

Mr. Bates was of opinion that the individual of *Pieris Pyrrha* described by Professor Westwood presented simply an instance of unequal hermaphroditism, three-fourths male and one-fourth female. As such it was a mere monstrosity, and had no bearing whatever on the question of the origin of species; the Darwinian theory dealt only with variations that were propagated, and not with monstrosities, the peculiarities of which were not transmitted to their descendants. With regard to those cases where the female sex of a species alone was found to mimic species of other families, the male remaining true to the normal type of its group, he thought it was absolutely necessary that an entomologist should have had opportunities of observing the habits of the species before drawing conclusions concerning them. In all such cases he had found that the females had a different mode of life from the males. In *Pieris Pyrrha* and other allied species the females were confined to the shades of the forest, where they flew near the ground, and were slow in their movements; whilst the males spent the hours of sunlight flying about open places, in company with the males of a great number of other butterflies; they resorted to the forest shades only towards evening or on cloudy days. The cause of the female of *Pieris Pyrrha* having been brought to resemble a *Heliconid* butterfly was the same as that which had drawn out the wonderful mimetic dress of the *Leptalides*; namely the protection which such resemblance afforded them against the persecutions of insectivorous animals. A more remarkable case than *Pieris Pyrrha* was that of *Papilio Torquatus*, a well-known Brazilian butterfly, of light yellow and black colours (in the male). Like the male of *Pieris Pyrrha*, *Papilio Torquatus* (male) spent his days in the open sunshine, whilst the female was confined to the shades of the forest, flying heavily and depositing her eggs one by one underneath the leaves of low trees. The female offered the most striking contrast in colours to the male, being black with white spots and crimson macular belt. It was significant that the dominant forms of *Papiliones* of the forest shades of tropical America had precisely that style of coloration; but the importance of the present case lay in this, that the female *Torquatus* presented local varieties in the various regions inhabited by the species, the male remaining unchanged, and the varieties were adapted in dress to the species of the dominant *Æneas* group peculiar to the localities. Thus on the Lower Amazons the form of the female was that which had been named *P. Caudius* by Hübner, having a white spot on the fore wing, and a crimson belt on the hind wing, precisely as in the females of the common species inhabiting the same region, *e.g.* *P. Æneas*, *P. Parsodes*, *P. Echelus*, *P. Ergeteles*, &c. On the Upper Amazons, the female was very variable, but the commonest varieties resembled closely the females of the species of the *Æneas* group most prevalent there, namely, *P. Lysander* and *P. Bolivar*: the resemblance to the female *Bolivar* was most extraordinary, for in that species the crimson macular belt was replaced by yellow. Mr. Bates also made some remarks in answer to the objections which Professor

Westwood had urged against the explanation of these imitative analogies on Darwinian principles. He said that the case of the *Leptalides* published by him could not, in his opinion, be explained in any other way. The species of *Leptalis* in question was found in several distant localities; in some of them it existed under one constant local form only, in others it was exceedingly variable, the common varieties showing a wonderful tendency towards a likeness to the predominant species of *Ithomia* of the respective localities. If the dress now worn by the *Leptalis* was given it at its creation, as Professor Westwood believed, how would he explain all these numerous shades of variety found in one and the same locality? To be consistent he must say that each variation was lineally descended from an originally created variety, which would be absurd, as so many species are known to offer numerous similar varieties in one and the same brood. As some of these varieties of *Leptalis* resembled species of *Ithomia* peculiar to the locality more than their sister varieties did, the conclusion was simple and natural, that, the imitation being a rule in all other localities, the process was there at work by which the close imitation was brought about. The less exact imitations were in course of time destroyed without bringing forth progeny, and then the state of things was identical with what was found in other localities, namely, one or more constant forms of *Leptalis* resembling closely their companion *Ithomiæ*.

Dr. Sharp remarked that whether the resemblances under discussion were purely accidental or not could be determined by a numerical investigation, by ascertaining what proportion the cases in which species resembling one another occurred in company bore to the cases in which species with a similar amount of resemblance occurred away from one another. He thought, however, that some of the cases of mimicry might be accounted for on other grounds than those supported by Messrs. Wallace and Bates, for if the Darwinian theory of a common descent were true, then the laws and principles of heredity could be applied to different species, as they have heretofore been to individuals. He proposed four classes, under each of which he believed some of these resemblances could be placed:—

1st. Resemblances purely accidental; for the doctrine of chances would show that if there were in the world a sufficient number of species resembling one another, a greater or less number of these would be sure to occur in company.

