instances in various parts of the world in which *Papilios* of certain groups are the objects of mimicry. Although Mr. Scudder has never seen a bird capture a butterfly, others have been more fortunate, and that they are thus captured very largely in the tropics is certain. It is not improbable, from the rarity of mimicry in the temperate zone, that the few cases which exist may have been produced under the more favourable climatal and organic conditions of the semi-tropical epochs anterior to the glacial period. ALFRED R. WALLACE

## The Difficulties of Natural Selection

THE papers read by me before the Entomological Society "On the Relation between the Colour and the Edibility of Lepidoptera and their Larvæ" having been noticed and commented upon by Mr. A. W. Bennett and others in NATURE, I have deemed it desirable to offer a few remarks on the subject.

The object I had in making the experiments was to ascertain whether there could be proved to exist any relation between the colours of larvæ and their edibility.

The disciples of Mr. Darwin argued that the brilliant colours of so many male birds arose from sexual selection, and that the equally striking colours of flowers were but guides to insects, to enable them to distinguish, at some distance, the flowers from the leaves, and thus insure fertilisation by the interchange of pollen. Such reasons, however, were quite valueless to account for the bright colours of the asexual larvæ of many Lepidoptera, several species of which are banded and striped with blue, yellow, and red; colours which instead of concealing them by harmonising with the leaves on which they feed, are often in complete contrast with them.

Now Mr. Wallace had a theory that these gaily coloured larvæ were uneatable by birds, and that their gay colours were protective, because if they were indistinguishable from eatable species, they would be seized by birds, and though rejected afterwards, would be so much injured that the probability of their becoming imagines would be very remote, even if they were not at once killed.

This I found to be the case; in my experiments extending over many years, and most carefully made with several species of birds, I have not met with one instance in which a strikingly-coloured larva was eaten. In most cases they were not even regarded when thrown into the aviary, although I had several birds always on the watch for the eatable species, with which I constantly fed them; while these latter were seized immediately they were seen.

The larva of the *Cucullia verbasci* is conspicuously coloured blue and yellow, and feeds without any attempt at concealment on several species of Verbascum. I placed the plants in the aviary, and fed the Cuculliæ upon them until every leaf was devoured, and the caterpillars gnawed holes in the stem; but not one was in the slightest degree injured, yet at the same time other larvæ were greedily eaten.

On the other hand, I found that all larvæ were eagerly eaten which have soft smooth bodies and dull colours, while the hairy larvæ are rejected entirely.

These eatable species are protected in various ways; some are nocturnal in their habits, descending to the ground during the day; some feeding on the under sides of the leaves; others arrange their bodies in a line with the shoots of the plants and look like a streak of the bark; some are of precisely the colour of the leaves, or even of the corolla of the plant on which they feed; others roll themselves up in leaves, the larvæ of the *Geometridæ* are often exactly like twigs, with the terminal and side buds imitated.

This latter resemblance is so complete that, after being thirty years an entomologist, I was deceived myself, and took out my pruning scissors to cut from a plum-tree a spur which I thought I had overlooked. This turned out to be a larva of a Geometer two inches long. I showed it to several members of my family, and defined a space of four inches in which it was to be seen; but none of them could see that it was a caterpillar. Surely this was a case of protective mimicry.

All the eatable larvæ agree in not moving when there appears the least danger, and very rarely moving at all during the day.

Even if there were no cases of protective mimicry in the larval states of Lepidoptera, I do not think that would be any argument against the existence of such in the perfect state. It appears to me rather that as so few specimens become imagines in proportion to the eggs produced, the more need is there that these few should survive.

I cannot, therefore, agree with Dr. Scudder in thinking that mimicry has been supposed to exist where it is least wanted, viz., in the perfect state of Lepidoptera. Nor can I coincide with Mr. Bennett that it is a matter of indifference to the supporters of the theory of Natural Selection whether twig-like caterpillars are eaten by birds or not. My point is that they are often so like twigs that they are passed over as such by insectivorous birds, and that the closer the resemblance the better their chance of escape.

I believe myself that Mr. Darwin's theory will survive, and even be benefited by, the criticisms of its opponents; but what I do dread is the injury it may receive from the false arguments of some of its illogical supporters.

Lest I may unwittingly place myself in the latter category, I will bring my remarks to a close. J. JENNER WEIR

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## Butterflies and Birds

A CORRESPONDENT in NATURE, Dec. 22, states that after fifteen years' experience in butterfly hunting, he has never seen one in a bird's bill. I was not aware the circumstance was unusual, for I have frequently seen the common sparrow chase and capture such butterflies as *V. urticæ* and *P. rapæ*. It is quite a hare and greyhound affair, the butterfly often eluding for some time the swift pounces of its pursuer, so that the hunt is a long one. T. G. B.

St. John's College, Cambridge

## Ceratodus Forsteri

SIR PHILIP GREY EGERTON presents his compliments to the Editor, and would esteem it a favour if he would insert the following paragraphs, from two letters recently received from Professor Agassiz, in an early number of NATURE. It will be gratifying to all men of science to know that the distinguished Professor has so far recovered from his late severe illness as to be able again to interest himself in scientific pursuits.

Oulton Park, Tarporley

"Cambridge, November 9

"I am slowly recovering, and find myself gradually returning to the ways of active life. As I wake anew to feel an interest in scientific pursuits, there is nothing for which I have a greater longing than the fossil fishes. If I could leave my house I would fly to you to resume the examination of your and Lord Enniskillen's collections. The recent discovery of Krefft has added fuel to the fire, and I feel the most intense desire to revise the facts bearing upon the relations of the Ganoids and Selachians in general, and more particularly those of the Cœlocanthi, to which, from the examination of the skeleton sent me by Krefft, I find his *Ceratodus Forsteri* belongs. It will no doubt turn out that the Dipterini are close relations. In this connection I am reminded of what you once wrote to me of the teeth of Ctenodus. Will you now have the kindness to give me all the particulars? I am having sections of the teeth of *Ceratodus Forsteri* and some of the fossil species made for comparison. I have little doubt already that this genus will turn out to be one of the most curious *synthetic* types (I call them) in the animal kingdom, exhibiting characters of Placoids (Selachians) in the teeth, Ganoids in the scales, their embryonic characters in the preservation of a dorsal chord, instead of distinct bony vertebræ, and finally hollow bones as in birds."

"Cambridge, Dec. 8

"I take it some of your naturalists will crow over what they will be pleased to call my stupendous mistake in referring the teeth of Ceratodus to the Selachians, when the fish proves to have large imbricated scales; and yet I never was more pleased than when I learned the fact, for it settles beyond dispute the existence in nature of types, to which I have long ago called attention, under the name of *synthetic types* (see my Essay on Classification), but of which naturalists have thus far taken little or no notice. When I described the teeth of Ceratodus as those of a distinct genus among the Cestracionts, I was led to do so by appearances which secured for this association the assent of all naturalists. As long as the fossil teeth only were known, nobody questioned the relationship. Owen himself, in his 'Odontography,' mentions the teeth of Ceratodus and their structure, and has not a shadow of a doubt that I am right in placing that genus near Cestracion; and now comes the discovery that Ctenodus, a genus also referred to the Cestracionts, is based upon the dental plate of a bony fish, closely allied to the one recently discovered by Krefft, and referred by him to