Furneaux William Samuel

Butterflies and Moths (British)

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Furneaux W.

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Содержание

William S. Furneaux
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Plate I
Danielsson & Co., del. ad. Nat. et Chromolith.

PREFACE

The favourable reception with which the 'Out-door World' has been greeted has encouraged the publishers to issue a series of volumes dealing in fuller detail with the various branches of Natural History treated of in that work. Necessarily each subject was only briefly touched upon, but the study is of so enticing a character that 'appetite grows by feeding,' and the students of the 'Out-door World,' having tasted the sweetness of companionship with Nature, will not rest satisfied with the help afforded by that handbook. Each one will want to go deeper into that particular department which most appeals to his own inclinations.

The present volume is written expressly for those who desire to extend their knowledge of the British Lepidoptera, or, to use the more popular names, 'Butterflies and Moths.'

The general characteristics of this interesting order of insects are described somewhat fully, but, of course, it would be impossible to give an individual account of all the British Lepidoptera in a work of this size, so a selection has been made such as will satisfy the requirements of the great majority of those who intend to take up this particular branch of entomology. The number of British Butterflies, however, is so limited that a place has been found for a figure and a description of every species; and, of the larger moths, many of the common and typical kinds have been included. An introduction to the study of the Micro-lepidoptera has also been added.

No trouble has been spared to render this work thoroughly practical. In addition to the verbal descriptions of so many species, twelve coloured plates and a large number of woodcuts have been specially prepared to help the student in his work. It is believed that the extreme care with which these have been produced will render them of the greatest assistance to the collector in the recognition of his specimens.

But he has not only to recognise his specimens – he must first catch them; and here full directions have been given to insure success in this part of his work, as well as in the management, preservation, and arrangement of his captures.

The Author hopes that this volume may be the means of adding many happy hours – hours of the purest enjoyment – to the lives of those whom he has succeeded in luring into the fields and lanes and woods of the Out-door World.

PART I
STRUCTURE AND LIFE-HISTORY OF THE LEPIDOPTERA

CHAPTER I
GENERAL CHARACTERS

The word *Lepidoptera*, which you see at the head of this page, is the name of the order of insects to which this volume is to be devoted. It is formed from two Greek words, one (*lepis*) signifying a *scale*, and the other (*pteron*) denoting a *wing*; and was applied by the great naturalist Linnæus to the scaly-winged insects popularly known as Butterflies and Moths.

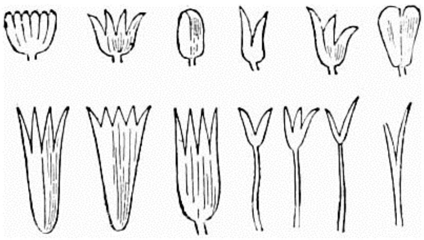

Fig. 1. – Scales from the Wings of Butterflies.

Every one of my readers has undoubtedly handled some of the interesting creatures of this group – having been led to do so either by the extreme beauty of their clothing, or, perhaps, from a murderous intent in order to protect his own garments from the ravages of a supposed marauder. A light mealy powder will probably have been observed afterwards on the fingers that have touched the victim's wings.

This powder, although it sometimes presents a beautiful glossy surface when spread over the skin, does not exhibit any definite form or structure without a more minute examination. Yet these are the scales that led the immortal naturalist to invent the somewhat long but useful term *Lepidoptera*.

The very next time the opportunity offers itself, dust off a little of the mealy powder with a small and very soft brush on to a strip of white paper or a slip of glass, and examine it with a powerful lens or the low power of a compound microscope. What a sight you will then behold! Each little particle of dust is a beautifully formed scale, stamped with a number of minute rounded projections, and often displaying the most gorgeous colours. A great variety of designs and tints are often exhibited by the 'dust' from a single wing. Take, for instance, for your inspection, scales from the wing of one of our commonest insects, the Small Tortoiseshell Butterfly (Plate III), and you will be surprised at the pleasing contrasts. But when your curiosity leads you to deal with others in the same manner, the varied display of forms and colours is simply amazing.

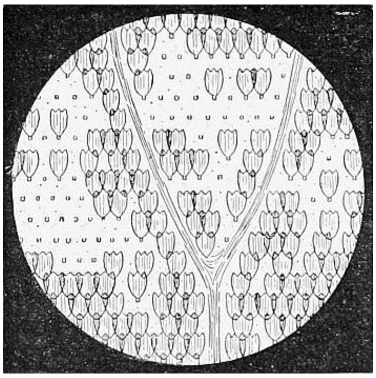

Fig. 2. – Portion of the Wing of a Butterfly from which some of the scales have been removed.

In order that we may learn still more of the structure of the wings of the *Lepidoptera*, we will examine a portion of one from which some of the scales have been removed, again bringing the lens or the microscope into our service. We now see that the scales are arranged in rows with great regularity on a thin and transparent membrane, which is supported by a system of branching rays. And the membrane itself, in parts which have been laid bare, is marked with regular rows of dots – the points at which the scales were originally attached by means of short hollow rods.

The framework that supports the thin membrane we have spoken of as consisting of a system of *rays*, but to these the terms *veins*, *nerves*, *nervures*, or *nervules* are more commonly applied by various naturalists. We cannot do better, however, than adhere to the name originally used, for the structures in question do not perform the functions of veins, though at first they contain blood, nor are they themselves parts of the nervous systems of the insects to which they belong.

The result of our examination of the wings of butterflies and moths has been to justify the application of the term *Lepidoptera*; but we must now study other equally important and interesting features of the structure of these insects. First, let us note the general form of the body.

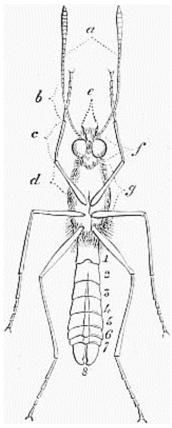

Fig. 3. – Body of a Butterfly – Under Side.

1-7, segments of the abdomen; 8, anal extremity; *a*, antennæ; *b*, tarsus; *c*, tibia; *d*, femur; *e*, palpi; *f*, head; *g*, thorax.

A cursory glance at this portion of the creature's anatomy will show that it consists of three distinct and well-defined parts. In front there is the head, the size of which is somewhat small in proportion. Two very large eyes make up the greater portion of its bulk. It is remarkable, too, that butterflies possess eyes proportionately much larger than those of moths. Now, since butterflies always fly by day, and moths are, generally speaking, nocturnal insects, we might be led to suppose that the reverse of this arrangement would have suited the creatures better; for a small eye, we should think, would be able to collect sufficient light in the daytime to form a bright image, and a larger light-receiving area would be necessary during the darker hours for the same purpose. But it is evident that the sense of vision must depend on other conditions besides the size of the eye; and as these conditions are not understood in relation to the eyes of insects, any attempt at an explanation would be quite useless.

The eye of a butterfly or moth is worthy of a closer examination, for it is a most beautiful and marvellous structure. The outer globular transparent membrane – the *cornea*– is divided into a large number of minute polygonal *facets*, each one of which admits light into a small conical compartment surrounded by a coloured membrane, and supplied with a fibre of the nerve of vision (the *optic* nerve). Hence the eye is often spoken of as *compound*.

If you look closely into the eyes of various butterflies and moths you will generally see a ground colour of grey, blue, brown, or black; but when viewed at certain angles in a strong light the most gorgeous hues of metallic brilliancy – gold, copper, and bronze – are to be observed. All such colours are due to the reflection of light from the colouring matter that lies between the numerous conical compartments.

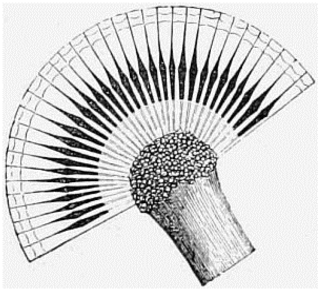

Fig. 4. – Section of the Eye of an Insect.

A glance at the section of a compound eye will show you that all the little cones radiate from a common centre. And, as each little compartment is surrounded by opaque colouring matter, it is clear that perpendicular rays only are capable of penetrating to its base and exciting the nerve fibre that lies there. Thus each little division of a compound eye forms its own image of the object that happens to be exactly opposite its facet. But how many facets do we find in a single eye? Sometimes only a few hundreds, but sometimes as many as seventeen or eighteen thousand! We must not, however, conclude that the nature of the vision of butterflies and moths is necessarily very different from our own. We have two eyes, but the images formed by them are both blended, so that we do not see double. We can understand, therefore, that the thousands of images formed in a single eye may be blended together so as to form one continuous picture. Still there remains this difference: while in our own case the two images formed by the two eyes are practically the same, in the case of insects every one of the little conical tubes of a compound eye forms an image of an object that cannot possibly be formed by any one of the others. Thus, if the lepidopterous insect sees a continuous picture of its surroundings, such a picture is produced by the overlapping and blending, at their edges, of hundreds or thousands of distinct parts.

There is yet another interesting difference between the vision of these insects and that of ourselves. As already stated, our two eyes are both turned toward the same point at the same time. But look at the butterfly's eyes. Here are no movable eyeballs, and the two eyes, placed as they are at the *sides* of the head, are always turned in *opposite* directions. The corneæ, too, are very convex; and consequently the range of vision is vastly wider than ours. A boy is often easily surprised by a playmate who approaches him stealthily from behind, but did you ever try the same game with a butterfly? I have, many a time. After getting cautiously so near to a butterfly at rest as to be able to distinguish between its head and its hinder extremity, I have quietly circled round it so as to approach it from behind, being at the time under the impression that it wouldn't see me under those circumstances. But not the slightest advantage did I derive from this stratagem, for the position and construction of its eyes enabled it to see almost all ways at once.

In addition to the two compound eyes, the *Lepidoptera*, or at least most of them, are provided with two small simple eyes; but these are generally so hidden among the closely set hair that covers the head, that it is doubtful whether they are of much service as organs of vision.

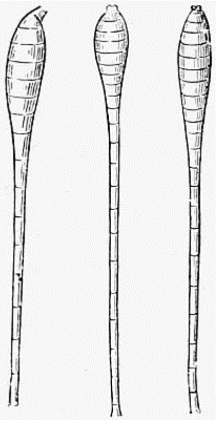

Fig. 5. – Antennæ of Butterflies.

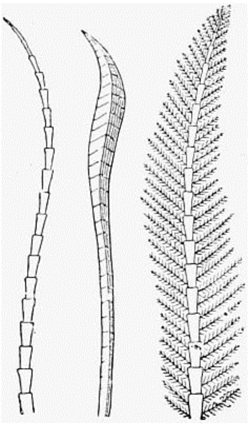

Fig. 6. – Antennæ of Moths.

The antennæ proceed from two points close to the upper borders of the eyes. They are jointed organs, and are of very different forms in the various species of *Lepidoptera*. They are generally long, slender, and clubbed at the extremity in butterflies, but exhibit several minor points of difference which we shall have to note later on. In moths the antennæ are sometimes long, slender, and pointed. Some are thick, and more or less prismatic in form; while others are slightly or deeply pectinated or comb-like. The antennæ of butterflies are always straight, or only slightly curved; and, although the insects can sway them bodily, they have no power to bend them, or to stow them away in any place of shelter. Moths, on the other hand, when at rest, are almost invariably found to have their antennæ snugly tucked under the wings, and brought so closely against the side of the head for this purpose that even the uncovered portion is often difficult to find.

There are two other prominent appendages belonging to the heads of the *Lepidoptera*. These are the *labial palpi* or feelers of the lips. They are generally easily seen, projecting forward on the under side of the head, sometimes so long and conspicuous as to give one the idea of a snout or long nose. The palpi are jointed – usually in three parts – are covered with scales, and often furnished with hairs or bristles.

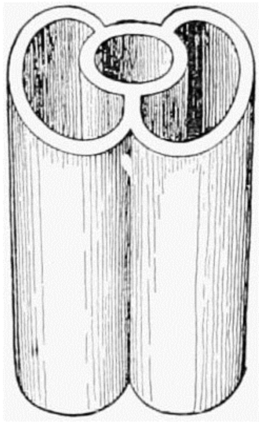

Fig. 7. – Section of the Proboscis of a Butterfly.

If you watch a moth or butterfly when it is feeding on the sweet juices of a flower, or on some kind of artificial sweet with which you have provided it, you will observe its long trunk or *proboscis*, by which food is sucked up. This instrument is so long and slender that it seems almost impossible that it can be a tube through which a liquid freely passes. But a careful examination will show that this is the case. It is composed of two separate pieces – two half tubes, which, when closely applied to each other, form a very thin and flexible pipe, perfectly air-tight and adapted for suction. Sometimes you can see a butterfly or moth manipulating with its proboscis as if it required readjustment in some way or other. It has split the tube throughout its length, so that it now looks like two exceedingly fine hairs. Then, after a short time, the two halves are put together again, and immediately, as if by magic, become a single tube in which no kind of seam is to be observed without a powerful magnifier.

In order to observe the nature of such a wonderful arrangement we must have recourse to the aid of a good microscope. Thus assisted, we can see at once how the junction of the two sides of the proboscis is brought about so quickly and so perfectly. The inner edges of each half are very regularly fringed with lines of closely set hairs – so regular, in fact, are they, that they give one the idea of long yet minute beautifully formed combs. When the two parts are brought together, the hairs of two opposite edges interlock, those on one side exactly filling the spaces between those of the other.

The microscope also reveals another interesting fact, viz. that the proboscis is not a single tube, but, although so remarkably thin, is really a set of three distinct pipes, one lying on each side of the central one. It is said that the central tube only is used for sucking up the liquid food, and there seems to be some doubt as to the uses of the other two. Some naturalists are of opinion that the latter are air tubes, and are connected with the respiration of the insect; while others say that through these the insects eject a thin watery fluid with which to dissolve or dilute those sweetmeats that are not sufficiently liquid to be readily sucked up. But possibly both these opinions are correct, the proboscis serving all three of the purposes here named. The only observation of my own bearing on the subject is this. While a moth was feeding on a drop of syrup in a strong light, a powerful lens revealed drops, of liquid, mingled with bubbles of air, passing alternately *up and down* the two lateral tubes of the proboscis. At the same time the upward current of syrup in the central tube was by no means steady and continuous.

When this organ is not in use, it is beautifully coiled into a close spiral which lies between the labial palpi. The length varies considerably in different insects, and consequently the number of turns in the spiral must differ also. Sometimes there are less than two turns, while some of the longer ones form spirals of from six to ten turns.

In concluding our brief account of the head of lepidopterous insects it is, I suppose, hardly necessary to add that there is no kind of chewing apparatus to be described; all the members of this order, at least in the perfect state, deriving the whole of the little nourishment they require entirely by suction through the proboscis or 'trunk.'

The second division of the body is the *thorax*. This is much larger than the head, and consists of three ring-like segments, joined one behind the other so intimately that the lines of junction are hardly visible, even after the thick clothing of fine hair has been brushed off. Behind the thorax is the abdomen, which is composed of several segments, the junctions between the rings often being most distinct.

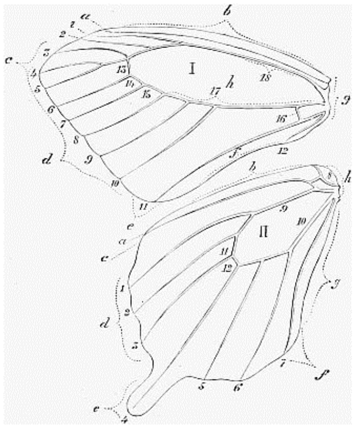

Fig. 8. – Diagram of the Wings of a Butterfly.

I. *Fore wing.*– 1-5, subcostal nervules; 6, 7, discoidal nervules; 8-10, median nervules; 11, submedian nervure; 12, internal nervure; 13-15, disco-cellular nervules; 16, interno-median nervule; 17, median nervure; 18, subcostal nervure; *a*, costal nervure; *b*, costa or anterior margin; *c*, apex or anterior angle; *d*, posterior or hind margin; *e*, posterior or anal angle; *f*, interior or inner margin; *g*, base; *h*, discoidal cell.

II. *Hind wing.*– 1, 2, subcostal nervules; 3, discoidal nervule; 4-6, median nervules; 7, submedian nervure; 8, precostal nervure; 9, subcostal nervure; 10, median nervure; 11, 12, disco-cellular nervules; *a*, costal nervure; *b*, costa or anterior margin; *c*, apex or anterior angle; *d*, hind margin; *e*, tail or caudal appendage; *f*, anal angle; *g*, abdominal or inner margin; *h*, base.

From the sides of the thorax proceed the two pairs of wings, the general structure of which we have already to a certain extent examined. But when we are a little farther advanced in our insect studies, we shall have to become acquainted with detailed descriptions given as aids to the identification of species. Now, such descriptions cannot be satisfactory, either to the one who gives or to him who receives, unless expressed in such definite terms as render a misunderstanding impossible. A botanist cannot give an accurate and concise description of a flower without the use of certain names and expressions which have gradually become an almost necessary part of his vocabulary; neither can an entomologist give a really useful, and, at the same time, a *succinct* description of an insect unless he is acquainted with the names of its parts. Therefore, seeing that we distinguish the various species of butterflies and moths *mainly* by the arrangement and colour of the markings of their wings, it is really necessary that we should know the names of the different parts of these organs. For this reason I have inserted drawings of a fore and of a hind wing of a butterfly, together with the names of the various parts of the wings, and also the names of the principal rays or *nervures*. Yet I would not advise any young entomologist to attempt to commit to memory all the names given. Rather use the diagram for reference when occasion requires, more particularly when you have an insect in your possession that you desire to study. In ordinary descriptions of butterflies and moths the names of the *nervures* are not so generally used as those of the *parts* of the wing. Consequently it is exceedingly useful to know what is meant by the terms *base*, *costal margin*, *apex*, *hind margin*, *anal angle*, *inner margin*, *discoidal cell* &c. as applied to the wing.

