

IV THE STRUGGLE FOR EXISTENCE

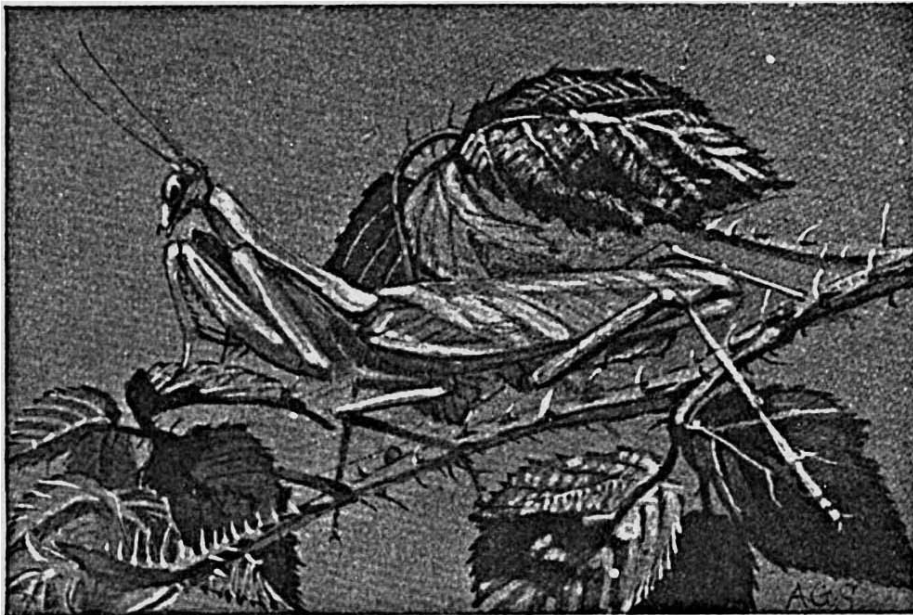
ANIMAL AND BIRD MIMICRY AND DISGUISE

§ I

FOR every animal one discovers when observing carefully, there must be ten unseen. This is partly because many animals burrow in the ground or get in underneath things and into dark corners, being what is called cryptozoic or elusive. But it is partly because many animals put on disguise or have in some way acquired a garment of invisibility. This is very common among animals, and it occurs in many forms and degrees. The reason why it is so common is because the struggle for existence is often very keen, and the reasons why the struggle for existence is keen are four. First, there is the tendency to over-population in many animals, especially those of low degree. Second, there is the fact that the scheme of nature involves nutritive chains or successive incarnations, one animal depending upon another for food, and all in the long run on

plants; thirdly, every vigorous animal is a bit of a hustler, given to insurgence and sticking out his elbows. There is a fourth great reason for the struggle for existence, namely, the frequent changefulness of the physical environment, which forces animals to answer back or die; but the first three reasons have most to do with the very common assumption of some sort of disguise. Even when an animal is in no sense a weakling, it may be very advantageous for it to be inconspicuous when it is resting or when it is taking care of its young. Our problem is the evolution of elusiveness, so far at least as that depends on likeness to surroundings, on protective resemblance to other objects, and in its highest reaches on true mimicry.

Many animals living on sandy places have a light-brown colour, as is seen in some lizards and snakes. The green lizard is like the grass and the green tree-snake is inconspicuous among the branches. The spotted leopard



THE PRAYING MANTIS (*MANTIS RELIGIOSA*).

¹A very voracious insect with a quiet, unobtrusive appearance. It holds its formidable forelegs as if in the attitude of prayer; its movements are very slow and stealthy; and there is a suggestion of a leaf in the forewing. But there is no reason to credit the creature with conscious guile!

is suited to the interrupted light of the forest, and it is sometimes hard to tell where the jungle ends and the striped tiger begins. There is no better case than the hare or the partridge sitting a few yards off on the ploughed field. Even a donkey grazing in the dusk is much more readily heard than seen.

The experiment has been made of tethering the green variety of Praying Mantis on green herbage, fastening them with silk threads. They escape the notice of birds. The same is true when the brown variety is tethered on withered herbage. But if the green ones are put on brown plants, or the brown ones on green plants, the birds pick them off. Similarly, out of 300 chickens in a field, 240 white or black and therefore conspicuous, 60 spotted and inconspicuous, 24 were soon picked off by crows, but only one of these was spotted. This was not the proportion that there should have been if the mortality had been fortuitous. There is no doubt that it often pays an animal to be like its habitual surroundings, like a little piece of scenery if the animal is not moving. It is safe to say that in process of time wide departures from the safest coloration will be wiped out in the course of Nature's ceaseless sifting.

