

Physical Science.

Contributions to the Theory of Natural Selection. By Alfred Russel Wallace. London: Macmillan and Co., 1870.

AMONGST the immense number of writings which the publication of Darwin's *Origin of Species* has called forth, the present work is noteworthy in more than one way. Mr. Wallace arrived at the theory of natural selection contemporaneously with Mr. Darwin, but independently of him. This collection of ten essays, published between the years 1855 and 1870, is interesting not only in their relation to the great theory, but also from the light which they throw on the gradual development of a remarkable man.

The first essay is headed "On the Law which has regulated the Introduction of New Species." It is worth remembering that this essay was written in Borneo; whilst it was in South America that Darwin, as he himself says, first came face to face with the great problem the solution of which has been the work of his life, and which has exercised such a fruitful influence on the whole of human thought. It is also worth noting that both enquirers received their first impulse towards a successful solution of the problem from Malthus's celebrated work *On Population*; and doubly interesting again is it to see how the great idea has worked itself out in its two principal representatives, until they culminate in very divergent results—an example ready to hand of the Darwinian law of the divergence of character.

The law which, according to Wallace, has regulated the introduction of new species, is as follows:—"Every species has come into existence coincident both in space and time with a pre-existing closely allied species." In this primitive and indeterminate form, it is difficult as yet to recognise the clear apprehension of the principle of natural selection arrived at some years later: but still it takes its stand in the most definite manner on the basis of the theory of descent, which had been so completely stamped out since the time of Lamarck. It claims, indeed, "a superiority over previous hypotheses (and therefore especially over that of Lamarck), on the ground that it not merely explains but necessitates what exists; granted the law, and many of the most important facts in Nature could not have been otherwise, but are almost as necessary deductions from it, as are the elliptic orbits of the planets from the law of gravitation." There is a firm ring about this statement, very different from the timid asseveration of most of the naturalists of that time, for whom all enquiry into the origin of the wonderful manifoldness of the organised world was an attempt to transcend the limits of human knowledge, and for whom the efforts of Lamarck and Geoffroy St. Hilaire, even of Goethe, were only matter for a shrug or a smile. It required considerable boldness to undertake a problem, regarded at that time by almost every one as unscientific, beneath the tropical sun of the Sunda Islands; it was only three years later, however (a year before the publication of Darwin's *Origin of Species*), that the second essay of this collection was written at Ternate, "On the Tendency of Varieties to depart indefinitely from the Original Type," opening a vista of new and undreamt-of relations between phenomena not hitherto understood.

It is this essay which Wallace sent to Darwin to be read before the Linnean Society, and which Darwin gave to the world side by side with the results of his own prolonged researches. The close *rapprochement* between this essay and the *Origin of Species*, which appeared soon afterwards, may be seen by a comparison of the titles of the various sections of the former with the facts and considerations that form the basis of the latter. As these two essays form together the one fountain-head from which the theory of natural selection

has flowed, so we may recognise side by side with the mighty development of Darwin a perfectly independent position for Mr. Wallace.

After his return to England in 1862, our author occupied himself with the working-up of the extensive material which he had collected, as well as with the development, and especially with the defence, of the new theory. As the first-fruit of this work we have the essay dated March, 1864, "On the Malayan Papilionidæ or Swallow-tailed Butterflies, as illustrative of the Theory of Natural Selection," the fourth in this series. This essay is a model of weighty and acute research. From the apparently unimportant theme which the history of a family of butterflies supplies, we are led on, step by step, through definition of the word species, laws and modes of variation, the occult influence of locality on form and colour, phenomena of dimorphism and mimicry, the modifying influence of sex, and general laws of geographical distribution, to indications of previous changes in the surface of the Earth. The third and seventh essays show how, on the theory of natural selection, the colour and marking of animals are phenomena subject to law. The third, "On Mimicry and other Protective Resemblances among Animals," and the seventh, "A Theory of Birds' Nests," showing the relation of certain differences of colour in female birds to their mode of nidification, open a new field of biology, as well for laymen as for trained enquirers.

"Creation by Law" (the eighth essay) is a critical essay, or rather a rejoinder to the criticism of the Duke of Argyll, and to an article on his *Reign of Law* which appeared in the *Times*, and which contained a number of ridiculous statements about the theory of natural selection. The Duke's argument was that the harmony and beauty of creation is so perfect, as to be inexplicable except upon the hypothesis of a constant supervision and direct interference of the Creator; and, as Mr. Wallace says, is a fair representation "of the feelings and ideas of that large class who take a keen interest in the progress of science in general, and especially that of natural history, but have never themselves studied Nature in detail, or acquired that personal knowledge of the structure of closely allied forms which is absolutely necessary for a full appreciation of the facts and reasonings contained in Mr. Darwin's great work."

