



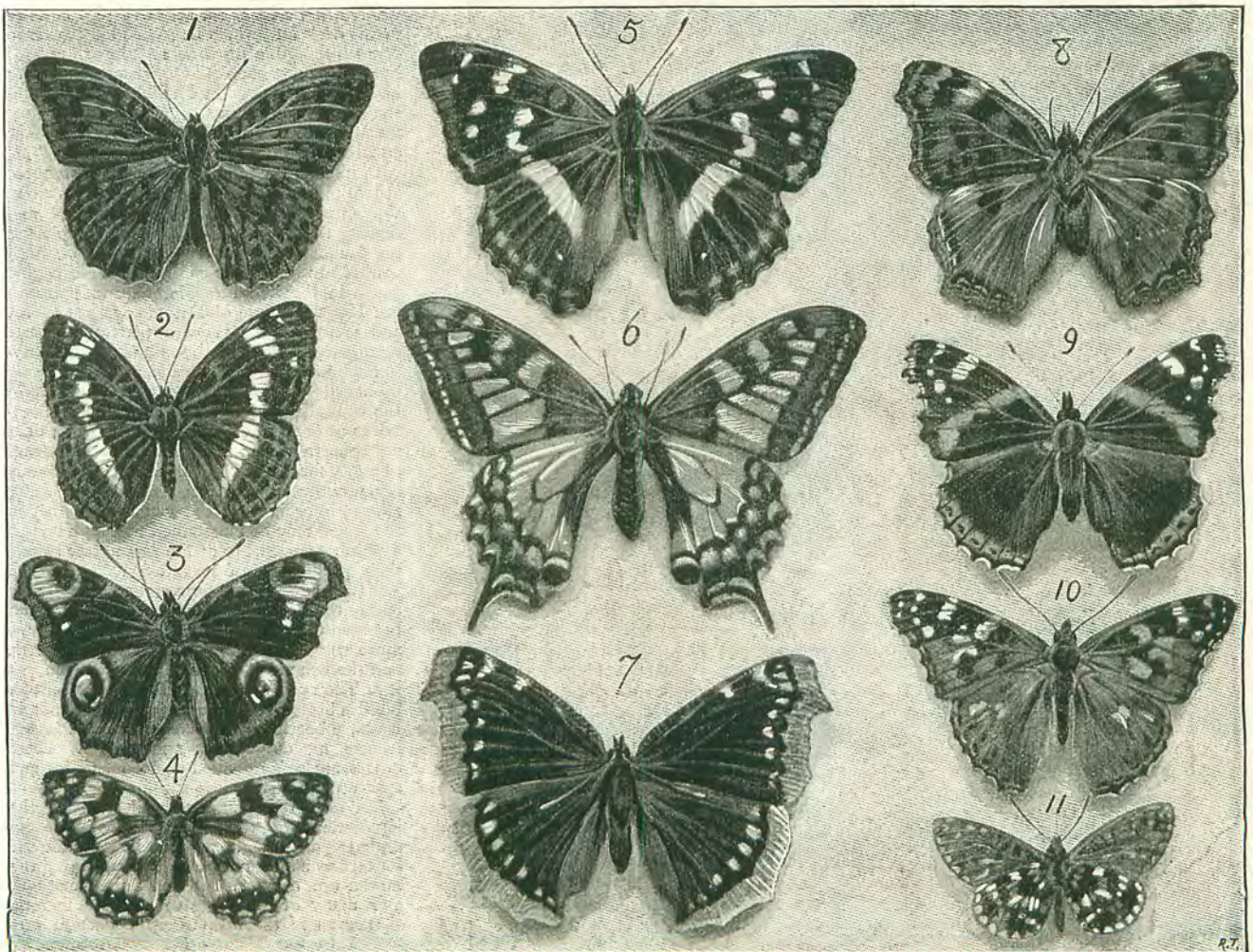
Vol. XVII.—No. 863.]

JULY 11, 1896.

[PRICE ONE PENNY.]



THE STUDY OF BUTTERFLIES.



1. FRITILLARY. 2. WHITE ADMIRAL. 3. PEACOCK. 4. MARBLE WHITE. 5. PURPLE EMPEROR. 6. SWALLOW-TAIL. 7. CAMBERWELL BEAUTY. 8. TORTOISESHELL. 9. RED ADMIRAL. 10. PAINTED LADY. 11. SILVER WASHED FRITILLARY (UNDER WINGS).

(From specimens bred in the Insect House in the Zoological Gardens.)

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PART I.

"The velvet nap which on his wings doth lie,
The silken down with which his back is dight,
His proud outstretched horns, his hairy thighs,
His glorious colours and his glistening eye."—*Spenser.*

THE study of insects, especially our native butterflies, is one more easily followed than many other branches of natural history, because specimens are procured at little or no cost, so that a reader of THE GIRL'S OWN PAPER could, during one season, collect a large number of specimens of both "day" and "night"-flying butterflies, or moths as we usually call the latter, though the distinction between these two groups of insects is a purely arbitrary one. If I were to ask my readers, can you tell a moth from a butterfly,

they would most probably answer promptly "of course." And I daresay they could in a good many cases, for they would take some very familiar butterfly such as the red admiral and compare it to an emphatic-looking moth as, say, the death's head, the largest specimen of the lepidoptera in our country. (Lepidoptera is the name given to the group of insects included in the terms butterflies and moths.) But if we look down the list of butterflies in any entomological work, say that one of Kirby's, or Westwood and Humphrey's, we shall find at the end of the diurnal insects or day-fliers some eight known as skippers, and called *Hesperidae*, insects which partake of the characters of the day and night-fliers. They have the clubbed antennæ (those two projecting feelers which stick out in front of the head) which roughly speaking indicates the butterfly, though these if examined are found to be hooked at the end, and yet their bodies are thick and hairy and just like a moth in general build. Also as a further

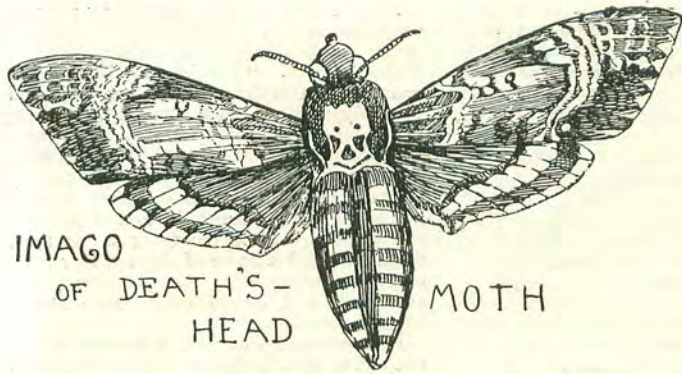
link the caterpillar has the habit of enclosing itself in a curled-up leaf, which is the habit of moth larvæ. These skippers are indeed a link between the two groups which we commonly call butterflies and moths, and whatever branch of natural history we take up we shall find that the arbitrary divisions which were made when knowledge was very limited (because so much less was known about the subject of natural history in all parts of the world), cannot be upheld as our facts increase and our observation widens. To make this clearer we have only to refer to exotic lepidoptera to see how difficult is this classification into butterflies and moths. There are two groups of more or less gaily-coloured insects, which fly in the bright sunshine called uranias and castnias, which were long classed as butterflies, but which are now shifted into the second division or moths. The former look not unlike a papilio (swallow-tail), and are beautifully coloured, black bands running across the wings which are of a metallic emerald blue. The antennæ are clubbed not plumose (or feathery), and altogether the observer is confronted with one of the constantly occurring difficulties in classification. I can hear some reader saying, "Why all this bother about names; what does it matter?" Order is as necessary here as in your drawers or desk. If you are wanting in method in your everyday affairs see what a waste of time ensues. Your editor, for instance, who has hundreds of articles to look through to select from and keep by him until wanted, if he hadn't a series of pigeon-holes in his desk into which he placed his papers in some intelligible order so that he can put his hand upon any one without delay would spend his time and energy in looking for things instead of doing things. I think this simple illustration will bring home to my readers the equal importance of the pigeon-hole system with insects, the number of which is computed at two millions, out of which we know up to the present time some two hundred and seventy thousand! of which twelve thousand are found in our own country. I have been working to obtain the matter for these papers partly in the Zoo insect-house, and partly in the Hope Museum of Entomology at Oxford, and you can only value a perfectly orderly arrangement when you are obtaining information about particular specimens where many thousands are stored, and though of course the wranglings of scientific men among themselves as to minute points in classification does not concern us here it is necessary, as a don said to me, "for us here in Oxford to be absolutely accurate (or as nearly so as human infirmity allows) in order that the general accuracy in the world may be maintained at a high level."

