

Blasius states that he himself saw it at Antibes in the south of France, and he repeatedly obtained it from the Alps in south-eastern France. It has also been taken at Stuttgart; and Rüppell mentions that it has been sent to him from America. In this country it has long been known to rat-catchers in the neighbourhood of the docks both in London and Liverpool.

---

Contributions to an Insect Fauna of the Amazon Valley.—*Lepidoptera*:—*Heliconinæ*. By H. W. BATES, Esq. Communicated by GEORGE BUSK, Esq., Sec. L.S.

#### ABSTRACT.

[Read Nov. 21st, 1861.]

THE author, who founds his memoir on personal observations made on the banks of the Amazon, commenced by defining the limits of the group. It comprises a number of strangely formed butterflies peculiar to tropical America. Its relations to the allied groups, *Danainæ*, *Acræinæ*, and true *Nymphaliniæ*, are of a peculiar nature, as it contains two essentially distinct types of form, the one having an affinity with the *Danainæ*, the other with the *Acræinæ*, or with the *Argynnide* group of *Nymphaliniæ*. As, however, all authors have combined them into a district family, and they are homogeneous in external aspect, they will be treated as sections only of the sub-family, viz. Danoid and Acræoid *Heliconinæ*, instead of referring them, one to the *Danainæ*, and the other to the *Acræinæ*, and thus sinking the group *Heliconinæ*. This view of their affinities throws great light on the affiliation of the forms—an object to which all efforts in systematic zoology obscurely tend. The *Danainæ* and *Acræinæ* are common to the hot zones of both hemispheres; and the *Heliconinæ* being the highest development of the common type, it results that the latter reaches its highest development in the tropics of the new world. The species are most numerous where the forests are most extensive and humid. They are characteristic of their region, and, like the Platyrrhine monkeys, the arboreal Gallinacea (*Penelopidæ* and *Cra-cidæ*), and other groups, point to the gradual adaptation, during an immense lapse of time, of the fauna to a forest-clad country. Two hundred and eighty-four species have already been described; but every collection made in a newly explored part yields several new ones. In some of the genera they are confined to very limited areas, the species being found to change in the uniform country of the Upper Amazon from one locality to another not further re-



moved than one hundred to two hundred miles. Such species, however, have often the character of local varieties, some of them indeed showing the connecting links. From facts observed, it would seem that the excessive multiplication together with the distinctness of the species were owing to their great susceptibility of modification, combined with the habit in pairing of selecting none but their exact counterparts, and probably other causes tending to eliminate the intermediate gradations. The species are mostly extremely numerous in individuals, and show every sign of flourishing existence, although they are of feeble structure, and fly slowly in exposed situations frequented by swarms of insectivorous animals. They are gregarious in habits, the individuals of the same species and clusters of closely allied species being found in company restricted to limited spots in the forest. They are often seen in pairs or small parties, apparently engaged in a kind of dance. The large handsome species are so numerous in some places that they form part of the physiognomy of the localities. The only secondary sexual characters are tufts of hairs on the fore margin of the hind wing in the males of most of the *Acræoid* group. These appear to be of no particular utility, but are apparently analogous to the pencil of hairs on the breast of the male turkey. The allied group, *Danainæ*, afford a similar feature, the males having a horny excrescence on the *disk* of the hind wing, which is evidently homologous with the structure above described. The most interesting part of the natural history of the *Heliconinæ* is the mimetic analogies of which they seem to be the objects. This involves questions of the highest scientific interest. Many of the species are mimicked by members of widely distant groups, *e. g.* *Papilio* and *Leptalis* (*Papilionidæ*), *Ithomeis* (*Erycinidæ*), *Castnia* (*Castniadæ*), *Diopis*, *Pericopis*, *Hyelosia*, &c. (*Bombycidæ* moths). It is fair to conclude that they are the objects imitated, because they all have the same family facies, whilst the analogous species are dissimilar to their nearest allies—perverted, as it were, from the normal facies of their genera or families. The mimicking species are found in company with the *Heliconinæ*; and it often happens, where these latter are modified into local varieties, species or local varieties of the former in an analogous dress also occur with them. A parallel series of imitations occurs in the old-world tropics, where it is the representatives of the *Heliconinæ* that are the objects imitated. The instance of this kind of analogy most familiar to European entomologists is that of the species of *Trochilium* (a genus of moths),



