

MIMICRY IN INSECT LIFE, AS EXEMPLIFIED BY CEYLON INSECTS.*

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With Illustrations.

BEFORE describing some of the more interesting instances of so-called mimicry in insect life, I must ask you to disabuse your minds of the idea that such mimicry is in any way conscious. One frequently hears the epithets "wise," "clever," and "ingenious" employed in connection with some particularly successful case of adaptation, and it is often difficult to avoid such misleading terms in ordinary conversation.

As a matter of fact it is probable that these wonderful arrangements of form and colour are the result of natural selection unconsciously working upon accidental variations or mutations through countless generations, those favourable to the organism having the better chance of being perpetuated and accentuated.

The word "mimicry" itself is unscientific in this connection, but is the term that has been generally adopted for the phenomena in question.

In studying animal mimicry, two main classes or purposes may be at once distinguished, *protective* and *aggressive*, though the latter may—and often does—serve both purposes. Protection may again be subdivided into *protective resemblance*, where the insect simulates some inanimate object, and *protective mimicry* proper, in which the insect assumes the appearance of some other species that is naturally protected either by some weapon, such as a poisonous sting, or by some unpleasant taste or odour. Of the former class—protective resemblance—we have abundant beautiful instances in Ceylon. The best known is that of the leaf insects.

(Fig. 1.) Our more common Ceylon species (*Pulchriphyllium crurifolium*) carries its disguise throughout every stage of its existence. The eggs are remarkably like the seed of some plants, and they are shed upon the ground, and lie amongst the dead leaves just as might the seeds of any tree. I must confess that I have never found the particular seed that matches them, but I am confident that such exists. If I were to send a packet of these eggs to

* This article is the substance of a lecture delivered by the author in Kandy in 1907.

some horticultural friend in Europe, he would almost certainly plant them carefully and expect to raise some interesting tropical plant from them. When first hatched the young insects are of a bright reddish colour, harmonizing with the young leaves of many of our shrubs and plants, and it is upon such tender leaves that they feed during this early stage. As they grow older they prefer the more mature leaves, and at the same time the red tints are gradually changed to green. The upper surface of most leaves is darker and more glossy than the underside. In the half-grown insect we find a reverse arrangement of the tints. The back of the insect is of a dull pale green tint, while the underside is of a deeper colour and more shining surface. This at first sight would appear to be faulty adaptation; but such is far from being the case, for the habitual attitude of the insect in this stage is head downwards, with the hinder leaf-like part of the body re-curved over its back, in which position the under surface of the body is uppermost. So perfectly leaf-like are the full-grown insects that they may be said to partially defeat the purpose of their disguise, for they are sometimes mistaken by their fellows for actual leaves, and may have parts of their wings nibbled off before they realize what is happening. Perhaps, though, this accident may really enhance their disguise, for the ragged insect looks like a leaf that has been partially devoured by a caterpillar.

(Fig. 2.) The allied "Stick Insects" (*Phasmidæ*) resemble the stalks of grasses or the thin twigs of bamboos and shrubs. One species frequents the common yellow-stemmed bamboo. It has a smooth cylindrical yellowish body, jointed at intervals like the bamboo upon which it lives. Another is covered with thorn-like processes and simulates a piece of bramble. Their eggs, like those of the leaf insects, resemble seeds of various kinds. They are either attached to the leaves of plants or shed upon the ground.

Another small insect (belonging to the family *Membracidæ*) apparently relies upon its similarity to the thorns of the plant upon which it is most frequently found. Both the young and the mature insects resemble thorns, but in a different manner. The young insect is green, and has a single erect-pointed prominence on the back. It frequents the young shoots where the natural thorns are soft and green. The adult insect has a pair of backwardly directed curved black horns, and may often be found on the older shoots where the thorns are dark coloured. To obtain the highest degree of imitation the young insects should rest with their heads towards the base of the stem, while the adult insects should adopt the opposite position. And this is most frequently found to be the case. By so doing the curve of the horns of the insects takes up the direction of the thorns of the plant. This thorn-like Membracid is named *Leptocentrus substitutus*, Wlk., and the thorny plant upon which it lives is *Capparis sepiaria*, L.

