

The butterfly vivarium : or, Insect home: being an account of a new method of observing the curious metamorphoses of some of the most beautiful of our native insects. Comprising also a popular description of the habits and instincts of many of the insects of the various classes referred to; with suggestions for the successful study of entomology by means of an insect vivarium / by H. Noel Humphreys ... Illustrated with coloured engravings.

Contributors

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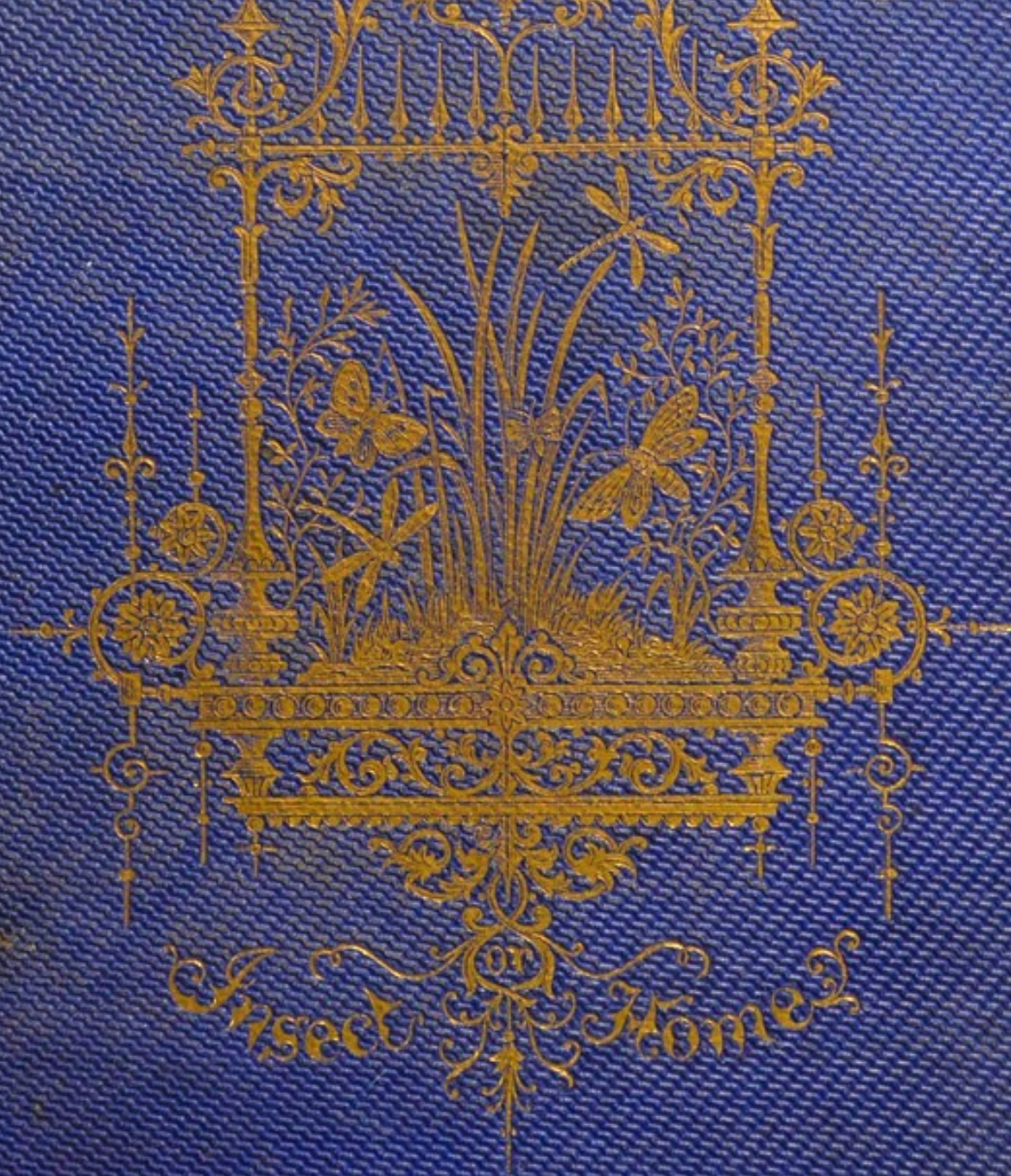
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The
Butterfly Vivarium



For
Insect Lovers

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"They are very graphic pictures of the French capital, and of Parisian life."—*Critic*.

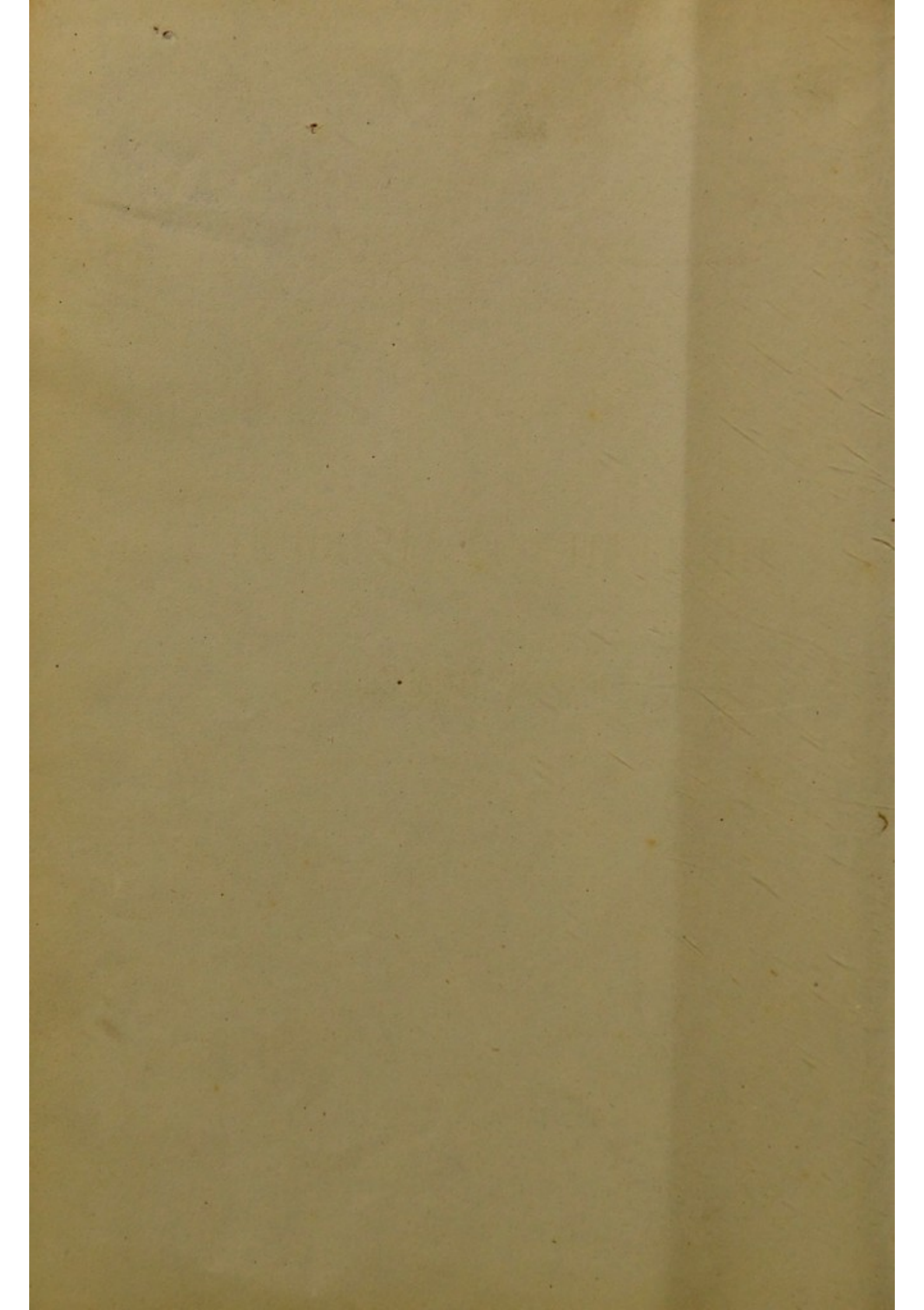
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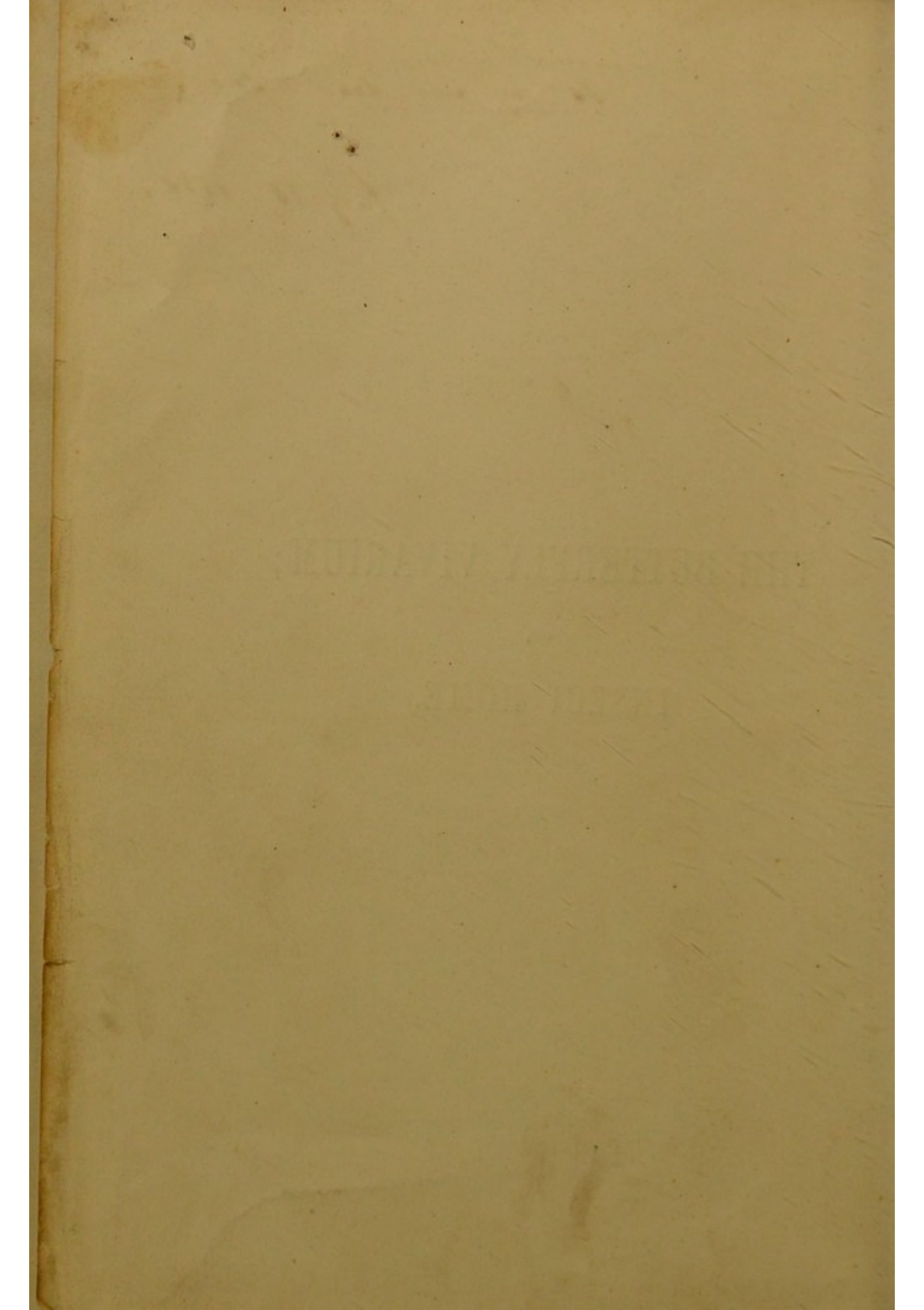
To my own dear Luc.