In no department of life has nature shown such prodigality of invention as in insects. What a wide range of form and colouring there is in the lepidoptera of our own country, between the swallow-tail butterfly to the plume moth whose wings look like separate feathers, and the bee moth, hardly like a moth you will say. Their enormous number evidences this, for besides butterflies and moths called lepidoptera we have beetles or *Coleoptera*, flies or *Diptera*, locusts or *Orthoptera*, and so on. These orders are again divided up into families and split still further into sub-families.

To obtain a complete collection of the lepidoptera of this country would be an undertaking of some magnitude, for while the butterflies alone number some sixty-seven the moths are between two and three thousand, and many of these are so exceedingly rare, that even in the magnificent collection presented to the Natural History Museum by Lord Walsingham, their collector, several spaces are at present blank, waiting for the capture of the absent ones. This collection, which is accessible to the general public and



MEADOW-SWEET. SWALLOW-TAIL, RINGLET, GREASY FRITILLARY, AND SKIPPER.



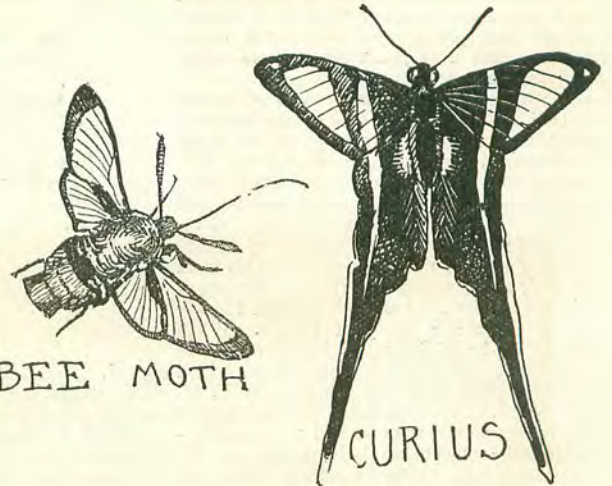
IMAGO OF DEATH'S-HEAD MOTH



DEATH'S HEAD MOTH



LARVA

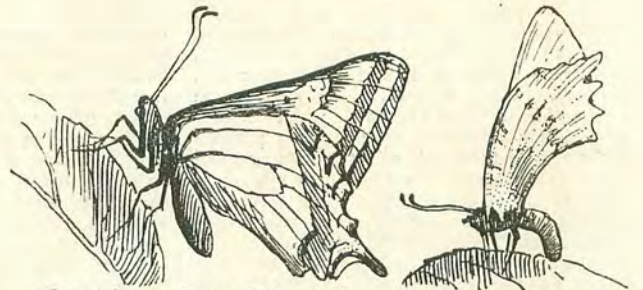


BEE MOTH

CURIUS



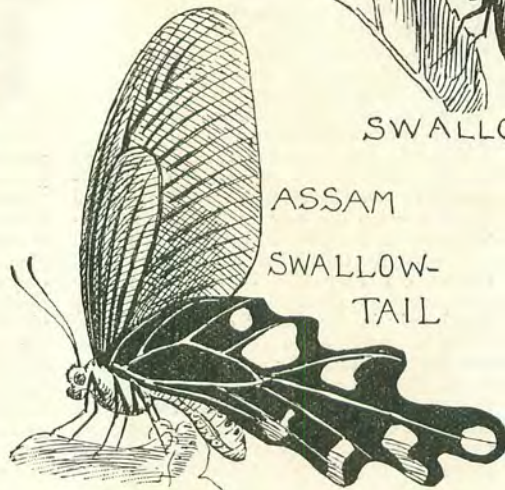
AND PUPA



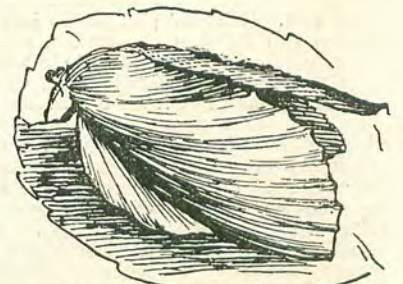
SWALLOW-TAILS AT REST



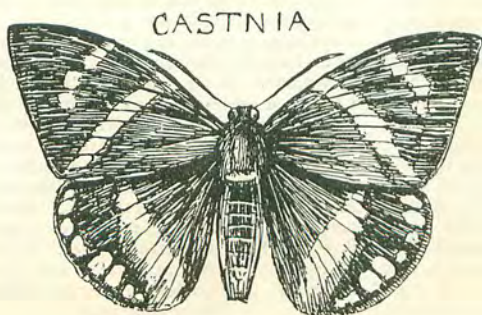
URANIA



ASSAM SWALLOW-TAIL



OAK-LAPPET MOTH AT REST



CASTNIA



HELICONIA

includes all the English butterflies, shows in the majority of species the larva or caterpillar state, the plant upon which it feeds, the pupa or chrysalis state, and the imago or perfect insect, and is a munificent bequest to the nation.

It is just the collection for the tyro to refer to, for many of the best specimens are reared from the larva or pupa state, and by collecting either of these and keeping them until the imago appears, and killing this as soon as its wings are fully developed you obtain insects without blemish, for the scales or powder covering the wings giving it colour and pattern are easily brushed off, and the insect in the act of flying about and knocking itself against flowers and plants soon loses some of its feathers, and it is just these feathers which make a fine insect.

With such an enormous number of insects to deal with, we can see that entomology is a complex and life-long study. The late Hope Professor at Oxford, T. O. Westwood, who died in 1891 at the great age of eighty-seven, had spent his life in this study, and became perhaps the most eminent entomologist of his day. He named a large number of insects which were then new to science, and his work on their classification is a classic. He began life as a solicitor, but soon abandoned the law for his favourite study of insects. When Hope died he left his entomological collection to Oxford, and founded a chair there which was first filled, and that till 1891, by T. O. Westwood, and it is probably no exaggeration to say that no one has ever had a wider knowledge of the subject than the late professor. He published many works beautifully illustrated by himself, for he was an "artist"-naturalist.

Westwood is a link between the old and new school of entomologists. He takes us back to those eminent men of the last century, Hübner, Fabricius, Linnæus, Reaumur and Drury. What a work these pioneers in natural history had to grapple with! It may be faintly illustrated by imagining yourself given many thousands of foreign stamps, and told to arrange them and give their values and the names of the countries using them, and with no works on the subject to refer to but incomplete dictionaries and an atlas.