We have at present concerned ourselves only with those essays in which the principle of natural selection is employed by the author as the *ultima ratio* of all explanation of organic nature. But the volume contains four additional essays, in which the author strikes out another path, and maintains with great emphasis that there are very important facts in Nature for whose explanation this principle does not suffice, and will never suffice. These essays are entitled (5) "On Instinct in Man and Animals;" (6) "The Philosophy of Birds' Nests;" (9) "The Development of the Human Races under the Law of Natural Selection;" and (10) "The Limits of Natural Selection as applied to Man." Of the time of the composition of the first of these essays we are not informed; the second and third were written in 1867, but the third contains some very important modifications in the present reprint; the fourth is new, and contains, in the author's own words, "the further development of a few sentences at the end of an article on 'Geological Time and the Origin of Species' which appeared in the *Quarterly Review* for April, 1869."

The essays on instinct in man and animals, and on the philosophy of birds' nests, contain not unimportant deviations from the 7th chapter in Darwin's *Origin of Species*, in which instinct is discussed also in its relation to the theory of natural selection. Darwin saw in this question one of the greatest difficulties of the theory; since he is not satisfied

to name in a general manner those cases in which the heredity of instincts is indisputably carried out, but has brought forward special instances from the life of ants, which are in fact excessively difficult to harmonise with the theory of natural selection. We cannot here allow ourselves to discuss whether Darwin has successfully conquered this difficulty, or at least has pointed out the way in which it may hereafter be overcome; it only interests us at present to note that Darwin insists on the direct transmission of complex instincts. He says, for example: "We can understand, on the principle of inheritance, how it is that the thrush of tropical South America lines its nest with mud in the same peculiar manner as does our British thrush; how it is that the hornbills of Africa and India have the same extraordinary instinct of plastering up and imprisoning the females in a hole in a tree, with only a small hole left in the plaster through which the males feed them and their young when hatched; how it is that the male wrens (*Troglodytes*) of North America build cock-nests to roost in, like the males of our kitty-wrens, a habit wholly unlike that of any other known bird." Wallace, on the other hand, sets aside the view that all instincts are congenital, and thus brought about by inheritance, and maintains that all phenomena of this kind may be explained either from the instruction of the young by the parents or by some other kind of earlier experience. He is also of opinion that much of what is ordinarily called instinct is the result either of organization or of habit. If the newly born calf can walk from the moment of its birth, this is a consequence of its organization, which makes walking both possible and pleasant; if we ourselves stretch out our hands in order to protect us from falling, this is an acquired habit which the child does not possess. It seems therefore extremely difficult to say what is the difference between an act of instinct and an act which follows the necessities of organization. When Wallace defines instinct as "the performance of complex actions by an animal, absolutely without instruction or earlier acquired knowledge," and from this attempts to prove that it is not present either in the case of cell-building bees or nest-building birds, or at least cannot be proved by observation, we may adduce, on the other hand, all those cases where the completion of such "complex acts" as Wallace never had in his mind are evident, and yet all possibility of instruction and experience is excluded; and the alternative of an organic force, as Wallace appears to understand it, or of an acquired habit, also appears inadmissible. Such an instance is furnished in another place by Mr. H. Higgins, who adduces the case of the young of an *Epeira*, which, separated from their parents, after a comparatively short time, constructed the same elaborate web which the parents had made, and thus formed their own erection without observation of the act of construction of the parents or instruction from them. How, again, can we explain the following fact, which I have very often observed, and which any one may verify for himself? It is well known that the larvæ of the caddice-worm live in water, and build around the tender hind part of their body a house constructed of all kinds of vegetable, mineral, and even animal materials, bound together by spinning-threads. During my studies of insect-embryology, I have often examined the eggs of these caddice-worms, which are found in clusters wrapt up in a gelatinous mass on water-plants, and have hatched the eggs myself in a small aquarium. After the lapse of a few days, the larvæ begin to glue together a protecting ring of little pieces of leaf, which they bite off for that purpose, and then gradually enlarge it, until it covers like a tube the whole of the hinder part of the body, and increases in length with that of the animal. The construction of such a tube appears perfectly analogous to

the building of nests by birds; and here it is as little admissible to suppose any instruction, or any learning by experience, as it is to attribute the building of the tube about the hinder part of the body to an organic necessity. While it is indisputable that in other instances instruction, experience, and imitation may be of considerable and indeed of unique importance, these great and important questions must nevertheless be allowed to remain open ones; and thus naturalists and laymen become interested in their solution. And to this end these essays of Wallace will give a great and healthy impulse.

