BIRDS AND BUTTERFLIES

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THE extraordinary mimetic resemblances which exist between certain apparently edible species of insects and other distasteful species, which are found in the same neighbourhood, reach their highest development in the Rhopalocera or butterflies. The resemblances are purely external and frequently confined to the upper surfaces of the wings only. They are obviously meant to deceive an eye.

If this mimicry has been brought about by natural selection of smaller or larger variations because they are of survival value to the mimics, there must be some enemy whose eye is deceived, and further, in view of the perfection of many of the resemblances, it must be sometimes not deceived by the less perfect resemblances.

Undoubtedly the chief death-rate of butterflies is in the egg, caterpillar and chrysalis stage, but these resemblances which we are now considering are in the adults, so that we have to search for an enemy which can exert a considerable selection pressure in the short period between the emergence of the butterfly from the chrysalis and the time that most of its eggs are laid; for after this latter no selection is of survival value to the race.

We need, therefore, a sharp-eyed predator which is active by day and which sees the butterflies when their upper surfaces are exposed, that is, probably when in flight. Birds are the obvious choice, but when the suggestion was first critically examined it was found that the evidence of bird attack on butterflies was very small. Quite experienced field naturalists commented on its rarity.

In the subsequent search for evidence two promising lines of work have been in progress. At an early stage field experiments were made by offering to tame or wild birds butterflies that were believed to be palatable or distasteful, together with mimics of the latter.

More recently, progress has been made by the discovery that the butterfly wings often show definite marks where they have been nipped by the beak of a bird. In these cases, of course, the butterflies have been fortunate enough to escape. The marks may be so definite that the size and angle of the beak may be measured and a close guess made at the group or even species of bird that caused the injury.

Prof. G. D. H. Carpenter has been associated with these lines of study for many years and in two recent papers*, one prepared from notes left by the late C. F. M. Swynnerton, he brings forward much new evidence on both counts.

On the problem of the relative frequency of beak marks he shows that in more than ten thousand museum specimens of the distasteful genus *Euploea*, 123 (1.15 per cent) showed beak marks on the wings; in more than six thousand African *Danain* butterflies, also distasteful, 117 (1.05 per cent) had marks; but in more than seven thousand African *Colotes* spp., a quite edible genus, only 11 (0.15 per cent) were marked.

* (1) Observations and experiments in Africa by the late C. F. M. Swynnerton on wild birds eating butterflies and the preferences shown. *Proc. Linn. Soc. Lon.*, Session 154, 10-46 (1942).

(2) The relative frequency of beak marks on butterflies of different edibility to birds. *Proc. Zool. Soc. Lon.* (A), 111, 223-230 (1941).

The inference is, as Prof. Carpenter points out, not that the distasteful species are more frequently bitten by birds, but that, being bitten, they more frequently escape or are allowed to escape.

A comparison was also made between 550 distasteful *Danaine* models which showed 17 individuals with beak marks, and 340 *Nymphaline* mimics, of which there was only a single one with a beak mark.

In an appendix to this paper, it is also shown that of 613 distasteful butterflies from all parts of the world which had beak marks, 133 or 21 per cent had evidence of more than one attack, while of 179 edible butterflies with beak marks only 21, or 11.7 per cent, had evidence of more than one attack. The difference is statistically significant.

Prof. Carpenter's conclusion, which seems to be justified, is that distasteful (aposematic) species are more frequently found with beak marks because they "live to fight another day", owing to not having been eaten by their bird enemies even when they have been seized.

The summary of Swynnerton's field experiments is a mine of interesting information. The main portion deals with the behaviour of birds towards butterflies of different species which were 'planted' in positions visible to the birds but prevented by various means from flying away. Twenty-two such experiments are described and the results are very striking. Time and time again the more distasteful species are either completely neglected, or, even more convincingly, carefully examined at first and then neglected. The more palatable species, on the contrary, were eaten in very high proportions. The distinction between palatable and distasteful is not absolute but comparative, and very hungry birds will eat relatively distasteful species, while replete birds will require to be tempted by a particularly choice morsel. Other things being equal, a hungry bird will eat a large butterfly in preference to a smaller one.

In one example given (Section C, Experiment 1), 84 butterflies were exposed, and after five hours 45 had been eaten. Among the butterflies were 7 *Danains* (aposematic), none of which had been touched, and 24 *Vanessa cardui*, of which 22 had been eaten.

In other experiments the birds were shown to be definitely deceived by mimics of aposematic species.

There is no doubt that a considerable body of evidence has been brought forward to show that birds are important and critical enemies of butterflies, that they have to learn by experience the appearance of distasteful species, and that once having learnt this they are frequently deceived by mimetic resemblance.

UTILIZATION OF GLASS

PROF. W. E. S. TURNER read a paper on "New Uses for Glass" before the Royal Society of Arts on January 20. He briefly traced through history the development of the use of glass from its main original use for decorative purposes to its ever-widening use as an essential material for utilitarian purposes. No period has seen more fruitful advances than the past fifteen years.

Systematic scientific investigation has resulted in providing us with glasses having a density from 2 up to 8: a coefficient of thermal expansion varying at least thirty-fold; a range of thermal endurance such