Observations on the habits and natural surroundings of insects made during the 'Skeat expedition' to the Malay peninsula, 1899-1900 / by Nelson Annandale.

(5.)

[*From the* PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF LONDON, December 4, 1900.]

Observations on the Habits and Natural Surroundings of Insects made during the "Skeat Expedition" to the Malay Peninsula, 1899-1900.

By NELSON ANNANDALE, B.A.[1]

CONTENTS.

I. INTRODUCTION.

The observations which form the subject of this paper were made in the months of April to September, 1899, while I was a member of Mr. W. W. Skeat's expedition to the Siamese Malay States. I take this opportunity of expressing my thanks to the University of Cambridge for permitting me to join that expedition as a

[1] Communicated by Prof. E. B. POULTON, F.R.S., F.Z.S.

volunteer, and also of saying how much I am indebted to Professor Poulton, F.R.S., of Oxford, and to Dr. David Sharp, F.R.S., of Cambridge, who have aided me in ways too numerous for specification. I also must thank Mr. Malcolm Burr, F.Z.S., F.E.S., for identifying many of the Orthoptera mentioned. The immaturity of many of my specimens has made it impossible to place them more definitely than by saying that they belong to such and such a family; in at least one instance even this has been impossible. In the few cases in which species are new to science I have not ventured to name them, as that is more properly the task of the specialist who describes them from a systematic or anatomical point of view. The immense importance of climatic and other physical conditions of life in the consideration of an animal's habits has induced me to preface my observations with a short general account of the country through which we passed, especially as little is known of the geography of lower Siam. I found a knowledge not only of the native names of animals but even of the native stories in connection with them to be of such value in my work, both as a collector and as an observer, that I have treated the etymology and what may be called the mythology of the subject at greater length than is perhaps usual in a zoological paper.

The climate of lower Siam is extremely damp, and is not divided into regular seasons in most districts, though more rain is liable to fall during the winter (November, December, and January) months than at any other time of the year. The most northerly State that we visited, except for a hurried trip to the Tale Noi (Little Lake) in Ligor, was Patalung, which abuts on the Tale Sap or Great Lake of Singora. In Patalung the rainfall is very small in March and April, but the jungle is never parched by drought. The interior of the eastern States is mountainous, and is buried in deep jungle, which is only broken, along the banks of the numerous rivers, by villages; clearings for hill rice, bananas, and maize; and by lawns, which are cropped smooth by half-tamed or feral buffaloes. The soil on the sea-coast is sandy, and in some places produces only a scanty vegetation. Between the mountains and the sea there is a great plain, dotted with isolated hills, mostly of limestone, some of which reach a considerable height, and some of which are riddled with caves. The mountain-region is the dampest of the three, being subject to violent thunderstorms, which are very local and lose much of their violence before they reach the coast. In nearly all regions rain falls almost daily for the greater part of the year.

A very large proportion of my observations were made at Aring, in the hill-country of Kelantan, the most southerly of the States which I visited. Aring is a village in the midst of exceedingly dense jungle, which commences close to the houses. The specimens which we obtained there were comparatively few in number, but very many of the species were peculiar in one way or another. Biserat in Jalor, the only other place where we stayed for more than a few days at a time, is in the plains, at the base of some hills

of no great height about 25 miles from the coast; it is the Siamese headquarters of the State. At Biserat we obtained a very large number of specimens, including probably more individuals and species than did the rest of our land collections; but very few of the species were highly specialized. Every sort of environment is to be found near a place like Biserat: swamp, lawn, orchard, open wood, cave, river, and even jungle on the hills, but not jungle of the densest. The animals in such a locality have no need to adapt themselves to any very limited environment, they can choose what environment they will. In the deep jungle, on the other hand, though few animals of any sort are seen on the ground, the fiercest struggle for existence rages among the upper foliage and also in the rotten wood underfoot—though there the termites, as a rule, far outstrip all competitors; while, even in the clearings, the space and the food-supply is so limited that every animal must make the best use of its natural advantages or else disappear. Though the clearings are of recent formation, due to man, who has become no longer a savage, yet the struggle which goes on in them seems already to have led in many cases to extreme modifications in habit and structure. We can only suppose that this struggle commenced long ago in places such as sand-spits running out into the rivers, where vegetation was necessarily scanty, owing to poverty of soil or constant change of conditions.

II. Flower-like Mantidæ.

Hymenopus bicornis (pupa).

Colour.—Head: very pale grey, almost white. Eyes of same shade, but with a slightly darker longitudinal stripe running down the centre of each. Leaf-like process between the eyes white, with median vein of pale green. Antennæ black.

Thorax: prothorax pale pink, with a tendency towards mauve; shading off posteriorly to white, and finally bounded by a bold transverse bar of deep sage-green. The posterior region of the thorax, which was usually concealed by the upturned abdomen, was pearl-white, as were also the rudimentary wings.

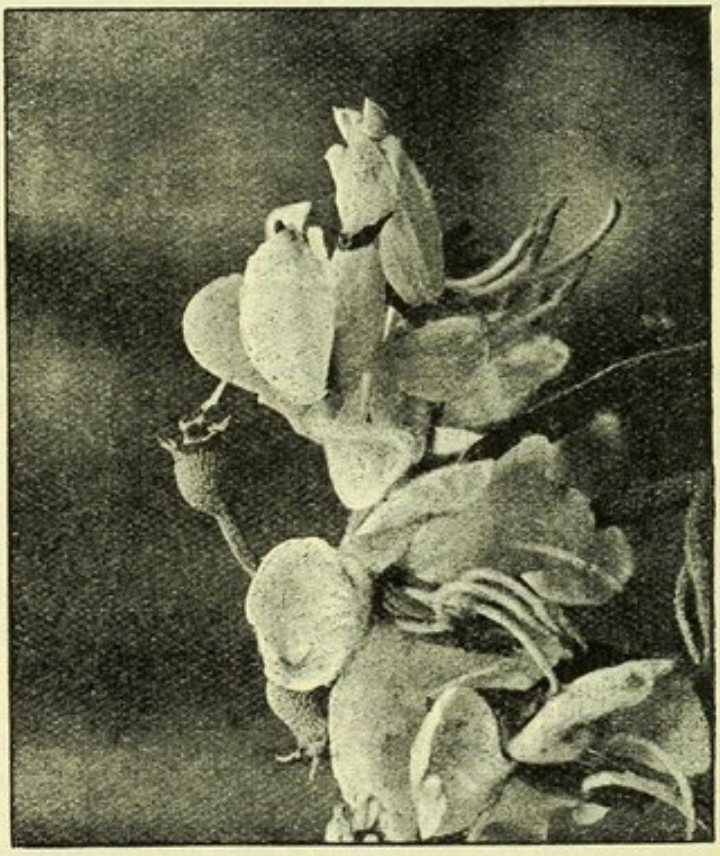
Abdomen: ventral surface pale pink. Dorsal surface pale pink, with 5 longitudinal dotted stripes of deep yellow-brown. Near the junction with the thorax were several irregular transverse bars of the same colour, but slightly darker. At the extreme tip of the abdomen, surrounding the anus, was a very conspicuous dark patch, almost black.

Limbs: 1st pair pale translucent pink. 2nd and 3rd pairs pink of a deeper shade, with a more marked tendency towards mauve. The distal joints were horn-coloured and almost transparent. At the inner edge of the broad petal-like expansions on the femur of the 2nd and 3rd pairs, more conspicuous on the 3rd than on the 2nd, was a slightly livid, bruise-like mark, such as one sees on flowers that have been battered by tropical rain.

The whole surface of the trunk and that of the flattened

expansions of the femur of the posterior limbs had that semi-opalescent, semi-crystalline appearance that is caused in flower-petals by a purely structural arrangement of liquid globules or of empty cells. On the grasping-limbs and on the extremities of the other pairs the absence of this peculiar sheen was compensated for by the translucency of the integument and the tissues—a translucency more proper to Cœlenterates than to an air-breathing insect. The petals of *Melastoma polyanthum*, the flower with which the Mantis was found associated, are of mauve-pink on the upper surface, slightly darker in tone than that of the limbs of the insect. Their lower surface, and consequently the visible surface of the older flower-buds, is considerably darker than the upper, more like that of the Mantis's abdomen. The leaves are of the same shade of green as the bar across its thorax. The flower was in bloom in

Fig. 1.



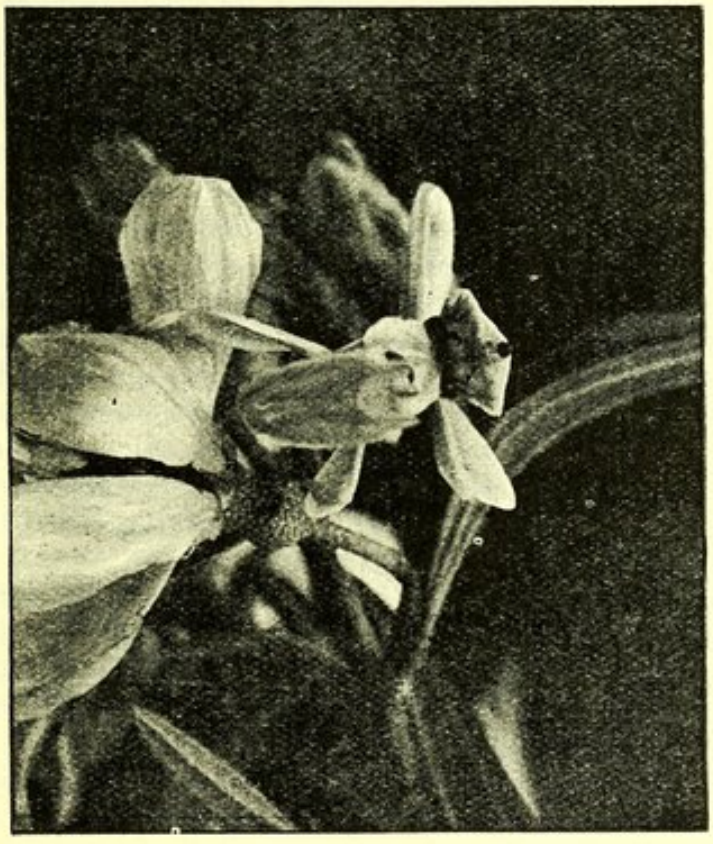
Pupa of *Hymenopus bicornis* on inflorescence of *Melastoma polyanthum*.
(Photographed from life.)