Just for a moment ask yourself how you would decide as to the grouping say of butterflies and moths, for it is very clear that judging superficially by the eye would lead one into strange errors, as it did the entomologists of the past. Fabricius' plan was to look to their mouths for their classification, yet, as the most conspicuous organs are the wings, while the mouths are inconspicuous, we, in these days, wonder how it was that so eminent a naturalist to a great extent ignored the wings in classifying the lepidoptera, a race of winged insects. Linnæus, who had a genius for "system," divided the lepidoptera into butterflies, *papilio* or day-fliers, *sphinxidae* or twilight-fliers, and *phalana* or moths. The neuriation or veining of the wings is perhaps the important feature in classifying butterflies and moths, though the stages in their metamorphosis and other anatomical characteristics are matters of great value in grouping insects.

If we dust off the colouring-matter, we find that the wings consist of a semi-transparent membrane supported upon a network of veins running more or less to a point where the wings join the body and outward to the edges of the wings. This neuriation classifies butterflies into families. Thus the swallow-tail, which is at the head of the butterflies, belongs to the *Papilios*, and though many of the butterflies bear an outward kinship, others again are only alike in this neuriation and not in colouring or shape. A glance at two exotic *papilios*, curius and the Assam swallow-tails, will show the variation which may occur in insects closely related. You see in attempting to classify insects some one trait which is common

or persistent in all individuals is the only possible plan to adopt—a natural as opposed to an artificial system. Thus to say that all insects having clubbed antennæ are butterflies, and all having plumose are moths is a very general truth, and which in this country holds



good. Butterflies again, when at rest, close their wings, keeping them vertical, while moths on the other hand fold theirs over their backs.

If all *papilios* have the veins arranged on the same plan, a plan differing from all others, we have some trait common to all members of this family, whereas the shape of the wings and the colouring may be very dissimilar. Two people may have a strong resemblance facially and yet be in no way kinsfolk, and this is true of butterflies.

Butterflies are divided into five families, and in England we have representatives of them all. Their beauty is obvious. They may be likened to most brilliant pieces of winged embroidery. Endless variations of such forms as the tortoiseshell and fritillaries are found all over the world, while the painted lady appears to remain the same wherever it be found. Our butterflies are small compared to some exotic specimens, some of which measure six or seven inches from tip to tip, and we find that insect life only reaches its fullest development in countries much warmer than ours.

One family called *heliconias* differs from any of our butterflies in having perfectly transparent or gauze-like wings. They are found only in the district of the Amazons. Other butterflies again have transparent eyes and spots, a peculiarity we remarked in many of the silkworm moths. Many of our butterflies are common to the continent, while just across the channel some which are exceedingly rare with us, like the Camberwell beauty are plentiful. In any work on English butterflies there are some included which have only been taken a few times and that not for many years. The scarce swallow-tail is now never found here, and the Camberwell beauty, so named from its being taken in the past in that "village," appears also to be all but extinct, though it has been taken in numbers many years ago. Those reared in the Zoo of these two rarities in this country are from imported pupa from Germany.

It is singular, seeing how thoroughly the lepidoptera of this country has been worked, that an addition to it should have been made so recently as 1888, when Mr. F. W. Hawes, desiring to improve his series of the small skipper (*H. linea*), collected a number in Essex, and among them were three which were thought to be varieties of *linea* but which are classed as distinct under the name *lineola*.

A butterfly which has been taken on several occasions in '76, '81, '84 and '86, *Danais archippus*, is a handsome insect, a native of North America. "This butterfly I have often seen," says Doubleday, "cross the Ohio and Mississippi, where these streams were more than a mile in breadth. It is abundant even in the largest towns of the middle and northern states. Its Australian kin was found by Captain King in countless myriads on the northern coast of Australia, and is probably the species which Captain Cook saw in 1770, when he found a space of three or four acres covered by millions of them on the wing, and every twig and branch loaded with almost equal numbers at rest."

In Columbus's voyages it is mentioned that one day in June 1494 there came to the ships, then off the coast of Cuba, innumerable butterflies, so numerous that they obscured the sky and continued passing until night, when a sudden storm of rain destroyed them.

Foreign insects which have been taken here from time to time have probably been brought over in the pupa state with imported plants or produce. In some future work on the subject this *Danais* may be classed as British, and yet it may be many years before another is seen or taken here, for those which have been taken are evidently only stray migrants. There can be no question that many butterflies with advancing civilisation will tend to become extinct. The large copper, the glory of the fens, has not been taken for many years, and is supposed to have been destroyed when Whittlesea Mere was drained. It is now valued at £6, while forty years ago specimens



were to be had for a shilling or you could go and catch them yourself.

Another peculiarity of butterflies is the intermittent way many of them appear. The clouded yellow for instance will be strikingly plentiful in one year, and two or three years may go by with very few being seen. Various theories have been started to account for these visitations of particular butterflies. One is that the ova, like some plant seeds, may remain dormant for a long period. We know that butterfly eggs or ova have been subjected to extremes of cold without destroying their fertility, but heat on the other hand acts upon them quickly bringing out the larva, and one of the difficulties experienced in importing ova is, their liability to emerge during the journey.

Butterflies like animals and birds are subject to variation, and in any good work some of these variations are given. These variations have in some instances been so marked as to have led to their being classed under a new name. In all good collections it is usual to have a series of each species to show if possible variations in colouring and markings.

The sex again of some butterflies has led to error, for the colouring of the female in some cases would lead one to suspect a different insect altogether, so unlike are the two. Even Linnæus mistook the female of our common meadow brown for a different species. In the case of two moths, *Nyssia sonoria* and *Hybernia defoliaria*, the females are apterous or wingless.

(To be continued.)

THE STUDY OF BUTTERFLIES.

PART II.

COLLECTING.

NEVER go out collecting in a cold east or north-east wind. A genial day with sunshine is the collector's weather. When swallows fly high it is held to be a sign of fine weather, and Sir Humphry Davy accounts for this sign in his *Days of Fly-fishing* as follows:—

“Swallows follow the flies and gnats, and flies and gnats usually delight in warm strata of air; and as warm air is lighter and usually moister than cold air, when the warm strata of air are high, there is less chance of moisture being thrown down from them by the mixture with cold air, but when the warm and moist

air is near the surface of the earth it is almost certain, as the cold air flows down into it, a deposition of water will take place. It is always unlucky for anglers,” he continues, “to see a single magpie, but two are a good omen; and the reason is that in cold and stormy weather one magpie always remains sitting upon the eggs or young ones, to keep them warm; when the two go out together the weather is warm and settled.”

Another sign of fine weather is when the red clouds of the setting sun take a tint of purple, upon which Davy remarks that “the air when dry refracts more red or heat-making rays; and as dry air is not perfectly transparent, they are again reflected on the horizon.

I have generally observed a coppery or yellow sunset to foretell rain, but as an indication of wet weather approaching, nothing is more certain than a halo round the moon, which is produced by precipitated water, and the larger the circle the nearer the clouds, and consequently the more ready to fall.”

“A rainbow in the morning is the shepherd's warning;

A rainbow at night is the shepherd's delight.”

Sir Humphry Davy comments upon this old country saw in this wise:—“A rainbow can only occur when the clouds containing or depositing the rain are opposite the sun, and the evening therefore the rainbow is in the east and in the morning in the west, and as our heavy rains in this climate are usually brought by westerly winds, a rainbow in the west (occurring only in the morning) indicates that the bad weather is on the road, by the wind, to us; whilst a rainbow in the east (occurring only in the evening) proves that the rain in these clouds is passing from us.”

Caterpillars are to be collected as early as the beginning of April, the best time to find them being early in the morning or late in the evening. They must be handled carefully, and placed in boxes with gauze over the top as quickly as possible, and the plant upon which they are found must also be supplied them, its freshness maintained by being kept in a phial of water and changed daily. When the caterpillar is changing its skin, which it does four or five times before being full grown, it must not be disturbed. Those caterpillars which undergo their change into the pupa in the ground must be supplied with earth at the bottom of their cages, and therefore earth should be at the bottom of your cages so as to be ready in case of need.