July 28. 1858.

THE BUTTERFLY VIVARIUM;

OR,

INSECT HOME.







THE VIVARIUM; OR, INSECT-HOME.

FOR OBSERVING THE TRANSFORMATIONS OF BUTTERFLIES, MOTHS, AND OTHER INSECTS.

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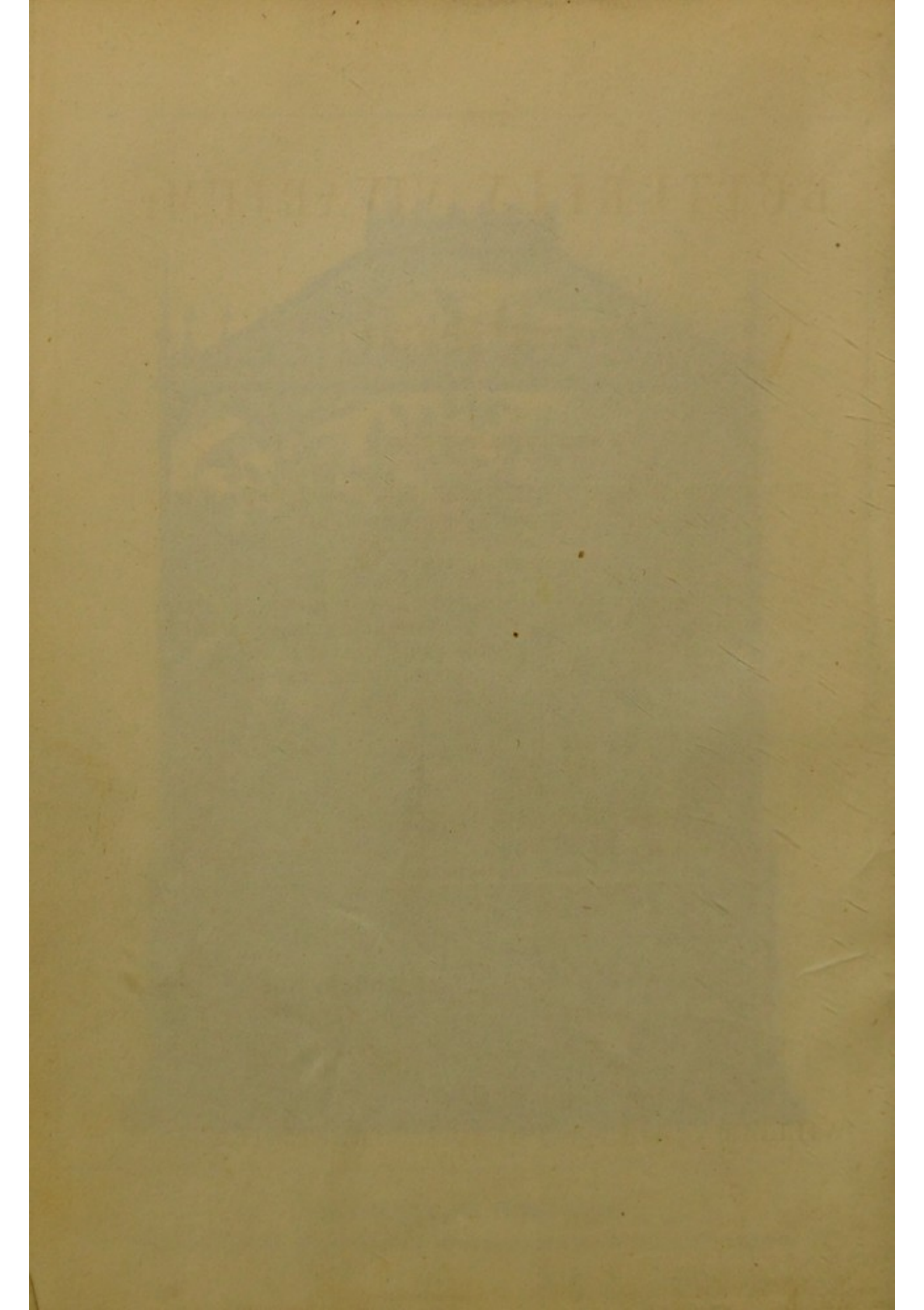
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THE
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OR,

Insect Home:

BEING AN ACCOUNT OF

A NEW METHOD OF OBSERVING THE CURIOUS METAMORPHOSES OF SOME
OF THE MOST BEAUTIFUL OF OUR NATIVE INSECTS.

COMPRISING ALSO

A POPULAR DESCRIPTION OF THE HABITS AND INSTINCTS OF MANY
OF THE INSECTS OF THE VARIOUS CLASSES REFERRED TO; WITH
SUGGESTIONS FOR THE SUCCESSFUL STUDY OF ENTO-
MOLOGY BY MEANS OF AN INSECT VIVARIUM.

BY

H. NOEL HUMPHREYS,

AUTHOR OF "BRITISH MOTHS AND THEIR TRANSFORMATIONS," "INSECT CHANGES,"
"OCEAN GARDENS," ETC.

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PREFACE.

FOR many years past, the occasional pursuit of studies connected with the habits and transformations of insects, has helped to fill a considerable portion of my leisure very agreeably; and in this unpretending volume I have endeavoured to arrange some of the results of those pleasantly remembered labours in such a way as to tempt others to seek their holiday amusement in a similar course of research and observation, as it is a field which never fails to reward the labourer with instruction as well as entertainment.

This little book must not, therefore, be deemed a scientific essay on the subject of which it treats, nor even an elementary introduction to entomology, to neither of which it has any pretension. Nevertheless, I have not been contented with stringing together a number of unconnected anecdotes; but have sought, while describing many of the interesting aspects of insect life, to explain at the same

time something of the order and method of arrangement by means of which the thousands of creatures forming the insect world have been named, classed, and grouped into homogeneous families, so as to facilitate their study, and enable naturalists to methodize, in an orderly and easily accessible form, all the successive discoveries of those who have made this branch of natural history their particular study.

Order and arrangement are always among the first wants experienced by young naturalists. Even children, in their first gatherings of wild flowers, seem to have an instinctive desire to sort out those of similar colours or appearance, and group each kind together. The lamented Hugh Miller, in his very last work, "The Testimony of the Rocks," has especially dwelt upon this natural tendency of the human mind to that kind of order and classification upon which the arrangement or summing up of all positive science is founded; and several other physiologists have also noticed this general and unmistakable tendency.

A feeling of this kind was one of the first which I experienced myself, as a tyro in entomology; for I soon became convinced that the learning the mere name of the insect whose habits I had been

observing, conveyed but little information to the mind; and that it was the origin of the name itself, and its reference to other names, and to other groups of names, and the reason for their being so grouped, which was the kind of knowledge most likely to enable me to organize the information I was acquiring, and to take that general view of the subject which alone gives to a student the power to appreciate duly each separate part.

With this view I have endeavoured to show how the first glimpses of our knowledge of insects gradually grew up into an important branch of science, by successive improvements in the various methods of classification adopted at different periods.

To some this may appear a "dry" portion of the subject; but to me the history of Entomology, from its crude beginnings to the establishment of the present systematic arrangement, by means of which the great tribe of insects has been grouped into well-established "orders," with their subdivisions of "families," "genera," and "species," has always appeared nearly as interesting as the immediate study of the structure, the habits, and even the metamorphoses of the insects themselves.

Therefore, while describing the best manner of

establishing a Vivarium for the convenient observation of some of the wonders of the insect world, I could not resist the temptation to say something of Entomology as a science, instead of confining myself, as is most usual in popular works on the subject, to the mere narration of interesting or entertaining facts.

I have also endeavoured to avoid another common feature in works of this class. I allude to that continual straining after the discovery of specially providential arrangements in matters which do not seem to require that kind of interpretation, and in which the plainest evidences of design are frequently distorted by volunteered explanations, the shallow ingenuity of which, in the imperfect state of our knowledge of the subject, often amounts to something more than ridiculous.

H. N. H.

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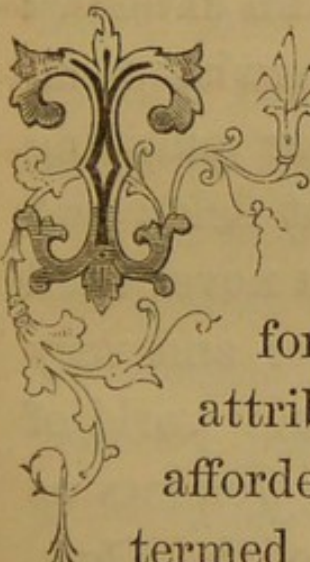
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THE BUTTERFLY VIVARIUM.

