

IS PROTECTIVE MIMICRY DUE TO NATURAL SELECTION?

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IN the *American Naturalist* for September is an abstract of an article by that able naturalist, Fritz Müller, advocating the view that the curious phenomena of protective mimicry in Lepidoptera can be fully explained by the theory of natural selection. Notwithstanding the deference that is due to the conclusion of so eminent an observer, I have thought that the other side of the question should be heard.

I think it will be generally admitted that when we have a series of similar facts occurring throughout both the animal and vegetable kingdoms, an explanation should be sought that will cover the whole of these facts, while one which explains a portion of them only, but is obviously inapplicable to the remainder, should at least be looked on with suspicion and accepted with hesitation. Now external resemblances of a most minute kind between widely separated species both of animals and plants are

of very frequent occurrence, and, in a very large number of instances, are obviously not "mimetic" nor of any apparent service to the "mimicking" species. As a justification for this assertion, I may refer to a perfectly unexceptionable authority, namely, one of the best known advocates of the theory of natural selection, Mr. A. R. Wallace. In his inaugural address to Section D at the recent meeting of the British Association at Glasgow,¹ Mr. Wallace adduces the following illustrations of his law: "Our first example is from tropical Africa, where we find two unrelated species of butterflies belonging to two very different families (*Nymphalidæ* and *Papilionidæ*) characterized by a prevailing blue-green color not found on any other continent. Again, we have a group of African *Pieridæ*, which are white or pale yellow with a marginal row of bead-like black spots; and in the same country one of the *Lycænidæ* is colored so exactly like these that it was at first described as a species of *Pieris*. None of these four groups are known to be in any way specially protected, so that the resemblance cannot be due to protective mimicry." "In another series of genera, all belonging to the *Nymphalidæ*, we have the most vivid blue ground, with broad bands of orange-crimson on a different tint of blue or purple, exactly reproduced in corresponding yet unrelated species occurring in the same locality; yet, as none of these groups are protected, this can hardly be due to mimicry. A few species of two other genera in the same country also reproduce the same colors, but with only a general resemblance in the marking. Yet again, in tropical America, we have species of *Apatura* which, sometimes in both sexes, sometimes in the female only, exactly imitate the peculiar markings of another genus confined to America. Here again neither genus is protected, and the similarity must be due to unknown local causes." Mr. Wallace adduces several other instances of a similar character; and even in the case of the very South American instances on which so much stress is laid by Fritz Müller, and, before him, by Bates, admits that "this can hardly be true mimicry, because all are alike protected by the nauseous secretion which renders them unpalatable to birds."

In the abstract of Fritz Müller's article it is stated that "Fritz Müller insists, as all writers on the subject have done, upon the similar geographical distribution of the imitating and the imitated species as a necessary concomitant of mimicry." If, there-

¹ See *Nature*, vol. xiv. page 403, September 7, 1876.

fore, it can be shown that species which would be called "imitating and imitated" if they occurred together are in reality found widely separated, it is obvious that this would materially weaken Müller's argument. Whether this is the case with Lepidoptera, I have not sufficient knowledge to state; but that accomplished entomologist, the late Mr. Edward Newman, assured me that in the case of some of the most remarkable instances of such resemblance known in this country, between particular species of Diptera and particular species of Hymenoptera, the resemblance is not associated with geographical contiguity. In the case of plants, at all events, I am prepared to state that resemblances as striking, which would certainly be considered illustrations of mimicry if they were found together and were of any apparent utility, do occur between species widely separated in space.

In the number of the *Popular Science Review* for January, 1872, appeared an article entitled *Mimicry in Plants*, in which I gave a number of illustrations of plants, or parts of plants, belonging to species widely separated according to any natural system of classification, and yet so exactly alike in their vegetative organs that they would deceive a practiced botanist. The resemblance extends in some instances not merely to general habit and appearance, but even to the arrangement of the veins. Dr. Berthold Seemann, no mean authority, speaks of having met in the Sandwich Islands with a variety of *Solanum Nelsoni*, which looked for all the world like *Thomasia solanacea* of New Holland, a well-known *Buttuereaceous* plant of our gardens, the resemblance between these two widely separated plants being quite as striking as that pointed out in Bates's *Naturalist* on the Amazon "between a certain moth and a humming-bird."¹ In no one instance, that I am aware of, in the vegetable kingdom has protective mimicry been suggested as an explanation of this homoplasm. In most cases, as the one recorded above, the plants in question do not grow in contiguity.

But a more serious objection to the theory, that these remarkable resemblances are brought about by natural selection acting in the way indicated by Bates and Müller, lies in the difficulty of understanding how the first steps in the approach of one insect towards another could possibly be useful in deceiving an enemy. All the most cautious advocates of the theory, including Mr. Darwin himself, admit that "natural selection acts with

¹ *Gardener's Chronicle*, June 27, 1868.

extreme slowness ;” and again that “only those variations which are in some way profitable will be preserved or naturally selected.” By a train of reasoning founded on these two premises, I attempted to show, in a paper on *The Theory of Natural Selection from a Mathematical Point of View*¹ read before the British Association at the Liverpool meeting in 1870, that the chances against the required amount of change being brought about by this agency solely, are, on a hypothesis most favorable to the theory, say ten million to one ; and I am not aware that the arguments there used have been met. Again, the purpose of mimicry is generally stated to be the perpetuation of the imitating insect, in consequence of deceiving its natural enemies by its resemblance to some species distasteful to them. If so, the purpose seems to have been somewhat inadequately fulfilled, even by the most perfect mimetism, as Mr. Bates and Mr. Wallace agree in stating, that, both in South America and the Malay Archipelago, the imitating species are always confined to a limited area, and are always very scarce compared with the imitated species.

Mr. Wallace, in his address to the British Association alluded to above, lays great stress on the probable influence of local conditions on the coloring and other external markings of animals, dependent on laws of which we are at present almost entirely ignorant. There can be little doubt that the instances of close resemblance in the vegetable kingdom of which I have spoken are due entirely to similarity of external conditions. When, therefore, we find similar phenomena in the animal world, it would appear more reasonable to attribute them to similar causes, rather than to refer them entirely to a hypothetical process like that of natural selection acting through protective mimicry, in which we are unable actually to follow two consecutive steps.

Mr. Mivart, in his *Genesis of Species*, and Mr. J. J. Murphy in his *Habit and Intelligence* have argued, much more forcibly than I can do, against the adequacy of natural selection to account for the phenomena in question ; and, lest it may be thought that I am opposing the united view of all our best naturalists, I may remind my readers that so uncompromising an advocate of the theory of evolution as Professor Huxley has stated his deliberate conviction “after much consideration, and with assuredly no bias against Mr. Darwin’s views, that, as the

¹ *Nature*, vol. iii. page 30, November 10, 1870.

evidence stands, it is not absolutely proven that a group of animals having all the characters exhibited by a species in nature has ever been originated by selection, whether artificial or natural." ¹

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