In rearing caterpillars from the egg, the best way is to fasten the eggs in the proper plant out of doors, securing some in a muslin bag or frame, and as the worms grow and eat up the vegetation shift them to fresh plants or branches.

In the Zoo insectarium, glass cases with perforated zinc tops are used, and the bottom is filled with earth, in which grass and other plants are growing, and in addition a plant growing in a pot, or the branch or spray of the plant upon which the insect feeds, is placed standing in a bottle of water. Some sticks are placed inside, upon which the moth or butterfly can climb when he bursts his chrysalis-case.

The autumn is the best time to collect chrysalides, but the average collector will be in a state of doubt until the imago appears; what he has collected for his chrysalis may be a moth, butterfly, or some insect other than either of these. The chrysalides of British butterflies are angular, while moths are more cylindrical.

I recommend my readers to collect pupæ rather than larvæ, for you have only to wait for the insect to emerge in the former case, while the feeding of the latter until they change into pupæ is troublesome, and unless the conditions are observed weakly specimens will result or none. The silkworm culture in the South of Europe has been seriously threatened, owing to the diseases which attack the caterpillars, diseases entirely induced by domestication.

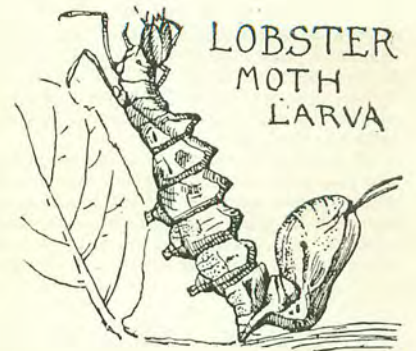
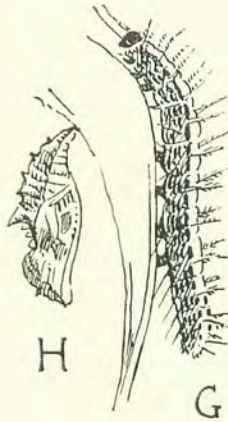
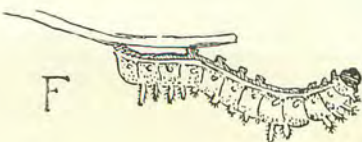
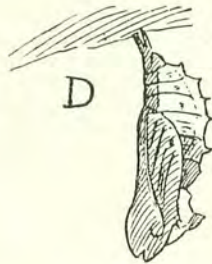
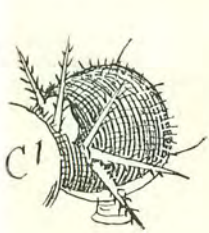
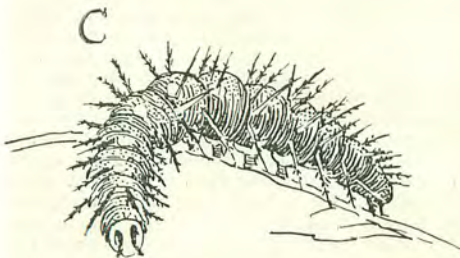
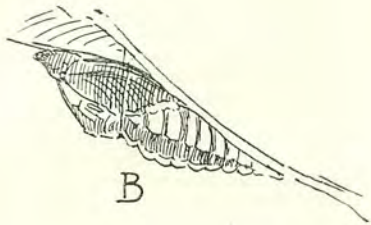
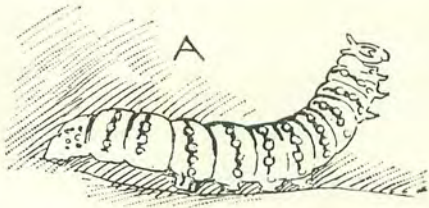
The caterpillars vary considerably, some being quite smooth as in the swallow-tail, A, and purple emperor E; thickly covered with tubercles as the fritillaries, G, and Camberwell beauty, C, less so in the white admiral, F; C1 shows an enlarged view of one segment of



YELLOW FLAG.

WHITE ADMIRAL.

FRITILLARY.



LOBSTER MOTH LARVA



NARCISSUS. FRITILLARY (SMALL PEARL BORDERED), AZURE BLUE, PAINTED LADY, AND SMALL WHITE.

the Camberwell beauty. As to their colouring it varies considerably. The large tortoiseshell for instance is yellow with a green band and reddish spots, the black veined white, black with red markings above and greyish black underneath, while in the swallow-tail, sulphur and several others, green is the prevailing colour with bands and dots of yellow, red, black and blue. The connection between the colouring of the caterpillar and the imago is far from being evident in many cases. I give a drawing of the lobster moth larva, as it is unique as a caterpillar.

The larvæ of moths varies as much, some being plain, others tuberculated or hairy, but moth caterpillars are usually much larger in proportion to their imago than butterflies, and while no butterfly larva has a tail many moths have, as is well shown in the death's head.

Larvæ have in all cases thirteen divisions or segments, of which the first is the head, the next three thoracic segments to which belong the three pairs of true legs. Attached to the seventh, eighth, ninth, tenth and thirteenth segments there are usually pairs of what are generally known as pro-legs or claspers which have considerable clinging power. Most larvæ have hairs upon their bodies, arising from small, raised, hardened disks. Each has sometimes a single delicate bristle or bunch of bristles; in other cases a spine, simple or branched; but in many species the covering is much more dense, either short soft down, or hair, short or intermixed with longer, or in part forming thick tufts. Along both sides above the legs and pro-legs is a complete row of minute orifices called the spiracles, through which the air is conveyed to a wonderful series of vessels called *tracheæ* which fulfil the function of lungs. To suffocate a caterpillar therefore you have only to paint down both sides with oil, which filling up these spiracles kills the larva.

Chrysalides of butterflies are either suspended by hooks at the tail of the pupa as in the silver-washed fritillary H and G and Camberwell beauty C and D, or by a silken cord around them as in swallow-tail A and B. Chrysalides which are embedded in a silken cocoon may be always taken for moths, for only the "skippers" spin a cocoon.

It may astonish many readers to hear of lepidoptera singing, yet Darwin in speaking of the butterflies of Brazil mentions one, *Ageronia feronia*, inhabiting the orange groves, which makes a clicking noise, similar to that produced by a toothed wheel passing under a

spring catch. A. R. Wallace corroborates Darwin.

Reaumur was the first who published an account of the note of the death's head, which resembles the faint scream of a macaw. His conclusion was that the note of the moth might be produced "by the friction of the two-bearded limbs against the proboscis."

This moth keeps well in confinement, and a number of individuals living together showed a disposition to pat one another with their forefeet; and a touch of the delicate tarsus provokes a squeak. They had a tendency to die of gluttony. This moth will attack beehives, ravaging the honey and dispersing the inhabitants. Hubner, who first noticed that this moth should prove victorious over thousands of insects armed with stings, asks "may not this moth—the dread of superstitious people—also exercise a secret influence over insects, and have the faculty, either by sound or some other means, of paralysing their courage. May not such sounds as inspire the vulgar with dread be also the dread of bees?"