The question of the relation of so-called instincts to the complicated process of natural selection leads us to the last two essays in the volume, the relationship of man, and of his corporeal and spiritual nature, to the principle of natural selection.

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(To be continued.)

Science and Philosophy.

Contributions to the Theory of Natural Selection. A Series of Essays, by Alfred Russel Wallace. London: Macmillan and Co., 1870.

[SECOND NOTICE.]

THE first problem to which Mr. Wallace addresses himself in the last two essays is whether the human race is to be considered as one or as several species. The question is one of those which is usually discussed rather in a dogmatic than a critical spirit, and with more passion than knowledge. Mr. Wallace succeeds in steering clear of these dangers, and in furnishing a line of argument which concedes the point to those who recognise a single origin for mankind, and which will at the same time satisfy those who, on various historical grounds, adduce the physical invariability of the existing races of man, as an argument in favour of the conviction that men were originally constituted in as many varieties or species as we now find them. The argument is shortly this:—The races of men now living, even the most savage, live in a social manner, and have more or fewer sympathetic affections. The weak, deformed, and sick, are not killed, but supported; such services for the general good are assigned them as they are competent to perform, while the strong and healthy undertake the more important duties of the protection and food-supply of the community. Thus, by one member of the community—whether tribe, nation, or race—helping the others instead of destroying them whenever opportunity offers, not only the community, but every member of it, prospers. The endless *struggle* for existence gradually ceases amongst the members of such a community; even the weaker and more imperfect of them succeed in propagating like the rest, and thus the progress towards greater perfection in mere bodily organization is either entirely checked or at least considerably retarded. On the other hand the possession of greater intelligence, by the bodily weaker, may exercise an important influence on the survival of the fittest. The physically stronger is not always distinguished by the keener mind, but frequently obtains the means for the better husbanding of his strength through the inventive capacity of a weaker but cleverer individual; the latter contrives and prepares his weapons, and provides himself also with means of protection against attack. By imitation and instruction the art of more secure aggression and of better defence quickly spreads even among the members of the community of smaller intellectual endowment: the thing learned exercises their intellectual powers, and they transmit these by inheritance to their children. It is in this manner that all progress passes over gradually from the physical to the intellectual; the body remains unchanged in outward form, whilst the mind, and those organs like the brain which are essentially concerned with its activity, alone develop.

This is, as near as may be, Wallace's argument. And if it be urged against him that the physical differences between various races of men at the present time are not inconsiderable, especially in the colour of the skin and the texture and quantity of the hair, our author refers the origin of these differences to the time when the effects of intellectual training had not so exclusively asserted themselves, and physical peculiarities were more easy of acquisition.

With this line of argument those who are disposed to dogmatise on the unity or plurality of the human species may content themselves as best they may.

We now come to the last essay, "On the Limits of Natural Selection as applied to Man." This essay has already given much occasion for criticism and rejoinder; and in a certain

sense the greatest interest is concentrated on it, since it touches directly and immediately the highest problems of existence. It is divided into two sections, the first of which adduces certain facts, which, according to the author's view, exclude natural selection as the mode of explanation; while the second attempts to introduce another principle to supply its place. In a more recent reply to an attack by M. Claparède, Mr. Wallace has expressly affirmed that he rests on these facts the whole burden of proving the insufficiency of the explanation afforded by the principle of natural selection. What are these facts?

Mr. Wallace believes he has established that primeval man, at the time of his first appearance, must have possessed characters which were hurtful, or at least useless, to him, and which therefore can never have arisen according to the laws of natural selection, or at all events can never have been transmitted by descent. These characters are expressed as follows:—"The brain of the savage is larger than he needs it to be;" "Man's naked skin could not have been produced by natural selection;" "The feet and hands of man considered as difficulties on the theory of natural selection;" "The origin of some of man's mental faculties, by the preservation of useful variations, not possible." Let us examine some of these a little more closely.