(Fig. 3.) The "Leaf Butterfly" (*Kallima philarchus*) is a very beautiful example of protective resemblance. While it is on the wing the bright blue tints of the upper surface render it a conspicuous insect, but when the wings are folded together in the resting position, their form and colouring exactly imitates a withered leaf. The markings take the form of the midrib and veins of the natural leaf, while the resemblance is heightened by a blunt tail-like process from the hind wing, which takes the place of the stalk of the leaf. It even copies the frequent blemishes that are found on a dead leaf. There are often irregular dark-coloured blotches, such as are caused by fungus diseases of the plant, and in some examples there is a small transparent spot suggesting a hole in the leaf. In natural history books this insect is usually represented perched on a leafy branch, in which position the brown tints of the wings would not harmonize with their surroundings. But in nature the insect more usually settles head downwards on the trunk of a tree, and it has acquired the habit of swaying gently from side to side. It might then be mistaken very easily for a detached leaf that in its fall has hitched up in a cobweb and is being shaken by the breeze.

Then there are many insects that habitually rest on the bark of trees. These have assimilated themselves most perfectly to such surroundings. And as bark is very frequently spotted and mottled with gray and greenish lichens, so these particular insects are usually variegated with similar markings. Moths of various kinds, certain beetles, several Homoptera, and a few grasshoppers exhibit this form of protective resemblance.

(Fig. 4.) Even such a large and bulky insect as our large Wood-boring Moth (*Duomitus leuconotus*), which has a wing expanse of nearly 8 inches, can conceal itself very successfully by its resemblance to a patch of lichen-covered bark. Its wings are closely mottled with gray and black. Another large moth (*Elphos hymenaria*), with similar markings, rests with outstretched wings on the trunks of trees, where it is in perfect harmony with its surroundings.

The large "Hawk Moth" (*Pseudosphinx discistriga*) becomes practically invisible when resting in similar situations.

A large beetle, common in the Kandy districts, is ornamented with irregular streaks of light and dark brown, and looks curiously like the fibrous surface of wood where some branch has been torn off.

(Fig. 5.) Another beetle (*Alaus speciosus*), which, when seen by itself, appears to be most conspicuously marked, when resting—as it frequently does—on the charred stump of some tree in a newly burned clearing, would be mistaken for an irregular patch of white ash. But in this case it is doubtful if the apparent adaptation is real, for the insect cannot of necessity confine itself to recently charred stumps, and the gradual evolution of this pattern must date

back to a period long before the clearing of our forests commenced. Possibly the scheme of coloration was unconsciously modelled upon the form taken by some of the shapeless white fungi that grow upon decaying wood.

(Fig. 6.) There is a common long-horned grasshopper with mottled brownish wings, which clings close against the branches of the trees upon the leaves of which it feeds. Its wings partially encircle the branch, and its back is rugged like the bark. When at rest in this position it looks merely like some natural excrescence of the branch itself.

(Fig. 7.) And a small Homopterous insect (*Atracis neitneri*) is so like—in texture and colouring—to a patch of gray-green lichen that it is indistinguishable until it is disturbed and flies off.

Another common form of protective resemblance, in which the insect imitates a small lump of earth, has been adopted by many members of the beetle tribe. Such species are of a dull brown colour, and have a rough granular or warty surface. They do not necessarily live in the soil, but have acquired the habit—when alarmed—of suddenly dropping from their perch and falling to the ground, where they lie perfectly motionless, with limbs close pressed to the body, until the danger has passed. The habit of feigning death is itself a form of protective mimicry.

As a general rule, predatory animals will not touch even their natural prey when it is dead or motionless. A preying mantis, one of the most voracious of insects, will take no notice of a motionless insect, but will seize it as soon as it shows any signs of life. Many defenceless insects, therefore, have acquired the habit of lying inert and to all appearances dead when alarmed.

Insects that inhabit grass land have very generally assumed an elongate narrow shape that assimilates itself to the form of the stems and blades of the grasses amongst which they conceal themselves. Examples of many different families may be found exhibiting this device. We find in the patanas long narrow grasshoppers, stick insects, mantises, bugs, caterpillars, and even moths of the same general form.

The caterpillar of a small green moth (*Thalassodes*, sp.) disguises itself by fastening pieces of leaves and withered blossoms to the fleshy spines on its back.