The two pairs of wings are attached to the second and third segments of the thorax; but of the *three* pairs of legs, which we have next to consider, one pair arises from each of the three segments. The arrangement of these limbs is well shown in the sketch on page 3, as are also the names of the different parts of the limb, the latter being given for reference by the reader when the need arises.

All insects, in their perfect state, we are told, have three pairs of legs; but if you examine the under surface of certain butterflies, such as the Marbled White, or any of the Vanessas, Browns, or Heaths, it is quite likely that you will raise objection to such a statement; for in these you may possibly see only four legs. But this is the result of a too cursory observation. Look a little more closely at your specimen, and you will see a pair of smaller legs folded up under the fore part of the thorax. By means of a blunt needle you can straighten out these limbs, and then the difference in length to be observed between them and the other four is very striking indeed. They are also thinner than the middle and hind legs; and, unlike these, are not provided with claws.

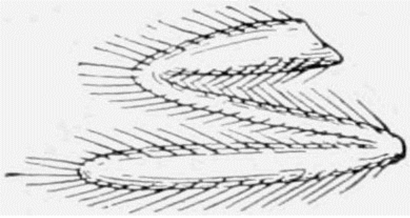

Fig. 9. – The Undeveloped Fore Leg of a Butterfly.

These imperfectly developed legs are, of course, quite useless as far as walking is concerned; indeed, it is extremely doubtful as to whether they are of any service whatever to the owner. On one occasion, however, while watching a Peacock Butterfly apparently engaged in cleaning its divided proboscis, I observed that this organ was frequently passed under the thorax, and that the front pair of legs were pressed against it on each side, while it was being drawn outward between them. It is probable, therefore, that these limbs constitute a pair of brushes by means of which the fine grooves of the divided trunk are cleared of any solid or sticky matter that may lodge therein. It is certain that moths, and those butterflies that possess six *equal* legs, use the front pair for this same purpose. The former, also, employ them for brushing their antennæ, which seem to be, by the way, particularly sensitive to different kinds of irritation.

It is a well-known fact that tobacco smoke has a powerful influence on certain small insects; and even though it can hardly be regarded as a perfect all-round insecticide, it is certainly more or less objectionable to the larger and hardier species. A short time since, while watching a number of newly emerged moths of the *Sphinx* group, and at the same time enjoying the solace afforded by the luxurious weed, a puff of the smoke was accidentally allowed to play into the box in which my pets were for the time imprisoned. Immediately they rubbed their front legs vigorously over the antennæ, as if to remove the obnoxious irritant that had thus intruded on their presence. Similar observations have led many naturalists to suppose that the antennæ are the seat of various senses, such as those of touch, hearing, and smell. Seeing that insects do not, as far as we know, possess special organs for all the five senses which we enjoy (and it is interesting to note here that some insects certainly experience other sensations which are quite beyond our ken), we can quite understand the common tendency to locate the seats of certain of the senses in such easily affected parts as the antennæ. But little, I believe, has been definitely proved save that the antennæ are sensitive to touch and to irritants generally.

While speaking of the senses of insects, I cannot refrain from mentioning a most remarkable example of a peculiar sensitiveness that has been observed in certain moths of the family *Bombyces* (page 217) – notably the Oak Eggar, the Emperor, and the Kentish Glory. Take a newly emerged female of either of these species, shut her up in a small box, conceal the box in your pocket, and then walk about in some country spot known to you as being one of the haunts of that species of moth. Then, if any of the males of the same species happen to be in the neighbourhood, they will settle or hover about close to the female which, although still concealed and quite out of their reach, has attracted them to the spot.

What a marvellously acute sense this must be, that thus enables the insects to scent out, as it were, their mates at considerable distances, even when doubly surrounded by a wooden box and the material of a coat pocket! You would naturally expect that entomologists have turned this wonderful power to account. Many a box has been filled with the beautiful Kentish Glories of the male kind, who had been led into the snare by the attractions of a virgin Glory that they were never to behold. Many an Emperor has also been decoyed from his throne to the place of his execution, beguiled by the imaginary charms of an Empress on whom he was never to cast one passing glance. And these and other similar captures have been made in places where, without the employment of the innocent enchantress, perhaps not a single male could have been found, even after the most diligent search.

Speaking of this surprising sense, I am again tempted to revert to the antennæ; for it is a remarkable fact that the males of those species of moths which exhibit the power of thus searching out their mates, are just those that are also remarkable for their very broad and deeply pectinated antennæ – a fact that has led to the supposition that the power in question is located in the antennæ, and is also proportional to the amount of surface displayed by these organs.

Up to the present time we have been considering the butterfly and moth in their perfect forms, but everybody knows that the former is not *always* a butterfly, nor is the latter always a moth; but that they both pass through certain preparatory stages before they attain their final winged state.

We shall now notice briefly what these earlier stages are, leaving the detailed descriptions of each for the following chapters.

The life of the perfect butterfly or moth is of very short duration, often only a few days, nearly the whole of its existence having been spent in preparing itself for the brief term to be enjoyed

… in fields of light,
And where the flowers of Paradise unfold.

It may be interesting to consider of what use the metamorphoses of insects are, and to what extent these metamorphoses render them fit for the work they have to do.

It is certain that the chief work of insects, taken as a whole, is to remove from the earth the excess of animal and vegetable matter. If they are to do this work effectually, it is clear that they must be very voracious feeders, and also be capable of multiplying their species prodigiously. Now each of these powers requires the special development of a certain set of organs, and an abnormal development of one set must necessarily be produced at the expense of the other. Hence we find insects existing in two distinct stages, with or without an intermediate quiescent state, during the first of which the digestive apparatus is enormously developed, while the reproductive organs occupy but very little space; then, during the other stage, the digestive apparatus is of the simplest possible description, and the organs of reproduction are in a perfect state of development.

Allowing, then, that the chief work of the insect is the removal of surplus organic matter, we can see that a large share of its life should be spent in the larval or grub stage, and that the perfect state *need* not occupy any more time than is necessary for the fertilisation of the eggs that almost completely fill the body of the female at the time of her emergence from the chrysalis shell.

Many insects undergo their metamorphoses by slow degrees, but the *Lepidoptera*, after existing for some considerable period without any important visible change in structure, pass by a rapid transition into the next state. Thus, a caterpillar, that has not altered in general form for several weeks, changes into a chrysalis within the course of a few days; and again, after a period of quiescence that may extend throughout the whole of the colder months, becomes a perfect butterfly or moth within twenty minutes of the moment of its emergence.

But this suddenness is more apparent than real, as may easily be proved by internal examinations of the insect at various stages of growth; showing that we are led astray by the rapidity of *external* changes – the mere *moultings* or castings of the skin – while the gradual transformations proceeding within are not so readily observed.

We have already said that the life of the perfect butterfly or moth is short. A few days after emergence from the chrysalis case, the female deposits her eggs on the leaves or stems of the plant that is to sustain the larvæ. Her work is now accomplished, and the few days more allowed her are spent in frolicking among the flowers, and sucking the sweet juices they provide. But males and females alike – bedecked with the most gorgeous colours and overflowing with sportive mirth when first they take to the wing – soon show the symptoms of a fast approaching end. Their colours begin to fade, and the beauty-making scales of the wings gradually disappear through friction against the petals of hundreds of flowers visited and the merry dances with scores and scores of playful companions. At last, one bright afternoon, while the sun is still high in the heavens, a butterfly, more weary than usual, with heavy and laborious flight, seeks a place of rest for the approaching night. Here, on a waving stalk, it is soon lulled to sleep by a gentle breeze.

Next morning, a few hours before noon, the blazing sun calls it out for its usual frolics. But its body now seems too heavy to be supported by the feeble and ragged wings, and, after one or two weak attempts at play, incited by the approach of a younger and merrier companion, it settles down in its final resting place. On the following morning a dead butterfly is seen, still clinging by its claws to a swinging stem, from which it is eventually thrown during a storm.

The tale of the perfect moth is very similar to the above, except that it is generally summoned to activity by the approach of darkness.

We see, then, that butterflies and moths exhibit none of that quality which we term parental affection. Their duty ends with the deposition of the eggs, and the parents are dead before the young larvæ have penetrated the shell that surrounds them.

Yet it is wonderful to see how unmistakably the females generally lay their eggs on the very plants that provide the necessary food for their progeny, as if they were not only conscious of and careful concerning the exact requirements of their offspring, but also possessed such a knowledge of botanical science as enabled them to discriminate between the plant required and all others.

Has the perfect insect any selfish motive in this apparently careful selection of a plant on which to lay its eggs? Does the female herself derive any benefit from the particular plant chosen for this purpose? In most cases, certainly not. For it often happens that the blossom of this plant is not by any means one of those that supply the sweets which insects love, and still more frequently does it occur that the eggs are deposited either before the flowers have appeared or after they have faded.

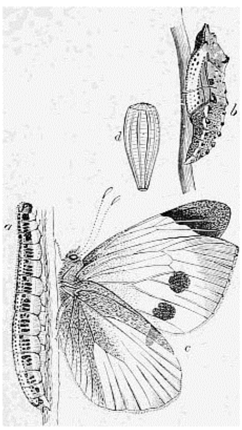

Fig. 10. – The Four Stages of the Large White Butterfly (Pieris Brassicæ).
a, larva; *b*, pupa; *c*, imago; *d*, egg.

Neither can we easily impute to the insect an acquired knowledge of the nature and wants of her offspring, or an acquaintance with botany sufficient to enable her to distinguish plant forms. Our only solution of the problem (which is really no solution at all) is to attribute the whole thing to that inexplicable quality which we are pleased to term *natural instinct*. It is to be observed, however, that it is not *all* butterflies and moths that display this unerring power. Some few seem to deposit their eggs indiscriminately on all kinds of herbage. But, I believe, the larvæ of these species are generally grass feeders, and would seldom have to travel far from any spot without meeting with an acceptable morsel.

But we must now pass on to a brief consideration of the other stages of the insect's existence. After a time, varying from a few days to several months, the young caterpillars or larvæ make their appearance. They soon commence feeding in right earnest. Their period of existence in this state varies from a few weeks to several months, and even, in some cases, to years. During this time their growth is generally very rapid, and they undergo a series of *moults* or changes of skin, of which we shall have more to say in a future chapter. Then, when fully grown, they prepare for an apparently quiescent form, which we speak of as the *pupa* or chrysalis, and in which they again spend a very variable period, extending over a few days, weeks, or months. Now, inclosed in a protective case, each pupa is undergoing a remarkable change. Some of its old organs are disappearing, and others are developing; and, after all the parts of the future insect have been developed as far as its narrow shell will permit, it bursts forth into the world as a perfect insect or *imago*.

Its wings at first are small, shapeless, and crumpled in a most unsightly fashion; but it is not long before they assume their full size, beautiful form, and gorgeous colouring. Then, in about another hour or two, the wings, at first soft and flaccid, have become sufficiently dry and stiff to bear their owner rapidly through the air.

We have thus observed some of the more striking features in the structure of the butterfly and moth in its most perfect state; and alluded in a very brief manner to the various stages through which these creatures must necessarily pass before finally reaching this stage. But now we must study these earlier stages more closely, and watch the insects during the marvellous transitions they are destined to undergo. This we shall do in the following chapters.

CHAPTER II
THE EGG

I suppose you are all acquainted with the general structure of the hen's egg, having dissected several, in your own way, many a time.

Its outer covering, which you speak of as the 'shell,' you have observed is hard and brittle. It is composed of a *calcareous* or limy substance, known chemically as *carbonate of lime*. If you put some pieces of it into an egg cup, and throw over them a little vinegar or any other liquid acid, you will see them gradually dissolve away, and small bubbles of carbonic acid gas will rise into the air. Then again, if you take a long and narrow strip of the shell, and hold one end of it in a gas or lamp flame, after a short time that end will become softer, and will glow brightly in the flame, for it is converted into lime – the same substance that is used by the builders for making their mortar – and the bright glow is really a miniature *lime light*, such as is always produced when a piece of lime is made intensely hot.

Just inside this shell you have seen a thin membrane or skin that is easily peeled off the substance of the egg itself. Next to this comes the 'white' of the egg, which is really colourless while liquid, but turns white and more or less solid in the cooking. Last of all, in the centre of this, you have noticed the oval yellow mass that is termed the 'yoke' or 'yolk,' and which contains the embryo of the future chick.

Now if you imagine this egg to be reduced in size till two or three dozen of them would be required to form a single line about one inch long, the outer calcareous shell to be entirely removed, the skin or membrane to be converted into a firmer substance of a horny nature, and, finally, the yolk to be absent and the whole internal space to be filled with the 'white,' you will then have some idea of the nature of the egg of a butterfly or moth.

To put the matter more briefly, then, we will say that the eggs of these insects are simply little liquid masses, usually of a colourless substance, surrounded by a horny and flexible covering.

Such a description may certainly give you some idea of the nature of the eggs of insects, but no amount of book reading will serve the purpose so well or be so pleasant as the examination of the eggs themselves. During the summer months very little difficulty will be experienced in finding some eggs in your own garden. Turn over some leaves and examine their under surfaces, choosing especially those plants which show, by their partially eaten leaves, that they are favourites with the insect world. Or you may amuse yourself by catching a number of butterflies – common 'Whites' are as good for the purpose as any – and temporarily confine them in a wooden or cardboard box, containing a number of leaves from various plants, and covered with gauze. In this way you are sure to obtain a few females that have not yet laid all their eggs; and if you watch your prisoners you will soon see them carefully depositing the eggs on the under surfaces of leaves, bending their abdomens round the edges if there is not sufficient room to get themselves completely under. And then, when you are satisfied with the number of eggs thus obtained for your examination, you can have the pleasure of seeing all your liberated captives flying joyfully in the free air.

In giving these simple instructions I have assumed that the reader has not yet learnt any of the characters by which female butterflies are to be distinguished from their lords and masters; but I hope that he will know soon, at least with regard to a good many species, from which individuals he may most reasonably expect to obtain eggs, and so be able to avoid the imprisonment, even though only temporary, of insects which cannot satisfy his wants.

Again, it is not necessary, after all, that butterflies should be captured for the purpose of obtaining eggs. Watch them as they hover about among your flowers. Some, you will observe, are intent on nothing but idle frolicking; and you may conclude at once that *these* have no immediate duty to perform. Others are flying without hesitation from flower to flower, gorging themselves with the sweets of life: these are not the objects of your search. But you will descry certain others, flying round about the beds and borders with a steadier and more matronly air, taking little or no notice of their more frivolous companions, and paying not the slightest heed to the bright nectar-producing cups of the numerous flowers. These are seriously engaged with family affairs only. Watch one of them carefully, and as soon as she has settled herself on a leaf, walk steadily towards her till you are near enough to observe her movements. She will not move unless you approach too closely, for, like busy folk generally, she has no time to worry about petty annoyances. You will now actually witness the deposition of the eggs exactly as carried on in the perfect freedom of nature; and the eggs themselves may be taken either for examination or for the rearing of the caterpillars.

Some species of *Lepidoptera* lay some hundreds of eggs, and it is seldom that the number laid by one female is much below a hundred.

As already stated, the under surfaces of leaves are generally chosen for the deposit of eggs, but a few of the insects we are considering always select the upper surface for this purpose. Thus the Puss Moth (page 235), and two or three others resembling it, though much smaller, known as the Kittens (page 234), invariably lay them on the upper surface. And this is the more surprising since the eggs of these moths are brown or black, and consequently so conspicuous on the green leaves as to be in danger of being sighted by the numerous enemies of insects.

The Hairstreak Butterflies (page 183) afford another exception to the general rule, for their eggs are deposited on the *bark* of the trees and shrubs (birch, sloe, elm, oak, and bramble) on which their larvæ feed.

At the moment each egg is laid it is covered with a liquid sticky substance, so that it is immediately glued to the leaf or stem as soon as it is deposited. The sticky substance soon dries, causing the egg to be so firmly fastened in its place that it is often impossible to force it off without destroying it completely.

Some of the *Lepidoptera* deposit their eggs singly, or in small irregular clusters; but by far the larger number set them very regularly side by side, in so compact a mass that it would be impossible to place them on a smaller area without piling one on top of another. This is not accomplished with the aid of the sight, for the insect performing her task with such precision often has her head on one side of a leaf or stem while arranging her eggs on the other. If you take the trouble to watch her, you will see that she carefully *feels* out a place for each egg by means of the tip of her abdomen immediately before laying it.

The eggs are laid by moths and butterflies at various seasons of the year. In some cases they are deposited early in the spring, even before the buds of the food plants have burst; and the young larvæ, hatched a few weeks later, commence to feed on the young and tender leaves. Then, throughout the late spring, the whole of the summer and autumn, and even till the winter frosts set in, the eggs of various species are being laid.

Those deposited during the warm weather are often hatched in a few days, but those laid toward the autumn remain unchanged until the following spring.

In this latter case the frosts of the most severe winter are not capable of destroying the vitality of the eggs. In many instances the perfect insect or the larva would be killed by the temperature of an average winter day, but the vitality of the eggs is such that they have been subjected to a temperature, artificially produced, of fifty degrees below the freezing point, and even after this the young larvæ walked out of their cradles at their appointed time just as if nothing unusual had occurred.

Experiments have also been performed on the eggs with a view of determining how far their vitality is influenced by high temperatures. We know that the scorching midsummer sun has no destructive influence on them, but these experiments prove that they are not influenced by a temperature only twenty degrees below the boiling point – actually a considerably higher temperature than is *necessary* to properly cook a hen's egg.

Let us now examine a number of eggs of different species, that we may note some of the many variations in form and colour.

With regard to colour, we have already observed that the eggs of a few species are black; but more commonly they are much lighter – pearly white, green, yellow, and grey being of frequent occurrence.

The great variety of form, however, will provide a vast amount of enjoyment to anyone who possesses a good magnifying lens or a small compound microscope. Some are globular, others oval; while many others represent cups, basins, and domes. Then we have miniature vases, flasks, bottles with short necks, and numerous figures that must remind a juvenile admirer of the sweet cakes and ornamental jellies that have so often gladdened his longing eyes.