2nd. Resemblances the result of a descent from a common parent; for it being understood that a certain character would be transmitted from parent to offspring through an indefinite number of generations, unless circumstances tending to alter it were brought to bear on that character, it could readily be perceived that some species of *Lepidoptera* might resemble one another in coloration, by reason of the resemblance of each to a common parent similarly coloured.

3rd. Resemblances the result of exposure to similar circumstances; for undoubtedly, if the Darwinian theory were true, the coloration of species of *Lepidoptera* must be referred sooner or later to external causes operating on the organism. But the cases where mimicry occurred were cases in which the species, being constantly found together, were necessarily to a very great extent subjected to the same external conditions. Thus in a certain locality a species of *Leptalis* was found closely resembling a species of *Heliconia*, and in another locality a second and allied species of *Heliconia* was found. Mr. Wallace would say that this *Heliconia* differed from the first *Heliconia* because of the changed circumstances to which it was exposed: but with this second species of *Heliconia* was found a second species of *Leptalis*, differing

from the first species of *Leptalis* in nearly the same manner as the second species of *Heliconia* differed from the first, and this was easily comprehensible, its companionship with the *Heliconia* having exposed it to exactly the same disturbing influences.

4th. This class was that to which Messrs. Bates and Wallace referred all these resemblances, and it was the only one that could correctly be spoken of as mimicry; the colour of the *Heliconia*, without any reference to common descent or to the operation of similar external agencies, being the determining cause of the colour of the *Leptalis*.

Dr. Sharp offered some criticisms on the theory advanced by Messrs. Bates and Wallace, and argued —

1st. That natural selection was a power of differentiation, and, although it was quite possible that a differentiating power might work so as to produce resemblances, it was at first sight improbable that it should do so; and more evidence was required of the truth of a paradox than a truism.

2nd. It must be shown that animals possessing the so-called mimetic resemblances occurred far more frequently in company with one another than away from one another. But if this were shown, a single case of such resemblance between animals living in different localities would throw doubt on the theory, by suggesting that there was, probably, some more comprehensive law which would account for *all* those resemblances.

3rd. It must be shown that the cause of the rarity of the *Leptalis* was one acting on the insect entirely or chiefly while it was in the perfect state; this had not been done, and it was improbable that it could be; for the most critical periods in the life of *Lepidoptera*, as regarded their enemies, were the larval and pupal states.

4th. It must be shown that the enemy (whatever it might be) which attacked the *Leptalis* sought its prey principally by the sense of sight; but this suggested another improbability. If the *Heliconia*, which the *Leptalis* resembled, was protected by its nasty odour, surely the bird or other enemy of the *Leptalis* must be very foolish to let it escape when it smelt nice, because it *looked* like the *Heliconia*. The purpose of protection would have been better accomplished by the *Leptalis* mimicking the *Heliconia* in that point by which the *Heliconia* was protected.

5th. A forcible objection to the mimicry theory (as already pointed out by Prof. Westwood) was the rarity of the mimicking species. The theory involved the hypothesis that there was a time when the *Leptalis* differed in pattern from the *Heliconia*; was the *Heliconia* then commoner than now, or as rare? If commoner, it was curious that, when not protected, it flourished better than now, when protected. If as rare, how could it have survived at all before and during its transmutation? It would, perhaps, be suggested that the *Leptalis* was formerly commoner than now, and that some enemy arose, rendering it necessary that the *Leptalis* should find a new means of defence. This, however, was mere supposition, and it was almost impossible to adduce facts to prove it; but supposing it to be the case, why did not the enemy exterminate the *Leptalis* when it did not resemble the *Heliconia*, as (according to the theory) it would now, but for this resemblance. The further supposition must be made, that the enemy was not at first very dangerous to the *Leptalis*, and that in proportion as it grew dangerous, the *Leptalis* grew more and more to resemble the *Heliconia*: it was certainly very fortunate for the *Leptalis* that spontaneous variations, bringing it to resemble the *Heliconia*, should occur in the exact proportion required for its safety.

6th. Again, taking the time when the *Leptalis* differed in pattern from the *Heliconia*, it was said that specimens exhibiting small variations approximating to the *Heliconia* were selected for the preservation of the species. But a small variation in marking would be of no practical service to the *Leptalis*, especially as it was by its nasty *odour* that the *Heliconia* was protected; to which it might be added that on the theory of Natural Selection no reason or fact was brought forward to induce the belief that variations of the required sort should occur at all.

In conclusion, whilst admitting the impossibility that such a theory as that of mimetic resemblances could ever be shown by facts to be correct at all points, Dr. Sharp was of opinion that the evidence as yet adduced was insufficient to convince an unprejudiced observer. The most that could at present be said of the theory was, that it was very ingenious, and might or might not be true.