The phenomenon of protective mimicry proper is closely involved with that of warning colours, in which an insect has assumed conspicuous colours or markings that are recognized by insectivorous birds and other animals as associated with something dangerous or distasteful. In contradistinction to *protective resemblance*, which results in rendering the object inconspicuous, *protective mimicry* usually tends in the direction of conspicuousness. The wasp tribe are usually brightly banded with orange and black, and any bird

that had once been stung by a wasp would instinctively avoid another insect similarly coloured. We consequently find that many harmless insects have acquired this type of marking, and so escape molestation by their resemblance to their self-protected models. Thus, there are certain moths and flies with banded bodies, and beetles in which the same pattern is produced on the closed wing cases. Even members of the spider tribe have found the advantage of mimicking better protected insects. That very pugnacious insect, the "red ant" (*Ecophylla*), is naturally protected not only by its powerful jaws, but by the copious secretion of pungent formic acid, which renders it obnoxious to most insectivorous creatures. It is imitated both in form and colour by several other insects, more especially by a slender "hunting-spider." So close is this resemblance that most persons to whom I have pointed out the spider have declared unhesitatingly that it was verily the red ant itself. We have in Ceylon a whole series of such ant-like spiders, each apparently modelled upon some particular species of ant. Spiders are possessed of eight legs, while ants have only six apiece; but this does not interfere with the resemblance, for the first pair of the limbs of the spider take the place of the antennæ of the ant. The deception is only noticeable when the spider becomes alarmed by a close inspection and lets itself down by a silken thread—a feat that is impossible to any kind of ant.

While on a recent tour in the neighbourhood of Trincomalee I saw on the ground what I supposed to be a species of *Mutilla*—a peculiar genus of wasp, the females of which are apterous and brilliantly coloured. Knowing that these insects are armed with a powerful sting, I was careful to pick it up with a pair of forceps, and it was not until I had bottled it that I realized that my capture was of much greater interest. It was a species of spider that had adopted the characteristic form and colouring of a *Mutilla*. I subsequently captured a second specimen, of the opposite sex, which apparently mimicked yet another species of *Mutilla*.

Large groups of insects, containing many widely distinct species, genera, and even families, are sometimes found to have acquired a type of coloration and pattern common to all of them. Such an association is distinguished by the term "Müllerian," after the famous naturalist (Fritz Müller) who first drew attention to the phenomenon. Each individual of such a group is usually itself protected by some disagreeable property, but by their common likeness to each other it is supposed that they contribute to the safety of the other members. This may require a little explanation. Every animal has to learn for itself what is good, wholesome food, and what is injurious or distasteful. An inexperienced young bird or lizard would not know that a certain gaudily coloured insect had an unpleasant taste until it had discovered the fact by actual experiment. But once learned, the lesson is never forgotten. The

victim of the experiment itself is none the better off for its warning colouring, but its sacrifice has probably saved the lives of many others. The more general the particular type of coloration, the fewer subjects for experiment are required, whereas, if each separate species adopted a distinctive danger signal, they would each have to pay toll for the education of their mutual enemies.

Such Müllerian associations of self-protected insects are not quite so conspicuous in Ceylon as in some other countries, notably in Africa and South America, but we have a few instances.

Thus, amongst the butterflies we find two species (*Danaïs chrysippus* and *Hypolimnas misippus*) belonging to distinct families (the *Danainæ* and *Nymphaliniæ* respectively) that are practically indistinguishable except by the most close examination. In the second species it is curiously the female only that has adopted the warning colour. The male is such a different looking insect that the relationship of the two sexes would never be suspected. A still more remarkable fact is that there are two varieties of the *Danaïs* and two corresponding varieties of the female *Hypolimnas*.

Yet another species of another family (*Telchinia violæ*) has somewhat the same general appearance. Though the similarity is not so complete, this insect probably reaps some advantage from its partial resemblance to the other two.

Four other Danaine butterflies (all different species of *Euplœa*) and a species of *Papilio* form another associated group. Here, again, we have the remarkable coincidence that the *Papilio* has two very distinct varieties, one of which resembles the *Euplœas*, while the other has the likeness of another self-protected species (*Danaïs septentrionis*).

A common type of warning colour, found in nearly all parts of the world, consists of a uniform reddish tint in front, followed by a more or less sharply defined hinder part. The members of this group comprise various species of beetles, bugs, wasps, flies, and moths.

Under protective mimicry may be classed the menacing markings that have been adopted by many insects.