Again, the beautifully sculptured surfaces of a large number are even more striking than their general shapes. Some are regularly ribbed from top to bottom with parallel or radiating ridges, and at the same time marked with delicate transverse lines. Others are beautifully pitted or honeycombed, some ornamented with the most faithful representation of fine wicker-work, while a few are provided with a cap, more or less ornamental, that is raised by the young larva when about to see the world for the first time. A few of these beautiful forms are here illustrated and named, and another has already appeared on page 14, but an enthusiastic young naturalist may easily secure a variety of others for his own examination.

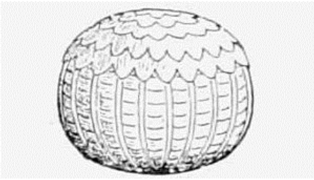

Fig. 11. – Egg of the Meadow Brown Butterfly.

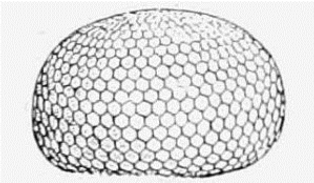

Fig. 12. – Egg of the Speckled Wood Butterfly.

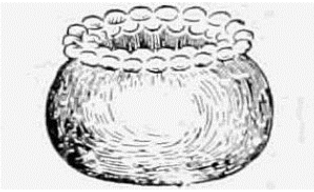

Fig. 13. – Egg of the Vapourer Moth.

It may be surmised from the accompanying illustrations that the form of the egg is always the same for any one species. This is really the case, and consequently an experienced entomologist can often decide on the name of the butterfly or moth that deposited a cluster of eggs he happens to find in his rambles and searchings; but in such decisions he is always greatly assisted by a knowledge of the food plants of the various insects, and sometimes also by the manner in which the eggs are arranged.

We have seen that the period during which the *Lepidoptera* remain in the egg stage is very variable, and depends largely on the season in which they were laid; but it is often possible to tell when to expect the young larvæ by certain changes which take place in the appearance of the egg. As the horny covering of the egg is transparent, the gradual development of the caterpillar from the clear fluid can be watched to a certain extent; but if you have a microscope, and would like to witness this development to perfection, proceed as follows.

Arrange that some butterflies and moths shall lay their eggs on strips of glass of convenient dimensions for microscopic work – three inches long by one wide is the usual size for this kind of work. This is easily accomplished by placing a proper selection of female insects in a rather small box temporarily lined with such 'slips.' When a few eggs have thus been secured, all you have to do is to examine them at intervals with your microscope, always using the reflector so as to direct a strong light *through* the eggs from below.

But even without such an arrangement some interesting changes are to be observed. As a rule, the colour of the egg turns darker as the time for the arrival of the infant larva approaches, and you will often be able to see a little brown or black head moving slightly within the 'shell.' You may know then that the hatching is close at hand, and the movements of the tiny creature are well worth careful watching. Soon a small hole appears in the side of the case, and a little green or dark cap begins to show itself. Then, with a magnifier of some kind, you may see a pair of tiny jaws, working horizontally, and not with an up-and-down motion like our own, gradually gnawing away at the cradle, till at last the little creature is perfectly free to ramble in search of food.

Strange to say, the young larva does not waste a particle of the horny substance that must necessarily be removed in securing its liberty, but devours it with an apparent relish. Indeed, it appreciates the flavour of this viand so highly that it often disposes of the whole of its little home, with the exception of the small circular patch by which it was cemented to the plant. When the whole brood have thus dispensed with their empty cradles, there remains on the stem or leaf a glittering patch of little pearly plates.

After the performance of this feat the young caterpillar starts off in life on its own account with as much briskness and confidence as if it had previously spent a term in the world under the same conditions; but we must reserve an account of its doings and sufferings for our next chapter.

CHAPTER III
THE LARVA

In almost every case the young caterpillar, on quitting the 'shell' of the egg, finds itself standing on and surrounded by its natural food, and immediately commences to do justice to the abundant supply. It will either nibble away at the surface of the leaf, removing the soft cellular substance, so that the leaf exhibits a number of semi-transparent patches when held up to the light, or it will make straight for the edge, and, closing its horizontal jaws on either side, bite the leaf completely through, and thus remove a small piece each time.

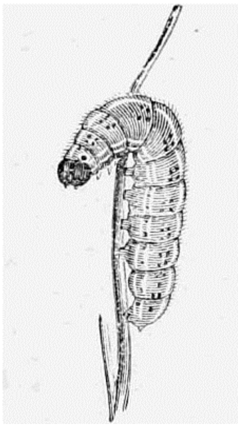

Fig. 14. – The Caterpillar of the Clouded Yellow Butterfly.

Several naturalists have amused themselves by performing experiments and making calculations on the efficiency of the masticating and digesting powers of the caterpillar. The illustrious Réaumur, for example, proved that some of the cabbage eaters disposed of more than twice their own weight of food in twenty-four hours, during which time their weight increased one-tenth. Let us see what this would be equivalent to in human beings: A man weighing eleven stone would devour over three hundred pounds of food in a day, and at the end of that day weigh about fifteen pounds more than he did at the beginning!

So the young caterpillar eats, and rests, and grows, till, while still young, its body has become too large for the already tightened skin. It evidently feels very uncomfortable. Its appetite fails, and it remains for a time perfectly quiet in one spot, having previously spun a little carpet of silk to form a firm foothold during its temporary indisposition. Its colours have also become dingy, and anyone, not understanding the character of its growth, might easily be led to suppose that the poor creature was displaying the earlier symptoms of a serious and perhaps fatal illness.

But soon an encouraging symptom is observed. The caterpillar begins to get restless. Its front segments are turned alternately right and left, and are also made to swell out much beyond their normal size. Then in a very short time – often less than a minute from the first appearances of restlessness – the skin, which has become somewhat dry and brittle, splits along the back over the second, third and fourth segments, revealing a new and bright coat beneath. The caterpillar continues its struggles and, in addition to the previous movements, causes the swelling to move backward along the body. This, acting like a wedge, causes the rent in the old coat to extend in that direction.

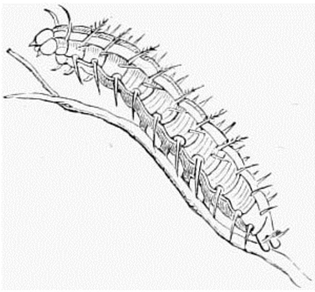

Fig. 15. – The Caterpillar of the Dark Green Fritillary Butterfly.

The caterpillar now draws its head backward, and, with a few convulsive struggles, pulls the front segments out of their old skin, and passes its head out of the rent in the back. With its foremost segments thus rendered perfectly free, it walks straight out of the old garment, which is left still fixed by the legs to the silken carpet.

The larva, although now fresh and smart in its appearance, is exhausted by these struggles and its prolonged fast. The new skin, moreover, is very soft and tender, even to the cases of the head and legs, which are normally very hard. But a short period of rest suffices to dry its skin and sharpen its appetite, and then it eats more vigorously than ever.

We will now leave the caterpillar for a moment while we look at its cast-off clothes. They are still clinging to a stem so firmly that they can scarcely be removed without injury. The hard shell that covered the head and jaws is perfect in form, and so are the claws and cases of the legs. All the hairs or spines that happened to adorn the previous owner still retain their positions; and the whole skin, although always more or less shrivelled, is sometimes so slightly altered in form that it might be mistaken for a living caterpillar if not closely examined.

But this is not all. For, according to the accounts of some authoritative observers, the lining of the digestive organs, which is really a continuation of the outer skin, is cast off (or rather cast *out*) at the same time, as are also the linings of the larger breathing tubes which are presently to be described.

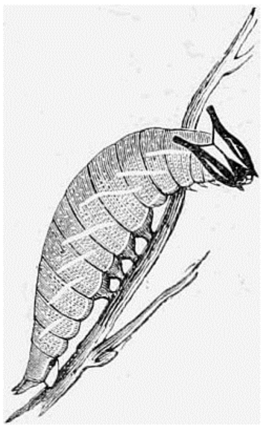

Fig. 16. – The Caterpillar of the Purple Emperor Butterfly.

We have seen that some caterpillars, on quitting their egg cases (which may really be regarded as the first moult), make their first meal of the old covering. So also some of them, in their future moultings, exhibit an apparently useless economy (seeing that they are surrounded by an abundance of their natural vegetable diet) by devouring their old coats! In the face of this fact we can hardly describe them as strict vegetarians.

Having thus passed through its first hardship, the caterpillar has by no means seen the end of the troubles and dangers that beset it; for, during its existence in the larval state, it has to go through a series of three, four, five, or even six moults, all of which are periods of considerable inconvenience, and perhaps even pain, and frequently prove fatal. And it is by no means an uncommon thing to meet with the lifeless body of an unfortunate individual who, as shown by its shabby appearance and the silken carpet under its feet, has evidently fallen a victim to the dangerous process of ridding itself of an old garment.

But this is only one of the many dangers to which caterpillars are exposed. Throughout every hour of the day the sharp and hungry eyes of the numerous insect-eating birds are searching the leaves for such delicacies to satisfy the wants of themselves and their broods. The lively little lizards, too, during the sunny hours are busily engaged in searching them out among the foliage of heaths and banks.

Very formidable enemies also exist in the form of Ichneumon and other species of flies, which pierce the skins of caterpillars with their sharp *ovipositors*, and lay their eggs within the bodies of the unfortunate victims. As soon as the young larvæ are hatched from these eggs, they commence feeding on the fatty substance stored beneath the caterpillar's skin. They carefully avoid, at first, attacking the vital organs of their host's body, and in this way secure for themselves a more lasting supply of fresh food. When the fatty substance is nearly all gone, they eat their way into the more important structures, of course steadily growing all the time; and so, even though the body of the caterpillar is rapidly diminishing, the total bulk shows often no very appreciable decrease in size. When the larvæ of the flies are fully fed, they either change to the pupa within the carcase of their host, or eat their way out of its body and construct for themselves a cocoon in which to undergo the transformation.

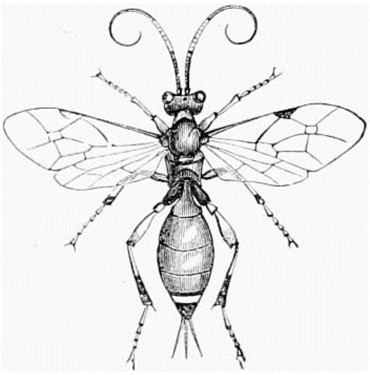

Fig. 17. – An Ichneumon Fly (Cryptus Migrator).

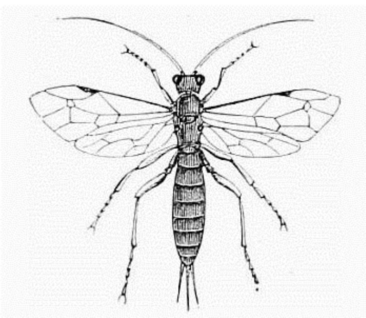

Fig. 18. – Another Ichneumon Fly (Pimpla Instigator).

As for the caterpillar itself, it sometimes dies before the time for its metamorphosis has arrived; but it often changes to the chrysalis before its fate is sealed. In this latter case, a number of flies, having undergone their final transformation within the chrysalis shell (there being but little else than shell remaining of the victim's body), break forth from the remains of the carcase somewhere about the time at which the butterfly or moth should have appeared.

Caterpillars have also their nocturnal enemies and devourers, among which may be mentioned frogs, toads, newts, and insect-eating mammals.

We must now learn something of the structure of caterpillars; and then become acquainted with their habits, and the change to the chrysalis or pupa.

Take a caterpillar from your garden, preferably a full-grown one of a rather large species, that is not very densely covered with hair, and examine it carefully as we note the main points in its structure. The first point that strikes our notice is the division of its body into segments or rings, separated from each other by a more or less distinct line or slight constriction of the body.

There are thirteen of these segments, reckoning, as is usual, the head as the first.

The head is usually very hard, and often of a much darker colour than the rest of the body. It is also frequently divided into two lobes by a couple of oblique lines, between which the parts of the mouth are situated. The two powerful horizontal jaws, to which we have already referred, are very hard and sharp, and curved like a sickle, and therefore splendidly adapted for biting from the edges of leaves. The head is also provided with a pair of antennæ, usually very short and inconspicuous and protected by a horny covering.

Unlike the perfect insect, the caterpillar has no large compound eyes, but twelve very small simple eyes, situated on the cheeks, very near the mouth – six on each side.

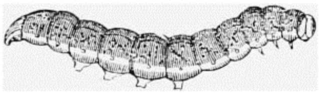

Fig. 19. – The Caterpillar of the Angle Shades Moth (Meticulosa).

If you examine them with a magnifier, you see that each one is provided with a small and very convex lens – a lens of very *short focus*, such as would be used for the examination of small objects held very near to the eye. From this arrangement we should be inclined to conclude that the caterpillar can see only those objects that are close to its mouth; and this idea is strengthened if you place one in a box containing a number of leaves, one of which is that of its own food plant. It will wander about the box, apparently looking at every part of every leaf it passes, after the manner of a very short-sighted individual, and never taking a general look round. A butterfly or a moth can see a flower in the distance, for it flies unhesitatingly from one to another in the straightest and shortest path, but if you place a caterpillar in the centre of a ring composed of a leaf of its food plant and nine others from other plants, the chances are (nine to one) that it will *not* walk towards what it would like to have.

Again, the eyes are situated on the *lower* part of the cheek, directed slightly downward, and are therefore adapted for seeing what is just under its jaws as it walks along. Had we no knowledge whatever of the caterpillar's twelve little eyes, we should probably have thought that it sought out its food by some sense other than that of vision.

Another important and interesting feature of the head is the silk-spinning apparatus, situated under cover of the lower lip. This consists of two tubular glands, corresponding to our own salivary glands, the special purpose of which is to secrete a viscid fluid that solidifies on exposure to air. The opening by which the fluid escapes is so situated that the caterpillar can easily apply it to the surface of any object over which it is walking, and then, by drawing or turning away its head, cause a silken fibre to be produced.

Some caterpillars make use of this spinning apparatus only on a few special occasions, but others, more especially some of the smaller species, seem to have it always in use, so that if at any time you suddenly start them into the air by giving a smart tap to the plant or twig on which they rest, they invariably fall slowly on the end of a growing web, the spinning of which they stop as soon as they consider they have fallen far enough. Sometimes, as you are walking through a wood, you will see hundreds, nay, thousands of little caterpillars thus suspended, swinging gently in the breeze. Not long since, after only a few minutes' walk among the trees of Epping Forest, I found I was decorated with several dozens of these swingers with which I had come into collision – in this case consisting chiefly of the larvæ of the Green Tortrix Moth (*Tortrix viridana*).

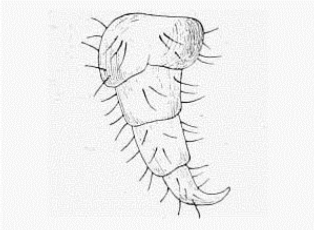

Fig. 20. – Walking Leg of a Caterpillar.

Now let us examine the caterpillar's limbs. Attached to each of the second, third, and fourth segments is a pair of true walking legs, corresponding with those of the perfect insect. These are covered with a hard and shining substance, and are also each provided with a hook. The fifth and sixth segments have no limbs at all, nor have the eleventh and twelfth, but some or all of the others (seventh, eighth, ninth, tenth, and thirteenth) are furnished with a pair of claspers which we shall presently describe.

First, as regards the number of claspers, it will be seen from what has just been said that this is not always the same. Some caterpillars possess five pairs, thus making up the total number of walking appendages to sixteen. In fact, we must regard this as the *usual* number. But there are at least a few hundred exceptions to the rule. Many of the *Bombyces* (page 217), for example, have only four pairs of claspers; and in others of the same group the fifth pair is present, but only partially developed, and quite useless for walking.

Fig. 21 – Larva of the Yellow Underwing Moth (Pronuba).

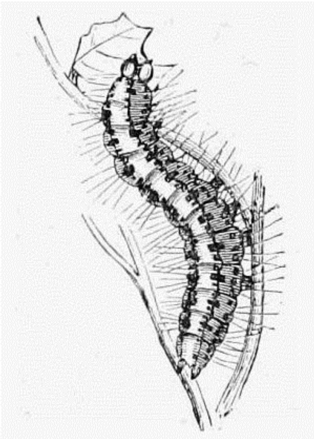

Fig. 22. – Larva of the Crimson Speckled Moth (Pulchella).

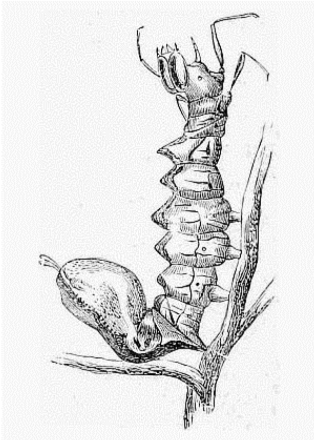

Fig. 23. – Larva of the Lobster Moth (Fagi).

Look at the peculiar caterpillar of the Lobster Moth (fig. 23) – a creature that differs from most other caterpillars not only in its claspers, but in many other respects too. Observe its long and slender legs, its humped middle segments, and its upturned hindermost segment, of enormous size and mounted with a pair of clubbed 'horns.' This last segment you will observe, has no claspers.

Another allied caterpillar is that of the Iron Prominent Moth (fig. 24). This one also has humped segments, and the claspers of the thirteenth segment are imperfectly developed.

A large number of other exceptions to the general rule are to be found in the caterpillars of the Geometer Moths (page 268), one of which is here represented. These have generally only two pairs of claspers, one pair on each of the tenth and last segments, so that there is a distance equal to the combined length of six segments between the hindermost true leg and the first pair of claspers. But even among the Geometers there are variations to be observed in the number of claspers, and some of these will be pointed out in our brief descriptions of the commoner species.