The Mantis is seated in an upright position, with the abdomen flexed backwards. The photograph represents it as it is seen on a level with the eye, and shows the horn-like eyes of the insect (at the apex of figure), the V-shaped bar on the thorax, the predatory limbs folded in front of the body, the petal-like expansions of the femora of the 2nd and 3rd pairs of legs arranged on the flowers, and the ventral surface and dark tip of the abdomen. The tarsus of the left leg of the 3rd pair is seen stretching out from beneath the expansion of the femur to a seed-vessel of the plant.

Patalung at the end of March, and not yet completely passed at Aring in the middle of September; but possibly the flowering-season does not exactly coincide in the two districts. I know of no other flower at all like it in the jungle of lower Siam. A rarer species of the same genus, very similar in general appearance, is found in the clearings.

Habits and Attitude.—The only specimen which I obtained was caught about midday on August 17th in a buffalo-lawn near Kampong Aring, a village in the Ulu Lebeh district of Kelantan—that is to say, almost at the centre of the broad part of the Malay Peninsula. I was attracted to a bush of the "Straits Rhododendron" (*Melastoma polyanthum*) by a curious movement among the flowers of a large inflorescence at the height of about five feet above the ground. On a cursory examination I could only see that one of the flowers—so it appeared—was swaying slowly from side to side; and it was not for several seconds that I realized that the moving

Fig. 2.



Pupa of *Hymenopus bicornis* on inflorescence of *Melastoma polyanthum*.
(Photographed from life.)

The same specimen as in figure 1, viewed from above, showing the dotted lines on the dorsal surface of the abdomen and the bruise-like markings on the expansions of the femora of the 3rd pair of legs. The head and fore limbs are slightly out of focus, and part of the bar on the thorax appears behind them. This photograph shows the difference in shape between the expansions on the legs of the Mantis and the petals of the flower.

flower was not a flower at all, but a Mantis. Even then it betrayed itself by turning round and staring me in the face in the manner characteristic of the Mantidæ. When I held the branch on which the insect had established itself in my hand, I could not tell exactly where animal tissue commenced and where flower ended, so perfectly was the one assimilated to the other, not only in colour but in surface texture, and perhaps even to some degree in structure. The Mantis had ensconced itself in the very centre of the inflorescence, a position which it never assumed in the three days during which it remained alive in my hands: it will be noticed in the figures (pp. 840, 841), which are from photographs taken from life at Aring, that the insect is clinging to the edge of a bunch of flowers. The attitude which it adopted did not change with its position in the inflorescence. In all cases, so long as the insect was on the watch for prey, the abdomen was bent backwards until its dorsal surface almost touched that of the thorax. The head and thorax were held upright, and the fore limbs in front of them, in the ordinary "praying" attitude of the Mantidæ. The other two pairs of legs, by which it clung to the flowers, were disposed round the upturned abdomen, more or less at right angles to the main axis of the body. Sometimes this was the same as that of the inflorescence, but often it was at an angle to it; for the Mantis seemed indifferent as to whether its head or one of its sides was uppermost. When once a position had been taken up, it was never changed so long as the insect remained on that particular inflorescence. Perfect as was the concealment thus effected, I cannot say that the Mantis imitated a single flower or part of a single flower with any great accuracy. Perhaps the upturned abdomen might be taken to represent a bud not yet opened, while the darker expansions on the femora showed a greater resemblance to petals which had already unfurled themselves. The petals of *Melastoma*, however, are more elongated than these structures on the legs of the Mantis, which are almost circular in shape, though their diameter is as great as, if not greater than, that of the floral structures which they represent. What I can say with certainty is, that a most marvellous resemblance is produced between the insect *Hymenopus bicornis* and part of an inflorescence of *Melastoma polyanthum* when the flower and the insect are combined, as they sometimes are in nature. I cannot say that they are always found together. An interesting point in connection with this simulation of the flowers is the part played by the green bar across the thorax of the Mantis. This bar divided the prothorax from the rest of the body, and apparently separated the insect into two parts, which appeared to have no connection with one another on the inflorescence. In no ordinary inflorescence of this plant are the flowers large enough to afford an expanse of uniform coloration of the size of *Hymenopus*.

During an unsuccessful search for further specimens in the buffalo-lawn at Aring, the Mantis was placed, together with the inflorescence to which it still clung, in a large box lined with dead leaves. On the lid being taken off from this, after about half an

hour's interval, it was found that the insect had deserted the flowers and was sitting quite still among the leaves at the bottom of the box. Though its attitude was essentially the same as before, its whole appearance was now completely changed; for it no longer resembled the flowers among which it had been found except in the most remote degree, but appeared rather to simulate an orchid fallen upon the ground. The brown lines on the upper surface of the abdomen, which had before been concealed among the petals of the flowers, became conspicuous from many points of view, now that the body was seen from above. Converging as they did towards the junction with the thorax, they bore no slight likeness to the "honey-guides" of many orchids. The darker transverse bars seen in the shadow cast by the head and thorax gave an idea of hollowness such as might be expected round the nectaries; while the abdomen itself represented the labellum, and the limbs the other petals of the orchid. The head and thorax took the place of the stamen and anthers, their resemblance to which was greatly increased by the horn-shaped eyes; and even the green bar on the thorax had a new part to play, for on not a few orchids there is just such a band at the base of this part of the flower. No change of colour aided the change of appearance. The Mantis remained among the dead leaves for the rest of the day of its capture and for the night which followed, without altering its tint or losing anything of its brilliancy. I do not know of any specific orchid which it may have simulated; orchids of sufficient size and brilliancy of colour are rare, if not unknown, in lower Siam.

Early the next morning the Mantis was placed on a packing-case in the open air, near a large branch of the "Rhododendron" fixed upright in a natural position. It deliberately walked towards the branch, swaying its whole body from side to side as it progressed, and commenced to climb one of the twigs. This twig, however, bore only green buds and unripe fruit. When the Mantis reached the tip of the twig and found no flowers, it remained still for a few seconds, and then turned and descended with the same staggering gait. It proceeded to climb another twig. This also bore no flowers. The Mantis descended from it and mounted a third twig, which was topped by a large bunch of full-blown blossoms. To these it clung by means of the claws of the two posterior pairs of limbs. For a few minutes it remained perfectly still, and then began swaying its body from side to side, as it had done while walking. (It was only during this brief interval of rest that I was able to secure a photograph, for in a tropical climate so damp as that of lower Siam instantaneous photography is never satisfactory. The light, in spite of its apparent intensity, is very feebly actinic, and the moisture of the atmosphere combined with the heat makes it impossible to keep "rapid" plates for any length of time.) While the body of the Mantis was in motion the fine hair-like antennæ were also in constant agitation, sometimes being held upright, sometimes stretched out like horns, and sometimes lying back along the thorax.

Almost as soon as the Mantis had settled itself on the inflorescence, a small, dark, dipterous insect, of a kind very commonly seen on the flowers of this species of *Melastoma*, alighted on one of its hinder legs. It was soon joined by others, apparently of the same species as itself. They settled quite indiscriminately on the petals and on the body and limbs of the Mantis. It was then that the significance of the black spot at the tip of the abdomen became apparent, for at the distance of a few feet it was impossible to distinguish it, except by its symmetrical position, from one of these small Diptera. The Mantis made no attempt either to drive off or to capture the small flies, for its motions seemed to attract rather than to repel them. After a short time a larger Dipteron, as big as a common house-fly, alighted on the inflorescence within reach of the predatory limbs. Then the Mantis became active immediately; the fly was seized, torn in pieces and devoured, notwithstanding the presence of a large crowd of natives who had collected to watch what was happening. I did not see *Hymenopus* actually catch an insect on its own person; but very probably this was owing to the short duration of my observations. The smaller Diptera were unable to discriminate between real and simulated vegetable tissue, and there is no reason to suppose that the larger ones are more intelligent. I was unable to detect any secretion from the integument or any part of the body of the Mantis which might have attracted them. It is quite probable that they acted gratuitously as lures for its prey, in that they made it appear that there was no trap set, if they did not form an actual bait for predaceous insects.

After the Mantis had been on the watch for some little time, I noticed that the abdomen was drooping slightly and was gradually coming to lie in line with the thorax. As it did so, the brown lines on its dorsal surface came into sight, and they grew more conspicuous the more it drooped. At last, only a very few minutes after I had first noticed this movement, the Mantis gave a sudden leap into the air and alighted on the ground at the distance of several feet from the place where the base of the stem would have been had it leaped from a real bush of the "Rhododendron." It then staggered quietly away along the ground. When interrupted in its progress it gave a short jump; but it was easily recaptured, as its leaping powers were chiefly developed in the direction of jumping to the ground from a height. I was able to watch this drooping of the abdomen and final hasty desertion of the flowers on four separate branches. In each case the process commenced when the flowers began to droop, and occupied, perhaps, two minutes in completion. The drooping of the abdomen was primarily a preparation for leaping. Of that I have no doubt, for the body was bent again the moment the insect reached the ground, almost as if it were brought into position by the action of a powerful spring. Whenever the Mantis gave one of its short jumps on the level, the body was previously straightened with almost the same rapidity of action.