But we must not be credulous, and there are three cautions to be borne in mind. (1) An animal may be very like its surroundings without there being any protection implied. The arrow-worms in the sea are as clear as glass, and so are many open-sea animals. But this is because their tissues are so watery, with a specific gravity near that of the salt water. And the invisibility does not save them, always or often, from being swallowed by larger animals that gather the harvest of the sea. (2) Among the cleverer animals it looks as if the creature sometimes sought out a spot where it was most inconspicuous. A spider may place itself in the middle of a little patch of lichen, where its self-effacement is complete. Perhaps it is more comfortable as well as safer to rest in surroundings the general colour of which is like that of the animal's body.



Photo: A. A. White.

THE VARIABLE MONITOR, (VARANUS).

The monitors are the largest of existing lizards, the Australian species represented in the photograph attaining a length of four feet. It has a brown colour with yellow spots, and in spite of its size it is not conspicuous against certain backgrounds, such as the bark of a tree.



PROTECTIVE COLORATION: A WINTER SCENE IN NORTH SCANDINAVIA.

Showing Variable Hare, Willow Grouse, and Arctic Fox, all white in winter and inconspicuous against the snow. But the white dress is also the dress that is physiologically best, for it loses least of the animal heat.

(3) The fishes that live among the coral-reefs are startling in their brilliant coloration, and there are many different patterns. To explain this it has been suggested that these fishes are so safe among the mazy passages and endless nooks of the reefs, that they can well afford to wear any colour that suits their constitution. In some cases this may be true, but naturalists who have put on a diving suit and walked about among the coral have told us that each kind of fish is particularly suited to some particular place, and that some are suited for midday work and others for evening work. Sometimes there is a sort of Box and Cox arrangement by which two different fishes utilise the same corner at different times.

§ 2

The common shore-crab shows many different colours and mottlings, especially when it is young. It may be green or grey, red or brown, and so forth, and it is often in admirable adjustment to the colour of the rock-pool where it is living.

Gradual
Change of
Colour.

Experiments, which require extension, have shown that when the crab has moulted, which it has to do very often when it is young, the colour of the new shell tends to harmonise with the general colour of the rocks and seaweed. How this is brought about, we do not know. The colour does not seem to change till the next moult, and not then unless there is some reason for it. A full-grown shore-crab is well able to look after itself, and it is of interest to notice, therefore, that the variety of coloration is mainly among the small individuals, who have, of course, a much less secure position. It is possible, moreover, that the resemblance to the surroundings admits of more successful hunting, enabling the small crab to take its victim unawares.

Professor Poulton's experiments with the caterpillars of the small tortoise-shell butterfly showed that in black surroundings the pupæ tend to be darker, in white surroundings lighter, in gilded boxes golden; and the same is true in other cases. It appears that the surrounding colour affects the caterpillars through the skin during a sensitive period—the twenty hours



SEASONAL COLOUR-CHANGE: A SUMMER SCENE IN NORTH SCANDINAVIA.

Showing a brown Variable Hare, Willow Grouse, and Arctic Fox, all inconspicuous in their coloration when seen in their natural surroundings.

immediately preceding the last twelve hours of the larval state. The result will tend to make the quiescent pupæ less conspicuous during the critical time of metamorphosis. The physiology of this sympathetic colouring remains obscure.

The ptarmigan moults three times in the year. Its summer plumage is rather grouse-like above, with a good deal of rufous brown; the back becomes much more grey in autumn; almost all the feathers of the winter plumage are white. That is to say, they develop without any pigment and with numerous gas-bubbles in their cells. Now there can be no doubt that this white winter plumage makes the ptarmigan very inconspicuous among the snow. Sometimes one comes within a few feet of the crouching bird without seeing it, and this garment of invisibility may save it from the hungry eyes of golden eagles.

Similarly the brown stoat becomes the white ermine, mainly by the growth of a new suit of white fur, and the same is true of the mountain hare. The ermine is all white except the black

tip of its tail; the mountain hare in its winter dress is all white save the black tips of its ears. In some cases, especially in the mountain hare, it seems that individual hairs may turn white, by a loss of pigment, as may occur in man. According to Metchnikoff, the wandering anæboid cells of the body, called phagocytes, may creep up into the hairs and come back again with microscopic burdens of pigment. The place of the pigment is taken by gas-bubbles, and that is what causes the whiteness. In no animal is there any white pigment; the white colour is like that of snow or foam, it is due to the complete reflection of the light from innumerable minute surfaces of crystals or bubbles.