Supported by the opinion "of all the most eminent modern writers" that there exists "an intimate connection" between the small size of the brain of the savage and his diminutive intellectual development, Wallace thinks it necessary to suppose that the brain of the savage has always been found too large for its intellectual functions. The apes, for instance, whose intellectual condition is not so very far behind that of the Hottentots or Papuans, have nevertheless a very much smaller volume of brain; the sudden advance is explicable merely on the supposition that man had from the beginning a large quantity of brain in order to enjoy the later requirements of civilisation. Even if we admit, however, that that proposition of "the eminent modern writers" is anything more than an unproved conjecture, Wallace's view distinctly conflicts with a proposition well known to every physiologist, and employed in a masterly manner by Darwin, on the use and disuse of organs. If the brain of the savage is not used in fact to its full capacity; *i. e.* if essential and considerable portions of it exist really without function, these portions must without doubt, according to all the laws of physiology, degenerate, and gradually disappear. This then must have been the case with the brain of prehistoric man.

Of what substance can we suppose this superfluous brain to consist? Of ganglionic cells? If so, these cannot have been different in character from modern ganglionic cells. They must have received excitations and have combined them in various ways: then have transformed them into excitations in us, as reflex actions, as volitions (how, we are for the present entirely ignorant), or have incorporated them in the form of ideas in the infinitely complex machinery which we call consciousness. Are we then to suppose these superfluous portions to belong to the cerebral connective tissues? Even that would not make them brain: indeed there is no conceivable ground explaining their presence and persistence or indeed for supposing them possible. Whichever way we turn, if we are not to fly in the face of plain physiological fact, we are compelled to regard these mainstays of Wallace's objections as untenable—not to mention the fact that elephants and whales have larger brain volume (and therefore on this theory ought to have superior capacities) than Cuvier or Napoleon.

The second point is more difficult to meet. Not that we are driven to admit that natural selection is insufficient to

account for the hairlessness of the human skin simply because such hairlessness might have been injurious, but because it is almost impossible for us to have any knowledge of the time when the gradual change took place from the hairy state of the ancestors of the present race of men to a hairless condition. But if we understand Mr. Wallace rightly, he lays great stress upon the circumstance that the back has become bare, and that it is this portion of the body which savages protect against rain. Even if it were true that "the naked and sensitive skin, by necessitating clothing and houses, would lead to the more rapid development of man's inventive and constructive faculties," how does it come to pass that that portion of the body which, according to Mr. Wallace's statement, is the best protected, the back, is the very one which, according to the most exact measurements of physiologists, is the least sensitive? And does not rain also fall as much on the breast, the legs, and the arms? Again, how does Mr. Wallace know that the *hairy* ancestors of the men now existing did not possess clothing and houses? Further, why may we not simply suppose that they gradually lost their hair because they did not any longer need it? Why, lastly, may not this be the reason which prevents the Esquimaux from again acquiring a thick coat of their own? We thus get question for question; dilemma for dilemma.

We may pass over any details respecting the hands and the feet, since Mr. Wallace himself says, "he did not attach the same importance to them as to those he had already dwelt on." But as to the human voice, Mr. Wallace will not deny that there are certain sounds of many savage languages which a singer who can render Mozart and Rossini to perfection and with the greatest ease, is nevertheless quite incapable of producing; that thus the accurate cultivation of the throat and windpipe (and the latter is of the greatest importance for the beauty of the voice) is necessary, not merely for those highest requirements of art, but also for the commonest sounds and cries of savages little elevated above the beasts. The supposition of a predisposition therefore, also becomes superfluous.

If we hold that none of the facts hitherto mentioned are sufficiently established to justify so important a step as the introduction of a new principle of explanation, we must equally object to any attempt to adduce reasons from the so-called psychical regions of human nature. Psychology is itself in far too incomplete a state to throw much light on the matter. The question how the motion of material particles can pass over into thought seems to be as far from a solution as it ever was. We must therefore concede to Mr. Wallace, and to those who think with him, the right to account for psychical and organic phenomena on other than mechanical principles, especially as he does not blink the attempt to get rid of these principles even in the explanation of the inorganic world. Criticism has merely to control the method and the cogency of the arguments: not to reject principles of explanation as such. We confess that Mr. Wallace's principles, as they are expounded in the last of his essays, admit of being methodically and consistently carried out: and shall welcome any attempt which he may make in a future edition to perfect them in these particulars. If such principles do not directly help us onwards, they at least preserve us from onesidedness.

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