Moreover, the upturned position of the abdomen is common to many Mantid larvæ, for instance those of several species of *Hierodula* and *Pseudomantis*, though in the adults of these forms it becomes an impossible attitude when the insects are at rest, owing to the outgrowth of the wings; and these larvæ have the habit of leaping to the ground when disturbed on the tree-trunks on which they watch for prey, and always straighten their body before they leap. But that this action has a secondary significance in the case of *Hymenopus bicornis* is proved by the deliberate and gradual way in which it takes place when the insect is seated on an inflorescence. It seems to me that its secondary object is to display the brown lines on the dorsal surface, in order that, as the flowers wither, the flower mimic may appear to wither also. It must be remembered that in the tropics the process of fading, in the case of most flowers, is an exceedingly rapid one. It is difficult, however, if this be the true explanation, to see why the Mantis should leap to the ground when the flowers of a single inflorescence begin to fade, for we can hardly assume that it looks round to see whether other flowers on the same branch are fading also, and *Melastoma* is not a plant on which all the blossoms naturally fall off at the same time. In the case when it could find no proper concealment on one twig of a branch, the insect did not behave in this way. It is quite possible that its instinct may warn it to seek for other shelter whenever the petals begin to droop, for flowers of this plant close at night and in very bad weather. Under either of these conditions the insect must find it impossible to get its prey, and may be exposed to death from cold or from the violence of the rain, should it remain in an exposed position. Most probably it takes shelter among the undergrowth during storm and dark. When placed in a dark box it deserted the flowers to which it clung while they were plucked from the bush with considerable violence.

Malay Beliefs.—The Kelantan Malays call this insect "*Kanchong*," but they consider it so rare that my desire to obtain more than a single specimen was ridiculed as being quite extravagant. I was told that few men ever saw more than one such Mantis in the course of their lives. It was agreed at Aring that the *Kanchong* is not a "*belalang*"[1] (the general term in Malay for any Orthopteron which is neither a cockroach, "*lipas*," nor an earwig, "*sipit-sipit*")[2], but a flower which has become alive. "Its origin is from the flowers." The blossoms of the "*Sendudok*" give birth to it, in the same way as the leaves of the "*Nanka*," or Jack-fruit tree (*Artocarpus integrifolia*), give birth to *Heteropteryx dilatata*, a large prickly Phasmid

[1] *Belalang* are named after the *Lalang* Grass (*Imperatia koenigii*), which affords a favourite shelter to many orthopterous insects.

[2] *Sipit* are the tweezers with which the Malays pluck out the few hairs that naturally grow upon their chins. The reduplication of a word in Malay either gives it a metaphorical sense or turns it into a plural of indefinite multitude. Thus, *mata-mata*, from *mata* an eye, means a policeman; *macham* is a kind or sort, *macham-macham* all sorts.

of great rarity which rich men keep alive in cages in order to secure its eggs, which they set in rings like jewels, and consider to be a most powerful charm against evil spirits of all kinds. These eggs are said to be of a beautiful red colour.

Remarks.—Professor Poulton has been kind enough to show me some young larvæ of *Hymenopus bicornis* that he has lately received from Mr. Shelford, Curator of the Sarawak Museum, Borneo, together with some Heteroptera to which they bear a very close and detailed resemblance. It is indeed remarkable that any animal should be so highly specialized in two different directions of deception during the lifetime of an individual. The imago of this form, judging solely from dried specimens, may possibly show a likeness in life to a withered flower. Its long white tegmina, with their faint brown markings, may well have this appearance in life, if they are possessed of the flower-like glistening which distinguishes certain parts of the body of the pupa.

The pupa of the Indian Mantis, *Gongylus gongyloides*[1], the habits of which have been described by Dr. J. Anderson, resembles the *Kanchong* in swaying its body while waiting for prey, but differs from it in that only the lower surface is coloured like a flower, the back being green, and that the flower-like shape is brought about by the expansion of the thorax. Two varieties of the pupa of *Hymenopus* itself are known: the one is pink, the other white. Any information as to whether these are seasonal forms, whether they confine themselves to the flowers which they resemble, and whether they are in any way modified by light reflected from their environment, would be of the very greatest interest. Wood-Mason reports[2] two specimens, the one white and the other pink, taken at an interval of six months, apparently from the same district, in Assam. Mr. R. L. Butler of Selangor tells me that he has taken white specimens, and white specimens only, on the verandah of a bungalow at Kuala Lumpur, on which white lilies were growing in pots. Wallace[3] says that in India the pink variety will settle among any flowers or leaves, and he seems to lay stress on this point in a note which I have received from him. In the figure[4] of this insect given in Poulton's 'Colours of Animals' (p. 74) it is represented as sitting head downwards, on a leaf, with the abdomen and thorax in a straight line; in all of which points the attitude of the specimen depicted differs from that of mine, though the first is of no great importance. The brown lines on the dorsal surface of the insect[5], and the dark spot at the tip of the abdomen, are entirely omitted by the Indian artist. My specimen certainly refused to sit among leaves when it was in

[1] P. Asiat. Soc. Bengal, 1877, p. 193.
[2] Ent. Soc. London, 1877, p. xxix.
[3] 'Darwinism,' p. 212.
[4] The figure is from a native drawing sent to Wallace by Wood-Mason, from whom the information about this insect in 'Darwinism' was also obtained.
[5] These lines, and also the black tip to the abdomen, are just as conspicuous, judging from dried specimens, in individuals from other parts of the East as they were in the one observed at Aring.

the light; and I am sorry that I did not experiment with other flowers than those among which it was found. It would have been exceedingly difficult, if not impossible, to find any of sufficient size in the immediate neighbourhood of Kampong Aring.

Hymenopus bicornis, the only representative of its genus, is an insect which has a fairly wide distribution, being found in Sikkim, Java, and Sarawak; but in none of these localities does it appear to be at all common; in Kelantan it is exceedingly rare. During the six weeks which the expedition spent at Aring, only one specimen was seen, though every clearing in the district was full of the blossoms of the *Sendudok*. It may be said that an animal so well able to hide itself might easily exist in considerable numbers without being detected. This would have been perfectly true had the Mantis been in the habit of sitting still; but movement in an apparent flower is just as attractive to a biologist as it is to a lizard. After the first specimen had been captured, hundreds of bushes were examined with the very greatest care by three zoologists and a botanist, but no *Hymenopus* was found. Granted that the insect is as highly specialized in instinct as it is in form—and I think there can be little doubt that this is the case—it is not difficult to suggest an explanation of its rarity. It is an animal which, for some reason, has had the greatest difficulty in holding its own in past ages, and it has been driven in the course of its struggle for existence to the extremes of specialization. It has become so highly specialized, in fact, that it has condemned itself, as it were, to a single and very limited environment; and should that environment be changed, even to a slight extent, by external circumstances, the insect must either perish or alter both its structure and its habits immediately, a thing which no highly-specialized animal is likely to do rapidly. Now in the Malay Peninsula the conditions of life are always undergoing small changes that are apparent even to a traveller hastening through the country; there must be many that years of research could not reveal. Suppose that the district of Aring were decimated by the small-pox, as many a Malayan district has been, and that the inhabitants who survived fled over into Pahang with their buffaloes, in a few years the jungle would kill off all the Sendudok bushes in the neighbourhood, for the plant can only exist in a clearing. In olden times, before the advent of the Malays into the Peninsula, the Sendudok must have been a rare plant in Kelantan, as neither the Sakais nor any of the other aboriginal tribes make clearings or keep cattle. The extremely local nature of the fruiting-season of various semi-cultivated trees, such as the Mangosteen (*Garcinia mangostana*), must have some influence on the insects of the different districts, and seems to depend not so much on local variations of climate as on the different varieties of the trees that are popular in the different villages. One would like to know whether the variations of a fruit of such ancient cultivation as the banana affect the insects which live upon it. In lower Siam over a hundred varieties of

this fruit are said to be commonly grown, differing from one another in shape, size, colour, and even smell; and it is often the case that in two villages separated by only a few miles the predominant variety of banana is different. The introduction of a foreign weed such as the "*Putri Malu*," or Shy Princess (*Mimosa pudica*), among the teeming insect population of a tropical clearing must have some direct effect upon the life therein, and indirectly must influence all the surrounding country. This plant has appeared in the Peninsula since the arrival of the white man, its natural home being South America; and has succeeded in becoming one of the commonest and most noxious weeds in the country, even in the districts to which the white man himself has not yet penetrated.

III. Another Harpagid Pupa.

Colour.—Head: pink, eyes and mandibles black. Antennæ black.

Thorax: prothorax, which is broad and slightly flattened, dull pink, striped transversely with dingy white and pale green, and edged with black. (There is no bar on the posterior edge of the prothorax as there was in the other form.) Posterior region of thorax dull pink. Rudimentary wings dingy white, with a pale green band at the base of each.

Abdomen: pale pink, ringed with pale green, dingy white, and black. The green and black rings did not completely encircle the body, but were interrupted in the mid-ventral line by a number of prominences, one to each segment, of pale pink. At the extreme point of the abdomen, surrounding the anus, was a black spot, not so large or so prominent as the one on the corresponding position in *Hymenopus bicornis*, but still conspicuous.

Limbs: all the limbs were ringed with bands of dingy white, pink, and green, which completely surrounded them, including the expansions on the femora of the 2nd and 3rd pairs. The spines on the predatory limbs were some of them green and some black. The black spines predominated towards the distal extremities.

This Mantis had none of the flowery sheen of the other, and the lappets on the 2nd and 3rd limbs are small, rounded, and in nowise petal-like. The flowers with which it was found associated were of a deep cream-colour. Their buds and leaves were considerably darker than the green markings on the insect's body.

Habits and Attitude.—Unfortunately I was unable to observe this species in a state of nature, but I have no doubt that its habits are very similar to those of the Kanchong. The natural attitude of the two species is precisely the same, and though they adopt different methods of concealing themselves, they were both found hidden among flowers, presumably for the same purpose—that of obtaining their food. The common possession of a black tip to the abdomen is interesting. A single specimen of the striped Mantis was brought me on August 19th, by Mr. R. H. Yapp,

then botanist to the Expedition, together with a spray of the flowers and leaves of an acacia among which he had found it. The flowers of this tree are very much like those of the common Mimosa, but larger in size and of a far less brilliant shade of yellow. The leaves are much divided. Mr. Yapp tells me that he found the specimen on a tree near the edge of a buffulo-lawn across the Kelantan river opposite Aring, about eleven o'clock in the forenoon. Even in the dim light of the mosque in which we were then staying the insect was very inconspicuous among the flowers; and when it was taken out into the brilliart sunshine it completely disappeared among the shadows cast by them and the leaves. The dark bars on its body and limbs were slightly wider than the spaces between the pinnules of the acacia-leaves, and the prominences on the ventral surface of the abdomen were of the shape, though not of the colour, of the prominent parts on the unopened flower-buds; for it will be noticed that the buds were green, while the structures on the insect's body were pale pink. These prominences were conspicuous; but the lights and shadows among the feathery leaves and fur-like flowers were so confused that a difference in colour detracted little from the similitude between the abdomen, cut into as it was by the black bars which were conspicuous on its edges but interrupted in its middle line, and the distal extremity of one of the racemose inflorescences of the acacia.

