

The Flight of Butterflies

IN the 103rd number of NATURE there are two notices of remarkable butterfly flights in America, and it is asked "Where the yellow butterflies are going?" Mr. R. Spruce, in "Notes on some Insect and other Migrations observed in Equatorial America" (published in the Journal of the Linnean Society, vol. ix. No. 38, read June 6, 1867), has the following curious account of similar flights, which, he says, have also been described by Messrs. Edwards, Wallace, and Bates: "The first time that I fell in with such a migration was in November 1849, near the mouth of the Xingú, when I was travelling up the Amazon from Pará to Santarém. . . . We saw a vast multitude of butterflies flying across the Amazon from the northern to the southern side in a direction from about N. N. W. to S. S. E. They were evidently in the last stage of fatigue. They were all of common white and orange yellow species, such as are bred in cultivated and waste grounds, and having found no matrix whereon to deposit their eggs to the northward of the river (the leaves proper for their purpose having probably been already destroyed or at least occupied by caterpillars) were going in quest of it elsewhere. The very little wind there was, blew from between E. and N. E., therefore the butterflies steered their course at right angles to it; and this was the case in subsequent flights I saw across the Amazon. . . . But the most notable circumstance is that the movement is always southward. . . . Since my return to England I have read Mr. Bates's graphic description of a flight of butterflies across the Amazon, below Obidos, lasting for two days without intermission during daylight. These also all crossed in one direction, from north to south. Nearly all were species of *Callidryas*, the males of which species are wont to resort to beaches, while the females hover on the borders of the forest and deposit their eggs on low-growing, shade-loving *Mimosas*. He adds, 'the migrating hordes, so far as I could ascertain, are composed only of males.' It is possible, therefore, that in the flights witnessed by myself the individuals were all males - in which case the flights should probably be looked upon, not as migrations, but as dispersions, analogous to those of male ants and bees when their occupation is done, and they are doomed by the workers to banishment, which means death. In the case I am about to describe, however, the swarms certainly comprised both sexes, although I know not in what proportion; and their movements were more evidently dependent on the failure of their food.

"In the year 1862 I spent some months at Chandsey, a small village on the desert coast of the Pacific northward of Guayaquil, where one or two smart showers are usually all the rain that falls in a year; but that was an exceptional year, such as there had not been for seventeen years before—with heavy rains all through the month of March, which brought out a vigorous herbaceous vegetation where almost unbroken sterility had previously prevailed. In April swarms of butterflies and moths appeared coming from the East, sucking the sweets of the newly-opened flowers, and depositing their eggs on the leaves, especially of a *Boerhaavia* and of a curious *Amaranth*, until the caterpillars swarmed on every plant. New legions continued to pour in from the East, and finding the field already occupied, launched boldly out over the Pacific Ocean, as Magalhaens had done before them, there to find a fate not unlike that of the adventurous navigator. No better luck attended most of the offspring of their predecessors, especially those who fed on the *Boerhaavia*. The shoal of caterpillars advanced, continually westward, eating up whatever to them was eatable, until, on nearing the sea shore and the limit of vegetation, I used to see them writhing over the burning sand in convulsive haste to reach the food and shelter of some *Boerhaavia* which had haply escaped the jaws of preceding emigrants. The explanation of this continual westward movement is not difficult. A few leagues inland, instead of the sandy coast-desert with here and there a tree, we find woods, not very dense or lofty, but where there is sufficient moisture to keep alive a few remnants of the above-mentioned herbs all the year round, and doubtless also of the insects that feed on them. There are also cattle farms. When the rains come on, therefore, they cause as it were a unilateral development of the vegetation from the forest across the open ground, and a corresponding expansion of the insect-life which breeds and feeds upon it."

The whole paper is very interesting, but I have copied only such portions as bear on the question "Where are the yellow butterflies going?"

T. S.-M.

The Origin of Insects

IN an article by Dr. Beale, in your number for Nov. 23, on "One of the Greatest Difficulties of Darwinism," a most extraordinary misconception is stated to be a difficulty. That the pupa state is a modification of the ordinary process of skin-shedding in the Insecta is proved by so many facts, that one cannot understand for a moment how it can possibly be denied, much less how its denial can be made use of as an argument against the doctrine of evolution. Sir John Lubbock pointed out long ago that, in the development of the Insecta, every grade of modification exists between those insects which are gradually developed, each successive ecdysis producing only the slightest possible modifications, and those which undergo a change so complete that it may be likened to the process of metagenesis, as it has been called, which takes place in the Echinodermata.

It is an utter mistake to suppose that any insect is redeveloped during the pupa state. The most perfect instance of metamorphosis is that of the flies (some Diptera). In these the materials out of which the perfect insect is developed are supplied by the breaking up of the muscular system and fat bodies of the larva; but the cellular structures known as the Imaginal discs of Weismann are formed in the egg, and persist all through the life of the larva. These, it is true, only form a skin or case in which the fly is developed; but they are really nothing more than a larva skin, formed on the inside of the larva skin in the egg, and detached from it by the subsequent modifications of the larva.

The nervous system undergoes extensive modification in the development of the fly, but it never undergoes degeneration. The mouth organs of the imago, it is true, are not the mouth organs of the larva, nor are they formed by their modification, but they are foreshadowed in the egg before the mouth organs of the larva are formed. It is the mouth organs of the larva which are new formations, not those of the imago. In this most extreme case, the pupa skin is derived directly from the inner layers of the first larval skin, about twelve hours before the creature emerges from the egg. The imaginal skin is likewise derived from cells laid down in contact with the imaginal discs. There is absolutely only a difference in the time at which the successive skins are formed in this and in ordinary ecdysis.

A cimex which undergoes no change of form develops each successive skins from cells laid down within the last integument, and the same process is followed in the development of the fly.

The alimentary canal is likewise undoubtedly formed in a similar manner around that of the larva, and the sexual organs are gradually developed, even from the time when the embryo is enclosed in the egg.

Fritz Müller in his "Facts for Darwin," has shown very conclusively that the larval forms of insects are probably derived from imaginal forms; such seems, without doubt, to be the case with the flies (*Musca*). Every day the difficulties presented by the development of the Insecta to the doctrine of evolution are vanishing. It is extremely probable that insects first emerged from the water with fully formed wings. We have still relics of an aquatic winged insect fauna in the hymenopterous genus discovered by Sir J. Lubbock. We may readily believe the larval forms now existing on the earth are modified forms of originally perfect insects; we know that the larvæ are subject to far greater changes of life and far greater struggle for existence than the perfect insects. They are all probably embryonic forms, brought from the egg in a modified state before their perfect development is attained. The same thing is seen in several crustaceans, which are hatched as *Nauplius* forms, whilst all their allies attain the *Zoea* stage in the egg. The existence of mandibulate larvæ in insects which in the perfect state have suctorial mouths, is an additional argument in favour of this view. It appears to be either a reversion in the larva to an anterior type, for the earlier types of the Insecta were undoubtedly mandibulate, or it may be an embryonic character, which has never been lost in the egg, modified by reversion or circumstances. This view may appear fanciful, but the aortic arches of a fish undoubtedly exist in the mammalian embryo, and no one can say what changes might take place by reversion in those arches under altered conditions. Teratological embryology goes far to show that the embryo may revert to long anterior types in its development.

I should, however, transgress too far on your valuable space in giving proofs of all that has been put forward. I trust, how-