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What are the uses of bright colors in Hymenoptera?

BY T. D. A. COCKERELL.

Following somewhat on the lines indicated in my letter published in the February number, p. 27, with the editor's permission, I will put the above question to your readers. Hereafter, I may have something to say on the uses of color among insects in general, but the present question seems so suitable for general investigation that I will briefly give some of the *pros* and *cons* and leave your readers to work the matter out themselves if they will. In that admirable work, "Darwinism," Dr. A. R. Wallace lays considerable stress on "Warning coloration," and shows that many animals are conspicuously colored as a sign that they are dangerous or inedible. With insects this is said to be specially noticeable, and thus insectivorous birds and other enemies of the insect tribes get to know and avoid those they cannot eat, to the great advantage of such.

On p. 233 of "Darwinism" is a reference to the Aculeate Hymenoptera in this connection, as follows: "We all know how well marked and conspicuous are the colors and forms of the stinging wasps and bees, no one of which in any part of the world

is known to be protectively colored like the majority of defenceless insects." Reading this I at once called to mind the numerous dull-colored species of *Andrena*, *Halictus*, etc., and the brilliantly-colored, non-aculeate Chrysididæ and Chalcididæ, so that it seemed to me that in this case, at any rate, "warning coloration" was not self-evident, so I submitted the point to Dr. Wallace, himself, who replied:

"Though the Andrenidæ are not usually gayly colored, yet they are not *inconspicuous*. The Chrysididæ are, I should think, colored so brilliantly partly, perhaps, to simulate stinging species, and partly to prevent their being taken for fruits or seeds when rolled up. They are *very* hard, and like many hard beetles are colored as a *warning of inedibility*." (A. R. Wallace *in litt.* Feb. 10, 1890)

Here it would be interesting to learn whether the Chrysididæ* are eaten by insectivorous birds. A spider, *Xysticus cristatus*, has been recorded as preying on *Chrysis ignita* in Lincolnshire, England, by Mr. H. W. Kew.

But to return to the *aculeata*, are they notable for warning coloration? To ascertain the exact state of the case from one who has paid much attention to the subject. I applied to Mr. Ashmead and here is his reply:

"The family Chalcididæ is without doubt the most extensive in the order, and taken as a whole the most brilliantly colored; no other family, not even excepting the Chrysididæ, can compare with it in the metallic brilliancy of its members. "In my opinion, when the species are thoroughly worked up, in this single family alone, their members will more than double the species in *all* the families of the *Aculeata* taken together, so numerous are they.

"It is really only among the parasitic bees that we find much brilliant metallic coloring, a few genera in Apidæ and Andrenidæ.

"In Andrenidæ only two genera, *Angochlora* and *Agapostemon* are very brilliant, although some *Halicti* show some.

* Although the Chrysididæ are classed with the bees, etc., they are not *aculeata*. Mr. Ashmead has kindly stated their systematic position to me as follows: "Although they are certainly *Hymenoptera monstrocha* and belong to the section with the bees, strictly speaking they can hardly be called true *Aculeata*, being, as Latreille observes, 'sur les confins des deux sections,' and were formerly classed with the *Terebrantia*. I agree with Westwood in considering them more closely allied to certain Proctotrupidæ, i.e., the Dryinæ and Bethylinæ, than to the bees. If I had the time I could point out some very remarkable structural similarities." (*in litt.* Feb. 5, 1890)

"I am of course speaking of the insects found in N. America, as I am not very familiar with exotic or oriental forms.

"In family Vespidae there are none; in Eumenidae none; in Masaridae none; in Crabronidae only a few species in the genera *Trypoxylon* and *Oxybelus* show any and then usually confined to the pubescence; in Pemphredonidae all are black or ornate with white and yellow; in Mellinidae and Mimesidae the same, although sometimes the pubescence is silvery or golden; in the Philanthidae they are highly colored, but are not metallic, or but seldom show any metallic splendor; in Nyssonidae and Bembicidae the same; in the Larridae some of the forms do, but strictly speaking they are not brilliant, and the metallic coloring is usually confined to the vestiture; the family Ampulicidae has but one species in America, and that is dark colored. In the family Sphecidae a large percentage show metallic colors, but only a few are very brilliant; in Pompilidae only a few; the Sapygidae are highly colored, but not metallic; in the Scoliidae only a few forms, while in the Mutillidae and Formicidae none that I know of.

"So now you have the showing, the North American *Aculeata* make, in a nutshell (W. H. Ashmead *in litt.* Feb. 5, 1890)."

From which summary it becomes evident that, as a whole, the *aculeata* do not compare in brilliancy with very many of the non-stinging kinds. Nor is it clear that the stings altogether protect the bees and wasps from birds, or render them inedible. Dr. Wallace remarks (Darwinism, p. 239): "We see that even the powerful stings of bees and wasps only protect them against some enemies, since a tribe of birds, the bee-eaters, have been developed to feed upon them, and some frogs and lizards do so occasionally."

Dr. Riley records that sparrows (*Passer domesticus*) feed on *Halictus*, *Tiphia*, *Myzine* and ants. In no less than *thirty* cases was *Myzine sexcincta* found in the sparrow's stomachs, and this is a brightly marked (though not metallic) species, which, perhaps, theoretically should not have been eaten. I have found ants in the stomach of *Sialia arctica*, shot in Custer County, Col. The stomach of a woodpecker, shot by Rev. A. Wright in the same locality, contained a great number of ants; the majority apparently *Formica fusca*, with a few *F. integra*. In England the tom-tit (*Parus*) is known to wage constant war against *Bombus*.

So clearly, the *Aculeata* do not always escape! *Myzine sexcincta* is marked pretty much as most of the species of *Vespa*, *Odynerus* and *Crabro*, and yet is not protected. So here is the great class of yellow markings on black, apparently useless for warning purposes. The humming and buzzing of bees may likely frighten their enemies in some cases. Certainly it scares those of the genus *Homo* in most cases. But that has nothing to do with the colors.

There seems to be a tendency for insects which are carnivorous in their early stages to be metallic, but there are very many exceptions to this rule. Thus in Coleoptera the Carabidæ are often metallic, but so are many of the plant-feeding Chrysomelidæ and several of the Curculionidæ, while many carnivorous beetles are dull. In Diptera, the blow-fly, *Lucilia*, is metallic. In Hymenoptera, the parasitic Chalcididæ are mostly metallic, while the plant-feeding Cynipidæ are brown, black or yellowish. And so on through numerous examples.

So much then on the colors of the stinging and stingless Hymenoptera. The question remains, what are they for? Why do they exist?