After several changes of the skin the caterpillar prepares to undergo its change into the chrysalis state, and spins a little hillock of silk, which it seizes firmly with the hooks of its anal feet. It has still, however, to construct a silken girth across the middle of its body, which it effects in a manner the most simple and least liable to accidents of the three modes adopted for this purpose by the different kinds of caterpillars which fasten themselves by girths. The caterpillars of the cabbage white have very flexible bodies, so that they are able to throw back the head until it extends to the back of the fifth segment of the body, its pro-legs being elevated in the air. It then applies the spinneret of its lower lip to the surface on which it is stationed, close to one of the first pair of fleshy pro-legs, and has only to carry its head over the body to the opposite side to fix the other end of the thread. It then causes its head to return by the same route, emitting a second thread in like manner, and by repeating this operation a sufficient number of times the skein of silk becomes strong enough to support the insect which reposes quietly at full length, or rather its body contracts and becomes thicker, and at length the skin of the fore part of the back bursts and the head of the chrysalis appears. By continued writhing of the body the slit is enlarged and the skin pushed backwards beneath the skein of silk and thrown off at the tail.

The butterfly appears in the perfect state about the middle of May, or earlier if the weather be favourable. It deposits its eggs at the end of the month, the caterpillars from which are soon hatched and feed together until the end of June, when they change to chrysalides, which period lasts from seven to about sixteen days. The perfect butterfly appearing therefore in July and depositing eggs which produce caterpillars which become full fed so as to undergo their change to chrysalis in the autumn, in which state they remain till the following May.

Reaumur, who described the transformation of the small garden white, says that it spins the silk as just recorded, and that the change is going on under the skin of the caterpillar, and its final transition is the affair of an instant, and the chrysalis by shortening and lengthening itself finally pushes the old skin out of the silken mesh where it lies until ready to emerge a butterfly.

Reaumur in his *mémoires* says—"The chrysalis of the peacock butterfly is suspended head downwards. To accomplish this after attaching itself by the hooks of its hind feet in the button of silk, as mentioned in the former case, it hangs with its head down. Whilst thus suspended, it succeeds after at least twenty-four hours' contortion in forming a slit down its back, through which the head of the chrysalis is protruded and the caterpillar's skin pushed upwards to the tail. A delicate operation has still to be performed; the caterpillar was suspended by the hooks of its own hind legs to the silken button; but not only has the still partially enclosed chrysalis to disengage itself entirely from the skin of the caterpillar and attach itself to the silken button, but also to get rid of the old and no longer necessary caterpillar skin. To effect these objects, the chrysalis carefully withdraws its tail from the skin, seizing hold of the outside of the latter by pressing two of the rings of its body together and enclosing between them part of the old skin. By repeating this proceeding, it at length pushes its tail upwards, till it reaches the silken button, to which it fastens itself by means of the hooks with which the tail of the chrysalis is furnished.

Those readers who wish for more details are referred to Dr. Knagg's *Lepidopterist's Guide*, Reverend J. Green's *Pupa Digging*, and Reverend I. S. St. John's *Larva Collecting and Breeding*.

(To be continued.)

DRESSES OF STRANGE MATERIAL.



NOT long ago, the Infanta Eulalie had presented to her a dress of most curious material—glass! and the following is a description thereof. The foundation is a silk warp, woven with five strands of glass, in each of which there are two hundred and fifty almost invisible threads. Three women can only make three-quarters of a yard of this material in a whole day, so that its cost may easily be imagined. The fabric is arranged as a gored skirt over one of white silk. It is bordered with a flounce of chiffon partially veiled with a glittering fringe of glass. The bodice is of silver

cloth, woven in with threads of glass, and glass epaulets glitter above the chiffon sleeves. This dress is white, but it can be made in several colours, and even shot effects can be produced, but it is not sewn—the various seams being glued together. But an Austrian inventor has gone further than this, and sells dress lengths and bonnets of glass cloth—the material being perfectly soft and pliable with the same shimmer as silk. If it gets dirty it need only be scrubbed with soap and water, to be like new again; and, in addition to this, it is waterproof.

But glass is by no means the only curious material of which dresses have been made. The Russians have long made a cloth from a mineral found in the Siberian mines, which is split up by some secret process and spun into thread. The finished stuff is quite soft, and when dirty is simply thrown into a hot fire when it becomes spotless again. It is

said to be far stronger than the strongest silk, and to be practically indestructible.

Not unlike this material is asbestos cloth. It is cleaned in the same way of course, but is not nearly like so strong, and very fine qualities of it cannot be made. Asbestos, however, has been used for making lace, and the Princess of Wales has, in her collection, supposed to be the finest in the world, several beautiful pieces of asbestos lace.

We all know that gold is capable of being drawn out into exceedingly fine wires. It has been drawn out so finely that it can be spun into very pliable threads, and one of the ruling Indian princes possesses a splendid gown of this pure gold cloth, which is so fine that its weight is not uncomfortable.

There have been many attempts to make silk, and one of these attempts came to something. It was made with wood—ordinary sawdust. This was treated with acids and other

THE STUDY OF BUTTERFLIES.

PART III.

THE COLOURING OF BUTTERFLIES AS A PROTECTION AGAINST ENEMIES.

A VERY diversified palette is needed to colour drawings of butterflies, for there is not a tint we can think of which is not found repeated in these winged and brilliant insects, though not necessarily British ones. For harmony and richness of colour our own peacock, painted lady,

and tortoiseshell are hard to beat, and they are at the same time among our most familiar butterflies, being seen in our gardens as much as in the open. Then for delicacy of colouring the brimstone, clouded-yellow, orange-tip, marble and black-veined whites have great distinction.

The purple emperor, the male of which is brown in one light and purple in another, is more the type of some of those prismatic exotic insects from Brazil and Central America. The Camberwell beauty, now, alas, so rarely seen in this country, reminds one of a gorgeous pansy, with its velvety dark-brown wings edged with cream.

Looking at British butterflies generally and comparing them to those from the tropics, we find a certain subdued harmony about them which is in accord with our greyer, lower-toned flora and atmosphere. Some foreign butterflies are, one might say, cruder in colouring with harsher contrasts, while the size of many of these tropical insects is from two to three times greater than any we possess, and the reason for increased brilliancy of colouring and size is due to environment, and shows an adaptation to their surroundings. It is now an accepted fact amongst naturalists that the colouring of insects is as much protective as the bands of dark on a tiger's skin which counterfeits the reeds of the jungle in which the animal lives; and the present Hope Professor of Entomology, W. H. Poulton, is engaged in collecting evidence and trying by experiment how far the colouring of English butterflies and their larvæ may be modified by changes brought about artificially. His work on the *Colours of Animals* should be consulted for fuller details.

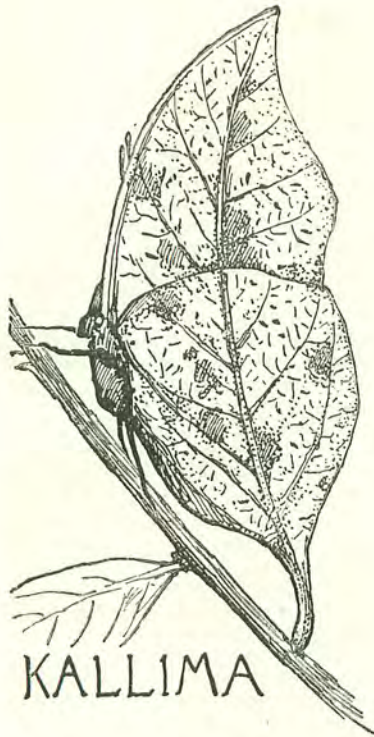
It must of course be understood that when we say that the colouring of insects is protective, we formulate a general law, true in the average number of cases, but which may not be quite obvious in some particular instance. That tropical butterflies are often more brightly coloured and larger than ours, can be explained in this way, for the flowers there are both larger and more brilliant and showy than our wild ones, and to be able to hide themselves among the flowers requires that they be suitably attired.