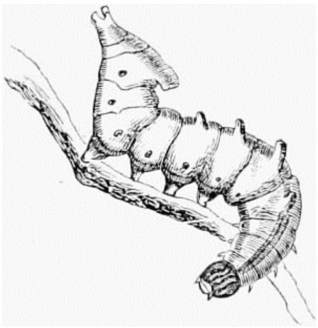

Fig. 24. – Caterpillar of the Iron Prominent Moth (Dromedarius).

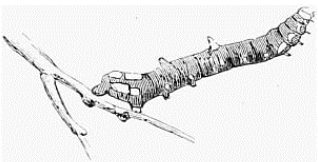

Fig. 25. – Larva of the Brimstone Moth (Luteolata).

These limbs which we have been calling claspers are known by several other names. Thus they are termed 'pro-legs,' 'temporary legs,' 'false legs,' and 'abdominal legs;' but if you watch a caterpillar as it walks up a stalk or along the edge of a leaf, you will certainly agree that the term 'clasper' is everything that could be desired. But why not call them legs, seeing that they are used in walking?

The reason is that they differ in many respects from the three foremost pairs of limbs as regards structure, persistency, and function. The true legs, as we have called them, continue to exist, though concealed, in the chrysalis state, and again appear, far more perfectly developed, in the butterfly or moth, but the claspers are no more to be seen after the caterpillar has passed into the quiescent stage. We have noticed, too, that the true legs are pointed and clawed, also that they are protected by a hard and horny covering; but examine a large caterpillar, holding it between the fingers and thumb with its under side uppermost, and you will soon see that the claspers are not at all hard, but soft and fleshy; not pointed, but often terminating in a broad flat circular surface. You will also observe, as the creature struggles to escape from your grasp, and tries to get a hold on something with its claspers, that these limbs, if we may so call them, are retractile, and are sometimes completely drawn into the body. Finally, examine the broad end of a clasper with a magnifier, and you will see it surrounded by a circle of little hooks, turning in all directions. You will no longer wonder how it is that a caterpillar can hold so tenaciously to a piece of twig that it is often almost impossible to remove it without injury.

Now put your caterpillar down, so that you may observe its gait. If it happens to be one with the full complement of sixteen limbs, you see that at each stride it makes but little progress. The segments contract and relax alternately and in succession, thus sending a series of wave-like motions along the body, and urging onward the front segments while the claspers keep the hinder portion firmly fixed.

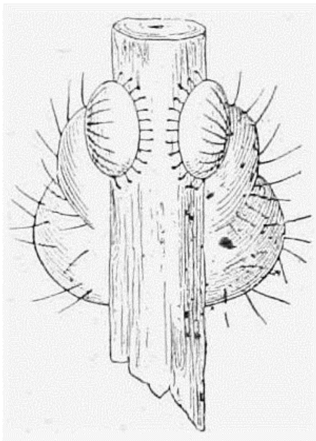

Fig. 26. – The Claspers of a Caterpillar.

But if your caterpillar is one of the Geometers, with only two, or perhaps three, pairs of claspers, the mode of procedure is very different. The creature stretches its body out at full length, often raising its head high in the air, and swinging its long body right and left with a most furious motion, as if to hastily scan the neighbourhood. Then, having satisfied itself as to the *direction* of its proposed course (which, by the way, is often changed considerably at almost every stride), it holds on by the true legs and pulls its hinder quarters forward till the body forms almost a closed loop, with the fourth segment nearly touching the ninth. The claspers now become the holdfasts. The little hooks with which they are provided are firmly fixed to the surface on which it is walking; and the body being again straightened out to its utmost length, the same manœuvre is repeated. So, you see, the insect progresses by strides equal in length to about six segments of the body, and these the longest segments generally; and the rate at which the strides succeed each other, especially in some of the smaller species, is really astonishing.

We have seen the caterpillar in the act of taking its walk, and now we will give it a twig of its food plant so that we may see it feed. It walks up the twig without hesitation – for caterpillars (excepting those which feed on roots) always seem to move upward when in search of food – and soon finds itself on a leaf. Over this it walks till it reaches the edge; and, grasping the edge firmly between the claspers, so as to give perfectly free play to its legs and head, it stretches its body at full length, and takes a series of bites as it brings its head backward in a curve. When the head has thus been brought close to its fore legs, the body is again extended, and the same ground is gone over again.

If the caterpillar is a fairly large and hardy one, it will bite through the smaller veins, and perhaps even the larger ones; but the smaller species often change their position on reaching a moderately thick vein, and so devour little else than the soft cellular substance of the leaf. In any case, it is astonishing to see how rapidly the leaf disappears under the influence of the powerful jaws and marvellous digestive apparatus of the hungry grub.

Those who take a delight in watching the *movements* of caterpillars are sure to be interested in observing them when at rest; for at such times the various attitudes assumed are as pleasing and instructive as are their active moments. And these attitudes are all the more interesting on account of the mimicry by which the creatures often baffle their numerous enemies. We may profitably spend a little time in studying a few cases in point.

Many species, when at rest, fix themselves by means of their claspers to a small twig or leaf stalk, or on the midrib of the leaf itself. Here they remain perfectly still, with their bodies perfectly straight or with head slightly raised. I need hardly say that these generally fix themselves on the *under* side of the leaves and stalks, thus securing themselves against the attacks of the feathered foes above. But some birds are equal to the caterpillars in this matter; and it is really amusing to see them hopping about beneath the leaves in our gardens, every now and again slyly turning one eye upward, and smartly plucking an unwary grub from its resting place.

The precautions of the caterpillar, however, do not end merely with the selection of an under surface. You will find that the bright green species invariably settle on a leaf or a *green* stalk, while the darkly coloured insects often choose a twig covered with a brownish bark. Some even make for the *trunk* of the tree on which they feed, and here remain quite still in a vertical position, so that they look just like a ridge in the bark, the colour of which is faithfully imitated by their skin. Further, many of the caterpillars that resort to this stratagem have bodies that are notched or knotted and spotted in such a manner that the resemblance to their surroundings is so perfect as to defy any but the most experienced eye. And even this is not all, for a number of these mimics of the insect world never venture to feed by day, but take in their quantum of provisions during the dark hours, and practise their deceptions throughout the day.

Most of the Geometer caterpillars, of which we have already spoken, are well trained in the art of deception. You are out on a caterpillar hunt, and engaged in carefully turning over the twigs of the hazel or some other shrub, so that you may the more readily examine the under surfaces of the leaves. At last you lay hold of a small broken twig for this very purpose. To your astonishment it is very soft, and readily bends between your fingers. You look more closely at this peculiar piece of stick, and find, to your surprise, that you have grasped a looper caterpillar that was standing out at an angle just like a broken twig, supported by its two pairs of claspers, and coloured and knotted exactly like the little branch on which it rested.

At other times you meet with little green caterpillars of the same group, supporting themselves in exactly the same manner on a small twig, and looking just like a leaf stalk from which the blade had fallen or been devoured.

What a wonderful power is exhibited in the grasp of the claspers and the tension of the muscles, enabling the caterpillar to fix itself and retain its position for so long a time! Imagine an acrobat fixing himself by his hands on an upright pole, throwing out his body at an angle, and without any further support retaining his position motionless for several hours!

Other experiences of the larva hunter are equally interesting and, perhaps, even more tantalising. He is engaged in very cautiously turning over the leaves of a certain food plant from which he hopes to obtain the larva of a much-coveted species. Then, just as his eye catches a glimpse of the very object of his search, down falls the caterpillar, rolled up into a little ball, among the herbage below. This latter is diligently and patiently examined. But no, the anticipated prize is nowhere to be seen. It is probably a green one, and this adds to the difficulty of the patient entomologist. Then, as he carefully separates the low herbs, hoping to find the spot where the larva had fallen, the insect, rolled up into a compact little ball, only sinks deeper and deeper into the maze.

Many caterpillars avoid capture in this manner, while others seek to avoid detection by remaining perfectly motionless, even when roughly handled. They allow themselves to drop from their resting place on the slightest sign of danger, and, when the alarm is over and all is quiet again, they ascend the food plant and resume their position.

Some caterpillars not only rest, but even feed under cover, quite secure from most, if not all, of their enemies. Several of them feed on roots, and many a farmer can relate sad experiences of the havoc committed by these caterpillars on his turnips and other crops. Then there are those which feed on flowers and buds, completely burying themselves in the dense mass of food.

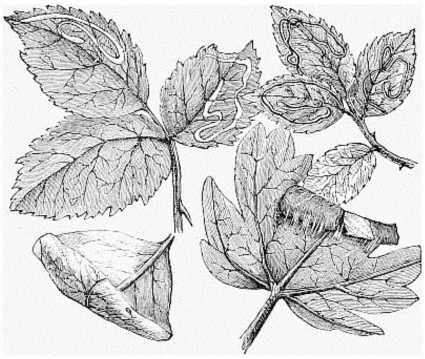

Fig. 27. – The Homes of Leaf Miners and Leaf Rollers.

We must conclude this brief account of resting and hiding places and attitudes of caterpillars by a few observations on the leaf miners and leaf rollers.

The former are very small caterpillars – the larvæ of certain small moths – that eat burrows into leaves without doing any considerable injury to the outer *epidermis*, and thus prepare a safe resting place within the substance of their food.

The latter, also mostly of small size, make themselves secure by curling a leaf or a portion of a leaf into a cylinder, and holding it in position by means of a number of silken threads.

If you examine a leaf thus curled you will soon be convinced that a considerable number of the extremely delicate threads must be necessary to hold it in position; but, if you would like to know how a very small and feeble caterpillar can manage to roll up a comparatively large and rigid leaf, you must watch the little creature at its work.

You need have but little difficulty in finding a willing worker, for such caterpillars are extremely numerous. Take a few out of their self-made homes, place them on a sprig of the food plant, and you will soon have the pleasure of seeing one start its extraordinary work.

At first it spins a number of threads stretching from the edge of a leaf to about the middle of the surface. These threads are not tight by any means, and the leaf is, as yet, unchanged in position. But now the little mechanic exhibits a tact that almost seems to prove a knowledge of the principles of its art. Each thread in turn is pulled *at right angles* at its middle, and then fastened by means of the creature's spinneret. Each time this is done the edge of the leaf is bent round *a little*; and when at last the cylinder is completed, a number of other threads are stretched across from the scroll to the flat part of the leaf to secure it firmly in its place.

Many caterpillars are solitary in their habits: that is, they are always found singly, whether walking, resting, or feeding. But a large number of species are gregarious, living in dense clusters either throughout their larval state or, perhaps, only while young. In many such cases it is difficult or even impossible to find any reason for this gregarious tendency – to discover any advantage that the insects may derive from the habit. Many species, however, are true co-operators in the defence of their communities. The caterpillars of such live in clusters, sometimes several scores in each, and all help in the spinning of a complicated mass of silk fibres, which, with the leaves and twigs they join together, form a safe home in which they can rest, feed, or change to the chrysalis state. In early summer hundreds of such caterpillar 'nests' are to be seen in many of our hawthorn and other hedgerows.

Before closing our general account of the caterpillar we must have a word to say about the breathing apparatus, more especially as in our future descriptions we shall frequently have to mention the colours and markings which surround the openings in its body through which the air supply is admitted.

If you examine the sides of the segments of a caterpillar, using a lens if the insect is a small one, you will observe some little round holes, often inclosed in a ring or a patch of some prominent colour. These are the *spiracles* or openings of a series of air tubes called *tracheæ*. These latter divide and subdivide within the body of the caterpillar, the branches of one often uniting with those of another, thus forming a really complicated arrangement of air pipes by which the supply of oxygen is distributed.

A microscopic examination of a portion of one of the tracheæ will show that its walls are supported by an elastic spiral of a firm substance. This arrangement serves to keep the air passages open, and secures for the caterpillar a free supply of air at times when a contraction of the segments would otherwise cause the tubes to collapse.

There are nine spiracles on each side of the caterpillar's body, and never more than one in the side of the same segment. The head, which we have been regarding as the first segment, has no spiracles. The second segment has a pair – one on each side. There are none in the third and fourth; but all the segments, from the fifth to the twelfth inclusive, have each a pair; the last (thirteenth) segment has none.

We have already observed the general arrangement of the caterpillar's limbs; but perhaps it may be interesting and even convenient to the reader to give here a little table that will show at a glance the disposition of both limbs and spiracles.

First	segment — head	Two short antennæ, two jaws, and twelve eyes.
Second	"	Legs and spiracles.
Third	"	Legs only.
Fourth	"	Legs only.
Fifth	"	Spiracles only.
Sixth	"	Spiracles only.
Seventh	"	Spiracles, and sometimes claspers.
Eighth	"	Spiracles, and sometimes claspers.
Ninth	"	Spiracles, and sometimes claspers.
Tenth	"	Spiracles, and generally claspers.
Eleventh	"	Spiracles only.
Twelfth	"	Spiracles only.
Thirteenth	"	Claspers only, and these occasionally absent.

We must now watch the caterpillar through its later days, to see how it prepares for passing into the pupal stage, and to witness the various interesting changes that take place at this period.

When fully grown, it ceases to eat, and begins to wander about in search of a convenient spot for the coming event. Its colours fade, and the body becomes appreciably smaller, especially in length, as it ejects the whole contents of its digestive apparatus. According to some accounts, it even evacuates the lining of the intestines with their contents.

A great variety of situations are chosen by the different species at this time. Some will fix themselves on their own food plant, and there remain till they finally emerge in the perfect state, suspending themselves from a silken carpet, hiding themselves in a rolled leaf, or constructing a cocoon of some kind. A large number walk down the food plants, and undergo their changes in moss that happens to lie at the foot; or construct a cocoon on the surface of the ground, utilising for the purpose any decayed leaves, fragments of vegetable matter, or pieces of earth or small stones. Many seek a further protection than this, and burrow into the soil, where they either lie in a little oval cell that they prepare, or in a cocoon constructed by spinning together some particles of earth. Again, there are those caterpillars, chiefly of butterflies that frequent our gardens, which find their way to the nearest wall or fence, and there secure themselves in a sheltered nook. We will watch a few of these varied methods of procedure, taking as our first instance the caterpillar of the common Large White or Cabbage Butterfly.

When fully fed, this larva seeks out a sheltered spot, generally selecting the under surface of some object, or of the ledge of a wall or fence. Sometimes it will not even leave its food plant, though it generally walks some considerable distance before a suitable shelter is found. Having satisfied itself as to the site of the temporary abode, it sets to work at spinning a silken carpet. At first the threads spread over a rather wide area, and seem to be laid in a somewhat irregular and aimless manner; but after a little time its labours are concentrated on one small spot, where it spins several layers of silk fibres.

This done, it fixes the little hooks of the claspers firmly in its carpet bed, and then proceeds with a highly interesting movement. It is not satisfied with only the one mode of suspension. In fact, this alone would hardly be safe, for when it casts its skin, as it is shortly about to do, its claspers will all disappear; and although it afterwards secures itself by the 'tail,' it would be dangling in such a manner as to swing with every breeze – a very unsatisfactory state of affairs, especially with those that pupate late in the summer and remain in the pupal state throughout the winter storms.

Its next procedure, then, is to make a strong silk band round the middle of its body, so as to keep it close to the surface against which it rests. But how is this to be done? It bends its head round till the spinning organ can be applied to a point close beside the middle of its body. Here it fixes one end of a thread; and then, gradually twisting its body, brings its head round to the other side, still keeping it close to the same segment, and fastens the other end of the thread exactly opposite the point at which it started.

The head is now brought back to its former position, thus adding another thread to the band; and the process is repeated several times, till at last the caterpillar is satisfied with the thickness and strength of the cord formed.

Now it straightens out its body as if to rest from its labours; but the work is not yet complete. Soon it exhibits much restlessness. Its foremost segments are seen to shorten, and consequently become thicker. Then the skin splits, and the last moult of the caterpillar commences. The movements that follow are exactly similar to those we have already described in connection with one of the earlier moults: the alternate and successive contractions of all the segments gradually force back the old coat, and this is finally thrown entirely off by a somewhat vigorous wriggling of the 'tail.'

Then, for a moment, the creature is supported only by its silken cord. But this lasts *only* for a moment. For, as soon as it is quite free from the old garment, it applies its tail to the densest part of the carpet it had prepared at the start, and secures its hinder extremity by means of little hooks.

But what a change has now come over the creature! It is no longer a caterpillar. Its head is no longer distinct, although we can readily make out the positions of the eyes. Its mouth and jaws have quite disappeared, and the legs and claspers are apparently gone. The three segments that bore the legs are no longer distinctly separable, though in reality they still exist. The head and thorax are peculiarly shaped; and, instead of being cylindrical, are angled and ridged; but, beneath the soft greenish skin – the new garment – we can discern the outline of a pair of small wings, and see a proboscis and a pair of long antennæ. Also the six long legs of the future butterfly can be traced with care.

The abdomen is conical in form, coming to a sharp point at the end, and its segments are quite distinct.

No stranger to the metamorphoses of insects would connect the present form with that of a caterpillar; they are so very unlike. And yet the time occupied in the whole change, from the spinning of the carpet, does not occupy more than about thirty or thirty-five hours.

The apparent suddenness of this change is really surprising, but in reality the transformation is not nearly so sudden as it appears. Dissection of a caterpillar a few days before the final moult is due will show that the changes are already going on. In fact, a simple removal of the skin will prove that the organs of the future butterfly are developing. Still, in proportion to the short time occupied, the change is extremely great; and it may reasonably be inquired, Why so great a change within so short a space of time? – why is not the change continued steadily and equally through the larval existence? The reason has already been hinted at. Caterpillars are living eating machines, whose office is to remove excess of vegetable matter. Consequently they must have their jaws and bulky digestive apparatus in full development to the end. If these organs were to *gradually* disappear as the caterpillar reaches its non-eating stages, it would simply be starved to death. So the change from the larval to the pupal state, which we may regard as the final moult of the caterpillar, is a far greater change than any of the preceding ones, and occupies a proportionately longer time, although it is principally confined to the last few days of the caterpillar life.

