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'Contributions to the Theory of Natural Selection. By Alfred Russell Wallace.
Macmillan.'

Although many of the essays in the volume now before us have already appeared in scientific magazines and reviews, we believe that they will be comparatively novel to the great bulk of readers. Mr. Wallace has, however, taken the trouble to correct, enlarge, and re-write those which seemed to require it, while he has also added a few short explanatory notes where elucidation was necessary. It may perhaps be as well to state the author's reasons for publishing this work, in order that the reader may be better enabled to appreciate the value of its contents as a contribution to the scientific literature of the day. Mr. Wallace considers that the first two papers of the series have gained him the reputation of being an originator of the theory of "Natural Selection." They contain an outline sketch of the theory of the origin of species, as conceived by the author long before he had "the least notion of the scope and nature of Mr. Darwin's labours." The present work, Mr. Wallace thinks, will show that he saw at the time "the value and scope of the law" which he had discovered, and that he has since successfully applied it in "a few original lines of investigation." Here, however, our author ceases to advance his claims. He does not wish to measure his strength with the great naturalist, and acknowledges that of all men now living Mr. Darwin was the best fitted for the great work he has undertaken and accomplished. Mr. Wallace's opportunities, however, have enabled him "now and then to seize on some conspicuous group of unappropriated facts, and to search out some generalisation which might bring them under the reign of known law;" although they may not be "suited to that more scientific and more laborious process of elaborate induction, which, in Mr. Darwin's hands, led to such brilliant results."

In the first essay of the present volume Mr. Wallace endeavours to set forth the law which has regulated the introduction of new species. He shows that geographical distribution is dependent on geological changes, and that it is possible to deduce the law from familiar geographical and geological facts. He also argues that the geographical distribution of organisms, the geological distribution of the forms of life, and the high organisation of very ancient animals, are all consistent with this hypothesis. Professor Forbes' theory of polarity he dismisses as inconsistent, the one fatal objection being that it is "essentially one that assumes to a great extent the completeness of our knowledge of the whole series of organic beings which have existed on the earth." Mr. Wallace then proceeds to show how the law that "every species has come into existence coincident both in time and space with a pre-existing, closely-allied species" connects and explains a vast number of isolated facts, which the researches of modern naturalists have brought together. In the second essay our author deals chiefly with the tendency of varieties to depart indefinitely from the original type. This tendency in nature he illustrates by a number of familiar facts. He adduces the law which regulates the population of a species, and the fact that the abundance or rarity of a species is dependent upon its more or less perfect adaptation to the conditions of existence. Lamarck's hypothesis is shown to be very different from that now advanced; and as Mr. Wallace's remarks on this subject may have the good effect of correcting some false impressions, we venture to quote them:

The hypothesis of Lamarck—that progressive changes in species have been produced by the attempts of animals to increase the development of their own organs, and thus modify their structure and habits—has been repeatedly and easily refuted by all writers on the subject of varieties and species, and it seems to have been considered that when this was done the whole question has been finally settled; but this view here developed renders such hypothesis quite unnecessary, by showing that similar results must be produced by the action of principles constantly at work in nature. The powerful retractile talons of the falcon and the cat-tribes have not been produced or increased by the volition of those animals; but among the different varieties which occurred in the earlier and less highly organised forms of these groups, those always survived longest which had the greatest facilities for seizing their prey. Neither did the giraffe acquire its long neck by desiring to reach the foliage of the more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than usual at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them.

Perhaps the most interesting, and certainly the most original, of the essays before us is that devoted to “mimicry and other protective resemblances among animals.” The curious adaptation of the colour of animals to their conditions of life has long been recognised, and has given rise to a variety of ingenious theories to account for the fact. All the hypotheses proposed, however, were singularly inadequate to explain the varied phases of the phenomenon, and it was reserved for the theory of natural selection to offer a solution of all these problems, and of many others indirectly connected with them. We may here briefly recapitulate a few of the facts which have been observed by naturalists with regard to the external colouring and markings of animals, in order that we may be the better enabled to judge for ourselves as to their value in explaining and verifying Mr. Darwin’s hypothesis. We need not dwell upon the importance of concealment in connexion with colour, whether we view animals that have numerous enemies, or those which prey upon others; or adduce all the instances in which nature has granted the boon of concealment by an appropriate tint. The tawny lion, which inhabits the sandy wastes, is almost invisible when crouching among the rocks and stones of the desert; while the same may be said of other desert animals, such as the antelope and the camel. If we pass to the Arctic regions the facts are still more remarkable. The polar bear is the only bear that is white, and it lives only among the white snowfields and icebergs. The Arctic fox, the ermine, and the alpine hare change to white only in the winter, because during the summer white would be too conspicuous. The American polar hare, on the contrary, is always white, because it inhabits regions of perpetual snow. Birds are just as remarkably protected as animals by their assimilative hues. The larks, the quails, and the grouse of the North African and Asiatic deserts are all tinted to match the soil of the district they inhabit; while the ptarmigan changes its coloured summer plumage to white in the winter. In the tropics, again, where the trees never lose their foliage, there are several groups of green birds, such as the parrots and the green pigeons of the East. Then we also find special modifications of colour:

The conformity of tint which has been so far shown to exist between animals and their habitations is of a somewhat general character; we will now consider the cases of more special adaptation. If the lion is enabled by his sandy colour readily to conceal himself by merely crouching down upon the desert, how, it may be asked, do the elegant markings of the tiger, the jaguar, and the other large cats agree with this theory? We reply that these are generally cases of more or less special adaptation. The tiger is a jungle animal, and hides himself among the tufts of grass or of bamboos, and in these positions the vertical stripes with which his body is adorned must so assimilate with the vertical stems of the bamboo, as to assist greatly in concealing him from his approaching prey. How remarkable it is that besides the lion and tiger, almost all the other large cats are arboreal in their habits, and almost all have ocellated or spotted skins,

which must certainly tend to blend them with the background of foliage; while the one exception, the puma, has an ashy brown uniform fur, and has the habit of clinging so closely to a limb of a tree while waiting for his prey to pass beneath as to be hardly distinguishable from the bark.

Among birds, the ptarmigan, already mentioned, must be considered a remarkable case of special adaptation. Another is a South-American goatsucker (*Caprimulgus rupestris*) which rests in the bright sunshine on little bare rocky islets in the Upper Rio Negro, where its unusually light colours so closely resemble those of the rock and sand, that it can scarcely be detected till trodden upon.

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Reptiles offer us many similar examples. The most arboreal lizards, the iguanas, are as green as the leaves they feed upon, and the slender whip-snakes are rendered almost invisible as they glide among the foliage by a similar colouration. How difficult it is sometimes to catch sight of the little green tree-frogs sitting on the leaves of a small plant enclosed in a glass case in the Zoological Gardens; yet how much better concealed must they be among the fresh green damp foliage of a marshy forest. There is a North-American frog found on lichen-covered rocks and walls, which is so coloured as exactly to resemble them, and as long as it remains quiet would certainly escape detection. Some of the geckos, which cling motionless on the trunks of trees in the tropics, are of such curiously marbled colours as to match exactly with the bark they rest upon.

In every part of the tropics there are tree-snakes that twist among boughs and shrubs, or lie coiled up on the dense masses of foliage. These are of many distinct groups, and comprise both venomous and harmless genera; but almost all of them are of a beautiful green colour, sometimes more or less adorned with white or dusky bands and spots. There can be little doubt that this colour is doubly useful to them, since it will tend to conceal them from their enemies, and will lead their prey to approach them unconscious of danger. Dr. Gunther informs us that there is only one genus of true arboreal snakes (*Dipsas*) whose colours are rarely green, but are of various shades of black, brown, and olive, and these are all nocturnal reptiles, and there can be little doubt conceal themselves during the day in holes, so that the green protective tint would be useless to them, and they accordingly retain the more usual reptilian hues.

Fishes present similar instances. Many flat fish, as for example the flounder and the skate, are exactly the colour of the gravel or sand on which they habitually rest. Among the marine flower gardens of an Eastern coral reef the fishes present every variety of gorgeous colour, while the river fish even of the tropics rarely if ever have gay or conspicuous markings. A very curious case of this kind of adaptation occurs in the sea-horses (*Hippocampus*) of Australia, some of which bear long foliaceous appendages resembling seaweed, and are of a brilliant red colour; and they are known to live among seaweed of the same hue, so that when at rest they must be quite invisible.

Perhaps in the insect-world this remarkable phenomenon of adaptation is most strikingly exemplified. Grasshoppers, locusts, and crickets are all protected by their resemblance to the vegetation or the soil on which they live; while most of the tropical *Locustidæ* and *Mantidæ* exactly match the leaves on which they usually repose, and in many instances the veining of their wings is a close imitation of that of a leaf. But what is still more extraordinary, we find among butterflies reproductions of leaves in every stage of decay. Mr. Bates observed that the South American long-horned beetle is found only on the rough bark of one species of tree. "It is very abundant, but so exactly does it resemble the bark in colour and rugosity, and so closely does it cling to the branches, that until it moves it is absolutely invisible." A large number of the species *Phasmidæ* (or spectres) are called "walking-stick insects," from their close resemblance to