Take a garden in midsummer and onward, when dabbias, hollyhocks, sunflowers, and gaillardias and other showy plants are in bloom, and watch red admirals, peacocks, tortoiseshells and painted ladies flitting about. As they open and close their wings it is astonishing how they blend with their surroundings, for the bright spots of colour suggest the flowers, while the underside of the wings, so much less brilliant as they are in most cases, causes the insect to seem to disappear in a moment. You can test this for yourself, and you will find that the peacock or red admiral, when their wings are upright (that is at rest), seem to vanish as if by magic. The underside of most butterflies differs from the upper, being usually much less brilliant, often quite dingy in fact, and this change between the expanded wings and the closed ones makes it difficult to keep them in sight. It requires no pulling of facts awry to say that their colouring is protective, but is the obvious deduction from observed facts, as my readers can test for themselves.

In the fritillaries the underside is more brilliant, or, at all events, has greater contrasts than the upper surface of the wings, and a feature which strikes one, and is unique in them, is their silver markings. In entomological drawings silver paint is used to give the effect, so metallic does it appear on the butterfly. These spots, like mirrors, reflect the light, and the change from the rich red brown of the expanded wings to the lighter and brilliant colour of them when at rest accomplishes this purpose of hiding the insect, and so protecting it from birds. In the lappet moth, one of our most striking night-fliers, we find this protective colouring well illustrated, for feeding as it does on oak trees

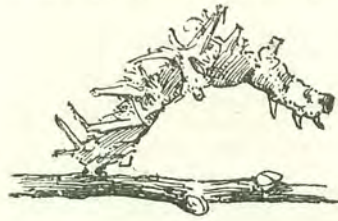


PURPLE EMPEROR, RED ADMIRAL, PEACOCK, AND MARBLE WHITE.

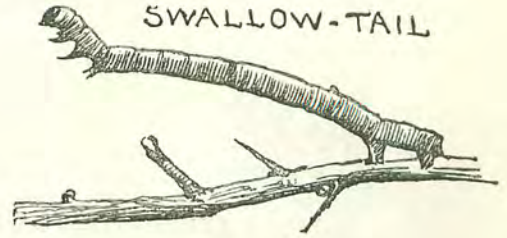


KALLIMA

ESSEX EMERALD



SWALLOW-TAIL



better say an adaptation to their requirements, one important requirement being to escape capture. Yet this conclusion did not strike the early entomologists, and it may be said to have been left to the present day for this theory to be worked out by them.

My readers should go and see these cases at the Natural History Museum, and they can then apply the theory of "the adaptation of the creature to the surroundings" for themselves, and see how far by observation they can find instances to support it. It is not obvious in several cases what connection there is between the colouring of the caterpillar and its imago, but the former would need to be protected more completely, seeing its incapacity of quick movement, than would the latter, which can

largely escape its enemies by flight, and hence the colouring of the larva might with advantage differ from its imago and more obviously mimic its surroundings.

This mimicry is carried still further, for some of these butterflies mimic in colouring some totally different species living in the same locality. The species copied being distasteful to birds and lizards, its mimic thinks thereby that birds seeing the apparent resemblance between what might be a toothsome morsel and its distasteful neighbour will not molest it, and so masquerades as the distasteful insect. It is a trick reminding one of Jacob's deception. This mimicry is seen too in the case of the clear wing moths, which at a casual glance look like bees and wasps.

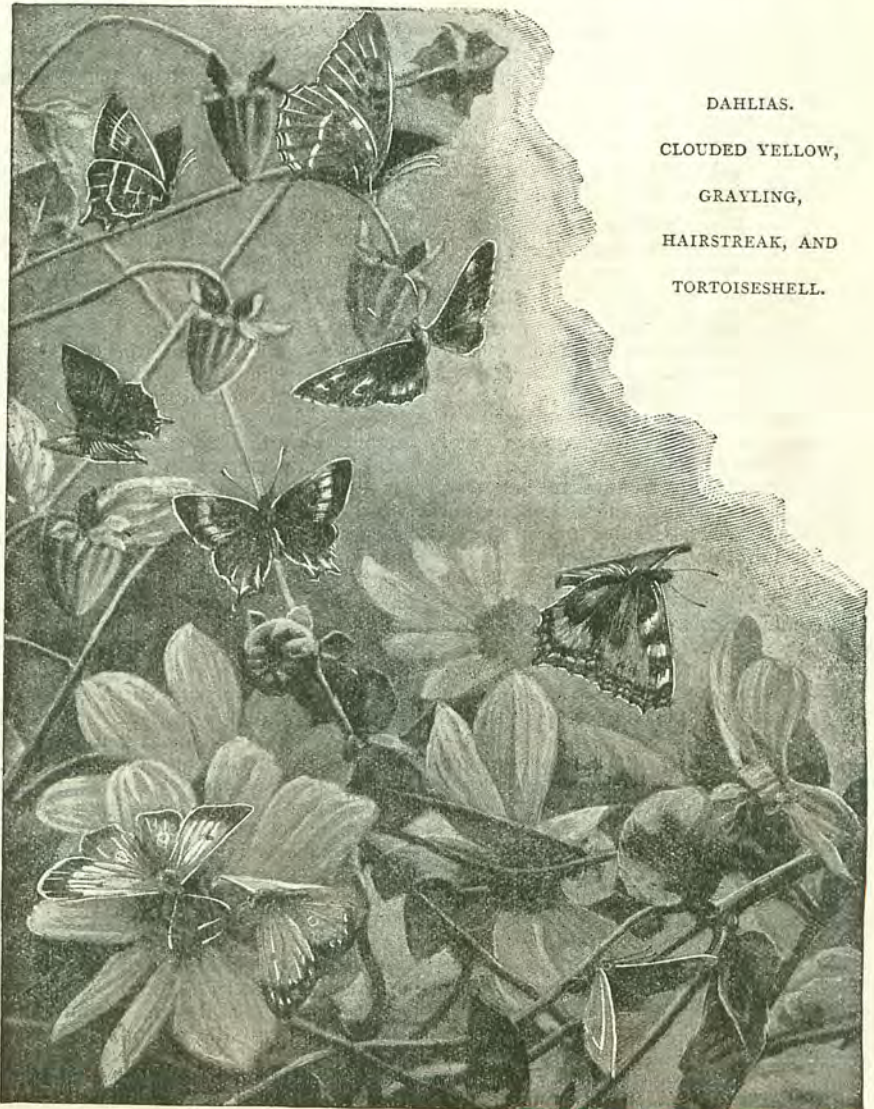
the insect looks very like a dead and dry brown leaf.

These metallic markings (both gold and silver) are found in many foreign butterflies and a few English moths, while in a number of cases *fenestrated* or transparent spots are a feature, and I take it that their transparency allowing the light to pass through the wings tends to hide the butterfly from the too curious gaze.

If we apply this theory of protective colouring to caterpillars we find it borne out more emphatically still, for what with the greenish colour of many larvæ and the bands, spots, tubercles and hairs covering their bodies, they are much less easily seen on a shrub than would be the case were they not so patterned and coloured. The Essex emerald moth larva is covered with lichen-like excrescences, while the swallow-tail moth larva is in form and colouring so like brown twigs as to easily escape observation.

In some of the cases in the large hall of the Natural History Museum this theory of protective mimicry is objectively explained by putting insects among their natural surroundings, so that the passer-by can see at a glance how admirably adapted to their environment these insects are. In the case of the Kallima butterfly from Assam the insect when its wings are closed are the shape of a leaf with a vein running through them, and to carry out this mimicry still further the blotches and markings are like those on a decaying leaf, and if in the museum one has to look twice to tell leaf from butterfly, what must the resemblance be in the Kallima's native haunts!

