PROTECTIVE COLORATION AND MIMICRY

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All of the animal forms existing on the earth today have, in the past, undergone a series of gradual changes, in response to their surroundings, which have enabled them to survive in the face of innumerable forces tending toward their destruction.

These changes are in the nature of adaptations, by means of which, through constant improvements, they have adjusted themselves to their special environments.

In the higher vertebrates, these changes have brought about remarkable modifications of the nervous system, more particularly in the brain.

With lower forms of life, adaptive modifications are preponderantly in the nature of color changes, by means of which the animal simulates its environment ,and is thus enabled to escape observation.

Most naturalists have noted the close similarity of the color and markings of certain tree toads and lizards, to the environment in which they are found. (See Plate 1).

Many sea-horses are colored like the seaweeds among which they live. The Zostera, of the Florida Coast, for example, has a coloration like that of sea grass.

The young of the British Shore-crab (*Carcinas maenas*) invariably harmonizes with the color scheme of the pool which it inhabits. The Turbit, (*Psetta maxima*) rests flat upon the sea floor, and its upper surface shows the mottled pattern of its sandy cradle.

Thousands of examples of protective resemblance have been noted in the Arthropods. A certain spider, found in California, closely resembles a bird-dropping. The simulation is further heightened by its habit of resting quietly on the upper surface of a leaf, with its legs held close to the body.

Many of the Mantids and Walking-stick insects are modified to resemble sticks, leaves and bark. (See Plate 2, fig. 3).

A Hemipterous insect occurs in San Diego County, which rests in the blossom of the wild buckwheat. Its form and color so perfectly imitate a portion of the bloom that butterflies frequently alight upon it, and are thus captured.

In the Lepidoptera, protective resemblance may be manifested in one or more of the changes through which the insect passes, in the course of its metamorphosis. A large number of the eggs of butterflies are colored after the manner of the plants on which they are deposited.

Innumerable caterpillars possess the form and coloration of their environment. Those which feed on grasses are almost invariably long, cylindrical and green. The larva of the California Sister, (*Heterochroa californica*), is a perfect match for the oak leaf. Most of the Lycaenid caterpillars are practically invisible in their natural surroundings, as witness the larva of the Juniper Hair-streak, (*Mitoura siva juniperaria*).

Many Geometrid caterpillars, of the measuring-worm type, are shaped and colored in the semblance of twigs, and the camouflage is further strengthened by the attitude they assume. *Phasiana curvata* admirably illustrates this.

Butterfly chrysalids commonly resemble leaves, twigs, bark or stone.

Some animals and insects have the power of modifying their color in response to a change of environment. A familiar example of this type is the chameleon.

It has been frequently observed that the caterpillar of the Cloudless Sulphur, (*Catopsilia eubule*), assumes a yellow tint when feeding on the blossoms of *Cassia*, whereas it is green when found on the leaves.

A large number of butterflies resemble leaves, the most familiar example being the Leaf Butterfly of India, (*Kallima inachis*). (See Plate 2, fig. 2).

The Angle-wings, (*Polygonia*) are exactly the color of bark on the under surfaces of their wings. It is a common habit for them to rest on the trunk of a tree, with their wings closed.

Another type of protective adaptation consists in certain unpleasant or noxious qualities, such as that possessed by the familiar skunk.

A few caterpillars, notably the *Papilios*, have protrusive organs which emit an offensive substance.

All of the Danaid butterflies are believed to be obnoxious to insectivores. Moths of the genus *Zygaena* possess acrid or offensive qualities, and the same holds true for many other groups.

Frequently, when characters of a poisonous or repellant nature are developed, there is also the assumption of a conspicuous pattern or color. This phenomenon is termed "warning coloration."

Many reptiles and batrachians are known, which possess this combination of qualities.

The Spotted Salamander (*Salamandra maculosa*) exemplifies this principle. Some of the showy beetles are protected in like manner, as are also many tropical butterflies and moths.

Another interesting mechanism of survival, consists in the acquisition by non-protected species of the colors and patterns of obnoxious forms.

PLATE 1.
Illustrating Protective Coloration

The figure on the left shows a tree-toad which simulates the color of the rock so perfectly as to be almost indistinguishable.

The right hand figure shows a protectively colored moth on a piece of bark.

—Photo, Courtesy W. Scott Lewis.