A number of caterpillars, and especially those of the butterflies, suspend themselves when about to change; and the peculiarities of the modes adopted must be left for our descriptions of species in a future chapter; but we will find room here for one more interesting example, taking this time the larva of one of the commonest of the Vanessas (page 166) – the Small Tortoiseshell Butterfly.

The caterpillars of this insect are gregarious when young; and if ever you meet with one, you are almost sure to be able to obtain a hundred or so without much searching. But as they grow older they feed singly, yet generally without straying very far from their birthplace.

When full grown they sometimes stray to a neighbouring plant or fence to undergo the change to a chrysalis, but more commonly they are perfectly satisfied with the protection afforded by the leaves of their food plant. We will now watch one of these as we did the larva of the Large White Butterfly.

Of course the under side of the leaf is chosen. Here a silken carpet is spun as before described; but the caterpillar, instead of clinging with *all* its claspers, suspends itself in a vertical position by its hindermost pair only.

Here it hangs, head downwards, awaiting the coming events. The splitting and casting of the skin goes on just as in the case of the Large White, but there is this puzzle to be solved: how can the insect shuffle itself out of its old coat without falling to the ground, leaving the cast-off garments still hanging by the hooks of the claspers? This really seems a matter of impossibility, since the little hooks which alone suspend the insect are thrown off with the skin of the claspers.

The thing is managed in this way. As the skin slowly splits through the wrigglings of the apparently uncomfortable occupant, it is gradually pushed backward – that is, upward – till it is in a shrivelled condition, and the body of the insect is nearly free. But the chrysalis thus brought to light is provided with little hooks on the end of its 'tail' by which it can attach itself to the irregularities of the crumpled coat. Its conical abdomen is also very flexible, and it can, by bending this, seize hold of a ridge in the skin, holding it between the segments. Thus, although practically quite free from the old garb, it never falls to the ground.

There is now, however, another point to be attended to. The newly formed chrysalis desires to be entirely independent of its cast-off skin, and to suspend itself directly from the silky carpet it has prepared. To this end it works steadily for a time, alternately bending its supple abdomen from side to side, gripping the folds of the skin between the segments, pulling its body a little higher at each movement, and securing itself at each step by the little hooks at its extremity.

So it climbs, and at last it reaches the network of silk fibres, and thrusts the tip of its abdomen among them till some of the hooks have taken hold. Not satisfied with this, it turns its body round and round to get the little hooks so entangled between the silk fibres that a fall is impossible, and in so doing it frequently pushes the old skin out of its place so that it falls to the ground.

Although the caterpillars of this species do not show any great gregarious tendency when nearly full fed, yet it is not an uncommon thing to find several hanging from the under surface of one leaf, all being attached to the one common carpet at which all had worked. And when bred in confinement, a number will often spin in company in a corner of their cage. I have thus obtained a cluster of thirty-seven pupæ, all hanging by the 'tails' to the same mass of silk, which was so small that they formed quite a compact mass of beings with their tails close together.

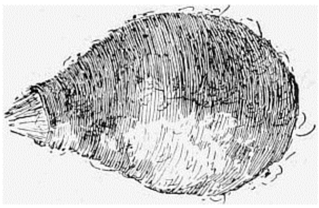

Fig. 28. – The Cocoon of the Emperor Moth.

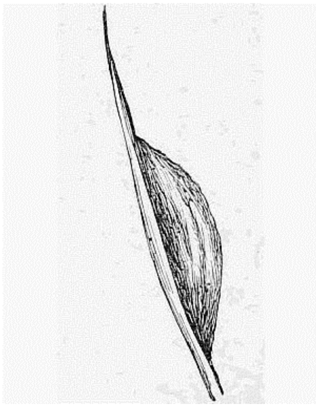

Fig. 29. – The Cocoon of the Six-spotted Burnet (Filipendulæ).

We have seen that the Large White Butterfly makes itself secure by a silk band round its middle, while the 'Tortoiseshell' is fixed only by its tail. But the extra provision for the safety of the former is not so necessary in the case of the latter, as it never spends more than two or three weeks in the pupal state. Here it is the perfect insect that braves the winter, and not the chrysalis.

There is a great variety in the means taken by the caterpillars of moths to protect themselves during their metamorphoses, but we shall have space for only a few illustrations.

A clever cocoon is spun by the larva of the Emperor Moth (*Pavonia*). It is pear-shaped, and composed of a brownish silk; and is so constructed that the newly emerged moth can easily walk out of the small end without breaking a fibre, while the entry of an insect enemy from without is impossible.

This is managed as follows. A number of rather stiff threads are made to project from the small end of the cocoon, and these converge as they pass outward so that the ends are all near together. The other portions of the cocoon are of compact silk, and any insect intruder that ventures to enter by what we may almost term the *open* end is met by a number of spikes, as it were, that play on it at every attempt. Many of these wonderful cocoons may be found during the winter months attached to the food plants of this insect.

Of the silken cocoons spun by various caterpillars some are so thin and light that the chrysalis can easily be seen through them, and others are so densely woven as to be quite opaque. A great difference is also to be observed in the adhesive power of the silk fibres. In some cases little threads of silk can be pulled off the cocoon; but some of them, that of the Oak Eggar (page 229) for example, look as if they had been constructed of paper rather than of silk, because, at the time of spinning, the moist silk fibres stuck so closely together.

An extreme case of this character is to be met with in the cocoon of the Puss Moth (page 235); for here the fluid from the spinneret of the caterpillar does not harden at once on exposure to air, and so the threads become thoroughly united together, thus forming a solid gluey cocoon.

When the Puss caterpillar is about to change, it descends the tree (poplar, willow, or sallow) till it is within a few feet of the ground. Then it commences gnawing away at the bark, at the same time cementing all the pieces together with the gluey substance from its spinning glands. In this way it surrounds itself with a very hard cocoon, which so closely resembles the surrounding bark in colour that detection is difficult indeed.

But how will the caterpillar proceed if it is removed from its native tree and has no bark to gnaw? That you can easily answer for yourself, or rather Puss will answer it for you. Go and search among the poplars, willows and sallows in the month of July. You may possibly come across a caterpillar that is just in the act of creeping down the bark in search of a resting place; but if not you may be successful in obtaining a few either by examining the twigs, or you may start them from their hiding places by smartly tapping the smaller branches with a strong stick.

Having secured one or more larvæ, take them home, and they will give some rather novel performances. If they are not fully grown, you must supply them with fresh leaves every day till they refuse to eat; and then is the time for your experiments. Shut one in a little wooden box, and you will have the pleasure of watching it construct a cocoon of chips of wood that it has bitten out with its powerful jaws, all joined together into a hard shell by means of transparent glue. Shut another Puss in a glass vessel – a tumbler, for instance – either by placing it under the inverted vessel, or by covering over the top. Perhaps it will not be superfluous to mention that, should you place it under an inverted vessel, this vessel should not stand on a polished table, for, whatever be the material, unless *extremely* hard, it is sure to be utilised in the manufacture of the cocoon.

Let us suppose, then, that the caterpillar is under an inverted tumbler that stands on a plate or saucer. Now it is for *you* to decide what material shall be used in the construction of the new home. Give Puss some fine strips of brightly coloured ribbon, and it will construct a very gaudy house by gluing them together. Or, provide it with sawdust, pieces of rag, glass beads, sand, paper, anything in fact; and the material will be 'made up' into a cocoon more or less ornamental according to the nature of the supply.

But what if you give it *nothing* with which to work, and so inclose it that nothing its jaws can pierce is within its reach? For instance, shut it in with tumbler and saucer as before, inverting the former on the latter, and give it no material whatever. What will it do now? We will watch and see.

At first it is very restless, and walks round and round the edge of the tumbler, evidently a little dissatisfied with the prospects. Then, after a little while, the events of nature transpiring in their fixed order regardless of trivial mishaps, the glutinous fluid begins to flow from the creature's spinning glands, and it moves about in a somewhat aimless fashion, applying the transparent adhesive matter both to tumbler and saucer.

It seems now to become a little more reconciled to its unnatural surroundings; and, making the best of bad matters, keeps its body in one place, and starts the construction of a ridge or barrier all round itself. By the continued application of the creature's spinneret this barrier is made gradually thicker and higher, till at last the overhanging sides meet and the caterpillar is inclosed in its self-constructed prison. But the walls of this prison are so transparent that every movement can be watched; and, after the insect has spent a few days in completing the cocoon, we can see it cast off its old skin, and appear in the new garb of a fine greenish chrysalis.

Its soft green skin soon hardens and turns to a rich dark brown colour, and it settles down for a long rest lasting till the following May or June.

When the whole operation of building is completed, lift up the tumbler, and up will come the saucer too. The two are firmly glued together by the substance secreted; and the power of this as a cementing material will be well illustrated if you endeavour by mere pulling force to separate the two articles.

The Puss is not the only caterpillar that works up a foreign material with the contents of the spinning organs. There are several others, in fact, that use for this purpose fragments of wood or other parts of the food plants; and a still larger number bind together leaves, fresh or dead, or particles of earth or other matter. Several such cocoons will be described in our accounts of individual species in another chapter. We shall now devote a little space to a few general remarks on the chrysalides and the final metamorphosis of butterflies and moths.

CHAPTER IV
THE PUPA OR CHRYSALIS

As soon as the last moult of the caterpillar is over, the chrysalis that had already been developing under the cover of the old skin is exposed to full view; and although the perfect insect is not to be liberated for some time to come, yet some of its parts are apparently fully formed.

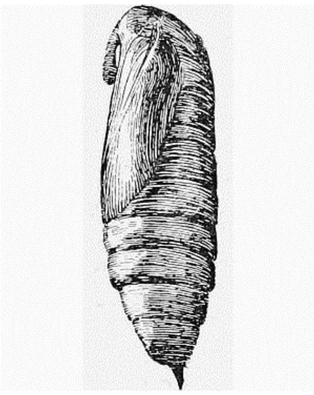

Fig. 30. – The Pupa of the Privet Hawk (*Ligustri*).

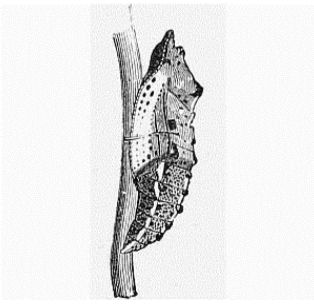

Fig. 31. – The Chrysalis of the Large White Butterfly (*Brassicæ*).

The newly exposed skin of the chrysalis is very soft and moist, but as it hardens it forms a membranous or horny covering that protects and holds firmly in place the trunk and the various limbs and appendages that are distinctly to be traced on the under surface.

If, however, you examine a chrysalis directly after the moult is over, you will often find that the wings, antennæ, proboscis, and legs of the future butterfly can be easily separated from the trunk of the body on which they lie by means of a blunt needle, and can be spread out so as to be quite free from that surface.

In form the chrysalides of butterflies and moths are as variable as the caterpillars. Many of the former are sharply angular like that of the 'Small Tortoiseshell' already mentioned; but some of the butterflies – the Skippers (page 197) – have smooth and tapering chrysalides, and so have most of the moths.

In colour they are equally variable. Some are beautifully tinted with delicate shades of green, some spotted on a light ground, some striped with bands more or less gaudy and distinct, but the prevailing tint, especially among the moths, is a reddish brown, often so deep that it is almost a black.

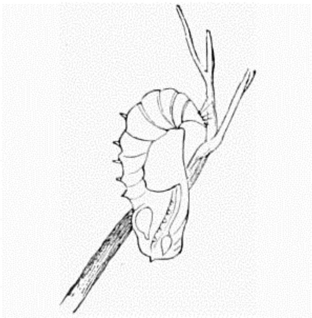

Fig. 32. – The Pupa of the Dark Green Fritillary (*Aglaia*).

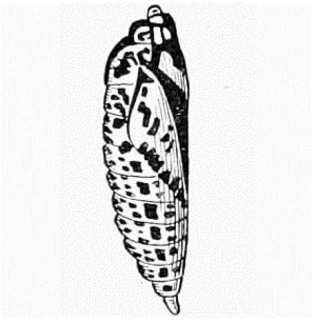

Fig. 33. – The Pupa of the Black-veined White Butterfly (*Cratægi*).

As a rule there is no marked resemblance between the different stages of the same insect. Thus, a brilliantly coloured caterpillar may change to a dull and unattractive chrysalis, from which may emerge a butterfly or moth that partakes of the colours of neither. But in a few cases there *are* colours or other features that remain persistent throughout the three stages, or show themselves prominently in two.

An interesting example in point is that of the Magpie or Currant Moth (page 279). The caterpillar of this moth is cream-coloured, with orange stripes along the sides, and very bold black markings down the back. The chrysalis, which is at first entirely yellow, afterwards turns black with the exception of some yellow transverse bands. Then, the moth exhibits the same colours as these two earlier stages, with the same degree of boldness; for its pale cream-coloured wings, tinted with patches of yellow, are marked with numerous deep black spots. Thus, in this case, we find the same general character of the colouring throughout the insect's existence.

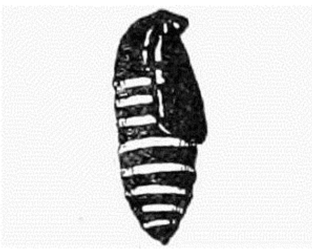

Fig. 34. – The Pupa of the Currant Moth.

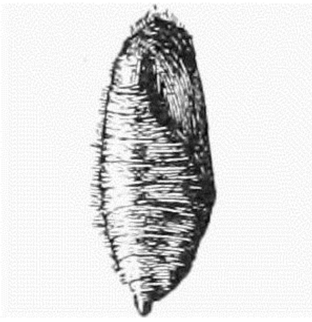

Fig. 35. – Pupa of the Pale Tussock Moth (*Pudibunda*).

Another interesting example, though not so striking as the last, is to be found in the case of a group of moths known as the *Liparidæ*. The caterpillars of these are remarkable for their very hairy bodies, often ornamented by several bold brush-like tufts. The chrysalides are also hairy; and several of the moths themselves are not only thickly clad with shaggy hair, but a bold tuft often tips the abdomen.

We must not leave these few remarks on the characters of chrysalides without a mention of the brilliant spots of burnished gold that decorate the pupæ of certain butterflies. This is the feature that led to the invention of the term *chrysalis*, which is derived from the Greek word *chrysos*, meaning *gold*. For the same reason the term *aurelia* has been applied to the pupæ of *Lepidoptera*, this being derived from *aurum*– the Latin name for gold.

Strictly, then, these two terms apply only to the pupæ of a certain number of the butterflies; but the former is now generally used to designate the pupæ of all the *Lepidoptera*, and is even extended to the corresponding stages of insects of other orders.

If you examine one of these gold-speckled chrysalides, the brilliant metallic lustre seems to belong to the outer surface, just as if certain spots had been tipped with real gold; but after the butterfly has quitted its case the beautiful golden spots are gone. This proves that the metallic appearance is not due to reflection from the outer surface of the chrysalis, but to a reflection from some structure beneath it. This latter is a very thin membrane which lies just under the outer transparent covering of the chrysalis.

The period during which the *Lepidoptera* remain in the chrysalis state varies very considerably in different species, and also depends more or less on the temperature. As a rule, when a caterpillar pupates before the end of the summer, it remains dormant in the pupal condition for only a few weeks; but, if late in the summer or in the autumn, it remains in this condition throughout the winter, and emerges in the following spring or early summer.

Both these conditions are illustrated in the life history of the Large White or Cabbage Butterfly – an insect with which we have already become acquainted. We get two distinct broods of this butterfly every year, the first appearing in May and the second in August. The eggs of the first brood hatch in about a fortnight, and the larvæ are full grown about four weeks later. These then change to chrysalides, from which the perfect insects (the second brood) emerge in a few weeks – the period varying slightly with the temperature of the season. From the eggs of this second brood we get another invading army of cabbage eaters that change to pupæ late in the summer. These remain dormant till the following April, and may be found in numbers throughout the winter, attached to the walls and fences of kitchen and market gardens.

If, then, the pupæ of the same species are so influenced by the temperatures of the seasons, can we limit or prolong the period of quiescence by subjecting them to high or low temperatures artificially produced? Most certainly we can; and every practical entomologist knows how to obtain the perfect butterflies and moths of certain species long before their appointed times, or, if he desires it, to compel them to remain in their dormant stage long after the natural period has terminated.

Sometimes an enthusiastic insect hunter obtains a large number of what we may term 'winter pupæ,' by collecting and breeding various species. He also anticipates a number of successful captures of perfect insects during the following summer. Thus, from two distinct sources, he obtains a goodly assortment of butterflies and moths, the setting, preserving, and arranging of which entails an immense amount of home work.

Under such circumstances he will sometimes endeavour to cause some of his pupæ to emerge before their accustomed time, so that he may get some of his insects 'on the boards' before his field work is in full swing, and so avoid a rush, or prevent the loss of insects that will be spoiled before he has time to take them in hand.

This process of hurrying up his pupæ he calls 'forcing,' and simply consists in keeping them for a time in a warm room or hothouse where the high temperature is pretty constant.

On the other hand, the entomologist may desire to try the effect of a continued *low* temperature on his pupæ. This he can do by placing his pupæ in an ice house. Such experiments have often been performed, and the results are very interesting. In some cases the emergence of the perfect insect has been delayed for many months, and even years; and then, after an exposure to a normal temperature lasting only a week or two, the winged insect has made its appearance just as if nothing unusual had happened.

Such are the effects of *extreme* temperatures on the duration of the chrysalis state; and we naturally infer, from such results, that the pupa under natural conditions is influenced, though in a lesser degree, by the variations experienced with the seasons, especially in such a fickle climate as our own.