The mountain hare may escape the fox the more readily because its whiteness makes it so inconspicuous against a background of snow; and yet, at other times, we have seen the creature standing out like a target on the dark moorland. So it cuts both ways. The ermine has almost no enemies except the gamekeeper, but its winter whiteness may help it to sneak upon its victims, such as grouse or rabbit, when

there is snow upon the ground. In both cases, however, the probability is that the constitutional rhythm which leads to white hair in winter has been fostered and fixed for a reason quite apart from protection. The fact is that for a warm-blooded creature, whether bird or mammal, the physiologically best dress is a white one, for there is less radiation of the precious animal heat from white plumage or white peltage than from any other colour. The quality of warm-bloodedness is a prerogative of birds and mammals, and it means that the body keeps an almost constant temperature, day and night, year in and year out. This is effected by automatic internal adjustments which

we know that they are there. It must be admitted that they are also very quick to get a sprinkling of sand over their upturned side, so that only the eyes are left showing. But there is no doubt as to the exactness with which they often adjust themselves to be like a little piece of the substratum on which they lie; they will do this within limits in experimental conditions when they are placed on a quite artificial floor. As these fishes are very palatable and are much sought after by such enemies as cormorants and otters, it is highly probable that their power of self-effacement often saves their life. And it may be effected within a few minutes, in some cases within a minute.

Rapid
Colour-
change.

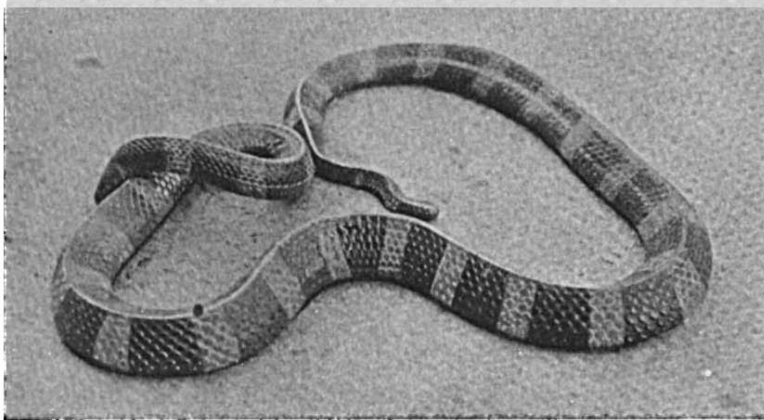


Photo: W. S. Berridge, F.Z.S.

BANDED KRAIT: A VERY POISONOUS SNAKE WITH ALTERNATING YELLOW AND DARK BANDS.

It is very conspicuous and may serve as an illustration of warning coloration. Perhaps, that is to say, its striking coloration serves as an advertisement, impressing other creatures with the fact that the Banded Krait should be left alone. It is very unprofitable for a snake to waste its venom on creatures it does not want.

regulate the supply of heat, chiefly from the muscles, to the loss of heat, chiefly through the skin and from the lungs. The chief importance of this internal heat is that it facilitates the smooth continuance of the chemical processes on which life depends. If the temperature falls, as in hibernating mammals (whose warm-bloodedness is imperfect), the rate of the vital process is slowed down—sometimes dangerously. Thus we see how the white coat helps the life of the creature.

§ 3

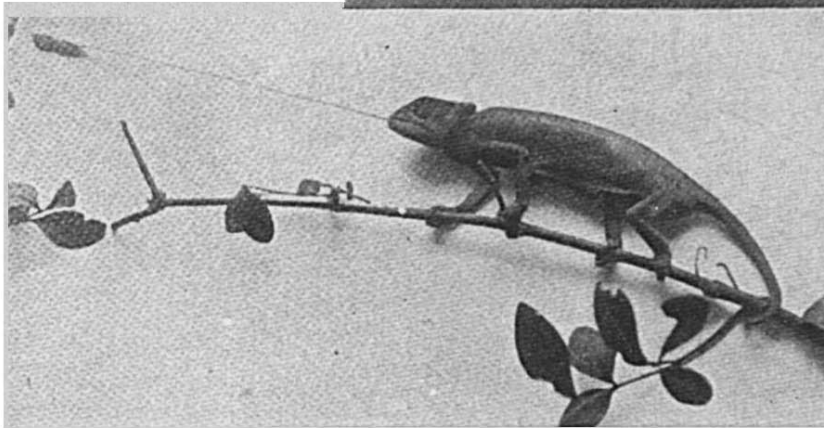
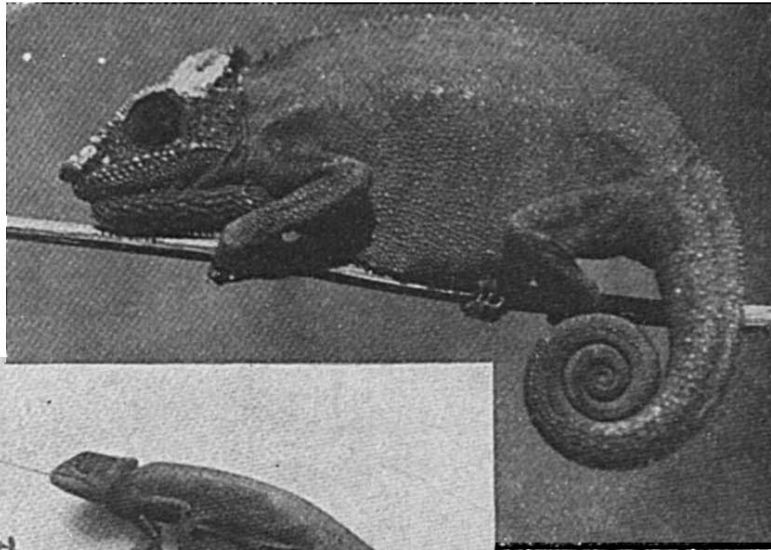
Bony flat-fishes, like plaice and sole, have a remarkable power of adjusting their hue and pattern to the surrounding gravel and sand, so that it is difficult to find them even when