The insect and the flower had not a single colour in common intrinsically; and yet, under given conditions of climate, the colours of the two became indistinguishable from one another.

The Malays at Aring called this insect Striped Kanchong; but the name was evidently invented for the occasion. The plant on which it was found being a tree and not a shrub, it was much more liable to escape detection, even had the acacia been as common as the "Rhododendron." There are plenty of similar acacias in Kelantan, and there is no reason why the Mantis should confine itself to one species, for its colour and form are adapted for concealment among any flowers and leaves of this peculiar type. The possession of leaf or petal-like expansions on the limbs is a peculiarity shared by many Mantids with leaf-like insects of different groups, but as a rule their outline is not so regular as it is in the case of this species and of *Hymenopus*. With regard to the origin of such structures and their primitive function, it is worth while noticing their rudimentary condition, whether it be a specific or merely a pupal character, in forms like this Striped Harpagid from Kelantan. It cannot be said that in this case they give any direct aid in concealing the insect by resembling petals of a flower or any other vegetable organ. But, especially where we get the extremes of light and shade, any little irregularity of outline or projection from the surface of the body of an animal may give it a distinct aid in hiding itself. This is truer in the case of the smaller invertebrates than it is in that of vertebrates, though the principle is well exemplified by many fish, and not a few lizards, that live among terrestrial and aquatic plants. A large nocturnal

snake, like the "*Ular katam tebu*" (*Dipsadomorphus dendrophilus*)[1] gliding among mangrove-roots beneath the moonlight, or a tiger resting at midday in the *Lalang* grass, is well concealed by its colour gradations and its black and yellow stripes, and has no need of an elaborately foliated tail like that of a heraldic lion; such a tail might be of very great advantage to a small Arthropod. Repeated observations, more especially in the small caves of the Koh Sih Hah, or Five Isles of the Tale Sap, have convinced me that the extreme elongation of the spinnerets in the Araneid family of Hersilidæ—the "*laba-laba berekor*" or tailed spiders of the Malays—aids greatly in effecting their concealment on the grey stones and tree-trunks which they frequent, by breaking the otherwise smooth and rounded outline of the abdomen, as the long legs break the outline of the cephalothorax. In short irregularity of outline bears much the same part in hiding an animal as does irregularity of colour such as is exemplified by the black bars on the otherwise pale and inconspicuous tints of the striped Mantis.

But irregular protective colour is by no means confined to definite bars and stripes, which might be said more exactly to represent definite shadows or spaces; it possesses even more frequently a scattered or speckled arrangement. In fact, it is very often the case that the actual colours present are not of such great importance as the manner in which they are arranged and their multiplicity in a given space. It is well known that even in the ordered light and surroundings of a picture gallery, if sufficient brilliant colours are crowded into a sufficiently small space they "kill" one another and are no longer brilliant. This is doubly true in the deep gloom of the jungle, where any colour has the greatest difficulty in asserting itself, and where so many hues that are in themselves brilliant have to contend with one another. On the jungle floor almost all colours are present in small quantities; there are patches of deep blue where the sky is reflected through a crevice in the upper foliage upon rain-water held in the hollow of a dead leaf; among the dead leaves themselves there is every shade of brown and yellow, and scattered black and white in plenty: patches of scarlet caused by fungi on rotten wood are sometimes frequent; there is the brown-pink of the seedlings struggling towards the light; and the dull green of tree-stems and creepers, and of the ferns and the few phanerogams which are adapted to exist down below. Bright green alone is absent, except in some

[1] *Katam tebu* are little round pieces of sugar-cane from which the outer skin has been removed. They are sold in the markets on bamboo skewers. The term "*Ular Katam Tebu*," in the Siamese States at any rate, is generic, and is applied to all snakes, whether marine or terrestrial, which are conspicuously ringed and which are too big to come under the category of "*Ular Kapak*" or Axe-snakes; the dark skin of the reptile being taken to represent the spaces between the *katam* on the skewer, and the lighter rings the *tebu* or sugar-cane itself. *Dipsadomorphus* is by far the commonest of such snakes, and therefore the species with which the name is most generally associated. In other parts of the Peninsula it is probable that the "*Ular Katam Tebu*" is *Bungarus fasciatus*.

mosses of the minutest size; so that large Locustids of yellows green, *Pseudophyllus* and others, which in the cabinet, and perhaps in their own place, form such admirable imitations of bamboo-leaves in colour, and to a lesser degree in form also (for doubtless they are part of the *plancton* of the jungle, and only gravitate down into its depths by misadventure), are the most conspicuous of the smaller jungle fauna which one meets with below. Yet all these shades are so altered and commingled in the chequer of deep shadow with occasional gleams of sunlight that they become completely confused to the eye. One is tempted to speculate as to whether the gorgeous tartan-like checks in which the Malays are so fond of clothing themselves may not have originally developed among a jungle-loving and somewhat murderous people at constant feud with their neighbours, as a means of secondary protective coloration, and have become more brilliant and less useful through the vagaries of sexual selection. On festive occasions these combinations of many colours are chiefly worn by the men, the women preferring for their holiday dresses simpler and more striking costumes into which only four or five masses of colour enter as a rule. On the jungle floor itself the most inconspicuous animals are certain long-legged but by no means bulky Phalangiids, which appear and disappear as they move or are still. Intrinsically they are of brilliant colours; one species is black, speckled on the body and limbs with scarlet, white, yellow, and green. But they are less conspicuous even than the majority of Phasmids found in similar situations, even than the forms which have green markings resembling minute liverworts, such as cover the stems and leaves of the jungle flora, on their otherwise stick-like bodies; for it is generally easy to distinguish the exact outlines of such insects if they have once been located; but even when the Phalangiids are moving it is rarely possible to see either their limbs or their bodies, though their motions are perfectly visible. Every such stick-insect resembles a particular stick, an ideal stick it is true; the Arachnids are assimilated, not to any particular object, but to their surroundings generally, by their irregular colour, their irregular form, and by the large extent of their surface in comparison with their bulk. The limbs of the Phasmids are often held in angular vegetable attitudes, but they do not always blend into their environment as the almost hair-like legs of the Phalangiids do; for it is often the case that the instinct of the insects is at fault in the choice of their immediate surroundings[1], whereas the protective adaptation of the Arachnids, being general and not particular, does not necessitate any high specialization of instinct to accompany it.

But that the object of brilliant coloration arranged in stripes is not always the same, even in a single group of insects, is proved, if proof were necessary, by comparing the striped pupa from Aring with the Arabian and African imago *Idolum diabolicum*[2], a form of which the natural colour and attitude have lately been described

[1] See Proc. Roy. Phys. Soc. Edinburgh, Dec. 1900.

[2] P. Cambr. Phil. Soc. vol. x. p. 175 *et post.*, plate ii.

by Sharp. This latter insect makes no attempt to conceal itself, but sits among leaves, showing, by reason of its broadened thorax and coxæ of the first pair of limbs, a likeness to some gorgeous flower.

In connection with these flower-like Mantids it may not be superfluous to mention the leaf-like form, *Deroplatys trigonodera*, which is sometimes found in the deep jungle near Aring. Though the whole visible surface of this species, including that of the tegmina and of the legs, is coloured like a dead leaf [1], and though the tegmina, the thorax, and the two posterior limbs bear irregular leaf-like processes, yet the posterior wings, where they are concealed by the tegmina, are coloured deep maroon, veined and rimmed with white. A specimen which crawled up my leg from the jungle floor made no attempt to fly when captured, but defended itself with its armed predatory limbs, drawing blood from my finger. Very possibly this species also may be nocturnal, or at least crepuscular, and only use its wings in the evening. This is certainly the case with the various species of large green Mantidæ that are common through the whole of lower Siam. At Biserat, in the State of Jalor, specimens of *Hierodula modesta* flew into our verandah in the evening on several occasions, and settling on the whitewashed wall, would feed on the termites and small Orthoptera attracted by the lamp, they themselves showing no inclination towards its flame. The insects which they caught did not avoid them in any way, but walked straight into their clutches. The larvæ of *Hierodula* and allied genera are often to be seen sitting on tree-trunks in the middle of the day; but I never observed an adult on the wing before sunset.

Ceratomantis saussurei is another interesting Mantis which may be taken at Aring. The head, body, and limbs of this species are of a dingy yellowish grey, speckled with black. The wings, which are unusually broad, are transparent, but the tegmina are marked with curious black streaks. The head is prolonged forwards between the eyes into a peculiar spike. The predatory limbs are broad and flattened dorso-ventrally; and the sides of the abdomen are produced into several irregularly shaped lobes. On the inner surface of the fore leg, which is concealed by that of the opposite limb except when the insect is struggling with its prey, there is a black bar running along the femur.