CHAPTER I.

INTRODUCTION.



THE increased attractiveness of the kind of knowledge to be derived from a careful study of Nature, in some of the lower and least known forms of animal life, is to be very largely attributed to the means of observation afforded by those miniature conservatories termed Aquaria. The Aquarium was an invention which offered so many delightful modes of recreation, combined with instruction, that the possession of such a structure first became a fashion, and then almost a rage, insomuch that hardly a house could be found without one. The interesting course of observation and study opened up by these household lakes and oceans, in which many forms of aquatic life hitherto undreamed of

by the uninitiated are exhibited as naturally and strikingly as if seen in their native depths, have, it must be admitted, given quite a new stimulus to this class of study. At the same time, it was beginning to be felt that the field of study was, to a certain extent, of a limited character, and a strong desire was manifested that the sphere of research of that class should be extended, and the subjects varied.

In order to gratify this longing for an extended range of observation, I propose, by somewhat similar means, to afford equal facilities for pursuing a course of study in an entirely different field; and with this view I am about to describe a novel kind of Vivarium, by means of which another and very distinct class of animal life—that of the “world of insects”—may be made to exhibit its wonders as conveniently and instructively as those of the *Algæ*, and *Zoöphytes*, and *Molluscs* of the river or the ocean have been shown in a well-ordered Aquarium.

The nature of the very simple structure by means of which this is to be effected, will be described after I have put in my plea concerning the interest of the living objects, whose curious habits and wonderful metamorphoses it is intended to display.

By means of such a structure as the one just alluded to, the insect, with its series of striking transformations, may be made to disclose to the curious eye a succession of phenomena in some instances more beautiful and surprising than even those of the singularly organized forms of life that clothe the borders of the ocean floor. Few, in these days of general education and shilling lectures, are without the knowledge, though of a vague kind, that all the caterpillars, so commonly seen feeding on our ordinary garden plants, are destined to become moths or butterflies, or, at all events, to undergo some remarkable change; but of the precise nature of that change, for want of some convenient mode of observation, they are in all probability profoundly ignorant. Of what particular kind of butterfly, moth, or saw-fly any caterpillar under observation may be the first stage, they have no idea.

Very few, for instance, even among those who take a tolerably correct general view of the nature of the metamorphoses of insect life—very few, on seeing a colony of caterpillars, of deep velvet black, feeding voraciously upon a bed of nettles, would be able to pronounce that these singular-looking and intensely black creatures are, in fact, the gor-

geously coloured Peacock Butterfly in its larva stage. Nor, if they observed suspended from one of the nettle leaves a curiously angulated object—something like a small model of a Gothic pinnacle, such as might have been hanging up in a museum as a specimen of mediæval art—would they be able to declare at once that it was the same creature in its chrysalid stage. Even the resplendent metallic specks on the little suspended object, looking like the remains of former gilding nearly worn off, would be no help, though such marks on the chrysalis are well known to entomologists as a peculiar characteristic of the genus *Vanessa*, to which the Peacock Butterfly belongs, and respecting which there are many other curious things to be told.

All these, and a thousand other things connected with the intricate history of insects, are but dimly learnt from books—that is, by the general reader; and when so learnt, they are soon forgotten. But when the knowledge is acquired from actual observation, then the impression is so vivid that it cannot be easily effaced. It is to enable the student to make these observations in his own study or drawing-room, that I have devised the little structure which I am about to describe in the present volume, as well as the habits, instincts, and transformations of

some of the beautiful insects, of which it may be made the healthful and enjoyable habitation.

It is true that such enthusiastic naturalists as Swammerdam, Lyonnet, Reaumur, Bonnet, and our own Kirbys and Spences, who have devoted a great portion of their lives to the subject, succeeded, by dint of extraordinary perseverance, in effecting the object they had in view without such artificial aid. They watched for weary hours, and days, and nights by the haunts of the insects whose habits they were studying, and so detected, in all their phases, the transformations which, in many instances, they were the first to observe and describe; and to such indefatigable observers it is that we are indebted for the mass of curious knowledge which we now possess upon the interesting subject of insect metamorphosis, which was entirely misunderstood down to a comparatively recent period.

It cannot be expected, however, that the ordinary entomological student, busy with household cares or with the continual calls of some all-absorbing profession, should resort to such means of acquiring knowledge, even upon this interesting subject; ordinary students require a method of obtaining this information as convenient as that of a book, but, if possible, combining at the same time

all the fascination of studies from living objects. I have therefore devised for myself, and others similarly situated, the contrivance which I may style, more comprehensively than on my title page, the "Insect Vivarium," for by its aid not only the changes of butterflies and moths, but those, still more extraordinary, of many other classes of insects may be observed in all their stages.

The plan of the structure is so simple that its manufacture may be very economical, and can either be made by the student himself, with the aid of the instructions I shall set forth, or can be purchased, at a most moderate cost, of an experienced manufacturer* of cases of this class, who is now devoting much careful attention to their practical construction in a convenient, and at the same time ornamental, form.

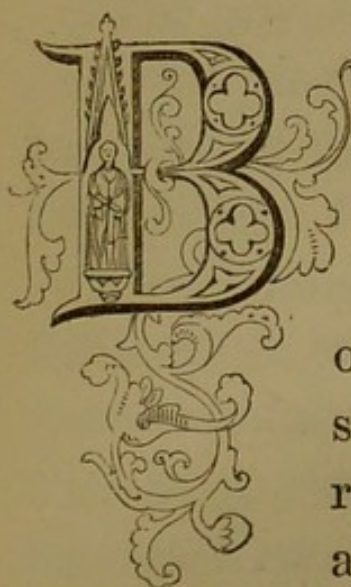
The collecting of objects for furnishing the Vivarium will form a very fascinating recreation for all such as delight in a ramble through the fields and woods. It will form a delightful addition to the ordinary attractions of a country walk, for the searcher among the haunts of the insect tribes will find his rambles varied by a thousand incidents, full of little

* The address of the manufacturer, with a list of prices, will be found at the end of this volume.

discoveries and surprises, each of which will furnish another page to his mental book of Nature—an ever ready and delightful volume of reference, which he will often call upon memory to open when he desires to conjure up a retrospect of pleasant sunny hours passed within hearing of the song of the lark and the soothing hum of his insect friends, in the spring or summer fields.

CHAPTER II.

DESCRIPTION OF THE STRUCTURE OF THE INSECT
VIVARIUM AND OF THE INSECTS REPRESENTED
WITHIN IT IN THE FRONTISPIECE.



BEFORE proceeding to describe the form and structure of the "insect home," as an ornamental drawing-room object, I will say a few words on the more ordinary contrivances long since resorted to by entomologists for the rearing of caterpillars and chrysalides ; as that will at once prove to the reader the practicability of the plan about to be suggested. In these rude "breeding cages," as they are termed by entomologists, but which might more correctly be termed "rearing cages," many of the conditions have been already learnt and established by experience, which I shall adopt in my somewhat more elaborate, and decidedly more ornamental, structure.

By several of the primitive methods referred to, and, in some instances, without the seemingly requi-

site amount of ordinary care, I have seen caterpillars preserved and kept in health till they had successfully effected their change—though, of course, without affording any especial facility for observing that change in the way that will be secured by the glass Vivarium which I propose.

I well recollect, for instance, at one of the Wednesday evening entomological meetings, at the hospitable house of the late Mr. Francis Stephens, seeing a beautiful little colony of the larvæ of the pretty British Moth, *Nyssia zonaria*, in a very thriving and healthy state, although confined in a small tin box, with no ventilation beyond that obtained through a perforated lid. They were feeding upon some fresh leaves of the common milfoil, their natural food; and, though the box did not appear to be of sufficient depth to allow them to descend into a layer of earth to undergo their change, in an analogous manner to that in which the transformation takes place in their natural state, yet I believe Mr. Stephens succeeded in obtaining several fine specimens of the perfect insect from that brood, especially of the female moth, which is a curious wingless creature, totally different in aspect from the handsome male.

The graceful movements of those larvæ of

Nyssia zonaria, as I recollect, made a great impression upon me at the time—being then a very young entomologist—for they were *Geometridæ*, that is, what are popularly termed *Loopers*, from the curious manner in which the body is alternately looped and extended in their peculiar method of locomotion. In these evolutions the long graceful forms of the slender bodies of these caterpillars, which are of a deep green, with a single longitudinal line of brilliant yellow, were seen to the greatest advantage; and I did not rest till I, too, had a brood of *Nyssia zonaria*.

But though insects may sometimes be reared successfully by such simple means as those described, it can only be done by very constant attention, and with the experience of a thoroughly practised field entomologist, well acquainted with all the requirements of the insects. One of my own first experiments upon a similar scale, for instance, was very signally and fatally unsuccessful. I had discovered a brood of the remarkable, though common, larvæ of *Vanessa Io*, feeding on a bed of nettles; and observing their singular branching spines, several of which issue from each segment of the body, I imagined them to be creatures as rare as they were curious, and carried

off several scores of them as a valuable prize. I had taken the precaution of securing a few nice sprigs of nettle along with them; and placing a small saucer of water, to keep the nettles fresh, in the centre of a deep pie-dish, I put the caterpillars carefully upon the leaves, considering that if they fell off, or left them to seek fresher food, they would not be able to escape by climbing up the polished sides of the dish, while they could very easily regain some of the deserted leaves that touched the bottom of their prison, and so return to their food. I next considered, that as the caterpillars were still very small, not having been hatched many days, that the best way to enable them to acquire strength would be to give them as much air as possible. With this view I placed them outside my bed-room window, on the stone sill. They appeared to go to their food at once with great appetite; and, as they looked very healthy, I thought my contrivance—which secured them full liberty in the open air, and yet prevented their escape—was a most ingenious one. But, as it turned out, I had been too easily pleased with my devices and precautions; for, returning to my window in the after part of the same day, I found the bright summer sun full on that side of the house, and perceived that the heat, radiating from the

polished surfaces of the sides and bottom of the dish, had actually *baked* my brood of *Vanessa Io*. The little caterpillars, or rather their shrunk and shrivelled remains, lay, mere dried skins, at the bottom of the vessel, which I intended should have been to them a luxurious home.