brain; from the brain, instead of passing down the spinal cord, the message travels down the chain of sympathetic ganglia. From these it passes along the nerves which come out of the spinal cord and control the skin. Thus the message reaches the colour-cells in the skin, and before you have carefully read these lines the flat-fish has slipped on its Gyges ring and become invisible.

The same power of rapid colour-change is seen in cuttlefishes, where it is often an expression of nervous excitement, though it sometimes helps to conceal. It occurs with much subtlety in the Æsop prawn, Hippolyte, which may be brown on a brown seaweed, green on sea-lettuce or sea-grass, red on red seaweed, and so on through an extensive repertory. "According

to the nature of the background," Professor Gamble writes, "so is the mixture of the pigments compounded so as to form a close reproduction both of its colour and its pattern. A sweep of the shrimp net detaches a battalion of these sleeping prawns, and if we turn the motley into a dish and give a choice of seaweed, each variety after its kind will select the one with which it agrees in colour, and vanish. Both when young and when full-grown, the Æsop prawn takes on the colour of its immediate surroundings. At nightfall Hippolyte, of whatever colour, changes to a transparent azure blue: its stolidity gives place to a nervous restlessness; at the least tremor it leaps violently, and often swims

they hunt insects with great deliberateness and success. The protrusible tongue, ending in a sticky club, can be shot out for about seven inches in the common chameleon. Their hands and feet are split so that they grip the branches firmly, and the prehensile tail rivals a monkey's. When they wish they can make themselves very slim, contracting the body from side to side, so that they are not very readily seen.



Photos: W. S. Berridge, F.Z.S.

THE WARTY CHAMELEON.

The upper photograph shows the Warty Chameleon inflated and conspicuous. At another time, however, with compressed body and adjusted coloration, the animal is very inconspicuous. The lower photograph shows the sudden protrusion of the very long tongue on a fly.

actively from one food-plant to another. This blue fit lasts till daybreak, and is then succeeded by the prawn's diurnal tint." Thus, Professor Gamble continues, the colour of an animal may express a nervous rhythm.

The highest level at which rapid colour-change occurs is among lizards, and the finest exhibition of it is among the chameleons.

The Case of Chameleons. These quaint creatures are characteristic of Africa; but they occur also in Andalusia, Arabia, Ceylon, and Southern India. They are adapted for life on trees, where

In other circumstances, however, they do not practise self-effacement, but the reverse. They inflate their bodies, having not only large lungs, but air-sacs in connection with them. The throat bulges; the body sways from side

to side; and the creature expresses its sentiments in a hiss. The power of colour-change is very remarkable, and depends partly on the contraction and expansion of the colour-cells (chromatophores) in the under-skin (or dermis) and partly on close-packed refractive granules and crystals of a waste-product called guanin. The repertory of possible colours in the common chameleon is greater than in any other animal except the Æsop prawn. There is a legend of a chameleon which was brown in a brown box, green in a green box, and blue in a blue box,

and died when put into one lined with tartan ; and there is no doubt that one and the same animal has a wide range of colours. The so-called "chameleon" (*Anolis*) of North America



Photo: J. J. Ward, F.E.S.

PROTECTIVE RESEMBLANCE.