The insect hunter has always to bear this in mind, and particularly so when he sets out on a search for certain desired species. Suppose, for example, he has set his mind on the capture of a certain butterfly that *usually* appears in the *first* week in May. Before finally naming the day, he has to consider what the weather has been during the last few weeks, and if he finds that this has been much warmer than the average for the corresponding periods in the past, he selects a day in *April*, earlier or later according to the difference between the present season and the average.

If he does not pay due attention to such considerations, he will sometimes find that all the insects netted are shabby and much worn, even though, under average conditions, he would be catching newly emerged and brilliant specimens. This, then, will explain how it is that we so often see in entomologists' periodicals startling accounts of 'early captures,' and of the appearance of certain insects late in the season that *ought* not to have emerged till the following summer.

I will give just one illustration of these variations. The beautiful Orange Tip Butterfly (Plate I, fig. 7) generally appears about the middle of May in the southern counties. Farther north it is of course a little later. In the north of England it has been taken in June; and in Scotland as late as July. On the other hand, I have taken it in Gloucestershire as early as March, on a rather bleak day with a cold east wind; and, withal, in a field on the slope of the Cotswolds fully exposed to the unfavourable breeze; but it was evident that, in this case, the butterfly had been enticed from its winter quarters by the milder weather of the few previous weeks.

It may be as well, in passing, to observe that it is not only the pupa that is influenced by temperature. The hatching of eggs may be forced by high temperatures, or be retarded by exposure to cold; and in nature the period of incubation varies with the seasons. The larvæ, too, grow faster or more slowly, or pupate earlier or later from similar causes. And so no very definite date or period can be assigned to any one stage of any insect.

Now let us return to one of the chrysalides that we have already watched through the earlier stages of its existence, and follow it in its future development.

It is now, as we say, in its quiescent or dormant condition, but we must not suppose that it is always in a profound sleep, nor can we say that it is insensible to its surroundings. Touch it gently or surprise it with a puff of air from your mouth, and it will begin to wag its pointed tail, sometimes with such vigour as to send the body rolling round and round in its box. Lay it on a bed of cocoa-nut fibre or finely sifted soil and let it remain *quite undisturbed* for a few hours or days, and you will probably find that, by occasional movements of its body, it has made a slight depression in its bed, and lies partly submerged. I have known some chrysalides to completely bury themselves in this way during the course of a day or two, and others to partly expose themselves after having been lightly covered. Others again, I have observed, will move smartly if a strong light is suddenly turned on them. Many, too, certainly appear to have a strong objection to exposure to the direct rays of a hot sun; for, when thus exposed, they will struggle persistently, as if to work their bodies into some shady corner. I would not advise a young entomologist to try this experiment, however, if he values the pupæ he possesses, for direct sunlight is undoubtedly very harmful to many species, and perhaps it is to all.

Some chrysalides are not nearly so active as has just been represented; in fact, there are many which seem to show no signs of life during the greater part of the time spent in that state. But in all, whether apparently active or not, certain important internal changes are at work. We have already noticed that, even in the last days of the *larval* existence, some of the organs of the future imago are to be traced. But these are as yet imperfectly developed. We have also observed that a continuation of these changes, gradually carried on, would be impossible in a voracious feeder; so the insect, now fully grown, and no longer requiring a supply of food, settles down in perfect quiet, submitting itself quite passively to any further changes that nature may demand.

It has already suffered the loss of its claspers. Its wonderful jaws that did so much damage (for good or evil as the case may be) to the vegetable world are now gone, and the bulky digestive apparatus has rapidly dwindled to useless dimensions. These and other changes, already in progress, have to be perfected while the creature is in a restful and helpless condition, though they may often be retarded or even suspended during cold weather when progress would certainly bring it to an untimely end.

But now the grandest of all these transformation scenes is nigh at hand. The protective skin is already loosening from the almost perfect imago, and consequently feels softer and far more yielding than it did when in close contact with the body: the swaddled butterfly or moth (for such the pupa is) is slowly preparing to throw off its imprisoning garb. The wings and large compound eyes are assuming their final colours, which now begin to show themselves through the more or less transparent skin, and the long legs, the perfectly formed antennæ, and the slender proboscis, all of which are folded closely under the creature's thorax, now begin to move within their loosened sheaths.

Now let us watch it closely, for one of the most wonderful sights ever witnessed by a naturalist is about to be presented to our view. We think we can observe slight movements; and, it may be, we can actually see the struggling insect endeavouring to set itself free. The legs and proboscis are moving within the loosened skin; and lo! as we watch these motions, the prison wall bursts with a slight snapping noise (at least, such is the case with some of the larger species), and in a moment out pop a few long legs which immediately struggle for a foothold. The proboscis also appears, alternately lengthening itself out and coiling into a spiral, as if impatient to reach the sweet nectar from the bottom of some fragrant flower cup.

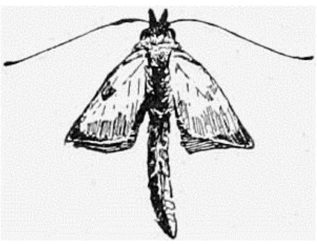

Fig. 36 – A Butterfly, just after Emerging.

All this takes place in less time than one requires to describe it; and, before many seconds have passed, the struggling insect has quite completed its last moult, and is bidding good-bye to the rent garment that has done it good service for so long a time.

But how dreadfully disappointing! Did we not say only a few minutes since, that a beautiful butterfly or moth was about to emerge? How, then, is this? Here is an odd-looking creature, such as we have never seen before! True, it has the right kind of body, though even that is so soft and heavy that it is fairly dragged along as the insect walks. Its antennæ, too, seem to be just the right thing – that is, just what we were expecting to see. But oh! the wings! Are we looking at a deformity? – a failure on the part of Nature to produce what she ought?

We will not judge hastily, but continue to watch it a little longer. It seems very restless at first, and, with the fluttering apologies for wings, drags its heavy body along till it reaches some surface up which it can climb. If nothing of the kind is close at hand you may place a *rough* upright stick in its path, and it will immediately begin to ascend. Its motto is now 'Excelsior!' and its ambition to rise may be so great that, on reaching the very top of the stick provided for it, it struggles for a still higher position in life till, failing to get a foothold in the air itself, it falls to the ground and has to retrace its steps.

I once thought I would like to test the perseverance of a large moth in performing its first upward journey; and as it was one from a chrysalis to be found in nature at the foot of a tree that attains some considerable height, I was, of course, prepared to exercise a little patience myself.

As soon as the moth had emerged, I placed it at the bottom of a window curtain that hung from about eight feet high to the floor. In less than half a minute it had reached the top, and was struggling hard to get still higher. I took it down, and again placed it at the bottom. Up it went as fast as before; and this was repeated nine times with exactly the same result. For the tenth time I placed the persevering creature at the bottom of the curtain; and, after it had walked about halfway up, it *suddenly* stopped, apparently quite satisfied with having travelled a distance of over seventy feet in an upward direction. Its six legs were immediately arranged symmetrically in a business-like manner, and there it settled quite still, as if it had some definite object in stopping just exactly in that spot.

But we must now return to our own insect, which has by this time settled itself in a similar manner on the stick we provided for it. The peculiar organs which represent the wings, though so very small, show distinctly, in miniature, the colour and pattern of the fully developed wings of the species. An interesting change is just now commencing. These wings are apparently growing larger, but the development is very unequal, so that they become curled and crumpled till they are even more unsightly than before. All seems to be going amiss. But this lasts only for a short time. The fluid from the body steadily rushes into the *nervures*, causing the wings to expand, and in a few minutes the beautiful pinions are stretched to the full extent, assume their normal shape, and expose the full glory of their brilliant colours.

It may be interesting if I give an example showing the exact time taken for the full development of the wings of a certain insect. So I will here quote an entry from my note book; and, by the way, let me strongly advise all my young readers who follow up this subject to habitually enter in a book kept specially for the purpose all facts which strike them as they pursue their study of nature. The note to which I refer runs as follows:

'Early on the evening of the 22nd [April] I selected a few chrysalides of Populi [the Poplar Hawk Moth, page 209] which, from the looseness of their cases, were thought to be just on the point of emerging. At 8.46 one of them showed signs of restlessness; and, after a few vigorous movements, during which it rolled itself over on the glass [I had placed the pupæ on a piece of plate glass so that slight movements might be more easily detected], the front of its case was suddenly thrust off with considerable force; and in *less than four seconds* the imago was quite free and crawling on the table. After trying hard to reach a higher point than was provided for about four minutes, it rested to expand its wings – now about seven-sixteenths of an inch long, or one-third the total length of the body. At

9 o'clock the wings reached half the length of the body, and were much curled. At 9.12 they were fully expanded and straightened out.'

From this extract we see that the whole period from the bursting of the case to the full expansion of the wings was only twenty-six minutes; and it will be well to remind the reader that the process occupies even a much shorter time than this with many species, both of butterflies and moths. It will be observed, also, that the *evening* was chosen as the time for the observation. There was a reason for this. The Poplar Hawk Moth, as is the case with many others, almost invariably emerges from the chrysalis in the evening – usually after dark. But it may be mentioned in passing that a far larger number of the *Lepidoptera* as invariably emerge in the morning.

Again we will return to our newly emerged insect, for there are still one or two interesting points to observe. The wings have fully expanded, it is true, but how very limp they are! Take the creature on the tip of your finger and hold it so that its body is in a horizontal position. Immediately the wings bend downward with their own weight, so soft and flexible are they. The body, too, is still very soft, and apparently much too heavy for flight. Then, if you place it on a flat surface, it will immediately try to find some perpendicular or overhanging surface from which it can suspend itself by means of its legs, so that the pendant and straightened wings are in the best possible position for drying. As the insect walks away in search of such a resting place, the body still drags as it did before, and the wings bend over, either both on one side or one on each side of the body.

It is some time before the wings are sufficiently dry and rigid for flight, but the period varies greatly with different species. Some of the small butterflies and moths take to flight long before an hour has passed, but in many cases several hours elapse before the creature starts from its first resting place. Butterflies that emerge in the morning spend their first day actively on the wing; but the nocturnal moths that emerge early in the day do not fly till evening twilight. When, however, the time arrives, the insect flutters its wings as if to test their power before committing itself to the air; and frequently, after only a few seconds spent in this preparatory exercise, off it darts with astonishing rapidity. But others seem far more cautious. They vibrate their wings, sometimes with such rapidity that they are lost in a kind of mist, and with such power that their bodies would be carried suddenly into the air were they not firmly anchored by three pairs of hooked claws. Then, continuing the rapid vibration, they move slowly along, always holding on firmly by one or more legs, as if to still further satisfy themselves concerning the efficiency of their wings. Then they venture on a few short trial trips from one neighbouring object to another, and at last gain sufficient confidence for a long voyage.

How strange must be the feelings of a winged insect during its first flight! After a long period during which it was a helpless, crawling grub, and this followed by a term of imprisonment during which it was almost or quite shut off from the world, it now suddenly acquires such great powers of locomotion that it is often a match for ourselves.

But, alas! this life is short. A few days spent in sporting with those it meets and in sucking the sweet juices of many flowers; then a day or two during which the female deposits its eggs; again a few days employed in pleasures that become less and less attractive, till, at last, the creature becomes weary of life and settles down to die.

We have now traced the complete life history of the *Lepidoptera* from the egg to the perfect insect, avoiding descriptions that apply only to certain species as far as possible, excepting where such are useful as illustrations.

Only one thing more remains to be done before we start in real earnest with our practical work. We shall shortly be giving hints on the modes of capture, the 'setting' and the preservation of butterflies and moths. And in so doing we shall often have to observe important points in which our dealings with these two great divisions of the order will differ very materially. Hence we must not consider ourselves ready to proceed with the practical portion of the entomologist's labours till we are perfectly satisfied that we know the main features that enable us to distinguish between the butterflies and the moths, and also know just a little concerning the subdivisions on each side.

This, then, shall form the subject of the next short chapter.

CHAPTER V
CLASSIFICATION OF THE LEPIDOPTERA

The *Lepidoptera* are divided into two very unequal groups, to which we have so frequently alluded as 'Butterflies' and 'Moths.' And, although these two terms are popularly applied in a fairly accurate manner, yet, strange to say, very few persons indeed have any definite knowledge of the differences that entomologists recognise between the two groups.

Every entomologist has his circle of sympathetic and, perhaps, even admiring friends. Consequently, many a little package is sent round to his abode 'with great care,' accompanied by a note or a message concerning the fine 'butterfly I have just caught, and thought you would like to add to your collection.'

The 'butterflies' that so frequently reach us through these channels nearly always turn out to be *brightly coloured* moths, and this naturally gives one the idea that the popular notion as to the classification of the *Lepidoptera* is based on colour or brilliancy of design, the term 'butterfly' being applied to the gayer species, and 'moth' to the more dingy members of the race.

There is really some shadow of a reason in this method of nomenclature, for butterflies *are usually* more brightly clad than moths; but the scientific classification, at least as far as the main divisions and subdivisions are concerned, has nothing whatever to do with colour or design; and we must at once acquaint ourselves with the fact that there *are* very dingy butterflies, and most beautiful and highly coloured moths.

How shall we account for the fact that the specimens so kindly sent us by our friends are generally moths? Is it because moths are more numerous and more frequently seen? They are certainly more numerous; for, while our butterflies do not number seventy species, the other division contains about two thousand. Yet, in spite of this fact, moths are not generally observed as much as butterflies, for the former are nearly all night-fliers, and the latter *always* fly by day and rest by night.

Still our question remains unanswered. The reason is this. The captives sent us are seldom caught on the wing. Most of our grown-up friends, even though they admire our own pluck and general carelessness concerning the remarks of the spectators of our entomological antics, would not themselves like to be seen, hat in hand, chasing a butterfly; and the night-flying moths are, of course, less frequently observed. But they often, in the course of their daily employments, meet with a large moth fast asleep in some corner of a dwelling house, workshop, or outhouse. Such moths are easily caught while in the midst of their slumbers, and, as they often make no attempt to fly by day, are as easily transferred to a box suitable for transmission by messenger or by post.

In the above few remarks we have alluded to some features by which the two great groups of the *Lepidoptera* may be distinguished; but we have already referred (page 5) to a far more important one in our description of the various forms of antennæ. All butterflies – at least all *British* butterflies – have knobbed or clubbed antennæ, while the corresponding organs of all our moths terminate in a sharp point.

This distinction obtains in all British *Lepidoptera*, and is so far regarded as the most important basis of classification that naturalists have derived from it the two Greek terms that are synonymous with our two popular names – butterflies and moths. The scientific name for the former group is *Rhopalocera*– a term derived from two Greek words, one signifying a horn, and the other a club, and thus meaning 'club-horned.' The corresponding name for moths is *Heterocera*, derived from the same source, and meaning 'variously horned.'

But, although we find embodied in these two long and formidable names an unerring mark of distinction between British butterflies and moths, we must not neglect other less important facts which, though less distinctive, are not without interest.

Observe a butterfly at rest. Its wings are turned vertically over its back, and brought so closely together that they often touch. In this position the 'upper' surfaces of the 'upper' wings are completely hidden from view, and the 'under' surfaces are exposed on the two sides, except that those of the 'upper' pair are partly hidden by the other pair.

Now look at a moth under the same circumstances, and you will generally find the wings lying over its body, which is almost or completely hidden beneath them. As a rule the upper pair together form a triangular figure, and entirely cover the second pair; but in some cases a portion of each of the under wings extends beyond the margin of those above them, and in others the upper pair extend so far forward that nearly the whole of the under wings is exposed behind them.

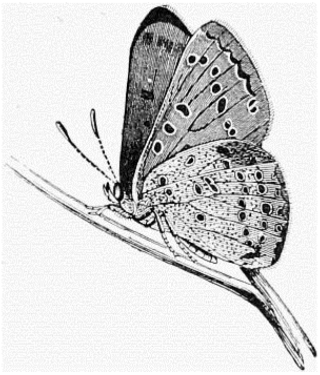

Fig. 37. – A Butterfly at Rest (Large Copper).

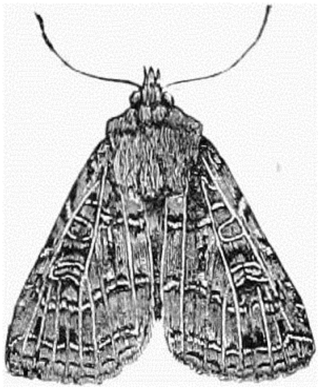

Fig. 38. – A Moth at Rest (Gothic).

Again, the wings of butterflies are so rigid that they can never be folded; but you will observe that the under wings of moths are generally very thin, soft, and pliant, and are neatly pleated lengthwise when not in use.

Another feature deserving notice is a slight difference to be often observed in the form of the body. The butterfly, which generally has a slender body, has a distinct constriction or waist between the thorax and abdomen. This is not so apparent with moths, and especially with the thick-bodied species.

The *Rhopalocera* or Butterflies are divided into *Families*, each of which contains insects that possess certain features in common by which they may all be distinguished from the members of any other family.

The British species represent eight families. They are as follows:

1. *Papilionidæ.*– Containing only one British species – the beautiful Swallow-tail (Plate I, fig. 1).

2. *Pieridæ.*– Containing ten species. These are often known collectively as the 'Whites,' but include four butterflies that are distinguished by beautiful shades of yellow and orange.

3. *Nymphalidæ.*– This family contains seventeen insects, among them being several splendid species. It includes the Fritillaries and Vanessas.

4. *Apaturidæ.*– Of this we have only one representative – the Purple Emperor (Plate V, fig. 1).

5. *Satyridæ.*– Including the 'Browns' and 'Heaths,' and numbering eleven species.

6. *Lycænidæ.*– Including the Hairstreaks, 'Coppers,' and 'Blues,' in all seventeen species.

7. *Erycinidæ.*– Containing only the 'Duke of Burgundy.'

8. *Hesperiidæ.*– This family contains seven British butterflies commonly known as the 'Skippers.'