My subsequent efforts were more successful; but the best rearing box of a rude kind that I ever saw was one in the garden of Mr. H. Doubleday, of Epping, one of our best known and most successful collectors. It was a strongly made box, about two feet long, one foot broad, and perhaps eighteen inches deep; being filled about half-way up with ordinary garden mould, and having a layer of broken bricks, etc., underneath, to secure drainage. The lid was formed of close wire-work, and the box was sunk in the ground to about half its own depth, with the view of preserving a certain degree of moisture in the mould contained within. The position in which the box was sunk was also well considered, inasmuch as it was sheltered by a thick hedge, as well from too much sun as from cold winds. In this box, at the time I saw it, many magnificent caterpillars were feeding, each upon its own particular kind of foliage, branches of which were kept fresh in water.

The caterpillars, thus placed as nearly as possible in a state of nature, performed their transformations perfectly and healthily ; and many of the matchless specimens, which now form the chief ornaments of Mr. Doubleday's celebrated collection, were, I believe, reared in that manner.

I have since had a similar contrivance in active operation in my own garden, in which I have been almost invariably successful in rearing to the perfect state every caterpillar introduced. But the objection to this arrangement is, that I was seldom enabled to observe the transformations at the time when they were most interesting. The case being at some little distance from the house, I could not visit it often enough to make sure of catching my *protégés* at the very moment of casting the skin, suspending or burying themselves for change, or spinning their cocoons in preparation for their coming transformation to the chrysalis state. Nor was I, except in a very few instances, ever in time to witness the escape of the moth or butterfly from the pupa case, and so be enabled to observe the sudden growth of the wings from a diminutive size to their full extent, which, in some insects, takes place in a few minutes—the rapid increase of size being distinctly visible.

In order to place the continually occurring wonders of my rearing case in a condition for more convenient observation, I conceived the plan of a glass Vivarium, of a form somewhat similar to that of a fern case, but with additions and modifications suited to its special purpose. The Frontispiece to this volume represents such a case. It is a front view; and, being intended for rearing aquatic as well as land insects, a portion of the interior is set apart for a small reservoir of water, starting from the front angles of the case and curving backwards in the form of a little bay. The water-tight separation forming this little reservoir consists of a piece of sheet-zinc of the necessary height. It is soldered to the bottom of the Vivarium, which is also formed of zinc; and up the front angles it is equally soldered to the zinc uprights or columns. The reservoir has, therefore, its back and sides formed of zinc, and its front of glass, the joint at the bottom of the glass, with the zinc floor, being rendered secure by means of cement. The semicircular course backward of the water division is intended not to extend above half the depth of the Vivarium, even at its furthest point, in the centre, so as to leave ample space for the land arrangements, which, in the two back angles, will thus form a consider-

able space. At the sides and back, the Vivarium is to be of zinc, or glazed tiles, or slate, up to the height of the joint just above the water-level, which is shown in the front view. And, at this joint, the whole of the upper part, or cover, of the Vivarium is intended to lift off, for the purpose of general cleaning, ventilating, etc., at proper opportunities, when none of the insects are in a flying state. The upper portion will be made to fit tightly to the lower, by sinking into a deep groove, extending round the whole joint. At the *sides* of the structure, joining both back and front columns, a broad strip of perforated zinc will be attached, for ventilation, which will form the frame-work to a glass-door, affording easy access to all parts of the Vivarium, and entirely occupying the rest of the space above the solid zinc or tile-work, which will reach up to the joint, as before stated. The lower part of the glass-door will, therefore, be on a level with the surface of the land arrangements, and will reach to the top of the square portion of the frame, from which the roof springs. The opposite side will be the same, except that the glass portion need not be made to open, as another door would scarcely be necessary; and I may remark here, that the little gallery at the crown of the roof is also of perforated zinc.

The back, as it will have been seen, will be like the front, with the exception that the frame will be solid—that is, of zinc or slate—up to the same height as the water-line in front. A variety of effect might, indeed, be obtained, if desired, by making the solid lower portion of the frame ascend gradually from the water-level, at the front angles, to some four or five inches higher at the back, so as to make the land rise all round from the level of the water, like the seats of an amphitheatre, till it reached the top of the solid portions of the frame at the sides and back; taking care not to follow the line too arbitrarily, but, for the sake of the picturesque, varying it by a few irregular pieces of moss-covered stone, etc.; and this kind of picturesque undulation should also be observed, as far as convenient, in the general level of the soil.

Before filling the water portion of the Vivarium, the bed of the little lake should be varied by a few groups of tasteful rock-work, which, at one or two points, might be made to conceal small shallow flower-pots, containing garden mould, in which water plants requiring earth may be planted, such as *Valisneria spiralis*, or a small plant of *Calla Ethiopica*. The other portions of the bed of the tank may be covered with small, and, if possible,

pretty pebbles, or a little sand, on which, in spring and autumn, a sprinkling of watercress-seed may be strewed, which, in the earlier period of its growth, will produce the effect of a small submarine lawn or grass-plot. But the plants must be taken out as they begin to get large, or they would soon fill up the tank. I believe I have stated, in another place, that it is necessary to put in a few Pond Snails to act as scavengers, by consuming all scraps of decaying vegetation, and so keeping the water clean and healthy; but this point cannot be too much impressed, even at the risk of repetition.

In arranging the land portion, a layer of drainers, full three inches deep, consisting of small pieces of broken flower-pots, bricks, etc., should be put in, before the earth is added, in order that portions of the earth may remain sufficiently dry for such plants and insects as would be injured by too much moisture. The planting may then commence, according to the following instructions, and, when complete, the little crystal palace is ready for the reception of its interesting tenants.

Common grasses may form the staple of the plantation, putting in a few nice closely-grown tufty roots, and sowing grass-seed between, of the smaller and low-growing kinds. Other plants may

then be added, taking care to select those which will thrive best in such a situation, but not omitting a few of the more hardy and ornamental Ferns. In the earth, certain tin or zinc tubes are supposed to have been sunk, for the purpose of receiving and concealing small bottles of water, in which the stalks of different kinds of plants required for the food of the Caterpillars may be plunged, in order to keep them fresh. This contrivance is very necessary, inasmuch as the foliage often required for the Caterpillars may be of a kind that could not be made to *grow* within the case—that of the Oak or Elm, for example. We may suppose, by way of illustration, that the collector has been so fortunate in his rambles in the woods as to capture a larva of the splendid Purple Emperor, which generally feeds on the Oak. It is evident that, in such a case, it would be necessary to keep a sprig of Oak continually fresh and green in the Vivarium—for which purpose one of the concealed bottles of water would be found precisely the expedient required.

Pots, with small plants in flower, may be plunged to their rims in other parts of the earth of the Vivarium which have been arranged for that purpose—an addition which will not only add beauty and variety to the general aspect of the

structure, but at the same time furnish, in the nectaries of their blossoms, food for the Butterflies which have reached their perfect state, during the short time that they can be preserved in the Vivarium.

In insect Vivaria, in which the rearing of water insects forms part of the plan, the same principles must be applied, in order to keep the water clear and pure, as those employed in fresh-water Aquaria, namely, the addition of water plants and *Algæ*, such as the favourite *Valisneria Spiralis*, and one or two species of *Chara*, or some of the *Oscillatoria*, the curious spasmodic movements of which are exceedingly interesting. These plants serve to aerate the water according to the principle first clearly announced by Ingenhauss in the last century, when he stated that "*plants immersed in water, when exposed to the action of light, emit an air known as oxygen.*"

Another approach towards the condition of natural ponds, and one almost equally necessary to preserve the purity of the water, is the introduction to the miniature lake of some of the Water Snails, whose function it is to consume those portions of decaying vegetation which would otherwise rapidly poison the water, and render it unfit for the support of any kind of animal life, as previously stated.

This was the discovery of Mr. Warington, the true founder of the Aquarium theory, without which it was found impossible to preserve, for any length of time, either salt or fresh water in a state of purity; the Periwinkle or Sea Snail performing those functions of the scavenger for sea-water which the common Pond Snail does for lakes and rivers. The Trumpet Snail is useful for this purpose, and, with its regularly coiled form, it is a very pretty object; there is also the beautiful Marsh-shell, *Paludina Vivipara*, with many others. A few of the graceful little fish popularly called Sticklebacks might be added, to give an appearance of life and movement to the water, and also for the chance of observing their curious instinct in forming a positive nest, in which to deposit their spawn—an almost solitary instance of nest-building among the whole of the fish tribe. Many other objects might be made to vary the water department; but as in the insect Vivarium they should not form the principal object, I shall not refer to them here, but proceed at once to notice the kinds of insects best suited for rearing in such a receptacle, which I may best do in a brief description of the contents of the Vivarium represented in our first Plate.

In the water, as there indicated, the larvæ of

the different species of Dragon-flies should hold the first place, as their transformations are among the most remarkable in the whole range of insect changes; the first portion of their existence being strictly aquatic, while in their perfected state the last portion becomes as entirely aerial; a fact which appears, at a glance, almost as astonishing as though a fish should, by a series of transformations, become eventually a bird. The larvæ of the flat-bodied and that of the purple-winged Dragon-flies are represented at the bottom of the water, where they form a singular contrast to the elegant winged form which they are destined eventually to assume, and which is shown fluttering above the surface near the same part of the case.

A few larvæ of the Gnat should also be present, though not represented in our drawing, as their playful gambols, ascending and descending in the water, and occasionally suspending themselves to the surface by their star-like breathing apparatus, would form very pleasing episodes in the daily story of the Vivarium. There might be also the larvæ and the perfected form of the great Water Beetle, *Hydrophilus Piceus*, which is not destructive, either in its larva or imago states, and its fine action in swimming is always an agreeable spectacle to the

naturalist. The curious Caddis Worm, safe within his moving castle of sticks and stones, should not be omitted, as his final change to an elegant moth-like insect is very remarkable; and the Water Spider, with his diving-bell formed of a glistening silver globule of air, must not be overlooked. There are also the important Pond Snails, represented on the rock-work; and many other things might be named as suited to the water portion of the insect Vivarium, which will be referred to and fully described in subsequent Chapters, though there is not sufficient space to exhibit them satisfactorily in our small drawing of the Vivarium.