Hawk Moth, settled down on a branch, and very difficult to detect as long as it remains stationary. Note its remarkable sucking tongue, which is about twice the length of its body. The tongue can be quickly coiled up and put safely away beneath the lower part of the head.

is so sensitive that a passing cloud makes it change its emerald hue.

There is no doubt that a chameleon may make

itself more inconspicuous by changing its colour, being affected by the play of light on its eyes. A bright-green hue is often seen on those that are sitting among strongly illumined green leaves. But the colour also changes with the time of day and with the animal's moods. A sudden irritation may bring about a rapid change ; in other cases the transformation comes about very gradually. When the colour-change expresses the chameleon's feelings it might be compared to blushing, but that is due to an expansion of the arteries of the face, allowing more blood to get into the capillaries of the under-skin. The case of the chameleon is peculiarly interesting because the animal has two kinds of tactics—self-effacement on the one hand and bluffing on the other. There can be little doubt that the power of colour-change sometimes justifies itself by driving off intruders. Dr. Cyril Crossland observed that a chameleon attacked by a fox-terrier "turned round and opened its great pink mouth in the face of the advancing dog, at the same time rapidly changing colour, becoming almost black. This ruse succeeded every time, the dog turning off at once." In natural leafy surroundings the startling effect would be much greater—a sudden throwing off of the mantle of invisibility and the exposure of a conspicuous black body with a large red mouth.

§ 4

Dr. H. O. Forbes tells of a flat spider which presents a striking resemblance to a bird's dropping on a leaf. Years after he Likeness first found it he was watching in a forest in the Far East when his eye fell on a leaf before him which had been blotched by a bird. He wondered idly why he had not seen for so long another specimen of the bird-dropping spider (*Ornithoscatoides decipiens*), and drew the leaf towards him. Instantaneously he got a characteristic sharp nip ; it was the spider after all ! Here the colour-resemblance was enhanced by a form-resemblance.

But why should it profit a spider to be like a bird-dropping ? Perhaps because it thereby escapes attention ; but there is another possibility. It seems that some butterflies, allied to our Blues, are often attracted to excrementitious material, and the spider Dr. Forbes observed had actually caught its victim. This is



WHEN ONLY A FEW DAYS OLD, YOUNG BITTERN BEGIN TO STRIKE THE SAME ATTITUDE AS THEIR PARENTS, THRUSTING THEIR BILLS UPWARDS AND DRAWING THEIR BODIES UP SO THAT THEY RESEMBLE A BUNCH OF REEDS.

The soft browns and blue-greens harmonise with the dull sheaths of the young reeds ; the nestling bittern is thus completely camouflaged.

borne out by a recent observation by Dr. D. G. H. Carpenter, who found a Uganda bug closely resembling a bird-dropping on sand. The bug actually settled down on a bird-dropping on sand, and caught a blue butterfly which came to feed there !

Some of the walking-stick insects, belonging to the order of crickets and grasshoppers (Orthoptera), have their body elongated and narrow, like a thin dry branch, and they have a way of sticking out their limbs at abrupt and diverse angles, which makes the resemblance to twigs very close indeed. Some of these quaint insects rest through the day and have the remarkable habit of putting themselves into a sort of kataleptic state. Many creatures turn stiff when they get a shock, or pass suddenly into new surroundings, like some of the sand-hoppers when we lay them on the palm of our hand ; but these twig-insects put themselves into this strange state. The body is rocked from side to side for a short time,

and then it stiffens. An advantage may be that even if they were surprised by a bird or a lizard, they will not be able to betray themselves by even a tremor. Disguise is perfected by a remarkable habit, a habit which leads us to think of a whole series of different ways of lying low and saying nothing which are often of life-preserving value. The top end of the series is seen when a fox plays 'possum.

The leaf-butterfly *Kallima*, conspicuously coloured on its upper surface, is like a withered leaf when it settles down and shows the underside of its wings. Here, again, there is precise form-resemblance, for the nervures on the wings are like the midrib and side veins on a leaf, and the touch of perfection is given in the presence of whitish spots which look exactly like the discolorations produced by lichens on leaves. An old entomologist, Mr. Jenner Weir, confessed that he repeatedly pruned off a caterpillar on a bush in mistake for a superfluous twig, for many brownish caterpillars fasten themselves by their

posterior claspers and by an invisible thread of silk from their mouth, and project from the branch at a twig-like angle. An insect may be the very image of a sharp prickle or a piece of soft moss; a spider may look precisely like a tiny knob on a branch or a fragment of lichen; one of the sea-horses (*Phyllopteryx*) has frond-like tassels on various parts of its body, so that it looks extraordinarily like the seaweed among which it lives. In a few cases, e.g. among spiders, it has been shown that animals with a special protective resemblance to something else seek out a position where this resemblance tells, and there is urgent need for observations bearing on this selection of environment.