Although all the members of the same family resemble each other in certain points of structure, or in their habits, yet we can often find among them a smaller group differing from all the others in one or two minor particulars. Such smaller groups are called *Genera*.

To make this all quite clear we will take an example.

The Brimstone Butterfly (Plate II, fig. 4) belongs to the second family —*Pieridæ*, *all* the members of which are distinguished from those of the other families by the characteristics mentioned on page 141.

But our Brimstone Butterfly possesses another very prominent feature in which it differs from all the other British *Pieridæ*, and that is the conspicuous projecting angles of both fore and hind wings. Among the foreign species of the family we are considering there are several that possess these angles; but as there are no others among our own members, the 'Brimstone' is placed by itself in the list of British *Lepidoptera* as the only member of the genus *Gonopteryx* or 'angle-winged' butterflies.

Thus the full relationship of this butterfly to other insects may be shown in the following manner:

The Brimstone Butterfly.

ORDER.—*Lepidoptera*
Section.—*Rhopalocera*
Family. —*Pieridæ*
Genus.—Gonopteryx
Species. —*Rhamni*

Now, every butterfly has a Latin or Greek name in addition to that by which it is popularly known. I should have said *two* Latin or Greek names. The first of these is always the *generic* name, and the second is the one by which we denote the particular member or *species* of that genus. Thus, the scientific name of the Brimstone Butterfly is *Gonopteryx Rhamni*.

'But,' the reader may be inclined to ask, 'why should we not be satisfied with the one popular name only?' And, 'If we *must* have a separate scientific name, could we not find suitable terms among our English words to build up such a name – one that might express the principal characteristics of the insect, and also serve all the purposes of classification?'

Such questions sound very reasonable, and so they are. But the entomologist's answer is this. We ourselves may get on well without the help of the dead languages, but we have brother naturalists all over the world, speaking a great variety of different languages. We endeavour to help one another – to exchange notes and generally to assist one another in our labours; and this can be greatly facilitated if we all adopt the same system of nomenclature. The educated of most of the great nations generally know something of Latin and Greek, and consequently the adoption of these languages is generally acceptable to all.

This sounds well, but for my own part I believe that if we are to make any branch of natural history a popular study, especially with the young, we must to a certain extent avoid anything that may prove distasteful. There is no doubt whatever that many a youngster has been turned away from the pursuit of the study of nature by the formidable array of almost unpronounceable names that stretch nearly halfway across a page; and those who desire to make such a study pleasant to beginners should be very cautious with the use of these necessary evils. One would think, on glancing over some of the scientific manuals that are written 'especially for the young,' that the authors considered our own too mean a language for so exalted a purpose, for in such works we find all or nearly all the popular names by which the schoolboy knows certain creatures he has seen entirely omitted, and the description of a species appended to a long Latin term that conveys no idea whatever to the reader, who is studying the description of a well-known animal or plant and doesn't know it.

Our plan will be to give the popular names throughout, except in the case of those few species that are not so well known as to have received one; but the scientific names will always be given as well for the benefit of those readers who would like to know them. And the short description of the method of classification just given will enable the more ambitious of my readers to thoroughly understand the table of British butterflies and moths toward the end of the book.

This table includes *all* the British species of butterflies and of the larger moths; and the arrangement is such as to show clearly the divisions into sections, families, &c. It will therefore be of great value for reference, and as a guide for the arrangement of the specimens in the cabinet.

In the foregoing description of the method of classification butterflies only are mentioned; but the division and arrangement of moths is carried out in just the same manner except that the system is a little more complicated. The number of moths is so large in comparison, that we are able to select from them some very large groups the species of which possess features in common. These groups are termed *tribes*, and are again divided into families just like the butterflies. Thus the arrangement of moths includes *tribes*, *families*, *genera* and *species*. We will take an example by way of illustration as we did before, and ask the reader to verify the same by comparison with our table:

Example.– The 'Common Tiger' (Plate X, fig. 3).

ORDER.—*Lepidoptera*
Section.—*Heterocera*
TRIBE. —*Bombyces*
Family. —*Cheloniidæ*
Genus.—Arctia
Species. —*Caia*
Scientific Name. —*Arctia Caia.*

I have already said that the Latin and Greek names of butterflies and moths are not at all necessary to the young entomologist. It is quite possible to be well acquainted with the natural history of these creatures, and to derive all the pleasure and benefits that the study of them can afford without the knowledge of such names; but most entomologists go in for them, often to the entire exclusion of the popular English terms.

There are those who consider themselves (or would have us consider them) expert entomologists because they have the power to vomit forth a long list of scientific names of butterflies and moths which (to them) have no meaning whatever; and it is astonishing that we meet with so many youngsters who can rattle away such terms, and, at the same time, are totally ignorant of the real nature of the creatures they name.

If you wish to be a naturalist in the true sense of the term, study your *specimens*, and take but little pains to commit their hard names to memory; and you will then find that the latter will gradually become your own property without any special effort on your part. Your continued reference to illustrated works and museum collections will bring them to you almost unconsciously, and you will generally find your entomological vocabulary extending as rapidly as your cabinet becomes filled.

Again, with regard to the *meanings* of the scientific terms, don't trouble much about them. It unfortunately happens that in a very large number of cases these names are ill chosen, and do not in any way refer to the distinguishing characteristics of the species to which they are applied. You will observe, too, if you look at the table, that many insects have *two* scientific names applied to the species, one being placed in brackets after the other. In such cases both these names are in common use, having both been applied by independent authorities, and the insertion of the two will prove an assistance at times.

It is a common practice with entomologists, in their communications, to use only the second or *specific* name of insects. Thus, they would speak of the Brimstone Butterfly as *Rhamni*, and not *Gonopteryx Rhamni*. When *writing* a communication, however, they very commonly place in front of the specific name the initial letter of the first or *generic* name. Thus the full title of the butterfly just mentioned would be abbreviated to *G. Rhamni*.

Having said so much concerning the principles of classification and nomenclature, we will pass on to the practical portion of the entomologist's work.

PART II
WORK AT HOME AND IN THE FIELD

CHAPTER VI
CATCHING BUTTERFLIES AND MOTHS

It is not at all surprising that entomology should prove such a fascinating study to the young, and more especially that portion which deals with the department we are now considering. Butterflies and moths are among the most beautiful and most interesting of living creatures. The study of their life history is enchanting, and the creatures themselves are of such a size as to be conveniently handled and preserved, and withal occupy so little space that anyone with only moderate accommodation may possess a fairly typical collection.

Compare the work of the entomologist with that of one whose hobby is the study of mammals. The latter has to deal with large and cumbersome objects, a collection of which requires an enormous amount of space; and, unless he has the time and means to travel in foreign countries, he cannot get together a good typical collection of specimens representing his particular branch, for the few British mammals contain no representatives of several of the orders into which the class is divided.

Entomology is undoubtedly, *par excellence*, *the* study for youngsters. It is equally suited to the studious and to those of an adventurous turn of mind. It leads its follower into the bright sunshine and the flowery meadows; and with body and mind pleasantly occupied, the joy of living is deeply felt. The necessary apparatus can be made by anyone. No dangerous gun is required, and there are no precipitous rocks to scale. When the autumn flowers fade the year's work of the entomologist is not done, for the arranging of his cabinet and the demands of his living specimens keep him more or less actively engaged until the flowers of the following spring call both him and the insects he loves once more into the field. And so, season after season, and year after year, he finds himself engrossed in labours so fascinating that idleness – the curse of so many of our youths – is with him an impossibility.

I assume that the readers of this book have a desire to take up the study of one branch of entomology – that of butterflies and moths – in real earnest; that they intend not only to *read* about these interesting insects, but to *know* them. And there is only one way in which one may really get to know living creatures; that is by searching them out in their haunts, observing their growth and habits, and by an occasional close examination in order to become acquainted with their structure.

Hence I shall in this, the practical portion of the work, give such information as will assist the beginner in catching, preserving, rearing, breeding, and arranging the specimens that are to form his collection.

Catching Butterflies

There was a time when we would try to capture a butterfly at rest on a flower by a quick sweep of the hand, or, more commonly, by a sharp downward stroke of the cap. We were led to this action by a mere childish love of sport, or by a desire to possess an insect simply because it was pretty. When we succeeded in securing our prize, we handled it somewhat carelessly, often passing it from one hand to the other, or boxing it in our closed and perspiring fist till our fingers were dusted with the pretty microscopic scales of the creature's wings, and the wings themselves, stripped of all their beautiful clothing, were merely transparent and veined membranes. Having thus carelessly but unintentionally deprived the creature of its greatest beauty, we set it free, often in such a damaged or exhausted condition that the poor thing could scarcely fly.

But our childish ideas and inclinations have vanished. Now we would rather watch the insect than catch it, for we find much pleasure and interest in its varied movements. And if for purposes of study we occasionally require to make one captive, we proceed in such a manner as to preserve its beauty unimpaired. The cap now gives place to a well-made and suitable net; and we are careful to provide ourselves with sufficient and proper accommodation for our captives.

It is probable that many of my readers are as yet unacquainted with the nature of an entomologist's requirements for field work, so we shall describe them, confining ourselves at first to those that are required for a butterfly hunt.

First and foremost comes the net. This essential portion of your equipment may be either purchased or constructed by yourself. Very little skill is required to enable you to do the former. Provided your pocket is well charged, you may start off at once to the dealer in naturalists' appliances, and treat yourself to a complete outfit. But even in this case a little advice may not be out of place. See that what you purchase is very *strongly* made. You can get nicely finished nets constructed on the most convenient principles, made to fold and go in an ordinary coat pocket, but with *weak joints*. See that you have the most convenient form of net by all means, but do not go in for convenience and appearance at the expense of strength and durability. Nothing is more annoying than to find your net give way just when you are in the midst of a good day's sport.

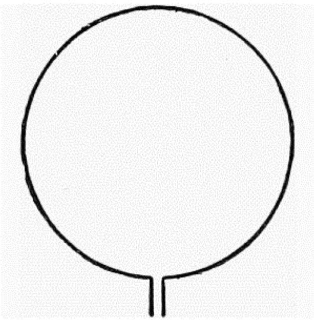

Fig. 39. – A Wire Frame for a Butterfly Net.

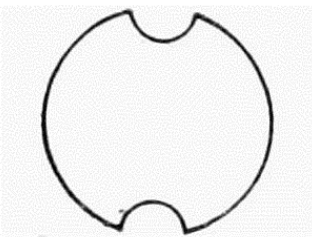

Fig. 40.

The folding net is certainly very convenient, for you can conceal it in your pocket while you are walking through town or travelling in a railway carriage, and thus avoid that contemptuous gaze which certain of the public are prone to cast on a poor 'bug hunter.' And although such nets are generally purchased, yet they *may* be constructed by anyone who has had experience in the working of metals. But other forms of nets, equally useful and even stronger, can be made by anybody; and I will give a few hints on two or three different ways of putting them together.

A very simple and strong frame for a net may be made as follows: Get a piece of stout iron or brass wire about forty inches in length, and bend it into a circle with the two ends, turned out about two inches each, at right angles to the circumference as shown in the accompanying sketch.

Now take a good tough stick, the length of an ordinary walking stick, and cut out two grooves opposite each other at the end, just large enough to take the straight ends of the wire. The end of the stick will now resemble fig. 40 in shape. Place the ends in their grooves, and bind them tightly to the stick by a good many turns of rather fine wire.

A frame well made after this fashion is as strong as anything you could desire, but it has the disadvantage of being always fixed to the handle, thus preventing the use of the latter as a walking stick when you are not directly engaged in your entomological work.

A much more convenient frame may be made by thrusting the ends of a piece of cane into the two narrow arms of a metal **Y**. You may purchase the **Y** at any of the naturalists' stores, or you can make one yourself if you know how to perform the operation of soldering. I have always made mine with odds and ends of brass tubing such as old gas pipes. One piece must be just the size to fix on the stick; and the other two must fit the cane tightly. The three pieces must be filed off at the proper angles, and the doubly bevelled end of the wider tube must then be flattened down to the width of the smaller ones before soldering. If you decide to buy one, give the preference to strong brass rather than the cheaper and more fragile ones made of tinned iron.

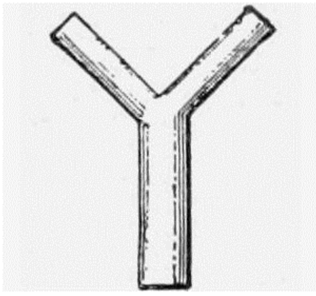

Fig. 41. The Metal Y.

The advantage of such an arrangement over the last frame is evident at once. The cane, with net attached, can be pulled out of the **Y** when not in use, and bent small enough to go in the pocket or a satchel; and the **Y** can also be separated from the stick, thus allowing the latter to be used as a walking stick.

Some entomologists speak very favourably of what is known as the 'umbrella net' – a large and light net that will shut up like an umbrella, and may even be made to look very much like this useful protector, but the possession of such an imitation is somewhat tantalising in a pelting shower. The ring of this net consists of two steel springs attached to a couple of brass hinges, one of which is fixed near one end of the handle, while the other slides up and down in the gamp fashion.

One other form of net – 'the clap net' – although still occasionally seen, has had its best days. Two sticks are provided to this one, so that the two sides of the net may be brought together on the insect; but as both hands are required to manage it, it is almost surprising that it ever had any advocates at all.

When your frame is completed, sew round it a strip of strong calico, to which the net itself may be afterwards sewn, for the lighter material of the net is too delicate to stand the constant friction against the metal or cane frame.

The material usually employed in making the 'bag' is called leno. It can be purchased at most of the drapers' shops, and three colours – white, yellow and green – are usually kept in stock. Measure the circumference of your net frame, and see that you get sufficient leno to make a good full net. Suppose, for instance, that the circle of your frame measures thirty-six inches round, then your leno should be at least forty inches in length. Fold this double, and then cut out two pieces of the shape shown in fig. 42, letting the depth of the net be nearly or quite equal to the width of the material. There is nothing to be done now but to stitch the bag together and sew it to the calico on the ring.

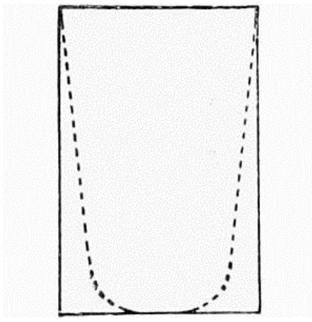

Fig. 42.

At first you will find the leno rather stiff and harsh, but a damping and good rubbing between the hands will soften it down; or, if you prefer it, you may soften the material by a slight washing before cutting out the net. The latter is perhaps the better plan, for the washing will remove the objectionable 'dressing' that renders the material rather hard and stiff.

Of the three colours mentioned above, green is the one most generally chosen, because it is more in harmony with the surroundings of a butterfly catcher; but many prefer the white leno to the green, as the insects are more easily seen in a net of this colour. Yellow is certainly not a desirable tint.

As a rule it will be necessary to kill an insect as soon as it is captured. This is always the case with butterflies unless you require to keep them alive either to watch their movements or to obtain eggs. For this purpose you will require a killing bottle or box containing some volatile substance.

The selection of this necessary piece of apparatus is a point deserving of much consideration, for so many different forms are in use by different entomologists, and so many advocates each declare that his own plan is far superior to that of any of the others, that the final decision is not to be worked out in a moment. The best thing for a beginner is to try as many as he can, and then, after some considerable experience of his own, he will be able to decide which apparatus suits himself best.

I recommend this because it is impossible to say of any one plan that it is the best, for that which gives perfect satisfaction to one individual will often fail to give anything but annoyance in the hands of another.

To enable my young readers to follow the advice I have just given, I will describe some of the commonly used killing arrangements and show how they should be used.

I will take first the 'cyanide bottle.' This is a wide-mouthed bottle, containing a very poisonous substance called *cyanide of potassium*. It is fitted with a good sound cork. The 'cyanide' is a solid substance, and must be fixed in some way or other at the bottom of the bottle so that it cannot shake about and damage the butterflies.

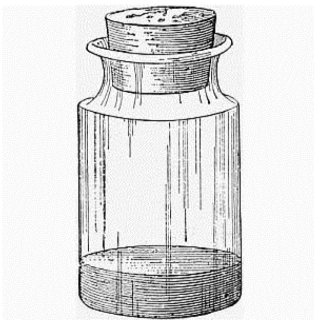

Fig. 43. – The Cyanide Bottle.

A cyanide bottle can be purchased ready for use at the cost of a shilling or thereabouts; but if you are old enough to be trusted with deadly poisons, you may buy the 'cyanide' of a chemist who knows you well and is satisfied as to your intentions, and then prepare your own. Every entomologist should know how to do this, for the poison loses its power after some time, and it is not always convenient to leave your bottle in the hands of a chemist or a 'naturalist' to have it recharged. This will cost you more than it would to do it yourself, but that is nothing compared with the annoyance that may result when, the night before an anticipated butterfly hunt, you are calmly told that 'your bottle will be ready in a few days.' You can charge it yourself in a few minutes if you can manage to keep a small supply of 'cyanide' in stock, and it is ready for use very shortly after.

Here is the *modus operandi*. – Purchase an ounce or two of the cyanide of potassium, and immediately put it into a stoppered or well-corked bottle. Label it at once, not only with the name, but also with the word Poison in very large and conspicuous letters. This dangerous chemical is often sold in sticks that look much like certain 'sugar sticks' I was acquainted with in my younger days; but whether this is or is not the case with your cyanide, see that the bottle is kept quite out of the reach of the inquisitive and sugar-loving juveniles of the house.

The quantity above mentioned is more than you will require for the first 'charge,' but you will soon experience the convenience of having a supply always at hand for recharging when your cyanide bottle fails to do its work expeditiously, or when an accident calls for the somewhat sudden appearance of a new one.

Now procure a bottle for your work. Its mouth must be wide enough to take the largest insect you hope to catch, and the widest part of the bottle need not be much larger. Get a perfectly sound cork to fit it tightly; and, to insure the more perfect exclusion of air, paint over the top of the cork with melted paraffin wax.