small branches and twigs; many of these have also the curious habit of stretching out their legs unsymmetrically, so as to render the deception more complete. Mr. Wallace tells us that one of these creatures obtained by himself from Borneo (*Ceroxylus laceratus*) “was covered over with foliaceous excrescences of a clear olive colour, so as exactly to resemble a stick grown over by a creeping moss or *jungermannia*.” But the strangest of all these fairy tales of science is that of “mimicry,” which is adopted by so many insects for purposes of protection. One of the most remarkable instances is that adduced by Mr. Wallace among certain families of butterflies in South America. The *Heliconidæ*, a family which are universally avoided by insect-eating birds, on account of the bitter and acrid nature of the juices of their system, are closely imitated in their gait and flight by an entirely distinct family, the *Leptalides*, which, on the contrary, possess an agreeable taste, and are very popular among the birds. In this manner these clever mimics often escape the beaks of the birds. There are also many moths and butterflies which imitate not only other species of the same family, but even other orders; assuming the dress of bees and wasps, with stings for weapons, in order to frighten their enemies. A genus of small wood spiders which feed on ants are a very good mimic of the ants themselves, while Mr. Bates mentions a caterpillar which assumes at will the appearance of a small snake. Now, what is the meaning of all this masquerading in nature? Is there any great purpose served by this strange travestie? Mr. Wallace points to the facts, and suggests a theory:

The resemblance of one animal to another is of exactly the same essential nature as the resemblance to a leaf, or to bark, or to desert sand, and answers exactly the same purpose. In the one case the enemy will not attack the leaf or the bark, and so the disguise is a safeguard; in the other case it is found that for various reasons the creature resembled is passed over, and not attacked by the usual enemies of its order, and thus the creature that resembles it has an equally effectual safeguard. We are plainly shown that the disguise is of the same nature in the two cases, by the occurrence in the same group of one species resembling a vegetable substance, while another resembles a living animal of another group; and we know that the creatures resembled possess an immunity from attack, by their being always very abundant, by their being conspicuous and not concealing themselves, and by their having generally no visible means of escape from their enemies; while, at the same time, the particular quality that makes them disliked is often very clear, such as a nasty taste or an indigestible hardness. Further examination reveals the fact that, in several cases of both kinds of disguise, it is the female only that is thus disguised; and as it can be shown that the female needs protection much more than the male, and that her preservation for a much longer period is absolutely necessary for the continuance of the race, we have an additional indication that the resemblance is in all cases subservient to a great purpose—the preservation of the species.

In endeavouring to explain these phenomena as having been brought about by variation and natural selection, we start with the fact that white varieties frequently occur, and when protected from enemies show no incapacity for continued existence and increase. We know, further, that varieties of many other tints occasionally occur; and as “the survival of the fittest” must inevitably weed out those whose colours are prejudicial and preserve those whose colours are a safeguard, we require no other mode of accounting for the protective tints of Arctic and desert animals. But this being granted, there is such a perfectly continuous and graduated series of examples of every kind of protective imitation, up to the most wonderful cases of what is termed “mimicry,” that we can find no place at which to draw the line, and say,—“so far variation and natural selection will account for the phenomena, but for all the rest we require a more potent

cause.” The counter theories that have been proposed, that of the “special creation” of each imitative form, that of the action of “similar conditions of existence” for some of the cases, and of the laws of “hereditary descent and the reversion to ancestral forms” for others,—have all been shown to be beset with difficulties, and the two latter to be directly contradicted by some of the most constant and most remarkable of the facts to be accounted for.

We have been thus copious in our extracts from Mr. Wallace’s essay on “Mimicry,” because it is altogether the most interesting paper in the volume before us. There are many others, however, rich in scientific suggestions, and full of strange facts and fanciful theories, which are as bold as they are ingenious. The essays on “Instinct,” on “The Philosophy of Bird’s Nests,” on “The Limits of Natural Selection as applied to Man,” are all worthy of attentive perusal. Whatever may be the opinions of readers with regard to this strangely fascinating volume, there can be no doubt of its value in explaining and connecting a variety of facts in natural history, which are too generally regarded as inexplicable anomalies. Notwithstanding the many objections raised against the Darwinian theory of natural selection, it is now no longer disputed that it is gradually producing conviction in the minds of the most eminent scientific men of the day, and that new facts as they are placed before us are elucidated and explained by it. A false hypothesis cannot long stand this crucial test; it is only a true theory which grows stronger and stronger as new problems arise and are solved by its application.

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The Alfred Russel Wallace Page, Charles H. Smith, 2015.