One morning in September, I found a specimen of this Mantis at Aring in the interior of a fallen tree which I was chopping up in the jungle. The wood was rotten and afforded a harbour to many other insects, such as beetles and cockroaches. A few days earlier another specimen was brought me by a Malay, together with a dead Selaginellid among which he had found it. If this Mantis is seated among the dead wood, its colour makes it inconspicuous; but if it is among dead fern-fronds or withered Selaginellids, its predatory limbs entirely disappear, owing to their

[1] Numerous other species of the same genus are coloured in a similar fashion.

colour and form. Among these leaves, the head and wings, though they are inconspicuous, are not invisible; the wings may be detected because they are transparent and glary, the head because it is held well raised above the surface on which the insect is sitting. Seen in such surroundings, there is nothing that would lead a human being to judge that the Mantis was a predaceous animal. Indeed, it bears a general likeness to a moth or a non-predaceous Neuropteron, not particular enough, perhaps, to justify one in saying that it "mimics" any other form, but sufficiently marked to deceive one as to its real nature. The fact that a specimen of the Mantis was found concealed in a dead tree would lend colour to the idea that it is nocturnal, as a large proportion of the Mantidæ appear to be. But it is quite possible that it may be sufficiently active in the daytime to seize any prey which comes within its reach. If so, it affords an instance that may be compared with that of the Kanchong. While the latter simulates a flower, and so actually allures its prey, the former sits still and looks harmless, so that its prey chances to come to it uninvited. The difference seems to me to be one of degree. Supposing that a green Mantis were seated among leaves of the same colour as its own body, and that a phytophagous insect alighted upon it, it might then be said to be an instance of "alluring" coloration. Whereas if the insect only alighted near it, the Mantis would scarcely come under this category. In any case the adaptation appears to be calculated to deceive Arthropod prey rather than mammalian enemies. The Mantidæ are well adapted for self-defence, and the movements of the Kanchong, at any rate, betray the insect to vertebrate eyes.

The curious prolongation of the head in *Ceratomantis* is not a feature of any systematic value; many other Mantids, belonging to widely separate genera, have a similar peculiarity. Undoubtedly, however, in this case it aids in masking the characteristic shape of the Mantid head; or, at any rate, appears to do so.

With regard to the marking on the femora of the fore limbs, similar markings, often emphasized by yellow lines running parallel to them or across them, occur in the same position in a large number of Mantidæ. I do not know that a function has ever been assigned to marks situated in this position except by the Russian naturalist Porschinsky, whose interesting observations [1], and imaginative explanations thereof, Professor Poulton has been kind enough to have translated for me from the Russian. Porschinsky has a theory that all eye-like markings on insects represent glands, which may be imagined to excrete a noxious fluid. He supposes that such markings simulate the liquid which has issued forth, with the blue sky or some other object reflected in it. He points out that the display of such spots is sometimes accompanied by a sound which might be taken to imitate liquid hissing out of a narrow opening such as the duct of a gland. *Mantis religiosa* is one of his examples. He says that there is a large

[1] Lepidopterorum Rossiæ Biologia, iv. (Petersburg, 1893), p. 36, fig. 10.

blue "eye" ringed with black on the inner surface of the femur of the fore limb in this species; and that the "eye" is concealed when the Mantis is at rest, because the two limbs are held folded together in front of the body. "But when danger threatens," to quote his own words, "the praying Mantis assumes a very peculiar and interesting attitude, which, so far as I know, was first described by Goureau. The long and narrow prothorax assumes a vertical position, so that the body is supported only by its two pairs of hind legs. Under these circumstances the insect widely separates the front pair of legs, giving to its long femora a horizontal position, so that the distal ends of them are directed on opposite sides. In this way the eye-spots, which are situated at their bases, stand out conspicuously and are most obvious, owing to their colour. The tibiæ of the front pair of legs are directed vertically upwards. At the same time the insect lifts up its tegmina and unrolls its wings, giving them a horizontal position, and it begins quickly to raise and lower its abdomen, which, rubbing against the posterior edge of the wings at the same time as these continual movements, produces a sound. The Mantis can produce the latter artificially by rubbing its wings against some extraneous object."

In the 'Entomologist's Record' for January 1900, Brunner von Wattenwyl calls attention to the markings on the fore limb of a species of *Hierodula* from Borneo. He speculates as to their origin, but does not assign them a use.

IV. Alarming Colour and Attitude.

A Hooded Locustid (*Capnoptera* sp. n. near *C. staudingeri*).

Colour.—♀. Body and limbs dull green, marked with dark brown. Tegmina dull green, veined and spotted with dull blue and marked with black. Hind wings pale smoke-colour. Between the head and the thorax there is a rectangular bladder of vivid scarlet. This is habitually concealed beneath the dorsal plate of the prothorax, but can be everted and project behind the head like a hood. When not in use the two corners most remote from its point of origin are inverted. When it was displayed these were everted, apparently by the forcing of blood into the hollow of the structure. ♂. Similar to female, but considerably smaller. The hood was equally well developed in both sexes.

Habits and Attitude.—The species is not uncommon in the jungle of Nawnchik, Patalung, and Jalor; but the male is much rarer than the female. I only obtained a single specimen of the former. So far as I know, there is nothing peculiar about the habits of this species when it is left to itself, except that the saltatorial legs being less highly developed than they are in most Malayan Locustids, it is unable to take the enormous leaps of forms, like the "*Belalang Rusa*" or Deer Grasshopper (*Mecopoda*), which are found in the same environment. When the hooded locust is taken in the hand it makes very little resistance. Leaving the consideration of its peculiar means of defence for a moment, this

is not surprising, as the chief resistance that the ordinary large Locustid can offer is that performed with its third pair of legs, which are incredibly powerful in some species and often armed with formidable spines. Instead of resisting, it lowers its head, so as to separate it from the thorax, and erects the hood. If this does not cause its enemy to let it loose, its resources are at an end. The sudden apparition of the vivid scarlet patch on the dull and inconspicuous body of the insect may well be disconcerting to its natural enemies. To a human observer it appears that he has injured his specimen, and that some brilliantly coloured portion of its internal anatomy is issuing from its neck.

Malay Name.—The Jalor and Rhaman Malays call this and allied species "*Belalang Gambor*," or Image Grasshopper, perhaps because they recognize a likeness between it in its alarming attitude and images of Buddha overshadowed by Cobras with expanded hoods. A colossal statue of this kind exists in a cave-temple near Biserat. When I asked for the "*Belalang Gambor*" at Aring, the natives brought me a large Locust (*Acridium succinctum*), that is known to the Malays at Biserat as "*Belalang Babi*," or Pig Grasshopper.

Remarks.—In the jungle near Kota Bharu, Rhaman, I found a single specimen of another species (*Capnoptera*, sp. n.) which had the same peculiarity of structure and attitude as this form, but differed from it in that the brilliant coloration was not confined to a part of the body which was concealed when the insect was at rest. Its head and body were of a dull neutral green; its tegmina pale, dull translucent yellow, barred and spotted with black; and its legs magenta. Magenta was also the colour of the hood, which in form and extent resembled that of the commoner species.

The action of these two grasshoppers may be compared with that of certain caterpillars, *e.g.* of one which is not common on pomegranate trees at Biserat in the month of June. It is a fair-sized form, probably belonging to the *Lymantriidæ*, which reaches a length of from 4 cm. to 6 cm. The dorsal surface is covered with long hairs of a pale lemon-yellow colour, those on the 4th to 7th segments being shorter and more closely set than the others. Between the 4th and 5th segments a black bar of a peculiar velvety appearance extends right across the body. This bar is surrounded by a kind of white halo, and is almost completely concealed when the caterpillar is feeding or walking; which it does in rather a peculiar manner, always resting after every few paces, and twisting its body about, as if it were feeling round to see that there was nothing wrong. If one blew upon the caterpillar, or irritated it in any other way, it suddenly bent the anterior and posterior regions of its body together, thus causing the black bar on the back to become stretched and be conspicuous, and to appear like a gaping, cavernous mouth, of which the bunches of hair behind and before formed the jaws. The phenomenon was first pointed out to me by Mr. D. T. Gwynne Vaughan, then botanist to the Expedition.

Some such cases come near to mimicry; for the one just

mentioned differs but little in essentials from that of the Sphinx larvæ, which bring into prominence the eye-like markings on their sides when alarmed, and thus seem to mimic small reptiles or mammals. One such caterpillar[1] is not uncommon in Nawnchik and Patalung during April. It feeds on a species of *Caladium*[2] growing in marshy localities, and is generally found on the underside of the broad leaves, in the shadow of which it may easily be mistaken for a small gecko which has lost its tail; though geckos do not live in the marshes, and though its eye-spots are perfectly round, more like the eyes of a snake than those of a gecko in the daytime.

In some cases structures which are alarming at one stage of an animal's existence may be mimetic or protective at another. The case of the larva of our English Lobster Moth (*Stauropus fagi*)[3], which in its youth is said to mimic an ant, is so well known that I need only refer to it. In lower Siam there is a common caterpillar, of what family it is impossible to say, which has a series of curious long, flattened processes rising in three rows from the dorsal surface of the anterior part of the body. When the animal is walking these structures are kept in constant motion. They may be supposed to alarm its enemies by their movements, and certainly they give the full-grown caterpillar no aid by concealing it or by making it resemble any other animal. But I have been completely deceived by a very young specimen of this form. It was hanging by a thread from a tree, and looked so extremely spider-like as it hung, that I captured it to add to our collection of spiders. Nor was I undeceived before the insect was in my spirit-tube; for in the Malay jungle there are many Araneids with elongated abdomens.

An animal which is habitually of an alarming appearance may even lose this appearance periodically. At Aring, one afternoon in the beginning of September, a caterpillar nearly allied to *Stauropus fagi*, and probably belonging to the same genus, came under my notice. When first I saw it I mistook it for a bird's dropping. It was seated on the edge of a leaf of *Melastoma polyanthum*, with the anterior and posterior regions of its body bent towards one another, with the true legs folded together upon the under surface of the thorax, and the abdominal feet firmly clutching the edge of the leaf. The body was bent over so that one side lay on the upper surface of the leaf, parallel to the mid-rib. The insect was motionless. Its skin was smooth and shiny; intense black in colour, except for some vivid white markings about the middle of the body. The likeness to a bird's dropping was not exact, because these white markings were at the

[1] The Malays do not appear to have any superstitious dread of this caterpillar, such as is felt by the Irish for that of the Elephant Hawk Moth (*Chærocampa elpenor*), a form to which it bears a close resemblance. For the Irish beliefs with regard to the caterpillar, see Miss Ormerod's Reports, 1898, pp. 72–73.

[2] The "*Kladi mabok*" or Sick Caladium, so called because, unlike some other species, it is inedible.