(Fig. 8.) The most common form of this is the development of eye-like markings on various parts of the body. The true eyes of an insect are usually inconspicuous, but the ocellated spots—the sham eyes—found on the wings of so many butterflies and moths attract attention at once by their intense colouring and disproportionate size. Though in some cases these specialized markings may serve the purpose of distracting the attention of a formidable enemy from a vital to a non-vital part, as by allowing an insect to escape from a bird with the comparatively unimportant loss of a fragment of wing, in others the eye-spots have a more directly protective function. We have in Ceylon a particular kind of praying mantis that preys principally upon butterflies. I have kept a living specimen of this mantis in a

cage for some time, and have fed it upon a small species of butterfly that happens to be very abundant in the immediate neighbourhood—a species that is ornamented with several conspicuous eye-spots. I have noticed that while one of these butterflies is walking quietly about the cage, when its markings are clearly visible, the mantis seems to be afraid of it : but as soon as it commences to flutter and the markings are obscured by the rapid movement of the wings, it is promptly seized and devoured.

The caterpillars of many of our large “Hawk Moths” show a pair of large and brilliantly coloured false eyes on the front part of the body that gives them a very alert and formidable appearance. These markings must be distinctly protective.

(Fig. 9.) Akin to this form of protection is that in which the markings simulate a sham head at the opposite end of the body, while the real head may be much less conspicuous than the false one. This is found in some small hopping insects, whose principal enemies are the “hunting-spiders” that spin no snare, but stalk their prey, endeavouring to take it unawares and seize it from behind. These hunters would be puzzled—when stalking one of these double-headed creatures—to know which was its blind side, and might be likely to approach it from the wrong end, and so give it timely warning of its danger.

Aggressive mimicry is adopted by predaceous insects, and usually takes the form of some disguise that enables them to approach their prey without alarming it. The disguise at the same time affords the wearer protection from its own enemies.

All the disguises that we have seen adopted for protection are repeated for the purposes of aggression. Thus, we find praying mantises that simulate leaves, others that frequent the trunks of trees and resemble lichen-covered bark ; and one peculiar species (*Gongylus gongylodes*) with leaf-like body and wings, while just behind its head is a hood with brightly coloured lining that is thought to imitate a flower. This is the species that has already been described as feeding upon small butterflies. It takes its stand on some leafy branch and awaits its opportunity. The head is elevated to display the coloured area. Presently a passing butterfly is attracted by the patch of pink, it approaches in expectation of finding a honey-laden flower, and finds itself seized by a pair of cruel arms arrayed with formidable teeth like a steel rat-trap. “And the subsequent proceedings interested it no more.” The juicy body is soon devoured, and the unnutritious wings are dropped.

There are several small hunting-spiders that have adopted the same kind of manœuvre. They are of a bright yellow colour, and lurk among the yellow stamens of flowers. From this coign of concealment they pounce upon small flies and moths that come to feed at the flower. When insect hunting I have on several occasions been deceived by some moth that appeared to be busily engaged in

sipping honey, but on attempting to capture it I have found myself forestalled, and the specimen already in the jaws of one of these little spiders.

Other predaceous insects assume the proverbial "sheep's clothing," and imitate the form of the creature upon which they prey.

(Fig. 10.) An interesting example is that of a large fly (*Hyperechia xylocopiformis*), which so closely resembles a species of "Carpenter Bee" (*Xylocopa fenestrata*) as to completely deceive its victim. I have watched one of these flies mount into the air to meet a passing bee, which appears to welcome it as a mate, with fatal results to the bee. One might suppose that the bee could protect itself with its powerful sting, but it discovers its mistake too late, when the fly is firmly perched on its back and has driven its sharp beak into the body of its victim.

It is possibly the same purpose that has led to the similarity of colour and pattern between two distinct insects of the bug tribe (*Antilochus nigripes* and *Serinetha augur*), for the former preys upon the latter.

Another device employed by one family of predaceous bugs is to cover their bodies with dust and small particles of rubbish until they look like anything but living insects. In this disguise they lie in wait and pounce upon their prey—other small insects—or are able to creep up within striking distance without being observed.

In these few examples of mimicry that I have described I have touched but the fringe of a most interesting and complicated subject. There are endless other instances to be seen around us by any intelligent observer. In fact it is probable that fully one-half of the insects that exist in Ceylon exhibit in some degree one or other of the several forms of mimicry.



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