To continue the description of my Frontispiece, I must next call attention to two of the purple-winged Dragon-flies, supposed to have emerged from their chrysalides long enough to acquire their rich purple colour; and there is also the broad-bodied species, still hovering closely over the element which formed the home of his infancy, but immersion in which would *now* very quickly terminate his gay career, and spoil the lace-work of his gossamer wings. To the left, creeping over the grass, is the Rose Beetle, in his golden armour, representing a very numerous class of insects which might be introduced with good effect; many of the Beetle tribe being

remarkably handsome, and at the same time easy to manage, as will be shown in the Chapter treating of "*Coleoptera*." The only other representative of his tribe which I have been able to find room for in the design under description, is our old favourite the pretty scarlet-coated Lady-bird, whose larvæ would find ample nourishment among the *Aphides* that doubtless infest the little Rose-bush shown in the background; but I shall have much to say about Lady-birds, which must be deferred till I enter more fully upon the description of Beetles in general.

We now come to the Butterflies and Moths, the conspicuous transformations of which, and the ease with which the insects may be managed and observed during their changes, will always render them the favourite objects of the Vivarium to all ordinary collectors. In a conspicuous position, just above the broad-bodied Dragon-fly, I have represented one of the handsomest of our native *Lepidoptera*, the Privet Hawk-moth; so called in consequence of the larva being generally found feeding on the Privet. It is a really magnificent insect, sometimes measuring nearly four inches across the wings, and very beautifully marked, though the tints, with the exception of the crimson of the under wings, are very sober. The specimen

represented is supposed to have just issued from the chrysalis, the empty shell of which is seen lying on the right bank of the little bay near the front angle. The larva, or caterpillar, of this fine Moth is shown feeding on a small spray of Privet to the left, the stem of the sprig being placed in one of the concealed bottles of water, as described when treating of the structure of the Vivarium. It is one of the handsomest of our British larvæ, and yet by no means rare, being found at the proper season, if carefully looked for, wherever there are Privet hedges, or large bushes of Privet in the shrubberies; its size, and its bright colouring, being light apple-green with diagonal stripes of violet, rendering it very conspicuous among the dark green leaves which form its favourite food. I have no space here to say more respecting this handsome Moth and its transformations, which will be fully described in the Chapter treating of the entomological order *Lepidoptera*, which includes the whole family of Butterflies and Moths.

Above the Privet Hawk-moth is the fine orange-coloured Butterfly, *Colias Edusa*, popularly known to collectors as the Clouded Yellow, probably from the colour of the female, in which the bright orange of the male is subdued in the hind wings to a

dusky greyish olive. Indeed, in a variety which is not extremely rare, the female is almost entirely of a singular clouded tone, like orange seen through a grey veil. This disparity of colouring in male and female insects will form a very interesting subject for discussion in its proper place, the differences being in many instances very striking, especially among the tribe of the pretty little blue Butterflies of our chalk districts, one of which is represented in the Vivarium a little below the Clouded Yellow. The specimen there introduced is a male, the wings of the female being clothed in dark sober brown, instead of the brilliant azure of her gayer mate. Immediately beneath the little blue Butterfly may be seen a colony of the sable larvæ of *Vanessa Io*, the well-known Peacock Butterfly. They are feeding on a few heads of the common stinging Nettle, which have been placed in one of the concealed bottles for that purpose. Two of their chrysalides are shown suspended to neighbouring plants, by a process to be hereafter described. From these chrysalides the perfect insect is destined to emerge, and to form, for a short time, one of the chief glories of the Vivarium.

At the front edge of the water, and near the centre, I have placed a specimen of the magnificent

Purple Emperor; though few, except very indefatigable collectors, may hope to see this beautiful creature reared in a Vivarium; the success of the old "Aurelian" Moses Harris, however, described in another place, may tempt many to try the experiment. The larvæ may be obtained from districts where Oak woods are abundant; and if properly fed, fresh branches being placed in one of the bottles each day, the change to the chrysalis state may often take place healthily. Even then it is doubtful whether the proper progress will be made in the pupa state to secure the production and emission of the perfect insect. However, with care, and starting with several caterpillars, one or two perfect specimens may be hoped for, the splendour of which will amply repay any trouble they may have cost. But this gratification must necessarily be of very brief duration, for when the exquisite beauty of the azure wings of this superb insect has been displayed in the sunlight, after their first full expansion, and even while their increasing power is being tested by alternately expanding and closing them, the natural instinct of the insect to take its lofty flight over the tops of the highest Oaks will begin to be felt, and for more than a day or two it will be impossible to keep the prisoned Emperor within the

narrow limits of his cell, however attractive it may be made ; so that he must either be remorselessly secured for a collection of dry specimens, or allowed to take his free flight to the woods, according to the feelings of the lord or lady of the castle in which he is held in durance. The female, however, almost as handsome, with the exception of the changeful metallic azure that distinguishes the male, may prove more tractable ; and, if so, whenever she lifts her wings and closes them face to face, displaying the exquisite markings of the under side, she will form a most attractive object till she has laid her eggs, which, as with all insects, will form the last performance of her brief existence.

Above the Purple Emperor is one of the commonest, but not least beautiful, of our native Butterflies—the “Cabbage White,” of our gardens, as it is popularly termed. The one shown is a female, distinguished from the male by its larger size, and also by the bright black spots which decorate the anterior wings. The habits of the handsome caterpillar of this common insect are well worthy of close observation, especially when it begins to sling itself up for change, a process which will be minutely described in the Chapter on British *Lepidoptera*; where also an account will be found of the fearful

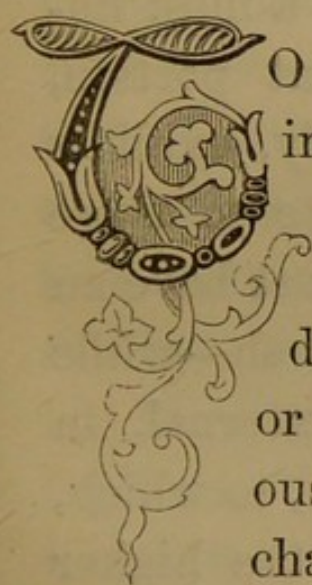
insect enemies to which it is exposed; with many other particulars concerning its chequered career, which would be out of place in this brief general description of the Vivarium.

There is only one more insect shown in the design for our insect-home, which is the pretty *Euchloe Cardamines*, better known as the "Orange-tip." It is an abundant species, seen frequently sporting about sunny places in the early spring, of which it is one of the most welcome and beautiful harbingers.

Cautioning all who have the care of an insect-home to keep it scrupulously *clean*, and to take care that the plants are always in a fresh and healthy state, continually replacing such as refuse to flourish in their miniature conservatory, I can promise them an ample harvest of delightful and instructive amusement.

CHAPTER III.

SOME ACCOUNT OF THE CHARACTERISTICS WHICH DISTINGUISH THE CLASS OF CREATURES TERMED INSECTS—AND THE CHARACTERS BY WHICH THEY ARE SEPARATED FROM OTHER ALLIED FORMS OF ANIMAL LIFE.



O begin at the beginning, which is always, in reality, the shortest way to the end, it may be well to consider for a moment the meaning of the term insect. It is directly derived from the Latin *insectum*, or *intersectum*, a term which very felicitously describes the most conspicuous general characteristic by which these creatures are distinguished, namely, the curious insection by which the thorax, or fore part of the body, appears nearly separated from the abdomen. In some instances, this leading feature of insect formation is so striking as not to escape the notice of the most unobservant, as in the case of the common wasp, for instance, or in the ant.

The Greek word *entomon* expresses the same idea, and, combined with *logos*, meaning a dis-

course or treatise, has furnished us with a name for that portion of natural science which concerns insects, and which has been termed "entomology."

With but few exceptions, this insection between the two chief portions of the body does not occur in insects in their preparatory or larva stages; but it is upon the characters of the perfected creature that all classification is founded, and, in that condition of the insect, it forms, as I have stated, a most important feature. The thorax, or front portion, which is, in fact, the trunk or main body, exhibits peculiarities of structure entirely opposite to those of the higher orders of animals. These last have an internal skeleton of bone, clothed with flesh—while in insects it is the skeleton which is external, in the shape of the horny case of the thorax, to which, however, the limbs are attached, as in the higher animals they are to the internal frame-work of bone.

Of all the tribes which have no cerebro-spinal system, and which have an external skeleton of "horn," instead of an internal one of bone, insects form by far the largest portion. As a whole, creatures of this kind of structure are now divided into five great classes—the *Annelida*, including leeches, worms, etc.; the *Crustacea*, including crabs, lobsters, etc.; the *Arachnida*, containing

spiders, scorpions, etc., etc.; the *Myriapoda*, containing scolopendres, centipedes, etc.; and, lastly, *Insects*.

With the exception of the Annelids, these tribes might all be included within the realm of Entomology—the lobster and spider sections having both the well marked character of the insection, while the Myriapods show a repetition of a similar method of structure throughout the whole length of their bodies, which are, in fact, formed of a series of such intersections. There are, however, certain characteristics, especially those connected with the metamorphosis which place true insects in a very distinct class.

All true insects, with a few insignificant exceptions, undergo, after coming from the egg, metamorphoses or changes analogous to those which, in other classes of animal life, take place in the egg state, or a corresponding epoch. This difference is so striking, that Swammerdam, one of the most illustrious anatomists and physiologists of any age, founded his system of insect classification entirely on the kind of metamorphosis to which they were subject, almost without reference to the anatomical structure; and so strong was his conviction on this point, that he committed the ridi-

culous and obstinate error of classing frogs and lizards, which are regularly *vertebrated*, along with *invertebrated* insects, in consequence of the metamorphosis which these animals undergo, subsequent to the egg stage, in the curious change from the tadpole to the eventual form. But, notwithstanding the frog difficulty, the positive metamorphosis may be considered one of the chief characters of insects; especially one which distinguishes them from the other classes of invertebrate animals.

Take the *Crustacea*, for instance; they have no metamorphosis—in the true sense of the term, as it is applied to insects—but are endowed, on the other hand, with a far more extended term of existence, giving birth to several successive broods, while insects never become parents but once.

The *Arachnida*, or Spider class of invertebrate creatures, though having the *insection* strongly marked, differ from true insects in having no antennæ, which in *Crustacea* are often remarkable; and, in common with these last, they do not perish like insects after their first brood of young, but live to give birth to several, which undergo no material change or metamorphosis after they are hatched.