§ 5

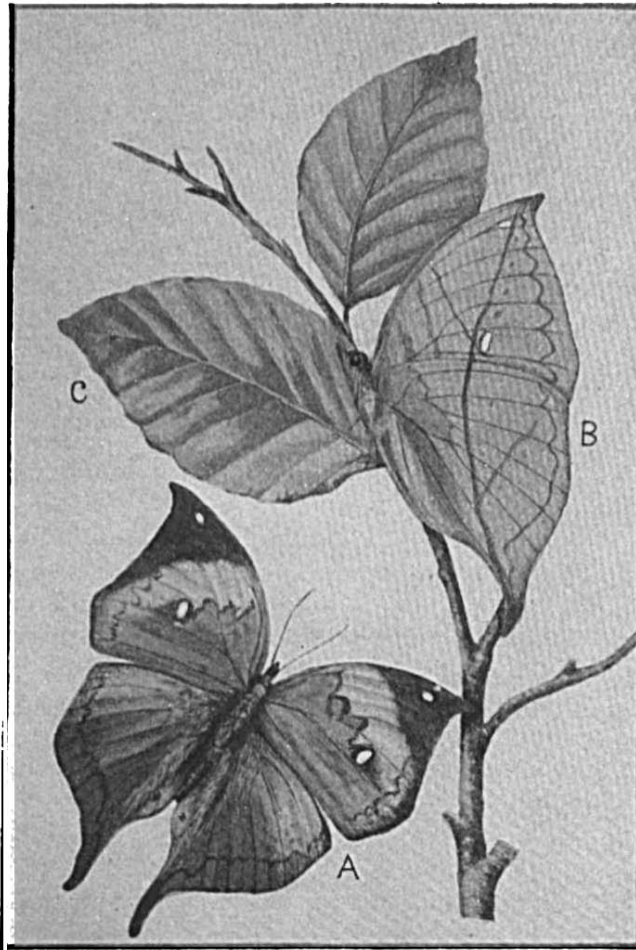
It sometimes happens that in Mimicry one in the true and the sense.

same place there are two groups of animals not very nearly related which are "doubles" of one another. Investigation shows that the members of the one group, *always in the majority*, are in some way specially protected, e.g. by being unpalatable. They are the "mimicked."

The members of the other group, *always in the minority*, have not got the special protection possessed by the others. They are the "mimickers," though the resemblance is not,

of course, associated with any conscious imitation. The theory is that the mimickers live on the reputation of the mimicked. If the mimicked are left alone by birds because they have a reputation for unpalatability, or because they are able to sting, the mimickers survive — although they are palatable and stingless. They succeed, not through any virtue of their own, but because of their resemblance to the mimicked, for whom they are mistaken. There are many cases of mimetic resemblance so

striking and so subtle that it seems impossible to doubt that the thing works; there are other cases which are rather far-fetched, and may be somewhat of the nature of coincidences. Thus, although Mr. Bates tells us that he repeatedly shot humming-bird moths in mistake for humming-birds, we cannot think that this is a good illustration of mimicry. What is needed for many cases is what is forthcoming for some, namely, experimental evidence, e.g. that the unpalatable mimicked butterflies are left in relative peace while similar palatable butterflies are persecuted. It is also necessary to show that the mimickers



DEAD-LEAF BUTTERFLY (*KALLIMA INACHIS*) FROM INDIA.

It is conspicuous on its upper surface, but when it settles down on a twig and shows the underside of its wings it is practically invisible. The colouring of the under surface of the wings is like that of a withering leaf; there are spots like fungus spots; and the venation of the wings suggests the midrib and veins of the leaf. A, showing upper surface; B, showing under surface; C, a leaf.

do actually consort with the mimicked. Some beetles and moths are curiously wasp-like, which may be a great advantage; the common drone-fly is superficially like a small bee; some

