, and in four or five years all good birds had upright combs; it was ordered that the Polish cock should have no comb or wattles, and now a bird thus furnished would be at once disqualified; beards were ordered, and out of fifty-seven pairs lately (1860) exhibited at the Crystal Palace, all had beards. * * As the actual time required to make a change has not often been recorded, it may be worth mentioning that it took Mr. Wicking thirteen years to put a clean white head on an almond tumbler's body." (ii., 240, 241.)

BARKING A TRAIT OF CIVILIZATION IN DOGS.

The very strong resemblance between the domestic dog and the wild dog, wolf or jackal, seems to have a remarkable exception in the habit of barking, "which does not characterise a single natural species"; but Mr. Darwin informs us that—

"This habit is soon lost and soon reacquired. The case of the wild dogs on the island of Juan Fernandes having become dumb has often been quoted, and there is reason to believe that the dumbness ensued in the course of thirty-three years; on the other hand, dogs taken from this island by Ulloa slowly reacquired the habit of barking. The Mackenzie River dogs, of the *Canis latrans* (barking) type, when brought to England, never learned to bark properly; but one born in the Zoological Gardens made his voice sound as loudly as any other dog of the same age and size. According to Professor Nillson, a wolf whelp reared by a bitch barks. Geoffroy St. Hilaire exhibited a jackal which barked with the same tone as any common dog." (i. 41.)

COLOR OF DEAF CATS.

But a stranger fact is this: "White cats, if they have blue eyes, are almost always deaf. I formerly thought that the rule was invariable, but I have heard of a few authentic exceptions. A clergyman says: 'Of the offspring produced at one and the same birth, such as, like the mother, were entirely white (with blue eyes), were, like her, invariably deaf; while those that had the least speck of color on their fur, as invariably possessed the usual faculty of hearing?' Another, who has seen more than a dozen instances of the rule, adds 'that, if one eye, as I have several times observed, be not blue, the cat hears. On the other hand, I have never seen a white cat with eyes of the common color that was deaf.' Dr. Sichel testifies that in one case the iris began 'at the end of four months to grow dark colored, and then the cat first began to hear.'" (ii. 396.)

PANGENESIS.

This is not the place to discuss the professional hypothesis of "Pangenesis," which Mr. Darwin puts forth as a tentative step towards a comprehensive explanation of the facts of inheritance. He holds it extremely probable that "the whole organization, in the sense of every separate atom or unit, reproduces itself. Hence ovules and pollen grains—the fertilized seed or egg, as well as buds—include and consist of a multitude of germs thrown off from each separate atom of the organism." (ii., 429.) It is enough to say that it explains many obscure phenomena, and many which seem at first inconsistent with each other; that it conflicts with no known fact; and that it is the first effort yet made to bring under a higher unity and comprehend in one scientific conception all the observations and empirical laws yet obtained in this department of thought. That it is free from objection, or that it is here stated in its final form, Mr. Darwin would be the last to claim. But that it is at once so general and yet even conceivably true is, to a thoughtful mind, a wonderful triumph over difficulties which seemed insurmountable.

ITS TWIN THEORY.

But one remark seems to be called for. This hypothesis may at first sight seem to contradict the "evolution hypothesis" so ably proposed by Mr. Herbert Spencer in his "Principles of Biology" a few years ago. But a careful examination of the two will perhaps show that each affords what is needed to supplement and complete the other; and that they may easily be so fitted together that both will be strengthened. Thus "evolution" will explain the origin of variations; "Pangenesis" their perpetuation and accumulation. And the following eloquent and forcible illustrations which Mr. Spencer gives of his theory may be accepted, and perhaps carried still further, by the disciples of Mr. Darwin:

H. SPENCER ON EVOLUTION.

"Each organism exhibits, within a short space of time, a series of changes which, when supposed to occupy a period indefinitely great, and to go on in various ways instead of one way, give us a tolerably clear conception of organic evolution in general. In an individual development we have compressed into a comparatively infinitesimal space a series of metamorphoses equally vast with those which the hypothesis of evolution assumes to have taken place during those immeasurable epochs that the earth's crust tell us of. A tree differs from a seed immeasurably in every respect—in bulk, in structure, in color, in form, in specific gravity, in chemical composition; differs so greatly that no visible resemblance of any kind can be pointed out between them. Yet is the one changed in the course of a few years into the other—changed so gradually that at no moment can it be said, Now the seed ceases to be and the tree exists. What can be more widely contrasted than a newly-born child and the small, semi-transparent, gelatinous spherule constituting the human ovum? The infant is so complex in structure that a cyclopædia is needed to describe its constituent parts. The germinal vesicle is so simple that it may be defined in a line. Nevertheless a few months suffice to develope the one out of the other; and that, too, by a series of modifications so small, that were the embryo examined at successive minutes, even a microscope would with difficulty disclose any sensible change.

"Aided by such facts the conception of general volition may be rendered as definite a conception as any of our complex conceptions can be rendered. If, instead of the successive minutes of the child's fœtal life we take successive generations of creatures; if we regard the successive generations as differing from each other no more than the fœtus did in successive minutes, our imagination must indeed be feeble if we fail to realize in thought the evolution of the most complex organism out of the simplest. If a single cell, under appropriate conditions, becomes a man in the space of a few years, there can surely be no difficulty in understanding how, under appropriate conditions, a cell may, in the course of untold millions of years, give origin to the human race."—(Spencer, Principles of Biology, i. 349, 350.)

A THIRD THEORY FOR THOSE WHO WANT IT.

Yet the reader will say at once that even these two theories together will not avail to bring the whole of organic life under the idea of law. Where does the first cell come from? Mr. Darwin's aim, both in the "Origin of Species" and in the work before us, is to place the science of organisms on the same basis with the physical and chemical sciences, as forever governed by the forces which are now at work in it. And he claims that "probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed." ("Origin of Species," chap. xiv.)

This self-destructive statement is probably only rhetorical. Whatever "breathed life" into one form could as easily breathe it into millions, under similar conditions. Mr. Darwin surely does not hold that a creative power, exceptional to the whole course of things, came into being for a moment, to breath life into one form, and then ceased to be. Yet, on the hypothesis he presses so sharply, that all organisms come from one, there appears to be no way of avoiding the conclusion that the laws of the universe were once broken, and an exceptional force set at work, for the production of that one.

Those who are jealous of the universality of law may take refuge in the famous theory of Giebel, Musset and Pouchet, which Dr. Schaafhausen of Bonn has made his own of late by his able advocacy; the theory, namely, that monads, individual life-cells, the lowest and simplest forms of both animal and vegetable life, come into being spontaneously, under favorable conditions, by a universal law; that the Protococcus appears, wherever there is water, light, air and heat, without the presence of any organic life of which it can be the progeny. Add this theory to the two we have referred to above, and the development of the whole world full of life around us becomes conceivable in the regular course of things, without interference, and without change or limit in the laws under which it began.

Messrs. Judd & Co. have done justice to the work and credit to themselves by the elegance and accuracy of this reprint. It is as pleasant to read as the English edition, and more convenient to handle than that, which costs twice as much.

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