The *Myriapods* are also distinct from true insects, inasmuch as they undergo no perfect trans-

formation; the only change analogous to that of metamorphosis being the appearance of additional segments, which do not exist in their earliest stage; otherwise, they have from the first the form they are destined to retain, and in the development of which they *grow* like other classes of animals, while true insects never *grow* after they have once received their final forms.

In different classes of insects there are different degrees of completeness of metamorphosis, which, as I have said, once formed bases upon which it was attempted to found a system of classification, among which the following may be particularized:—

—emipterous insects, for instance, have the elements of wings in their earliest stages, which develop themselves by degrees along with other parts of form. This was considered a *semi-com-metamorphosis*.

Other classes of insects, as some Bees, Ants, and Beetles, undergo a direct change of form from the larval state, without being encased in one general covering like the chrysalis of the Moth, but each part separately encased in its new covering as it developed, and becoming hardened by degrees. Some kinds of beetles are thus quite soft for some time after they come forth in their perfected state.

This has been termed *incomplete* metamorphosis. Butterflies and Moths undergo far more distinct changes—the Caterpillar, from its birth to its full growth, offering no apparent analogy with the perfect form of the eventual Butterfly, while in the dormant state; the metamorphosis of forms takes place in one entire shell, and the new members develop themselves, closely pressed to the body. This was considered the *complete* metamorphosis.

This most complete kind of metamorphosis was again divided into two tolerably distinct classes: the one, in which the internal forms are more or less distinctly indicated by the external irregularities of the chrysalis, and which was called *obtecta*; and the other, in which the chrysalis is an elongated spheroid without any mark or indication of internal parts, as in the chrysalides of Flies; which last was termed *coarctata*.

These were divisions and distinctions adopted by Linnæus, and more recently by Fabricius, but they are open to many objections. Latreille only makes three distinctions, based on the appearance of the insects in their different stages. In his first class he places all such as come from the egg complete, except in size; of which kind, according to more recent classification, there are but few ex-

amples among true insects; in his second class, those which are complete with the exception of wings; and in his third class, those which, after an active stage of existence, go into a perfectly impassive state, during which they take no food, and from which, after a certain lapse of time, they come forth in their perfected form.

We have learnt, by the discoveries made during the attempts to class insects according to their mode of transformation, that there is nothing so mysterious as was once supposed in insect changes. Since the discoveries of Swammerdam, indeed, and those of Reaumur, Bonnet, and others, we no longer imagine, as naturalists did up to that time, that certain Flies spring into their larva form of life spontaneously, from decaying matter; nor that the Gnat issues in a similar manner into spontaneous life from the slime of water acted on by the sun. We can, therefore, no longer consider such changes so astonishing as to deem them, as the alchemists did, positive transmutations, analogous to those which they sought to produce in metals, and of which they thought those of insects typical examples. But, notwithstanding the discoveries of science, and the mysteries unravelled by the power of the microscope, these changes still remain wonderful de-

monstrations of the extraordinary ways and powers of Nature ; and we still preserve, when speaking of them scientifically, the energetic term "metamorphosis," which expresses the idea of a sudden and wonderful change, though we can no longer consider such transformations in any other light than as a series of developments, having direct analogy with corresponding developments in other classes of animals, however they may differ from them in certain striking peculiarities.

CHAPTER IV.

OF THE EGGS OF INSECTS, AND THEIR NESTS.



HAVING, in the last Chapter, endeavoured to give a general idea of the leading characteristics of the class of creatures termed "insects," and of the general nature of the singular transformations which they exhibit in the course of their development from the egg to the complete state, it now becomes necessary, in order to convey to the reader a clear understanding of this part of the subject, to give a more definite account of the four distinct stages of insect life, namely, that of the egg, that of the larva or caterpillar, that of the chrysalis or pupa, and, lastly, that of the perfect insect.

In this Chapter I shall only attempt to describe the egg stage, which is in itself so curious that a much larger space than I can here afford might be given to the subject, without fear of fatiguing the reader,

or entering into any of those minute technicalities only suited for strictly scientific purposes.

The eggs of *Lepidoptera*, that is, of Butterflies and Moths, are, perhaps, more likely to interest the general collector than any other, and they are sufficiently various in form and character to give a fair general idea of those of all the other classes of insects. But it will, nevertheless, be necessary to allude also to those of the *Neuroptera*, *Diptera*, and the other entomological divisions. I shall, however, give the first place to the eggs of *Lepidoptera*. These, though of very various kinds and forms, as I have stated, are seldom of the *shape* to which the Latin term *ovum* can be applied, since we have made use of that term, in the word *oval*, to express an *egg-shaped* object. Few eggs of insects, in fact, are of an oval form, and in most cases, instead of being smooth like those of birds, with which we are so much better acquainted, they are intricately sculptured, as it were, with delicate raised patterns which enrich the whole surface. These patterns are generally, however, on a scale so minute that the aid of a powerful microscope is required to distinguish them, and to enable the student to appreciate their extraordinary beauty and regularity, as described by De Geer, Brunnich, Sepp,

our countrymen Kirby and Spence, and others, who, in their works, have introduced exquisite engravings of an immense variety of eggs of this class, magnified so as to show their geometric sculpture and endless variety of elegant devices with advantage. The eggs of a pretty, delicate Moth, *Geometra Cratægata*, are more nearly in the usual egg form, that of an elongated or oval spheroid, than most others of the class; but they are entirely covered with a very beautiful, though somewhat irregular, honeycomb pattern.

The eggs of the Orange Moth, *Geometra Prunaria*, are what might be termed flask-shaped, and perfectly smooth, with the exception of a series of small raised circlets close together, which have the appearance of a sealed aperture.

The eggs of one of our brown Meadow Butterflies, of the genus *Hipparchia*, are nearly spherical, having their surface varied with rows of minute knobs, disposed like the marks of the segments of a peeled orange, but much closer together.

Those of an insect of the same genus, *H. Janira*, the commonest of the Meadow Butterflies, are more oval in form, but broad at the base, and getting more pointed towards the apex. They are decorated with raised longitudinal ribs, connected in the

lower portion by delicate horizontal marks, which towards the top curve in the opposite direction, and assume the effect of laminæ laid one over the other, forming a kind of scaly cap.

The eggs of the beautiful Red-underwing Moth, *Catocala Nupta*, present somewhat the appearance of a small Echinus, being regularly ribbed from the crown, which is rather depressed, and having between the ribbings horizontal marks from one rib to another. The eggs of the "Lesser Tortoise-shell," one of our handsomest native Butterflies, are pump-kin-shaped, that is to say, in the form of a long oval spheroid, depressed at each end, and only marked with simple longitudinal ribs, which are, however, very strongly defined.

The eggs of other classes of insects differ materially from those of the *Lepidoptera*; many of them presenting characteristics so singular, and forms so strange that they would never be thought to be eggs at all, had they not been proved to be so by careful experiment.

The eggs of the Water Scorpion, for instance, are curiously crowned with seven delicate spirets, which give them the appearance of thistle seeds rather than eggs; and there are many other examples of striking external analogy between the seeds of

plants and the eggs of insects. Both are, indeed, living germs, destined to be developed in a much more closely analogous manner than is generally supposed.

The pretty bright green insect, *Chrysopa Perla*, with its transparent wings flushed with opaline tinges, which is so commonly seen fluttering about the shady walks of gardens in the twilight of summer evenings, lays an egg of very peculiar elliptic form, and provides for its security in a most singular manner, to be described in another place.

The eggs of a common Dipterous insect resemble a series of minute almond kernels, glued together longitudinally and touching at the widest part; and those of *Culex Pipiens* are shaped like a long slender Greek amphora, the opening of which, in the form of an enlarged rim, is quite clearly defined; and an endless variety of forms, angular or spherical, might be described did my space permit.

In colour, the eggs of insects are of all tones, though more commonly of some shade of white. Those of the *Chrysopa Perla*, however, are orange; and some are blue, a few are red or green, and others, again, are of varied colours and markings. Many, too, change their colour after they are first laid, those of *Endromis Versicolor* being at first

sulphur coloured, then green, then rose colour, and becoming eventually black. The size of the eggs of insects is, as I have noticed above, very various, and not always corresponding to the size of the parent. Those of some small parasitic insects, for instance, are nearly as large as the parent itself, while those of other classes of Butterflies are infinitely smaller. The largest insect egg known is that of a species of *Phasma*, one of the singular tribe of creatures popularly termed Stick-insects, having really the appearance of a portion of a branch furnished with long artificial legs. The egg in question is described in the "Linnæan Transactions"* as being as large as that of a Humming-bird, while those of many species of *Ephemera* are smaller than the finest grain of sand.

It has been remarked that the eggs destined to become females are generally larger than those containing the germs of males—a peculiarity which is especially visible in those of Ants, as noticed by Goulet; while Reaumur asserts that it is the contrary with respect to the eggs of Bees.

In some cases the eggs of insects increase in size after they are laid; those of certain *Ichneumons*, for instance, positively "grow," as do likewise those of

* Vol. iv. p. 18.

Ants. It would seem that in these cases the embryo has the power of absorbing oxygen through the shell, which, being of an elastic nature, the creature within is allowed to expand, and the egg, before it is hatched, frequently attains to twice the size which it was when first laid. The eggs of no other class of animals exhibit anything similar to this curious fact, excepting perhaps the spawn of fishes, the growth of which is, however, not of a strictly analogous character.

The shells of some insect eggs are extremely thick and hard, while others are composed of a mere film. Some of the harder kinds can scarcely be crushed with a knife; such, for instance, as those intended to brave the inclemency of our winters, while the more delicate are such as are destined to be quickly hatched. These, however, are often so delicate, that without the aid of different kinds of protection afforded by the parent, they would dry up and perish in the course of a single bright summer morning. It may be noted here that there is no calcareous substance contained in the egg-shells of insects similar to that which forms the basis of those of birds.

The number of eggs laid by a single parent varies to a most extraordinary degree, as a very few

examples will be sufficient to prove. One of our common Field Flies, the *Musca Meridionalis*, is said by Reaumur to lay only two eggs; some other Flies, six or eight; while many species of the Fly family lay thirty or forty, or more. The Moth of the Silk-worm lays about five hundred; the handsome Moth, *Cossus Ligniperda*, about one thousand; the Common Wasp, thirty thousand; and the Queen Bee even a greater number, varying from forty to fifty thousand in a season.