Dissolve a few drams of the cyanide in a little water, using a glass rod to stir up the mixture till the solid has all disappeared; and be careful that neither the solid nor the solution touches the skin if it should be in the slightest degree scratched or broken. Now sprinkle plaster of Paris into the solution, a little at a time, and stir all the while. As soon as the mixture begins to set, pour it into your bottle as cleanly as you can – that is, without touching the sides – and press it down with the flat end of a stick if it is not level. Now cork it, and put the bottle away in a cool place till required for use.

This is, I think, the best way of charging the bottle; but there are two other common methods that may, perhaps, be regarded as a little more simple. One is this: put a few small lumps of the 'cyanide' into your bottle, and then cover them with a stiff mixture of plaster of Paris and water, and press down as before. The other plan is to cover the 'cyanide' with a few thicknesses of blotting paper, cut just a little larger than the inside of the bottle. The first of these two methods is fairly satisfactory, but I have always found that the charge, when made in this way, has a tendency to become wet and pasty, in which condition it will spoil the wings of the insects. The other is very objectionable, especially for field work, for the blotting paper fails to keep its place while you are on the chase. If the plaster is used, the mixing must be done quickly and without hesitation, or the mixture will become solid before you can press it into your bottle.

We will not enter now into the *pros* and *cons* of the cyanide bottle, but will consider the advantages and disadvantages of the various methods of killing the insects after we have noticed a few more.

The 'laurel box' has had many devoted advocates, although it does not seem to be much in use now. It is a very good arrangement, however, but is a little more troublesome than the cyanide bottle, as it requires frequent replenishing.

A very good laurel box may be prepared as follows. Get a small tin box of cylindrical form, measuring about five inches by two, and cut a circle of perforated zinc or wood just the size to fit it snugly as a false bottom without any danger of falling out of its place. Now gather some of the young leaves of the green laurel bush, and beat them almost to a pulp with a mallet or hammer. Place this in your tin box, and press down the perforated false bottom on it. The bruised laurel leaves give off a very powerful odour, which stupefies butterflies immediately.

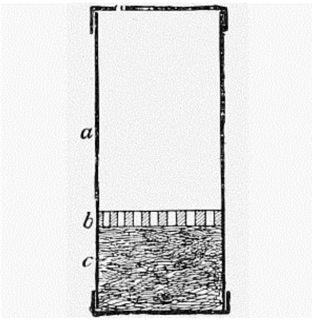

Fig. 44. – Section of the Laurel Box.
a, space for insects; *b*, perforated partition; *c*, bruised laurel leaves.

Of course the reader may be able to think of various other ways in which the laurel box may be made. Any arrangement will do providing the vapour can come to the insects without allowing the leaves to touch their wings; and any ingenious youth could manufacture a more satisfactory article than the one I have mentioned. My desire is, as far as possible, to give instructions that may easily be carried out by anyone, even if he has not the slightest mechanical skill, leaving the clever youth, sometimes, the opportunity of displaying his own inventive power. But in this case I will give a few suggestions concerning other ways in which a laurel killer may be constructed. A firm and *fixed* false bottom is a decided advantage. This is easily managed by fixing a circular piece of perforated zinc or 'tin' by means of a little solder; or even a wood partition may be used, fixed with a few brads, driven into it from the outside. With the fixed partition, however, you must have a lid at each end of the box. This is easily managed if you get two tins of the same size, knock out the bottom of one, and fit the lid of the other in its place.

I have heard of laurel boxes without any partition save a piece of rag in which the bruised leaves are wrapped. The whole is *pressed* into the box so firmly that it is not likely to be displaced while you are on the chase. I do not recommend this, for in addition to the chance of its slipping there is a danger of the sap of the leaves exuding through the rag and spoiling the insects' wings. But if the reader should prefer to try this on account of its simplicity, it will probably occur to him that a bottle may be used instead of a tin box.

A well-made laurel box, with a fixed metal partition, is a piece of apparatus strongly to be recommended to all young entomologists who desire to test the relative value of the various poisons that are used by the different experts; for with it any one of these substances can be used. In the poison compartment you can place pieces of 'cyanide' wrapped in blotting paper, or any kind of porous substance moistened with liquid ammonia, chloroform, benzole, or any other volatile liquid insecticide. All the above-named substances are declared to be 'the best,' so they must all be worth the trial.

'Cyanide' is valued on account of its lasting powers. A cyanide bottle well charged will retain its efficiency throughout a whole season. I always recharge two in the spring, one for active service in the field and the other as a reserve force; and these kept in a cool place do good execution throughout the year. If they should exhibit a slight failing, a few minutes' warming before a fire will improve them; but for field work it is better to recharge. At the same time see that the corks are in good condition.

Next to the 'cyanide,' the bruised laurel takes the first rank for permanency; but you must not expect this to last many days. For a few days' continuous work one charge will suffice, but if the laurel box has not been in use for some time you must have a fresh supply.

The liquid poisons, such as ammonia, chloroform, and benzole, are so volatile that they are very powerful for a short time, but so much vapour is lost each time the box is opened that it is absolutely necessary to carry a bottle of the one you use into the field with you. Also see that you have sufficient of the blotting paper or other absorbent to prevent the liquid from leaking through the perforations of the partition.

If you choose ammonia – a substance that is not regarded as a poison, and is therefore easily obtained from any chemist – always get the strongest, and see that it is labelled 'Liq. Ammonia, S.G. ·880' as a guarantee. A small bottle such as you can conveniently carry in the waistcoat pocket will contain sufficient for a day's work. Use only a few drops at a time, but renew frequently. Although the ammonia corrodes cork, yet a good cork is far preferable for the pocket to a glass stopper, for its elasticity prevents it from losing its hold, and the liquid from saturating your pocket and its surroundings; but a glass stopper is certainly better for the stock solution kept at home.

Most of the above remarks apply equally well to benzole and to chloroform, but the latter is so powerful a poison that a very little is required for a day's work, and consequently a very small bottle is more convenient. The dealers in naturalist's appliances supply metal 'chloroform bottles' with screw stoppers and a small nozzle that will allow the liquid to run out only in drops. This is a very good arrangement, since it enables you to avoid the 'drop too much' which is not only unnecessary and therefore wasteful, but saves you from experiencing the disappointment of an empty bottle before your work is half done.

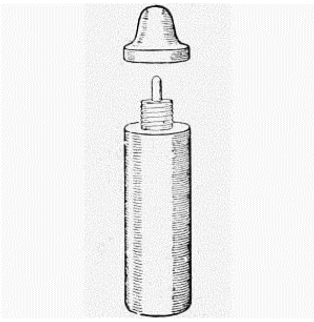

Fig. 45. – The Chloroform Bottle.

Some entomologists recommend the solid carbonate of ammonium instead of liquid ammonia, but this is not so powerful. It must be remembered that we have the butterflies to consider, as well as our own convenience, in the selection of the poisons we use. It is the opinion of many well-known entomologists that 'insects cannot feel pain,' and that we are therefore at liberty to deal with them in any way we please. Still it is as well to save all possible suffering, and be satisfied with no killing box that is not practically instantaneous in its effects.

Among other poisons used by entomologists I may mention sulphur fumes and tobacco smoke. The former may be obtained by burning a little sulphur or a sulphured lucifer match under the perforations of a killing box of the pattern described, and the latter – well, every smoker knows that. I should at once condemn the former method, at least for field work, as troublesome and inconvenient; and as to the other, I have tried the effect of a puff (and many puffs) of tobacco smoke on an imprisoned insect, but was so dissatisfied with the result that I am not likely to do so again.

We have now considered a good many insecticides more or less suitable to our purpose, but there still remains the unsolved problem as to which is the best. Each one has its advantages. For *convenience* nothing beats the cyanide bottle. It is very speedy in its action, and the use of a bottle is a little preferable to a metal box, for you can always satisfy yourself as to its efficiency without opening it. Cyanide, chloroform, benzole, and some others render the insects more or less brittle and stiff, so that it is not so easy to 'set' them for the cabinet. Perhaps, if you happen to have a supply of growing laurel close at hand, you cannot do better than stick to the laurel box. The time taken in bruising up a few leaves is inconsiderable, and the moisture given off from them will keep your insects moist and supple, or will even 'relax' them if they have become rigid. But try various plans for yourself, and you will be able to settle a question which all the entomologists in the world cannot answer for you – which method answers best in *your* hands.

The next item for our consideration is the 'collecting box.' This is merely a box in which the butterflies are pinned as soon as they are dead. Here, again, we shall note a few variations from which a selection can be made according to the means or the ingenuity of the reader. For a couple of shillings you can obtain a good zinc collecting box, lined with cork, of oval form (a most convenient shape for the pocket), and quite large enough for one day's captures; and half that modest sum will purchase a wooden box, also lined with cork, adapted to the same purpose.

As with many other things, so with collecting boxes, the cheapest is often the dearest in the end. You may feel inclined to save a shilling by buying a wooden box, but you are sure to discard it after a little practical experience for a metal one. We shall speak a little later on concerning the advisability of 'setting' the butterflies as soon as possible after capture; but this is not always practicable, especially after a good day's catch. Now, if the insects are pinned in a wooden box, they soon become dry and rigid, and consequently cannot be 'set' till they have been put through the more or less tedious process of 'relaxing.' If you use a wooden collecting box you will often find, on a hot and dry day, that all or nearly all your butterflies are rigid before you arrive home; but a metal box will keep them moist and supple, so that you can even put off the setting till the following day if you are unable to do it immediately after your return.

Another point worth considering is the best economy of space. If your collecting box is only about one inch deep inside, you have room for only one layer of pinned insects; but a box only a little deeper may be lined with cork both at top and bottom, and thus be made to accommodate double the number. The zinc boxes sold by the dealers are generally lined with cork in this manner, and are, of course, deep enough for the double layer of specimens; but the wooden boxes are sometimes lined on the bottom only. After these few remarks you will at once see the economy of expending the extra shilling on the former.

Although the prices of collecting boxes are low, yet there are many who would prefer making their own, and there is much to be said in favour of this. A great deal of pleasure is to be derived from the construction of your own apparatus, especially when that apparatus is afterwards to be used in the pursuit of a delightful hobby. During the whole of the time thus engaged, you are looking forward with the most pleasurable feelings to the glorious treat before you, and every joint you make seems to bring you nearer to the realisation of your joys. During the bleak winter months there is no better employment for an entomologist who has a little spare time than the preparation for the next outing. It is just one of those artful schemes by which he seeks to get as much pleasure out of life as it is capable of affording. How many there are who, for the lack of a pleasant and instructive hobby, find their leisure hours the most dismal of all, and who complain of the toil and wearisomeness of their lot! The mournful thought with them is, 'Is life worth living?' but who ever heard such an expression from the lips of an active entomologist?

But I must have done with moralising and proceed to business. The question is – How shall we set to work about the construction of a collecting box? If it is to be a wooden one, select or make a box of such a size as to suit your pocket or satchel, and cover the bottom, and lid too if the depth allows of it, with sheet cork or slices of good wine corks, about one-eighth of an inch thick, fixed on with glue.

The metal box is not quite so easy, but even here you may save yourself much work by keeping your eyes open. Very neat little collecting boxes can be made out of the flat metal boxes in which are sold certain favourite brands of tobacco. Some of these are just the right depth, and also of a very convenient size for the coat pocket. Beg one of these boxes from a smoking friend, and if the lid is not held by a hinge (a great advantage, by the way), you can easily solder on a brass one.

All that remains now is the fixing of the cork. Buy a sheet of cork at a naturalist's shop, this being a commodity always in stock, and cut out two pieces just the size to cover the bottom and the lid.

Gum and glue are not very satisfactory as fixing agents, for, as you will presently learn, there are times when it will be necessary to keep the box moist, and moisture softens both these substances. The cork must be fixed by means of little strips of metal. Here are two ways of doing this:

First. – Cut a few little strips of sheet tin, each about two inches long and one-eighth wide. Double and bend them as shown in fig. 46, and solder them to the surfaces which the cork is to cover (fig. 47). As the cork is pushed in its place, these little slips are allowed to force themselves through slits in it made by means of a penknife, and then the ends are bent over as shown in fig. 48. Two or three such fasteners will be quite sufficient to hold down each sheet of cork.

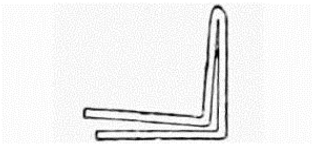

Fig. 46.

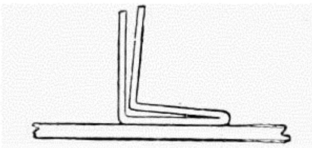

Fig. 47.

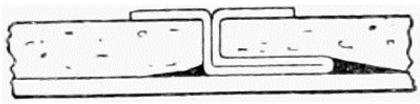

Fig. 48.

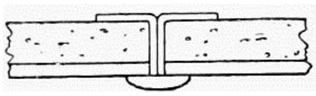

Fig. 49.

Second. – Put the sheets of cork in their places *first*, then make a few little slits through both metal and cork with the point of a penknife, and then bind the two together with a few ordinary paper fasteners. This arrangement is shown in section in fig. 49.

Just one point more concerning the metal collecting box. You will often call moisture to your aid in keeping the butterflies flexible and soft. This will have but little action on zinc, but will sooner or later cause the 'tin' (really tinned iron) box to rust. Here, then, is a point in favour of zinc, but still a home-made 'tin' collector will last a long time if kept dry when not in use.

As already hinted, there are times when it is desirable to take home certain butterflies alive, either for a study of their movements or for the purpose of securing eggs for breeding. To this end you must provide yourself either with a number of 'chip boxes' with a few small holes pricked in the cover, or with some metal boxes with perforations for the admission of air. If the latter, you will have no difficulty in securing a few 'tin' boxes of suitable size, but, as the surface of the metal is very smooth, you should always introduce a few leaves or something else that will provide a foothold for the inmates.

The last item of the outfit is the pins. Ordinary draper's pins are quite out of the question. They are far too thick and clumsy for the collector's work. If you are not already acquainted with the 'entomological pins,' you had better ask a dealer to give you a sample card. This will be very useful for reference until you become well acquainted with the various lengths, thicknesses, numbers and prices. The card will contain one of each kind, with price and number attached.

If you fix a butterfly with the ordinary pin, you may find the latter partly covered over with verdigris after a time. This bright green substance is formed by the action of decomposing animal matter on the copper of the pin, and gives a very unsightly appearance to the specimen. To avoid this the entomological pins are either silvered, blackened or gilded. The silvered pins tarnish after a time, but the two other kinds keep their colour well, and are therefore better. The gilded ones are rather expensive and unnecessary, and perhaps the black ones are to be preferred to the silvered, although they are rather more costly.

Most dealers will supply you with a box of mixed pins, each box containing about six different sizes. This is very convenient for those who work in a rather small way; but if you intend to make entomology a prolonged study you had better get an ounce or so of each of the more useful sizes.

Butterflies vary much in size, and Nos. 3 to 8 are the most useful sizes of pins to fix them; No. 3 being for the largest, and 8 for the smallest.

Supposing all the foregoing requisites to be quite ready, still you are really by no means prepared for all your work. The butterflies captured should be set as soon as possible after your return, and everything required for *this* part of the work must be in perfect trim. Yet I think it will be more convenient just now to confine our attention to the subject of 'Catching Butterflies,' leaving all the indoor work to form the substance of another chapter. Our next point, then, shall be the consideration of seasons, times, and localities.

The earliest of the butterflies make their appearance on the wing in April, or, if the weather is mild, towards the end of March; and from this time you can find employment up to the end of September or the beginning of October – a period of about seven months. But it must not be supposed that all parts of this long season are equally prolific, and will yield equally valuable catches. Remember the short term of a butterfly's life, and bear in mind that each one has its own regular season in which to spend the winged state; you will then see that anyone who wishes to 'work' as many species as possible must arrange his outings in accordance with the insects' own times.

Some butterflies are double-brooded, and the two broods may not come forth at certain fixed times. Hence they seem to be on the wing almost without cessation for several months together, and therefore need not have a special day set apart for them. But others are more uniform in their date of appearance, and die off at about the same time. To catch such as these you must be careful to watch the weather, make allowance for any severities that may tend to cause a delay, or an unusually high temperature that may hasten their emergence, and then select a day in which you may expect to find them fresh and unworn. A week too early, and none are to be seen; a week too late, and nearly all you catch are worn and worthless.

A glance at our Calendar (Appendix II) will give you a few illustrations in point. Thus you will observe that May is a month for the 'Whites,' early 'Blues' and certain of the Fritillaries; July for most of the Hairstreaks and Browns, and so on. Before you have been long collecting you will have captured the very common species, and then you will find that your butterfly hunts are very unproductive unless you make it a point to try for certain species at the proper times.

Time, however, is not the only thing to take into account when preparing for a day with the butterflies. It is equally important that we should carefully select our locality in accordance with the known haunts of the various species. As long as you are simply working up the common kinds, you may wander almost at random in waste places, flowery meadows, corn fields, railway banks, &c.; but when you have secured a few specimens of each of these, you must search out the favoured resorts of the more local and the rarer species. For instance, wooded spots must be visited if you are to take certain of the Fritillaries, oak woods for the Purple Emperor and the Purple Hairstreak, fenny districts for the beautiful Swallow-tail, and so forth. In some cases the butterflies are closely restricted to certain isolated localities, to which you must travel if determined to obtain them.

There yet remains another important matter to consider, and that is the kind of day you shall select for your outing. Butterflies are not only strictly day-fliers, but most of them venture out only on bright days. Always choose as hot a day as possible, with a very bright sun. If you are to be out for a full day's collecting, manage to be on the hunting ground at about ten o'clock in the morning. As a rule there are not many out before this time, and some do not appear to stir till an hour later: still there are a few 'early birds' among them, one of which – the Wall Butterfly – I have seen on the wing before eight.

Конец ознакомительного фрагмента.