[3] See Poulton, Journ. Linn. Soc., Zool. xxvi. pl. 40, and 'Colours of Animals.'

centre and not towards the periphery; but, nevertheless, it was striking and, at a first glance, quite deceptive. When disturbed the caterpillar commenced to walk along the leaf, slowly and irresolutely, unbending and rebending its long thoracic limbs as it moved, and shaking the two processes with which its abdomen terminated. I took it home, and shut it up till the next morning with a supply of leaves, hoping to photograph it when the light was better. During the night the insect cast its skin, and in the morning all likeness to anything else had left it. The skin was no longer polished and glittering, and the colour had changed to a dull brown with dingy white bars. Moreover, all sluggishness of movement had disappeared, and the caterpillar was now exceedingly brisk, behaving very much as a well-grown specimen of our own English form would do. During the languor and dangerous inactivity of the ecdysis and the period immediately preceding it, protective coloration had been assumed; as soon as the operation had been safely performed, the habitual means of defence were adopted once more.

But to return to animals which, being otherwise inconspicuous, have the power of exhibiting brilliant colour when alarmed. This phenomenon is not only exemplified by insects. A good instance is that of the Toad *Callula pulchra*, which is found not uncommonly in the Siamese States, among the rubbish which collects under the houses and in like situations. In this species, the upper surface of which is otherwise of a warm brown colour, a broad yellowish stripe runs along either side of the back; but the peculiar looseness of the skin and the folds into which it naturally falls prevent this stripe from becoming conspicuous. When the animal is disturbed, however, it draws air into its lungs until its body becomes almost globular, and the skin is stretched in such a way that its contrasting colours are displayed to their best advantage. We may compare this amphibian to the fish of the genus *Tetrodon* and others, which have earned the name of Balloon-fish among Europeans, and of "*Ikan buntal*," or Pillow-fish, among Malays, by the manner in which they gulp down air into their stomachs, so causing the brilliant coloration of many of them to become conspicuous, and also the spines with which they are armed to be erected.

Another interesting example is afforded by the Lizard *Liolepis bellii*, which the Malays call "*Biawak Pasir*" [1], or Sand Monitor, and which is common in all sandy plains where the vegetation is scanty in the north of the Malay Peninsula. The male of *Liolepis* is coloured in what sounds a very gorgeous fashion, and what is in nature by no means a conspicuous one. The upper surface is grey, mottled and eyed with green, the lower surface pale yellow veined with blue, which is more conspicuous on the underside of the thighs and the neck than on the rest of the body. Along each side there are a number of transverse bars, alternately of orange

[1] "*Biawak*" is the Malay name of *Varanus*.

and of deep purple. The female is very like the male, except that she is smaller, that her colouring is not so brilliant, and that the blue markings are almost entirely absent from her under surface. When the Lizard is running about the sand its brilliant shades are not conspicuous, for the lower surface is hidden beneath the body, and the bars on the sides are almost concealed in the folds of loose skin which are present in the living specimen. *Liolepis* is exceedingly timid and very agile; as a rule one does not see it until it commences to run away, at the distance of several yards. It lives in burrows, which it excavates, so the Malays say, by means of its feet and its snout. When one of the males is taken in the hand, it attempts to bite, for it has sharp teeth and a strong jaw, and struggles violently. As it struggles, it flattens out its body, by enlarging the lower angle formed by the ribs with the vertebral column, so that the purple and orange stripes on its sides come into view. The female tries the same tactics, but without such great effect, for in her case neither are the stripes so brilliant nor the ribs so mobile. It is very possible that the male makes some display [1] before the female at the time of courtship. The Malays say that the "*Biawak Pasir*" is monogamous, and on many different occasions, at Biserat and elsewhere, children brought me two specimens together, male and female, which they said they had snared in a single hole. The case of the Lizard is not quite parallel to that of the Grasshopper, for it is evident that in

[1] That reptiles do indulge in nuptial dances is proved by the case of the "*Sumpah-sumpah*" (*Calotes versicolor*), a Lizard whose great powers of changing its colour have caused the colonists of the Straits to misname it the Chameleon. When the male is courting the female, he is of a pale yellow colour early in the day, though in the afternoon he appears to become slightly darker; and he has a very conspicuous black patch [a] on either side of the throat which calls attention, as it were, to the gular pouches, that he is constantly inflating. He posts himself on some conveniently conspicuous perch, such as the top of a fence or a banana leaf, with his tail stretched out behind him and his fore-quarters raised as high as possible upon the legs. The head is held very erect, but is constantly being nodded up and down, very much in the same way as that of a cock pigeon is nodded under similar circumstances. He opens and shuts his mouth continually, as if he were chattering, but no sound is emitted; it is probably this habit which has given the Lizard its Malay name, which seems to be connected with a word (*sumpah*) that means to curse. In this manner the male advances gradually towards the female, only progressing a few steps at a time. The female remains concealed during the performance, which often commences at a considerable distance from her retreat. I found on several occasions that if one male was killed while dancing, his place was taken by another before many hours had passed. If he was captured, the black spots disappeared from his throat immediately; but they reappeared after death. The males of this Lizard are extremely pugnacious, and when they are fighting together they change colour repeatedly, the victor usually assuming a reddish tinge. The females differ from the males in most species of this genus in that the gular pouches and the nuchal and dorsal crest are smaller than in the other sex; also they do not seem to have the power of colour-change so well developed.

[a] See also Capt. Stanley Flower's paper on "The Reptiles of the Malay Peninsula and Siam," in the 'Proceedings' of this Society, 1899, p. 641. My observations were made in Bangkok, Singora, and Patalung, in the months of March and April.

the former the exhibition of brilliant colour is primarily a sexual attraction, being better developed in the male than it is in the female; but it seems probable that even in *Liolepis* any excitement may cause a display, and that in a secondary manner this display has come to be used as a means of alarming enemies, though it will be noticed that the conspicuous stripes are not exhibited suddenly, or immediately on disturbance, but only when the animal is handled. Also it is strange if the larger, more active male has this means of defence better developed than the female, which must be much less agile at times. The fact that *Liolepis bellii* has particularly strong teeth and jaws does not seem to me to be of any importance in considering the case. The Cobra affords one of the best instances of alarming coloration and attitude, and it happens to be a particularly venomous animal; but there are instances of similar display among animals which have no such dangerous qualities.

The black-and-yellow Snake, *Dipsadomorphus dendrophilus*, which is the commonest large Snake in Lower Siam, when driven to extremities exhibits movements which may be compared with the sudden display of colour by other forms. If a specimen of this Snake is tied up so that it cannot escape, it raises its head, gapes, hisses, strikes wildly at anything that is held near it, and drums spasmodically upon the ground with the last few joints of its tail, thus producing a curious noise. But I have never seen it bite, even when a stick was held close to its mouth; though many Snakes, e. g. *Coluber tæniurus*, will snap at anything, even at their own bodies, when they are sufficiently enraged. The Malays say that *Dipsadomorphus* is not poisonous; but they are much afraid of its bite, because of its violent appearance.

V. Sounds produced by Insects.

A Cicada (*Dundubia intemerata*).

There are two distinct colour varieties of this species, found together and independent of sex; the body of one being grass-green, and that of the other pale brown, which becomes yellow as the insect dries. Among my dried specimens there are intermediate forms more or less mottled; but this peculiarity did not appear for some days after death, and in life all the individuals were either one colour or the other.

At certain seasons this Cicada forms a regular article of diet among the Siamese inhabitants of Patalung; and as their method of capturing it is based upon a knowledge of its habits, I cannot do better than give an account of this method, as I saw in operation at Ban Nah, a village on the border of the hill-country of Patalung. Immediately after the sun had set several of the natives gathered in an open space, round a fire of brushwood or a number of torches fastened to stakes stuck into the ground, and commenced to clap their hands in unison, observing a regular time and rhythm. Very soon, if they were fortunate, the Cicadæ flew

out from the undergrowth of the surrounding orchards and jungle, and alighted on the persons of their captors, who had no difficulty in picking off the insects with their fingers and securing them, still alive, in a fold of their draperies. The clapping only continued for about half an hour every evening, and when, with considerable difficulty, I persuaded the men to recommence it again later in the night, not a single Cicada came near them, though the stridulating had now become loud all over the village, like the noise of machine hair-brushes in a barber's shop.

The insects were silent on the wing, and I only heard one stridulate when caught. The voiceless females, as might be expected, were in great preponderance over the males among the specimens taken; probably the one individual which was not dumb when captured was the only male taken that night. In order to be sure that the fire was not the chief attraction for the Cicadæ, I stood among a party of natives who were clapping, together with another member of the Expedition, who clapped also; while I kept my hands still. In the course of a few minutes, the natives captured many specimens, and ten alighted on my friend's coat; but only one settled on mine. Afterwards I heard from a Patani Malay that the children of Patani town have a game in which they attract Cicadas by clapping their hands, and without the aid of light at all; though they sing, as they clap, a nursery rhyme, calling upon the insects to come down from the trees. The season of the edible Cicada seems to be a very local one in Patalung. At Ban Nah on the 1st of April, and again on the 6th of the same month, the natives secured me as many specimens as I wanted, besides serving a dish of them with our curry on the second occasion. On April 3rd, at Ban Kong Rah, which is only about eight miles further inland than Ban Nah, our guard of native military police were unable to catch a single individual, although they adopted exactly the same method of procedure as the Ban Nah people had done, and clapped at the same time of evening. On none of these three occasions had the moon risen, and in Patalung one night is like another in the dry season. On April 5th, I noticed that the ground in a patch of primæval jungle near Ban Kong Rah was covered with the cast pupal skins of a Cicada. Whether they were those of the edible species or not, I am unable to say with certainty, but they were of the correct size, and, so far as I could see, such as might be expected to belong to this form.

Malay Name, etc.—The Malay-speaking Malays of lower Siam call a Cicada "*Riang-riang*," confusing it with certain large Melolonthid beetles belonging to at least four different species—*Lepidiota stigma*, another species of the same genus, and two species of *Leucopholis*—which buzz round the tops of the cocoanut-palms in the evening, and produce, probably in the same way as the common Cockchafer[1], a sound with a considerable resemblance

[1] See Lubbock, 'The Senses of Animals,' p. 67.

to the word "*riang*" (to call back) pronounced very rapidly and repeatedly. All four species of beetle are on sale for food in the local markets of Patalung, and their grubs, which are found in the earth or under fallen trees, are eaten also. (A conventional representation of the grubs is often carved on rice-stirrers and other objects of household use by the Malays, who call them "*Ulat Kiki.*") Both beetles and Cicadæ are either boiled or fried in cocoanut-oil. The latter have very little flavour of any sort, and what they have is vegetable rather than animal.