A bark-infecting winged insect (*Flatoides dealbatus*) from Madagascar is also shown, which varies in colouring with the lichen on the tree-trunks. These instances are given to show how completely at one end of the scale this protective mimicry is carried out by nature, and though, as I have said, it is not possible to see how the colouring of some particular insect protects it, yet unquestionably there is abundant evidence to support the general conclusion, that the colouring of the whole of the animal kingdom (and plants too for that matter) is protective, or perhaps one had



DAHLIAS.

CLOUDED YELLOW,

GRAYLING,

HAIRSTREAK, AND

TORTOISESHELL.

"Father is always at home Tuesdays," answered Ida. "He would mind it for me, I am sure; and Christie could almost manage now."

"Then we will say Tuesday mornings for an hour, from nine to ten, and you must work hard between in spare time."

Then her friend went away and amazed the good vicar by the news that she was about to give drawing-lessons to the village carrier's daughter.

"Limit your class to one pupil, I implore you, Emily," he said good-humouredly. "It will never do to revolutionize the parish by teaching all the young ladies who fancy they have a bent for art."

James Brooke wondered and fussed a little over the new plans and "didn't see the need."

"If it was to handle a scrubbing-brush, now, my girl, there would be some sense in it."

"Ah—but, father, I can do that now," said Ida gaily. "Better than Miss Grey, I fancy. Look at that kitchen floor; it couldn't be cleaner!"

And the carrier, who was secretly pleased that his girl should be noticed and helped, went away saying, "Sure enough, my girl, you

do keep it nice. I'll mind the shop for you, though I'd rather mow a five-acre field any day."

And so the window in Ida's life was opened wide, through which freshness and sunshine had come to her in all the years between. Miss Grey taught her thoroughly all she knew herself, and Ida learned the mysteries of perspective, and painting too, as time went on, and made such rapid progress that her teacher felt abundantly repaid for the small sacrifice of time and patience.

Many other lessons Ida learned in those quiet hours, and her voice became softer, and a new refinement of thought and motive governed her ways and words, as she learned the love of Jesus and became His true disciple in heart and life. She was at first overwhelmed with sorrow when the vicar's failing health led him to resign his living and go abroad, taking his sister with him. A box of the very best colours, and a stock of paper and brushes enough to last for years, was the good lady's parting gift, and, though she did not encourage Ida's secret ambition to make a living some day by her work, privately she thought it not at all impossible. Of late, Ida's only painting

time had been snatched from sleep in the very early morning, especially after the rare luxury of a good night's sleep.

She put her new painting in the shop window now, out of reach of the sunshine, and prayed that some stranger purchaser might come to buy.

Then, having put shop and sitting-room into immaculate order, she got breakfast and helped her father to dress. As they were sitting down to table the postman came. The one letter he brought was in Christie's handwriting, and her father clutched it eagerly. Just then Ben's freckled face appeared in the back doorway.

"Step out a minute, please, Miss Ida," he said, in a loud, penetrating whisper. "Dobbin's that bad I'm mortal feared he's going."

Waiting only to pour out her father's coffee, Ida hurried away. But when she came back in a few minutes, wondering how she should tell him that the horse was dying, she found the old man leaning back in his chair with the open letter in his hand, and the drawn look on his face that told her another stroke of paralysis had fallen.

(To be continued.)

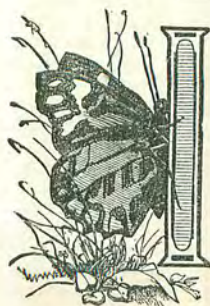


THE STUDY OF BUTTERFLIES.

PART IV.

BUTTERFLIES' WINGS.

"Winged flowers or flying gems."—Moore.



IN these desultory papers only the general study of butterflies has been attempted. My object is to start the reader on her way, and I hope interest her in the subject, leaving it to be followed up at will. It is worth while noticing that the late consulting entomologist to the Agricultural Society was Miss Or-

merod, whose studies in insects specially injurious to crops, such as the Hessian fly, were of great benefit to the farmers of this country.

Many of the illustrations of *Lepidoptera* issued in scientific papers, as well as the classifying and arranging of collections are done by women entomologists.

Those butterflies which are seen on warm days soon after the new year are hibernated specimens, the result of late autumn broods. How cheering it is as one strolls out in the garden looking at the aconites and snowdrops, the first flowers of the year, to see a brimstone or tortoiseshell fly down, while innumerable bees, tempted out by the first warm day, gather the "first-sweets of the year." It is April before the earliest butterflies emerge from the chrysalides, and then we can look for the common whites, the speckled wood, orange tip, and azure blue; but these stragglers from the previous autumn are welcome visitors. They shelter themselves in crannies of walls, and other warm places away from the frost. It is said that they feed themselves well in the autumn with honey which they obtain from flowers by means of their long tongue, which is rolled up when not in use.

On going into the Oxford Museum one

morning early in March, I saw a tortoiseshell flitting about the staircase. It had evidently found snug winter quarters in the warmed building.

How cheering to a Londoner is the sight of a butterfly in the streets. I remember when a schoolboy chasing a brimstone down the Marylebone Road, for as all my youth was spent in London, with only occasional visits to the country, the sight of a butterfly in the streets was indeed an event. They look sadly out of place in London streets, though it always gave me a thrill of pleasure to see one there.

Onward then through May and June most of the other British butterflies are to be seen, though some, like the clouded-yellow, marbled-white, red admiral and peacock are rarely seen before August, and may then be met with until the late autumn. Some few insects are only found locally, like the Lulworth skipper in Dorsetshire, and the mountain ringlet in Scotland, and to get them is therefore a matter of journeying to those localities where they only are found; but a collection of



YOUNG CUCKOO REARED BY MEADOW PIPIT ENTIRELY ON INSECTS.

most of our butterflies could be made during one season in many places near London, notably in the neighbourhood of Epping Forest.

The swallow-tail I have myself caught in the neighbourhood of the Norfolk Broads. I was taken there on one occasion early in the morning, and as the dew disappeared under the sun's rays we saw the swallow-tails clinging to the wild carrot, and could have captured several, as they had not long emerged from the chrysalides, and were therefore very sluggish.

In drawing specimens entomologists adopt the plan of putting in all the markings and dark parts with Indian-ink or indelible brown, and then running in the colours in transparent washes. Curtis, whose illustrations of British

insects are some of the best ever made, and were issued about 1830, had the drawings printed from engraved copper plates and then coloured by hand, with very beautiful results. Some of the books published in the last century by Drury and Donovan were illustrated in this way, and very sumptuous and beautiful works they are.

The use of a gauze net is necessary to capture insects with certainty and in good condition. A sharp nip with thumb and finger just under the wings causes instantaneous death. The setting out of the wings must be done at home, and requires a board made for the purpose which can be bought very inexpensively at a naturalist's shop. Those used in the Hope Museum are slightly convex, whereas the older kinds

were concave or rounded. These boards are grooved in the centre to take the bodies of the insects, and the wings are then spread out and kept in position by pins and strips of paper until the insect is dry. If it is required to pin out an insect which has dried as it was killed or reset a badly displayed specimen, you must soften it by placing it over some damp sand in an earthen vessel, covering the top of the vessel with damp cloths. By leaving it there for a day or two the driest specimen can be softened and then reset.

Great care must be exercised in setting the wings not to damage them, and I daresay that at first my readers may not be wholly successful. Make your experiment, therefore, on some common kind.