which mimic strangely various bees, wasps, and other Hymenopterous and Dipterous insects. The *Heliconinæ*, however, mimic each other to a great extent—the parallel species belonging to quite distinct genera. In this case also, when the species present local varieties, the analogues are modified in precisely the same way, so that two or three species belonging to different genera resemble each other so much that they can scarcely be distinguished except by their generic characters. Endless instances of these imitative resemblances occur in entomology. Why they are so plentiful and amazingly exact in insects, whilst so rare and vague in the higher animals, is perhaps owing to the higher degree of specialization attained by the insect class, which is shown also by the perfection of their adaptive structures and instincts. Their being more striking and numerous in tropical than in temperate countries is perhaps attributable to the more active competitive life and the more rapid succession of the generations in the former than in the latter. The meaning of these analogies is not difficult to surmise. In the first place, they cannot be entirely the result of similarity of habits or external physical conditions necessitating similar external dress. They are of the same nature as the assimilation of an insect or other animal in superficial appearance to the vegetable or inorganic substance on which it lives. The likeness of a beetle or lizard to the bark of the tree on which it crawls cannot be explained as an identical result produced by a common cause acting on the tree and the animal: one is evidently adapted to the other. The infinite variety of resemblances between insects and plants or inorganic substances—between predaceous animals and their victims—the adaptation of organs or functions to the objects or habits they relate to—are all of the same nature. They are adaptations either of the whole outward dress or special parts, all having in view the welfare of the creatures that possess them. Every species in nature may be looked upon as maintaining its existence by virtue of some endowment enabling it to withstand the host of adverse circumstances by which it is surrounded. The means by which the existence of species is maintained are of endless diversity; and amongst them may be reckoned the resemblance of an otherwise defenceless species to another whose flourishing race shows that it possesses peculiar advantages. The *Heliconinæ*, by the great number of their individuals, show themselves to be a favoured family. It is not easy to discover anything in their structure or habits which might give them an advantage. There



is some cause to believe that they are unpalatable to insectivorous animals—at least the *Acræoid* group. This would not explain, however, the numerous mutual resemblances of the *Heliconinæ*. All that we can say is, that some species are more successful in the battle of life than others, and that it is an advantage to others not otherwise provided for if they are brought to be deceptively similar to them. The process by which this is brought about in nature is a problem involved in the wider one of the origin of all species and all adaptations. There are some curious facts, however, in the geographical distribution of the species and varieties of certain members of the genus *Leptalis* which throw great light on the subject, at least as far as the *Leptalides* are concerned, which offer perhaps the most remarkable cases of mimicry. It would appear by these facts that a mimetic species has not always existed under the same specific mimetic dress which it now wears, as the following example shows. *Leptalis Lysinoë* in one district is very variable, but none of its varieties mimics very closely a Heliconine species there residing; they rather tend to imitate species of *Stalactis*—another flourishing group belonging to a different family; but a few individuals occur intermediate in character, and quite uncertain in their analogies. In another district, again, this species is very variable, and some of the varieties are indeterminate in their analogies, but the greater number resemble to deception one or other of three species of *Ithomia*, amongst which only they are found, and from which they are quite undistinguishable, except when closely examined in the hand. In a third locality this *Leptalis* is found under one form only, distinct from any of the varieties occurring elsewhere, but mimicking closely an *Ithomia* also found there and not in the other two districts. Thus we see that, although the changes a species undergoes, first simply variable, and then presenting local varieties closely mimicking other forms, cannot be watched in nature as they take place successively, they can be seen as it were simultaneously by tracing them over the area of its distribution. *Leptalis Lysinoë* is a species of great rarity, and therefore liable to complete extinction. It seems fair to conclude that, as the *Ithomiæ* which it mimics are certainly spared by the swarms of insectivorous birds which daily sweep through their abodes, the *Leptalis*, not being so favoured, escapes destruction by wearing the livery of the *Ithomiæ*. It may be added that the family to which *Leptalis* belongs (*Pieridæ*) are certainly much persecuted by insectivorous animals. As, then, the *Leptalis* varies from one locality to another, some few of its varia-



tions being of uncertain character, it seems evident that when the mimicry is complete the indeterminate and intermediate grades of variation have been eliminated by insectivorous animals. The *Leptalides* have probably been subjected to this untiring persecution, even to the verge of extermination, in each successive generation throughout an immense lapse of time. By living in the vicinity of other species free from the same persecution, and being already similar to them in general appearance, this latter being inherited through a long line of ancestors which have been more or less subjected to similar conditions, such of their varieties as nearest resembled the protected species would escape destruction and thus alone propagate their kind. General resemblances between forms may be owing in some cases to similar habits, or to such general causes as have produced what are called recurrent animal forms; this general resemblance must exist before the causes which produce mimetic analogies can come into play. It must be remarked that some of the exact resemblances already alluded to between species of *Heliconinæ* seem not to be owing to the adaptation of one to the other, but rather (as they have a real affinity, the genera to which they belong being throughout very similar in colours and all equally flourishing) to the similar adaptation of all to the same external local conditions. The check which acts by destroying the indeterminate variations in these cases would not be the same as in *Leptalis*; in other respects, however, the same law of nature appears, namely, the selection of one or more distinct varieties by the elimination of intermediate gradations. It may be remarked also that a mimetic species need not always be a rare one, although that is very generally the case: it may be prolific, or its persecution may be intermitted when the disguise is complete. The operation of checks successively eliminating variations unfavourable to a species, as thus explained, produces the impression of a stimulus impelling an advance of organization in a special direction. This apparent direct advance suggests the only other scientific explanation that could be suggested, viz. the operation of volition or an innate tendency in the creatures themselves to become gradually assimilated to other forms, and thus acquire a disguise favourable to the species. On examination, however, this explanation is found to be untenable, and the appearances which suggest it illusory. Those who earnestly desire a rational explanation must arrive at the conclusion that these apparently miraculous but always beautiful and wonderful mimetic resemblances, like every other kind of adaptation in beings, are brought about by causes similar to those here discussed.