Remarks.—The existence of auditory organs in the Cicadæ has not been demonstrated with certainty. The insects must indeed be deaf if they mistake the sound of clapping for the squeaky whirr of the male's stridulation. It is evident, however, that the females have some perception of rhythm, if not of sound. May not this perception be due to vibrations produced in the opercula of the stridulating apparatus? The opercula are often well developed in the voiceless females, though they differ in shape from those of the males. The males, supposing that the perceptive organ were situated in the stridulating apparatus, would be deafened by their own song; as Sharp points out when dealing with Swinton's theory that one of the membranes of the apparatus itself, a membrane which apparently is only present in the male, is an auditory organ. But there is no need for the males to hear their own song, and no proof that they do so. Though only one species of Cicada is attracted by the particular rhythm with which the people of Patalung clap their hands, another rhythm might attract another form. The several species of Cicadæ inhabiting the same country undoubtedly sing in different rhythm[1] from one another. The song of this species is fairly monotonous and unbroken, though it rises and falls to a slight extent. That of the large form *Pomponia imperatoria*, which restricts itself to deep jungle, rises in a series of trills, each of which concludes with a kind of click. Each section of the song is faster, louder, and clearer than the one which preceded it; until, about five minutes after the Cicada's settling, the noise suddenly comes to an end, as the insect flies off to another tree, where it commences again. The sound produced by this species is, at the beginning of the song, like the winding-up of a large clock, and ends by being comparable to the notes of a penny whistle. Another insect, commonly heard at night in the jungle, presumably also a Cicada, has a clear, loud, clarion-like call which can be heard for a great distance.

The sounds in a Malayan jungle after dark may justly be compared to those in the machinery-hall of an exhibition at the busiest time of day, and their volume increases materially before the coming of dawn. The body of the din is the work of small Cicadæ, like the edible species, but the true *riang-riang* and certain Locustids have no mean share in its production. In some places the "Singing

[1] See Riley, Proc. Amer. Assoc. Adv. Science, vol. xxiv. p. 331.

Earthworm"[1], a Gryllotalpid cricket, contributes from its hole in the ground a deep, organ-like note. What is the meaning of all this noise? "The *riang-riang* sing," a Malay would say, "because their livers are glad"; and in many cases we are not in a position to give any better reason. The stridulation of the male Cicada appears to be in the main and primarily a sexual call, but may also be used as a warning or alarming cry.

Of insects capable of producing a sound, some species stridulate when captured, but all do not. The brilliantly coloured little black and scarlet *Huechys sanguinea*, which, unlike the majority of Malayan Cicadæ, is diurnal and flies about among bushes in the open at midday, is silent when handled. The male of the large dung-beetle *Heliocopris mouhotus*, a pair of which was brought to me at Biserat by an elephant mahout, squeaks like a bat when touched, but is silent when lifted from the ground. The female of this species is dumb. On the other hand, many kinds of Orthoptera only stridulate when they are left in peace and quiet. In the Malay Peninsula the majority of stridulating species are nocturnal, or only sing at sunset and just before sunrise. There one does not hear the noise of grasshoppers among long grass at midday as one does in this country, though in the jungle there is a subdued hum of insects continually. At Belimbing in Legeh a man brought me several specimens of the "*Belalang Rusa Ijou*" or Green Deer Grasshopper (*Mecopoda elongata*). Each specimen was in a small bamboo-cage, as he said that if two were put together they would fight. He told me that children kept this grasshopper as a pet, feeding it on the young shoots of the pineapple, in order that they might hear it "crow." My specimens were silent all day, and all the evening while the lamp was lit; but in the middle of the night we were awakened by their stridulations.

VI. Insect Luminosity.

An Aquatic Lampyrid Larva.

Form and Colour.—The body is elongated and narrow: the head is minute, and can be retracted within the thorax. There are eight abdominal segments, which are little differentiated from those of the thorax superficially. The upper surface is corrugated. The colour is dark brown, minutely marked with dull yellow in some specimens. The luminous organs were situated in two small oval patches on the under surface of the last abdominal segment, just behind the anus.

Habits.—On March 30th, when catching fire-flies by the side of a marsh at Lampam, the chief town of Patalung, I noticed a number of luminous points on the surface of a small stagnant pool. We had some difficulty in ascertaining the origin of these, for they died away slowly when the water was disturbed; and it was not until we examined some of the plants floating on the top of the

[1] See 'Oxford Magazine,' Oct. 17th, 1900, p. 9.

pool that we discovered that the light proceeded from beetle larvæ, which were clinging, dorsal surface downwards, to the floating fronds of a small cryptogam. The luminous points were blue in colour and very brilliant, though small. They did not flicker like the lights of the fire-flies which flitted in hundreds over the surface of the marsh, and when they were extinguished they died away gradually. In the pool they did not change their position, but they became sometimes brighter and sometimes less bright slowly, occasionally dying out entirely for no apparent cause. When the larva was taken out of the water, its luminosity disappeared, and did not reappear until it had been restored to its habitual element for some minutes. The light of some specimens which were placed with water and weeds in a glass jar, and brought near a lamp after they had recovered from their capture sufficiently to shine again, went out. After a longer or shorter interval of rest near the lamp, on different trials, it reappeared again. Poking them with a twig sometimes caused them to shine more brightly, but more often to become entirely dark. If several individuals were in a bottle and one of them became brilliant from any cause, the others followed suit after a few seconds. A specimen which was put into corrosive solution ceased to be luminous, but after about a quarter of an hour became exceptionally bright. It was then transferred to a weak solution of formalin; whereupon its light went out finally, taking several seconds to disappear.

During the day I was unable to find any of the larvæ on the surface of the pool; but the captive specimens had deserted the floating weeds before morning, and were crawling slowly on the bottom of the jar. I did not see them feed, though the water in the jar was full of small animals of different sorts—Copepods, Protozoa, and water-mites. Nor, while I was watching them, did the larvæ ever come to the surface to take in air or to breathe. I can find no special respiratory organs in my specimens: when alive no part of the body was silvery in appearance under water.

Remarks.—The question of luminosity is one even more enigmatical than that of the sounds produced by insects. It is a phenomenon which is manifested right down among the Protozoa, and even in the border-land between the two great kingdoms; it reaches its highest development among some of the *Lampyridæ*. In the Westmann Isles I have seen a whole village accidentally lighted up by the action of putrefactive bacteria in cods' heads hanging to dry on the walls of the gardens; and a dead shark upon the shore was visible on the darkest night from the same cause to the distance of half a mile. *Noctiluca* and other marine animals—cœlenterates, crustaceans, tunicates, &c.—produce even more astonishing luminescent effects. It is not apparent what is the object of this display among these forms; though possibly in the case of the Medusæ it may serve as a lure for prey, as it appears to do among certain deep-sea fishes. Among the insects and Myriapoda the purpose of luminescence is also obscure[1]. It

[1] See Dubois, Bull. Soc. Zool. France, "Les Elatérides lumineux" (1886), &c.

cannot be in all cases a sexual attraction, for it is exhibited by larvæ and even by eggs[1]; neither can its object always be to attract prey: that it is a warning to enemies seems hardly probable, for most small animals, whether aquatic or terrestrial, are attracted rather than repelled by light. In the bacteria and in forms like *Noctiluca* it appears to be an adventitious result of metabolism rather than to bring any practical gain to the organism; among the adults of the *Lampyridæ* it very probably acts as a sexual charm; among the larvæ of the same group its purpose may possibly be to attract prey. In the case of the aquatic form there must be some reason why the larvæ should come to the surface at night and display their light on the top of the water. That purpose can hardly be to warn surface enemies not to eat them, or to scare away aerial aggressors. Much more probably the light attracts some surface or aerial prey. The fact that the light disappears when the water is disturbed also supports this view. It is not to the advantage of the larvæ to attract the attention of any animal big enough to make a commotion in the pool.

In three other species of Lampyrid larvæ, all terrestrial,—two, which were both over an inch in length, being found crawling on the ground among bushes in Patalung, and the other seated on a cocoanut-husk under a house in Kelantan—the light, which was situated in all cases on the ventral surface of the abdomen, was steady, and neither flickered as it did in the winged forms, nor slowly disappeared without apparent cause as in the case of the aquatic larva. A small specimen which I found under the mosque at Aring, mistaking it at first sight for luminous fungus which grew there commonly, continued shining when picked from the ground, but immediately became dark when dropped into formol, and never shone again. Professor Poulton tells me that North-American[2] fire-flies lose control of their lights when placed in a cyanide-bottle, and are no longer able to extinguish them. The same is true of the Malayan winged forms, though occasionally a specimen becomes entirely dark for a few minutes when first introduced into the bottle. The aquatic larva which allowed its light to reappear after it had been in corrosive sublimate for some minutes was probably only just beginning to become affected, for corrosive penetrates hard chitin very slowly. The insect allowed itself, when once affected, to be transferred into a more pungent medium before it finally ceased to shine.

Of all the manifestations of luminescence among animals there is none more curious, or, in the present state of our knowledge, more inexplicable, than the manner in which large numbers of individuals of certain fire-flies are able to display their light with absolute apparent simultaneity and unison and with regular intervals of darkness, under circumstances which make it impossible for all the members of the swarm to see one another. Even the power,

[1] See Dubois, Bull. Soc. Zool. France, xii. 1887, p. 137.

[2] Darwin makes very much the same remark with regard to the Brazilian forms, in his 'Voyage of a Naturalist' (p. 30).

possessed by some peculiar South-American beetles[1], of showing lights of different colours on different parts of the body at the same time is not more wonderful, or more conspicuous, than this. The phenomenon is not common on the east coast of the Malay Peninsula, where the soil is sandy; but it is said to be often manifested both in Siam proper and among the mangrove-swamps of Perak and Selangor in the west. I have only been able to see it on one occasion, and that was on the bank of the river near Kuala Patani, one fine evening at the end of June.