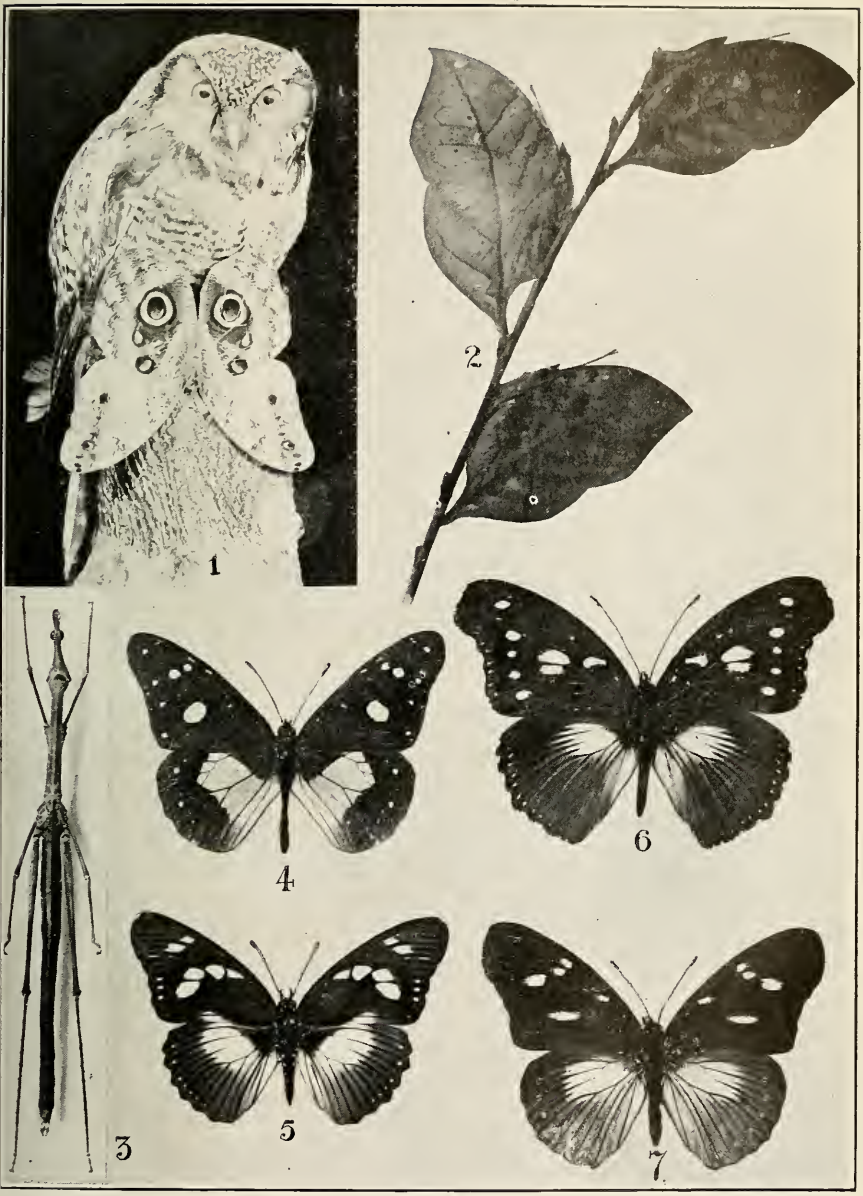

PLATE 2.
Illustrating Protective Coloration and Mimicry

Fig. 1. The Owl Butterfly of South America shown with an owl for comparison.
Fig. 2. Three Leaf-butterflies *(Kallima inachis)* of India, on twig, showing perfect simulation of leaves.
Fig. 3. Walking-stick insect resembling twigs.
Fig. 4. An *Acreid* Butterfly, protected by acrid qualities.
Figs. 5, 6, 7. Three African Butterflies which mimic the *Acreid* in color and pattern, but do not possess obnoxious qualities.

A good example of this is the case of *Basilarchia obsoleta*, which imitates *Danaus berenice*. The Basilarchias do not possess repellant qualities, and they would therefore admirably serve the palate of insectivorous birds and mammals. With the close resemblance of the two species, it is readily seen that confusion would arise, in consequence of which both would be shunned.

This imitative principle is widespread among the butterflies, and is termed "protective mimicry."

Dr. A. Seitz, in writing of the phenomena states that "there are many localities in South America, often quite circumscribed in extent in which almost all the lepidopterous species that occur in any numbers have one and the same wing-pattern indifferently, whether they be butterflies or moths, whether stoutly-built Swallowtails or weak Pierids or shy Nymphalids.

In Columbia one may see flying about a single flowering shrub a number of butterflies, all colored and marked alike, but belonging to four entirely different groups. They are all black, with an oblique scarlet band on the forewings. The first is a Pierid (*Pereute leucodrosyne*), the second a Heliconid (*Heliconius melpomene*), the third a Swallowtail (*Papilio euterpinus*), and the fourth (*Adelpha isis*) a species of Nymphalid allied to Limenitis. In certain districts of Southern Brazil a yellow band on the forewing and dentated longitudinal stripes on a brownish yellow ground provide the general scheme, which is followed by Pierids (*Perhybris*, *Dismorphia*), Danaids (*Lycorea*), Heliconius (*Heliconius narcaea*) and even some moths (*Chetone*)."

Still another type of mimicry exists, in which an insect assumes the form of some totally unrelated species or form. Many Syrphid flies resemble bees, although they are without stings. A number of Sesiid moths simulate wasps.

The giant Brassolids of South America, known as Owl Butterflies, bear a remarkable resemblance to the heads of owls. (See Plate 2, fig. 1). They fly in the evening, and the great eye-like spots may have a protective significance.

It must not be assumed that the many striking protective patterns of butterflies have been acquired as a matter of conscious choice on the part of these insects. They represent the end product of a long series of gradual changes, operating in accordance with the great laws of Adaptation, and along lines of continual betterment.