Another insect, *Termes Fatalis*, lays at the rate of sixty eggs per minute, or three thousand six hundred per hour, making eighty-six thousand four hundred per day, and per year at the rate of above two hundred millions. She does not continue at that rate, yet no greater example of fecundity exists. Insects, in fact, increase so fast, that Linnæus was perfectly right when he asserted that three Flies would consume the carcass of a horse sooner than a lion; which is easily conceived when we consider the rapidity with which they would deposit successive broods of their voracious larvæ upon the tempting carrion.

It is very interesting to observe the different methods pursued by different insects in placing their eggs as they are laid, some laying them in

pairs ; others in irregular quantities ; others singly ; others in large patches or symmetrical figures ; and in nearly all cases they are attached to the substances upon which they are deposited, by means of a peculiar secretion with which the parent is furnished for that purpose.

As an instance of the beautiful symmetry with which insect eggs are placed side by side in regular succession by instinct of the parent, those of the Great White Butterfly, *Pieris Brassicæ*, may be instanced, as they often form white patches on cabbage leaves at a certain season, which on examination look exactly like a beautiful piece of lace-work, with each minute opening filled by a globule of some semi-transparent substance, so exquisite is the regularity with which they have been deposited. The well-known Moth, *Clisiocampa Neustria*, lays her eggs with equally beautiful regularity, though in a different position. They are deposited in the autumn, and, consequently, having to pass the winter before they are hatched, a wonderful instinct teaches the Moth not to place them upon the *leaves* of plants, with which they would fall and be destroyed, but on the *branches*, round which they form those graceful little bracelets of minute beads which every lover of a garden must often

have noticed. It is to be feared that in our Vivarium we shall not be able to witness the fabrication of these little bracelets of miniature eggs, and note the mode in which they are so successfully woven round the branch selected for the purpose; for Reaumur, with all his patient perseverance, tells us that he could never induce the *Clisiocampa Neustria*, when in a state of captivity, to deposit her eggs in this manner. In confinement she seemed to lose her beautiful instinct, and dropped her eggs carelessly in any part of the rearing-cage, although every convenience and temptation, as it was thought, had been provided to induce her to display her skill in bracelet-making. With the superior arrangements of the glass Vivarium over the rude cages of Reaumur, our modern students may perhaps be more successful.

One of the most curious methods is that followed by the pretty insect, *Chrysopa Perla*, previously alluded to, whose small, elliptic, orange-coloured eggs are placed, like little clubs, at the top of a long slender hair attached to a leaf. In this position a group of the eggs of *Chrysopa Perla* has the appearance of a small tuft of some blossoming moss, or it might be taken, by a stretch of fancy, for a bunch of the clubbed antennæ of conquered

Butterflies, reared as a trophy by some cruel enemy of the tribe, just as a Red Indian of the last century displayed his captured scalps. When the eggs, thus stilted on their slender pinnacles, are hatched, the empty shells still remain at the end of the filaments, in which state they still more strongly resemble some slender kind of cup-moss, for which many of our old herbalists may easily have mistaken them.

In many cases we are not able to follow the intentions of Nature in her apparent eccentricities and curious arrangements of this kind, but in the present instance they are sufficiently obvious. The arrangement has been evidently resorted to in order to place the eggs out of the reach of insects infesting the leaves of the plant on which they are placed, and which would otherwise have preyed upon them. The contrivance bears a strong analogy to that adopted by some tropical birds to protect their nests from the depredations of serpents likely to prey upon their eggs, which consists in weaving together long slender fibres, by means of which the nest is suspended at a considerable distance below some far stretching branch, and quite out of the reach of the wily enemy.

Some insect eggs, instead of being attached to the ends of long filaments for safety, have several

filaments attached to their own point, which, like the crest described on those of the Water Scorpion, serve like an array of lances to keep off marauding intruders. Among other methods adopted by different insects for protecting their eggs, I may notice that of a Moth of the Bombyx family, *Liparis Salicis*, which covers its ova with a protective tissue of a cottony and yet somewhat friable nature, which is perfectly waterproof, and effectually conceals them against injury from wet in very rainy seasons, and from accidents of many other kinds.

Some insects resort to still more decisive measures for the protection of their eggs, actually carving a recess in a branch in which to deposit them, as in the case of the *Hylostoma Rosea*, for instance, which insect possesses the power of making an incision in a young shoot by means of a saw-like instrument, near the tail, with which it is furnished, and in the incision thus made it deposits its eggs, covering them immediately with a greenish fluid, which it emits from the mouth, and which rapidly hardens on exposure to the air.

The female of *Renchites Bacchus*, an insect infesting the vine, makes preparations for depositing her eggs by forming a kind of nest, which she does by rolling up a portion of some well-selected

leaf, thus producing a suitable recess, in which the eggs are placed with comparative security, both as regards the accident of weather and the attacks of other insects.

This little insect is, however, by far surpassed in the skill displayed in her maternal cares by some kinds of Butterflies, which may be said to build a positive *nest* for their eggs, precisely similar to that constructed by birds, except that it is not used for the purpose of incubation, the eggs being abandoned so soon as properly protected in the manner which instinct has suggested to the parent. The interior of this nest is formed by several layers of soft down, which the female plucks from her own body, and upon this delicate couch the eggs are deposited, and then protected by an elegant covering of the same material, often arranged with very curious intricacy. In some cases this covering is disposed in such a manner that each silken hair remains erect, the nest thus enclosed having the appearance of a small patch of the softest and most downy fur. Sometimes, when the eggs are laid spirally round a branch, this kind of covering naturally follows their course, and it then produces a very beautiful appearance, which it would sorely puzzle a tyro in entomology to account for, as it often assumes the

appearance of a minute bottle-brush, and at other times that of a miniature Fox's-tail. By the time this final protection to the eggs is completed, the body of the devoted parent, as may be imagined, is almost entirely denuded of its beautiful silky clothing; but she has fortunately no further occasion for it, as having thus completed the last act of her brief existence, she almost immediately expires.

Some species of Humble Bees, as *Bombus Muscorum*, cover their nests with a roof of moss; and Huber, in a paper published in the "Linnæan Transactions," has described a pair of these insects which contrived their nest under a bell-glass, and substituted small pieces of cloth when moss was no longer to be procured. It is thus evident that many of the solitary nest-building Bees might be so domesticated in a Vivarium as to exhibit under the eye all the processes pursued in their ingenious architecture. If a pair of "Poppy Bees," a species which line their nest with petals of the crimson poppy as a couch for the future young, could be induced to exhibit their skill in a state of confinement, the spectacle would be very gratifying.

Bees are, in fact, among the most ingenious of insect nest-builders, the beautiful *honeycomb* being simply a series of nests, or one vast nest divided into

separate compartments, in each of which an egg is to be deposited, and furnished with a supply of honey to serve it as food in its inactive larva state. But the habits of the Honey Bee are too well known to need description here, a glass hive having long since been invented as a kind of insect Vivarium, in which the habits of one of the most interesting of insects may be conveniently observed.

Some kinds of *Blatta* deposit their eggs in a kind of pouch, which completely protects them from all ordinary kinds of attack. This pouch is very curious, having somewhat the appearance of a small, shallow, black leather bag, well filled, and then tightly sewn up across the top. The first time I found this curious object I was quite unable, as an entomological tyro, to ascertain the nature of my discovery, and was indebted to my lamented friend, the late Miss J. Loudon, for the explanation of its true character.

Not only are many kinds of insects most careful, as I have shown, in protecting their eggs from the inclemency of the weather, from accidental injury, or from the attacks of enemies, whose prey they might become without such protection; but they also exercise as careful a foresight in placing them where the young larvæ, on hatching, are sure to

find a plentiful provision of their destined food; and by the position in which they place the eggs, they render the exit of the larva as convenient as possible for the objects which it will immediately have in view.

The eggs of the Lady-bird and *Syrphus* tribes, for instance, are invariably laid among a colony of plump Aphides, which are destined to become their future food, and of which they will very quickly clear a rose-tree so infested. The wise gardener knows this fact perfectly well, though perhaps no entomologist, and never destroys the larvæ of the Lady-bird or *Syrphus*, whom he recognizes as his best friend.

The Dragon-fly, with the assistance of her elegant tail, deposits her eggs on the stem of some water plant at some distance below the surface, in order that the larvæ may come into active existence in the element which is to form the region of the first phase of their changeful career. Sometimes, indeed, the parent Dragon-fly, in her anxiety to make quite sure that her eggs are placed at a sufficient depth to be secure against the chance of any slight sinking of the water, dives bodily beneath the surface, regardless of the gossamer delicacy of her beautiful wings, which, during the performance of

this act of maternal devotion, seem proof against injury by immersion in the water, which, at another time, would probably destroy them, or, at all events, render them unfit for flight.

Some kinds of Grasshoppers, in an analogous manner, by means of a similar but stronger tail-like appendage, deposit their eggs at some depth in the earth, where their larvæ are destined to pass the first portion of their development.

A family of Flies, known as Ichneumons, by means of a sharp, lance-like instrument with which they are furnished, actually deposit their eggs in the bodies of certain Caterpillars, whose skin they pierce for this purpose, and whose flesh is to serve as the food of the young Ichneumons, who take care not to destroy any vital part of the Caterpillar, which is to continue to exist, and keep making flesh for them to consume. He perishes, however, at last; and so, vast numbers of certain species are destroyed, which would otherwise very soon become a perfect pest to our gardens.

The “growth” of the eggs of Ichneumons has been observed, and also of Cynips, as well as the eggs of Ants, and others previously named; and it should be noted here that insects in the egg, as well as in the Caterpillar state, are subject to the attacks

of the Ichneumon tribe. This we learn from Vallisnieri, who minutely describes a small Ichneumon, named *I. Ovulum* (the Egg Ichneumon), which provides for its own young in this way. He also discovered subsequently that several other kinds of Ichneumons attack insect eggs, having had an opportunity of observing several individuals of one species come from eggs of *Saturnia Carpini*, the small Emperor Moth, in the shells of which he found two holes—one, no doubt, pierced for the deposition of the Ichneumon's eggs; the other, that by which the perfect Ichneumon escaped.

Some insects are furnished with the means of piercing the young shells of fruit-stones and nuts, for the purpose of depositing an egg within them. In these cases the egg is generally solitary, as the supply of food is limited to one kernel—the whole of which is evidently intended by the parent of the egg for the banquet of its one singly placed offspring.