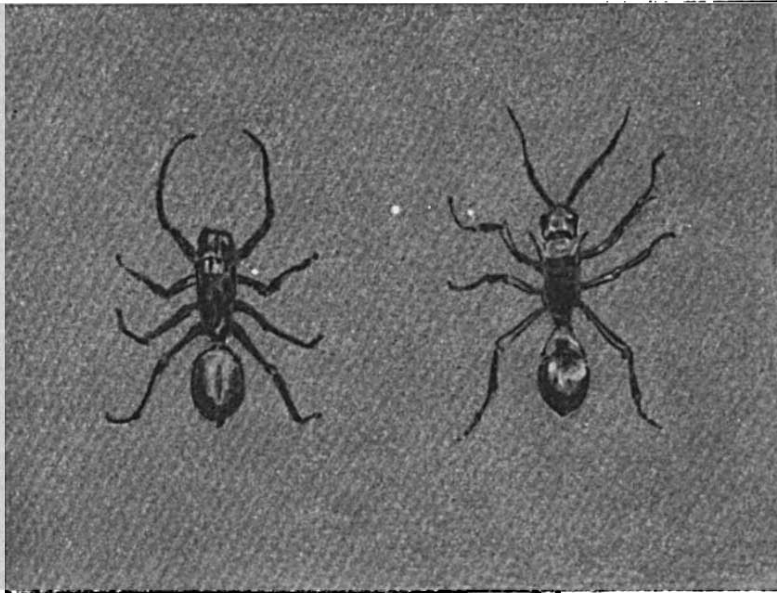
harmless snakes are very like poisonous species; and Mr. Wallace maintained that the powerful "friar-birds" of the Far East are mimicked by the weak and timid orioles. When the

alone. In any case it is plain that an animal which is as safe as a wasp or a coral-snake can afford to wear any suit of clothes it likes.

The episode in Scottish history called "The Walking Wood of Birnam," when the advancing troop masked their approach by cutting down branches of the trees, has had its counterpart in many countries. But it is also enacted on the seashore.

There are many kinds of crabs that put on disguise with what looks like deliberateness. The sand-crab takes a piece of seaweed, nibbles at the end of it, and then rubs it on the back of the carapace or on the legs so that it fixes to the bristles. As the seaweed continues to live, the crab soon has a little garden on its back which masks the crab's real nature. It is most effective camouflaging, but if the crab continues to grow it has to

moult, and that means losing the disguise. It is then necessary to make a new one. The crab must have on the shore something corre-



PROTECTIVE RESEMBLANCE BETWEEN A SMALL SPIDER (to the left) AND AN ANT (to the right).

As ants are much dreaded, it is probably profitable to the spider to be like an ant. It will be noted that the spider has four pairs of legs and no feelers, whereas the ant has three pairs of legs and a pair of feelers.

model is unpalatable or repulsive or dangerous, and the mimic the reverse, the mimicry is called "Batesian" (after Mr. Bates), but there is another kind of mimicry called Müllerian (after Fritz Müller) where the mimic is also unpalatable. The theory in this case is that the mimicry serves as mutual assurance, the members of the ring getting on better by consistently presenting the same appearance, which has come to mean to possible enemies a signal, *Noli me tangere* ("Leave me alone"). There is nothing out of the question in this theory, but it requires to be taken in a critical spirit. It leads us to think of "warning colours," which are the very opposite of the disguises which we are now studying. Some creatures like skunks, magpies, coral-snakes, cobras, brightly coloured tree-frogs are obtrusive rather than elusive, and the theory of Alfred Russel Wallace was that the flaunting conspicuousness serves as a useful advertisement, impressing itself on the memories of inexperienced enemies, who soon learn to leave creatures with "warning colours"

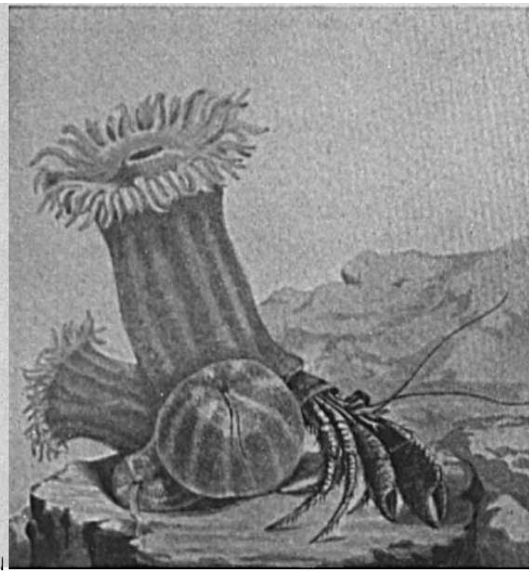


Photo: J. J. Ward, F.E.S.

THE WASP BEETLE, WHICH, WHEN MOVING AMONGST THE BRANCHES, GIVES A WASP-LIKE IMPRESSION.

sponding to a reputation; that is to say, other animals are clearly or dimly aware that the crab is a voracious and combative creature. How useful to the crab, then, to have its appearance cloaked by a growth of innocent seaweed, or sponge, or zoophyte. It will enable the creature to sneak upon its victims or to escape the attention of its own enemies.