I append a few particulars, which I think may interest my readers, of some of our native day-fliers. Speaking of the Clifden blue butterfly Mr. Haworth says this was much sought after by the Spitalfields collectors, who made distant pedestrian excursions for the sole purpose of procuring its charming males to decorate their pictures with. These pictures were of various shapes and sizes, and were composed entirely of lepidoptera ornamentally and regularly disposed, some of them consisting of as many as five hundred insects. After toiling at their weaving machines all the week these weavers would start at ten o'clock on Saturday night in order to arrive at Darent and Birchwood by daybreak, so as to collect the twilight flying moths. Crabbe in his "Borough" alludes to them—

"There is my friend the weaver; strong desires

Reign in his breast;
'tis beauty he admires.

See to the shady grove he wings his way
And feels in hope the rapture of the day—

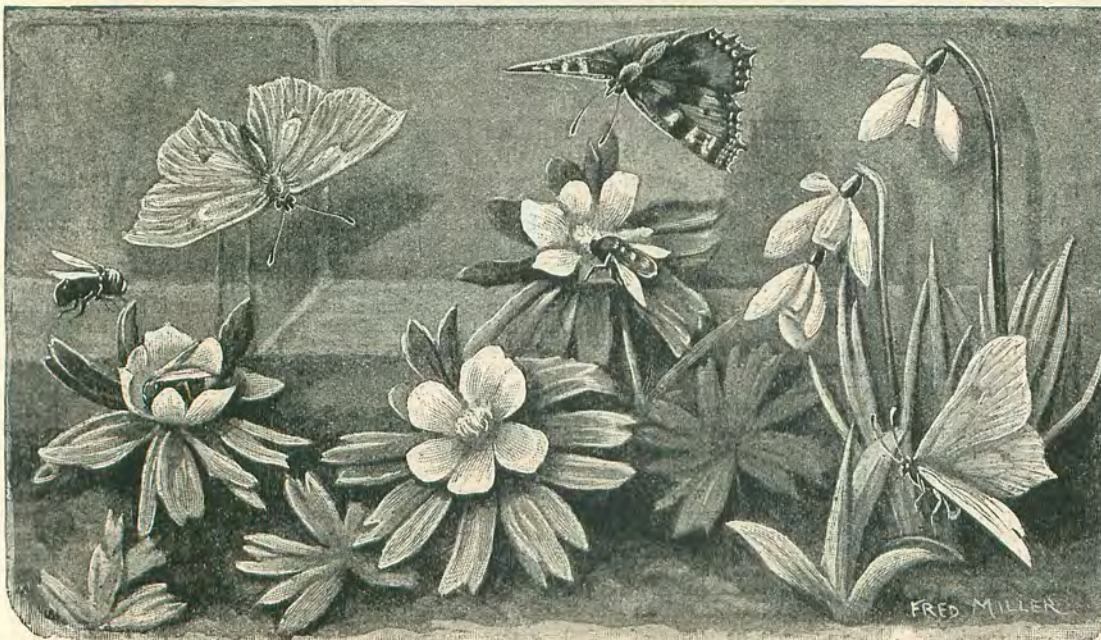
Eager he looks and soon to glad his eyes

From the sweet bower by nature formed arise

Bright troops of virgin moths and fresh born butterflies."

Some of these collectors formed themselves into a society of practical entomologists and began to arrange their collections scientifically.

The red admiral like the painted lady is widely distributed. The caterpillar shortly



THE FIRST FLOWERS OF THE YEAR—ACONITES AND SNOWDROPS. BRIMSTONE AND TORTOISESHELL BUTTERFLIES.

after it is hatched selects a nettle-leaf, which it draws together with threads into a roundish hollow form, leaving for the most part an opening into the interior before and behind, thus serving both for shelter and food until it is almost devoured, when it selects a fresh leaf and proceeds with it in the same manner, one caterpillar only being found on a single leaf, thus indicating a peculiar liking for a solitary life; a circumstance confirmed by the eggs being laid singly and apart, whereas caterpillars hatched from eggs deposited in clusters are gregarious.

The purple emperor is the largest British butterfly, and the beautiful colour of the male, who is seen only in certain lights, makes this butterfly unique, though many exotic specimens have this iridescent appearance. The larva feeds on the brown-leaved shallow, and is found at the end of May. It is green, with pale, lateral oblique stripes. These butterflies fly very high and are difficult to capture; but they are fond of carrion, and are taken by placing near an oak tree some offensive matter to which they will descend, being attracted by the smell. Sometimes they will alight upon dung in the road. It is said that these butterflies are very pugnacious, and will hold conflicts in mid-air with any other "emperors" which happen to come along.

The greasy fritillary caterpillars are very spiny, black above and yellowish beneath, with a row of white dots down the back and sides. The caterpillars are hatched in the autumn, the young brood passing the winter under a common web. They were full fed in April. The silver markings on the underside of the fritillaries is a unique and beautiful feature. These markings are quite metallic in their lustre.

Many specimens that have been taken vary slightly in colour; one of the silver washed fritillary in the British Museum is purplish on the upper surface of the wings instead of reddish brown, but generally speaking this genus are yellowish or reddish brown in colour with blackish markings differing but slightly in patterning.

These metallic-looking markings are due not to the presence of any metals, but to the scales reflecting the light or splitting it up in much the same way as a prism does.

The Duke of Burgundy fritillary lays its eggs solitary or in pairs on the primrose, upon the leaves of which the caterpillar feeds. Its body is almost oval, but long, depressed, and set with rows of bristly warts; the other parts are set with feathery hairs. It moves very slowly, rolls itself up when disturbed, and remains in that state a long time. It becomes a pupa soon after the middle of summer, not only fastening its body by the apex, but also by spinning a cord across its middle. In this state it remains until the end of the following spring. This account is Hübner's, who reared it from the egg. It is the only British representative of the family of *Erycinidae* (and is called a fritillary by courtesy because its markings are similar), the males of which have only four legs adapted for walking whilst the females have six. The chrysalis is unique in being hairy.

The skippers belong to the family, *Hesperiidae*, which is composed of a very distinct tribe of butterflies, constituting indeed a primary division amongst them. The caterpillar encloses itself in a curled-up leaf and spins a cocoon like moths, and in other important characters approaching the moths. They are thus placed last in the list of British butterflies, and serve as a link to unite the day-fliers with the night-fliers. Insects have their particular parasites (small fleas have lesser fleas to bite 'em, as Swift said), and caterpillars suffer by having the ova of flies deposited in their bodies, upon which the larvæ, when they are hatched out, feed. This does not kill the

caterpillar, but the pupa, instead of eventually developing into a butterfly, will only bring forth some small flies.

I include a drawing of a young cuckoo being fed by a meadow pipit, to show how insect life is kept within bounds by birds. Over my porch this year a pair of robins reared a family, and I counted on one occasion that the two parent birds returned on an average every three minutes with caterpillars or insects. Run this out for the whole day, which with birds is a long one, and some idea may be formed of the quantity of food taken by a pair of robins to their four or five youngsters.

In one of Lytton's stories there is a pretty fanciful account of a young girl who keeps butterflies in gauze cages, as other people do canaries. I came across some verses by a modern poet, John Davidson, which are so pretty and *apropos*, as it seems

to me, as a conclusion to these papers that I insert them.

"At sixteen years she knew no care;
How could she, sweet and pure as light?
And there pursued her everywhere
Butterflies all white.

A lover looked. She dropped her eyes
That glowed like pansies wet with dew;
And lo, there came from out the skies
Butterflies all blue.

Before she guessed her heart was gone;
The tale of love was swiftly told;
And all about her wheeled and shone
Butterflies of gold.

Then he forsook her one sad morn;
She wept and sobbed, 'Oh, love, come
back.'

There only came to her forlorn
Butterflies all black."



KING-CUPS. TORTOISESHELL, ORANGE-TIP, AND SPECKLED WOOD.