A large tree was covered with many hundreds of fire-flies, the majority of which seemed, judging from the similarity of their lights, to belong to one species, or perhaps to one sex. There were three individuals seated together, however, whose lights were larger and bluer than those of the others. The lights of all the specimens of the more abundant variety flickered in unison with one another; those of the minority, the three individuals, flickered together also, but in a different time. At one instant the tree was all lighted up as if by hundreds of little electric lamps; at the next it was in complete darkness, except for three blue points. Then, again, it was covered with white points, except for a little patch of darkness where the three blue lights had been, and would be again immediately. A similar power of displaying luminosity in unison is said to be exhibited by some marine animals, even after they have been removed from the water; but the questions as to how this unison is effected and what is its exact object are obscure. The power by which it is regulated may be somewhat analogous to that which causes all the individuals composing a flock of birds to wheel at the same instant. As Professor Poulton has pointed out to me, the rhythmical display of light among a crowd of individuals appears much more conspicuous to the eye than the simple flickering of a number of independent points.

Malay Names.—The ordinary Malay term for a fire-fly is *klip-klip*, a name which seems to suggest the rapid flickering of the insect's light, though the word *klip* is used in the sense of to glitter. Our west-coast servants called the luminous beetle larvæ with which we met in Patalung, "*klip-klip tanah*," land or earth fire-flies. The aquatic species, which they had never seen or heard of before, they christened "*klip-klip ayer*," or water fire-fly. His Excellency Phya Sukum, the Siamese Chief Commissioner for the Ligor Circle, to whose hospitality and administration we owed much, tells me that he has seen, in the south of Ligor and near Singora, a large green worm which sits on trees, and it is so brilliantly luminous at night that it well deserves its Siamese name of Lightning Grub. On one occasion he secured a specimen, and was conveying it to Bangkok; but unfortunately it was killed on the voyage through the carelessness of a servant who closed the box in which it was.

[1] See Haase, Deutsche ent. Zeitschr. 1888, pp. 146–167.

VII. The Use of the Spines of certain Orthoptera.

The Locustid (*Eumegalodon blanchardi*).

Colour and Form.—The whole exposed surface of this well-known and peculiar form is coloured pale brown, speckled, but not in any very marked way, with a darker shade. Its coloration bears a general, and by no means highly specialized, resemblance to a withered leaf.

The most peculiar features of its external form are the enormous stoutness of the head and jaws, and the well-developed thorn-like processes on the thorax.

Habits.—The only specimen secured was captured in a rice-field, then partially flooded, at Belimbing in the Ulu Legeh, on July 22nd. I was crossing the swamp towards a solitary tree of large size that grew on the embankment halfway across. When about ten yards distant from this tree, I noticed what appeared to be a dead leaf falling from one of its lower branches at a height of perhaps eight feet from the ground. Judging from the way it fell that the leaf must have something, perhaps a chrysalis, attached to it, I left the embankment and waded to the place where it had touched the ground, and was surprised to find a fine male specimen of *Eumegalodon* seated motionless on the damp earth. It made no attempt to escape but did its best to defend itself with its really formidable mandibles, a bite from which would have taken a piece right out of the finger.

Remarks.—It is very dangerous to generalize from a single instance of this sort; but the behaviour of the insect was interesting, and may possibly cast some light on the use of the peculiar spines on its back. I am sure, from the rapidity with which it fell and from its appearance while in the air, that the wings were folded as it dropped from the tree; I am also convinced that it dropped and did not leap down. Supposing that its usual habit is to descend thus—and I have no reason to suppose that the behaviour of my specimen was at all peculiar—it is easy to see that its spines, combined with the sturdy build of the anterior part of its body, might assist greatly in breaking its fall, should it strike against anything hard or sharp; for necessarily it would fall head downwards, the head and thorax being heavier than the abdomen. This suggestion does not interfere with the view that these structures may also be of use in defending the insect against its enemies, whatever they may be, should it be attacked from behind; in which case its jaws could not assist it; very possibly it may drop from the tree to escape assailants. Professor Meldola has suggested the same use for the hairs and spines on caterpillars.

VIII. The peculiar Prolongation of the Head in certain Fulgoridæ, and its use.

Hotinus, Pyrops, &c.

The curious anterior prolongation of the head in many genera of the Fulgoridæ has long puzzled entomologists, and some have

been found bold enough to suggest that in life it is luminous[1]; being led to this suggestion, I suppose, by the lantern-like outline of the "nose" in the more highly specialized members of the family, and perhaps by the fact that some of the species at any rate are nocturnal or crepuscular, and rest by day on the trunks of trees in a very open manner. At Biserat in Jalor I was fortunate enough to observe the real use of this peculiar structural modification.

On the morning of May 30th, I noticed a specimen of *Hotinus spinolæ* seated on the trunk of a Durian tree in the village and incautiously attempted to catch it in my hand. The insect remained almost still, merely drawing in its legs towards its body and pressing the claws firmly against the bark, until I had almost touched it. Then, it lowered its head with very great rapidity, flew up into the air without spreading its wings, and alighted on the roof of a house about six feet behind the tree and considerably higher than the position on the trunk whence it had started. When it was at rest its dorsal surface had been directed towards the roof and its head had pointed upwards; but it started off at a tangent from its original station, and landed with its head, speaking roughly, at right angles to an imaginary line drawn through the main axis of the body as it had been on the tree. The insect remained on the roof without moving while I went to get a butterfly-net, in which it was easily captured by a man who swarmed up one of the house-posts.

At the time I did not notice anything peculiar in the way in which this Fulgorid jumped, for there are many large species of the same family (e. g. *Aphæna atomaria*) which, without being provided with long noses, can leap for a considerable distance by means of their legs only; but, as I was examining my specimen after it had died in a cyanide-bottle, I was struck by an indentation or crease that ran across the central region of the nose, at right angles to its main axis. Then I discovered that the chitin was flexible at this point, and at this point only; and that if the tip of the nose and the dorsal surface of the abdomen were pressed together between the finger and thumb and then suddenly released, the insect would not fall straight to the ground, but would be propelled for some distance through the air before doing so; just as would be the case if a piece of whalebone were treated in like manner. Now supposing that the whalebone (representing the nose of the insect) was fixed rigidly to a small rigid object (the head), which in its turn was fastened by a flexible juncture to a larger rigid object (the thorax and abdomen); supposing that the larger object was then laid so that it rested for all its length along a smooth vertical support with the whalebone pointing in front of it, that the free extremity of the whalebone was bent downwards by some force, and that the whole structure was simultaneously shoved away from the support (as the body of

[1] For a coloured picture of a *luminous* Fulgorid, see Donovan's 'Natural History of the Insects of China,' p. 27; also for much evidence as to its luminosity.

the insect might be by its legs), it is obvious that the whole structure would fly off into the air at a tangent; only supposing that the pressure was slightly oblique at any point. I have no doubt that this is substantially what occurs in the case of *Hotinus*; but in the living insect the action is far too rapid for the eye to discriminate its details, and dead specimens cannot be made to leap in this way, because it is impossible to force the legs to perform their part of the action. In two specimens of *Hotinus*, which I observed on tree-trunks at Aring, the wings were spread after the insects had leapt into the air, but not immediately they left their perch. Both of them distinctly bent down their heads before they jumped.

The nose is perfectly hollow, and does not appear to contain any muscle. It differs, of course, from the whalebone in respect of its hollowness, and also in that it is only flexible at one point. In specimens preserved in spirit it is largely filled with liquid, but contains a bubble of air, which naturally rises to the tip when the apparatus is in its resting position, and runs towards its base when the head is lowered.

When I had made the discovery in my first specimen of *Hotinus*, I examined some Fulgorid larvæ, almost certainly those of *Pyrops nobilis*, which had been brought to me by a native at Ban Sai Kau in Nawnchik, and which I had preserved in spirit. The nose was well developed in these, although the abdomen was still small and unexpanded and the wings as yet mere stumps. I found that the joint was present in these specimens also, and still retained a certain amount of springiness, though they had been dead for a month.

Since coming home, I have been enabled, by the kindness of Professor Poulton, to examine dried specimens of twenty-six species of long-nosed Fulgoridæ, belonging to nine genera. In individuals of sixteen of these species I am able to distinguish a crease running across the nose in exactly the same position as it does in my specimen of *Hotinus*. All of the remaining ten species in the Hope Collection, of which species *Pyrops nobilis* is one, have either comparatively short, spiny, or otherwise peculiar noses. I have no doubt that the joint would be found in them also, were fresh specimens examined: even in my larvæ, in which it is still flexible, there is no external sign of its existence except a slight translucency of the integument. The members of the bulbous-nosed American genus *Fulgora* probably use their heads in the same manner as the less highly modified Oriental forms. There is a deep hollow across the noses of the former which seems to correspond to the crease in that of *Hotinus*; and I have satisfied myself at any rate that a certain very limited flexibility exists at this point even in dried specimens. What is wanted is a series of instantaneous photographs from life.

Malay Name.—At Biserat *Hotinus spinolæ* goes by the name of "*Raja Legeh*," but this is probably a corruption of some more direct appellation.

A large proportion of the insects mentioned in this paper have been identified by comparison with specimens preserved at Oxford in the Hope Department of the University Museum, to the officials of which I offer my thanks for the ready help which they have given me. I cannot conclude without expressing my personal gratitude to the Siamese Government for the kindness and generosity with which it treated us throughout: to the officials at Bangkok and Singora who arranged for our reception in lower Siam: to the Malay Rajas through whose territory we passed, without whose aid the Siamese Malay States are practically a closed country to Europeans: and to Luang Phrom, Commissioner of Patani, to Kun Rhat Wan Hussein, and to the other gentlemen who accompanied us as agents of the Siamese Government; at whose hands I received much personal kindness, and whose assistance and advice made it possible to travel in such a country with physical comfort and with some degree of celerity.