If a narrow-beaked crab is cleaned artificially it will proceed to clothe itself again; the habit has become instinctive; and it must be admitted that while a particular crab prefers a particular



HERMIT-CRAB WITH PARTNER SEA-ANEMONES.

Hermit-crabs hide their soft tail in the shell of a whelk or some other sea-snail. But some hermit-crabs place sea-anemones on the back of their borrowed shell. The sea-anemones mask the hermit-crab and their tentacles can sting. As for the sea-anemones, they are carried about by the hermit-crab and they get crumbs from its table. This kind of mutually beneficial external partnership is called commensalism, i.e. eating at the same table.

kind of seaweed for its dress, it will cover itself with unsuitable and even conspicuous material, such as pieces of coloured cloth, if nothing better is available. The disguise differs greatly, for one crab is masked by a brightly coloured and unpalatable sponge densely packed with flinty needles; another cuts off the tunic of a sea-squirt and throws it over its shoulders; another trundles about a bivalve shell. The facts recall the familiar case of the hermit-crab, which protects its soft tail by tucking it into the empty shell of a periwinkle or a whelk or some other sea-snail, and that case leads on to the elaboration known as commensalism, where the

hermit-crab fixes sea-anemones on the back of its borrowed house. The advantage here is beyond that of masking, for the sea-anemone can sting, which is a useful quality in a partner. That this second advantage may become the main one is evident in several cases where the sea-anemone is borne, just like a weapon, on each of the crustacean's great claws. Moreover, as the term commensalism (eating at the same table) suggests, the partnership is *mutually beneficial*. For the sea-anemone is carried about by the hermit-crab, and it doubtless gets its share of crumbs from its partner's frequent meals. There is a very interesting sidelight on the mutual benefit in the case of a dislodged sea-anemone which sulked for a while and then waited in a state of preparedness until a hermit-crab passed by and touched it. Whereupon the sea-anemone gripped and slowly worked itself up on to the back of the shell.

§ 6

There are various kinds of disguise which are not readily classified. A troop of cuttlefish swimming in the sea is a beautiful sight. They keep time with one another in their movements and they show the same change of colour almost at the same moment. They are suddenly attacked, however, by a small shark, and then comes a simultaneous discharge of sepia from their inkbags. There are clouds of ink in the clear water, for, as Professor Hickson puts it, the cuttlefishes have thrown dust in the eyes of their enemies. One can see a newborn cuttlefish do this a minute after it escapes from the egg.

Very beautiful is the way in which many birds, like our common chaffinch, disguise the outside of their nest with moss and lichen and other trifles felted together, so that the cradle is as inconspicuous as possible. There seems to be a touch of art in fastening pieces of spider's web on the outside of a nest!

How curious is the case of the tree-sloth of South American forests, that walks slowly, back downwards, along the undersides of the branches, hanging on by its long, curved fingers and toes. It is a nocturnal animal, and therefore not in special danger, but when it is resting

during the day it is almost invisible because its shaggy hair is so like certain lichens and other growths on the branches. But the protective resemblance is enhanced by the presence of a green alga, which actually lives on the surface of the sloth's hairs—an alga like the one that makes tree-stems and gate-posts green in damp weather.

There is no commoner sight in the early summer than the cuckoo-spit on the grasses and herbage by the wayside. It is conspicuous and yet it is said to be left severely alone by almost all creatures. In some way it must be a disguise. It is a sort of soap made by the activity of small frog-hoppers while they are still in the wingless larval stage, before they begin to hop. The insect pierces with its sharp mouth-parts the skin of the plant and sucks in sweet sap which by and by overflows over its body. It works its body up and down many times, whipping in air, which mixes with the sugary sap, reminding one of how

"whipped egg" is made. But along with the sugary sap and the air, there is a little ferment from the food-canal and a little wax from glands on the skin, and the four things mixed together make a kind of soap which lasts through the heat of the day.

There are many other modes of disguise besides those which we have been able to illustrate. Indeed, the biggest fact is that there are so many, for it brings us back to the idea that life is not an easy business. It is true, as Walt Whitman says, that animals do not sweat and whine about their condition; perhaps it is true, as he says, that not one is unhappy over the whole earth. But there is another truth, that this world is not a place for the unlit lamp and the ungirt loin, and that when a creature has not armour or weapons or cleverness it must find some path of safety



Photo: G. P. Duffus.

CUCKOO-SPIT.

The white mass in the centre of the picture is a soapy froth which the young frog-hopper makes, and within which it lies safe both from the heat of the sun and almost all enemies. After sojourning for a time in the cuckoo-spit, the frog-hopper becomes a winged insect.

or go back. One of these paths of safety is disguise, and we have illustrated its evolution.