The eggs of insects whose larvæ feed upon particular plants are never laid upon any other—even the various kinds of grasses being discriminated with the greatest nicety, while the eggs of those whose larvæ are general feeders are placed indiscriminately, on any convenient tree or plant.

In some cases the food for the young has to be positively provided, and even placed in a proper situation by the parents ; and this they never fail to effect with the greatest completeness, whatever may be the cost of labour necessary to effect the arrangements ; and although they never live to see the happy results of their contrivance, as the eggs are not hatched till after they have perished, which they invariably do when they have performed that last and most important act of their existence—the safe deposit of the eggs which are to continue their species. The insect here referred to is the handsome Red-spotted Beetle, known as the Burying Beetle, which, when the time for depositing the eggs arrives, seeks the dead body of some small animal, which, when found, is buried with great labour ; and the eggs are then deposited in the substance which is destined to form their food when hatched. Thus, not only is the proper food provided, but it is placed in a fitting situation for the young larvæ, which in their first stage are earth grubs, and consequently subterranean feeders. The kind of Beetles described are contented with the bodies of small animals that have died a natural death ; but other species kill insects for the express purpose of placing them in a subterranean larder, to become the food of their

progeny as soon as the eggs placed near the prey are hatched; and the Mason Wasp builds up the bodies of Caterpillars in the structure in which its larvæ are to come forth, taking care to select such as are just about to change, and which are consequently unlikely to attempt escape, being in a semi-dormant state, in which they remain as nice, fresh, live food for the carnivorous young as soon as they are hatched. The Spider Wasp pursues a similar method in providing a feast of spiders for its expected young—just stinging the victims sufficiently to prevent any attempt to escape, but not to kill them.

One of the most beautiful examples of the arrangement of the eggs, with a view to their preservation, and to the convenience of the exit of the future larvæ in a fitting position to commence their future existence, is, perhaps, that afforded by the instinct of the Gnat. Reaumur closely observed the female in the act of constructing her fairy raft of eggs, which she effected by gluing them together as they were laid, while they were supported and put into the requisite form by means of the long hind-legs, which, being crossed for the purpose, afforded the moulding shape for the pointed end of the little boat; for in that form the structure is made. In this process, the top of the eggs is

placed downwards, and the narrow end upwards. The secretion used to cement them together is of an oily nature, repellant to water, so that even if the little boat should become accidentally filled, the water quickly retires, as from the feathers of aquatic birds, and the little vessel floats securely till the time for the larvæ to escape from their shells arrives. They then issue from the lower part of the egg, and thus at once plunge into the element which is to be their home during the first portion of their active existence.

The eggs of insects may be said to be invariably hatched without the aid of the warmth or any other influence of the parent, being generally deserted after due precaution to protect them from accidental destruction has been taken. A few rare instances, however, are cited by naturalists, in which insects are said not only to practice incubation, like birds, but even to lead their brood about as a hen does her chickens. This is related of the little obscure insect *Pentamata Grisea*, of the habits of which De Geer gives a very interesting account. As I have stated above, however, the eggs of insects in general may be said to be hatched without the assistance of the parent, and in most cases without any reference to the temperature, as the larva emerges from its egg-

shell at the destined time, regardless of surrounding cold or heat. Many experiments have been made with the view to accelerate the hatching of insect eggs by the stimulus of heat, and to retard them by the application of intense cold; but, except in a very few cases, little or no effect was produced—*periodicity*, rather than any kind of atmospheric influence, being the governing power which regulates the hatching time. In some few instances, however, as stated, the time can be accelerated by warmth—as with Silk-worms, for example—which is, perhaps, owing to their existence in Europe being altogether artificial, and their instincts being more or less thwarted and confused in all their stages. It has been found much more difficult, and in many cases impossible, to retard the period of hatching by any degree of cold; and certain eggs destined to hatch in June, for instance, will, according to Brahm, hatch at that time even in an ice-house.

Eggs will, in fact, bear an extraordinary degree of either heat or cold without injury, and without being in the slightest degree influenced by its application, but the absence of air destroys their vitality very quickly. Spalanchini found that the vital principle was destroyed in all those which he submitted to the effect of perfect vacuum in an air-pump.

It is evident, therefore, that they absorb oxygen ; and the mode in which this is effected has led to many speculations, which it would occupy too much space to describe here. It may be remarked, however, *en passant*, as a curious fact, that the eggs are endowed with a power of breathing, even though it be by some very simple process of absorption, which bears a strong analogy to that enjoyed by the larva after its escape from the shell ; which thus establishes another link in the progress of their metamorphosis, showing still more clearly that each successive state is but a development of the former, and not an arbitrary change, as was once thought.

The natural time which elapses between the time of laying and hatching is very various. In Bees it is only three days, as ascertained by more careful and continual observations than have ever been applied to any other class of insects. These observations commenced at a very early period—for the ancients knew, comparatively speaking, almost as much about Bees as we do—in consequence of the valuable instinct of these insects in collecting honey, and the ease with which they may be domesticated, and the fruits of their industry taken from them to supply the cravings of human luxury. The eggs of Lady-birds are hatched in five or six days ;

those of Grasshoppers, and their tribe generally, require a month. Those of *Clisiocampa Neustria*, and many other Moths, whose eggs are laid in the autumn, are not hatched in less than nine months, while a spring brood of the same insect probably comes forth in as many days. This is the case with Butterflies' eggs also, the first brood being hatched in a few weeks, the second remaining in the egg during the winter.

Having described the leading features of our present knowledge respecting the insect egg till the period of hatching, we must now see how the embryo Caterpillar escapes from his miniature prison.

The mode of exit of the larva from the egg-shell is very different in different kinds. In general the little larva gnaws his way out at the part nearest the head, much as a chicken at the proper time pecks at the shell of its prison till it forces an exit. This gnawing process often costs the embryo Caterpillar some hours of labour, especially when the shell is thick, as in the case of the *Clisiocampa Neustria*. Some shells, however, are furnished with a regularly hinged lid, which the larva has only to lift in order to effect his escape. In some cases the lid is lifted by a very complicated spring and balance

apparatus, which would be very difficult to explain, although the insect appears to understand it perfectly, never making the mistake of pulling the wrong string. Others, intended to go through an aquatic course of existence in their first stage, like those of the Gnat, escape, as I have described, through the lower end of the egg, at once into the water. There would be no limit to describing all the modes in which larvæ are ushered into their first stage of active life ; but sufficient has been related to show the attractive interest of this subject ; and now, having devoted more space than I intended to the egg-period of insect life, I must proceed at once, in the next Chapter, to the description of the Caterpillar, or larva stage, from the time of its escape from the egg-shell to that of its full growth and preparation for the pupa state.

CHAPTER V.

OF THE CATERPILLAR, AND OTHER KINDS OF LARVÆ
—OF THE DERIVATION OF THEIR POPULAR AND
SCIENTIFIC NAMES—AND OF THEIR STRUCTURE,
HABITS, INSTINCTS, DEVASTATIONS, ETC.



THE Caterpillars of Butterflies and Moths, even of the most common species, are often so conspicuous and beautiful that they cannot fail to have been observed and admired even in the earliest times. It would be very interesting to know by what names they were distinguished in some of the primitive dialects of our race; for in the early languages the names of natural objects were almost always exceedingly expressive of the nature of the object itself. Such early traces of popular entomological nomenclature are, however, lost to us; but the Greek and Roman names of the Caterpillar, *Volvex* and *Καμπη* (*Kampē*), are still known, and both appear to be descriptive of its kind of action when in motion, from the peculiar

play of its segmental structure. Another Latin term for the Caterpillar, *Eruca*, may have its origin in the Greek verb Ερυκω (*Erucō*), *to contain*, in allusion to the fact, even then well known, that it contained the germ of some kind of winged creature, very different in appearance to itself. Our own popular name "Caterpillar" is doubtless a highly descriptive word, though its origin has not hitherto been very distinctly traced. When, however, we find that in the earlier stages of our language *cates* or *cate* was a common term for provisions or delicacies of any kind, and that the verb to *pill* was in common use as one of the derivatives of the French verb *piller*, from which we have still in use *pillage*, *pilfer*, etc., it is not difficult to trace an approximate derivation of the name. We have only to imagine the term *cate* applied to *vegetable* provision, and we at once get the term Cate-piller, naturally euphonized as Caterpillar; that is to say, "garden robber" or "plant destroyer."

Linnæus, however, when seeking a general term applicable to that stage in insect development which immediately follows the egg period, and which in Butterflies and Moths we term Caterpillar, seems to have been influenced by an idea similar to that which I have supposed to be contained in the Latin

name *Eruca*. But he carried that view still further, and conceiving that the Caterpillar not only contained another form, but that it was in fact a *disguised* or *masked* creature, whose *disguises* were used to conceal a perfect insect, he gave it the name of *larva*, from the Latin word *larva*, a mask. And when the structure of a Caterpillar is carefully considered, the kind of *disguise* by means of which it enfolds and conceals from us the form of a perfect insect, is shown to be of a nature which makes the name thus conferred by Linnæus remarkably felicitous. The smooth, orbless lobes of the head, for instance, positively form a mask enclosing the many facettèd eyes and conspicuous antennæ of the perfect insect, while the six or more skins with which the body is enclosed are, with their fantastic markings or silken tassels, just so many masquerading dresses, which completely conceal the form of the perfect insect which lies beneath their folds, till these disguising robes are shed in due succession.

When a Caterpillar is about to undergo its change to the pupa or chrysalis stage, a moderately careful dissection would enable the anatomist to discover the wings of the perfect insect in an already distinct form; and, even in the earlier stages, Swammerdam succeeded in detecting not only the

wings, but also the antennæ, the legs, the thorax, the abdomen, and indeed all the members of the perfect insect. From the semi-fluid state of these embryo members of the imago contained within the Caterpillar, the great entomological anatomist had found at first great difficulty in detecting them, though his theory convinced him of their existence. But, considering that the fluids of an egg become solidified by being placed for a time in boiling water, he made a similar experiment upon the analogous substances of the Caterpillar, which naturally produced a similar result; and in that state he was enabled to demonstrate not only the co-existence from the birth of all the skins which are to be shed one after another, till the larva attains its full growth, but also of all the parts of the perfect insect enclosed within them. He was enabled to perform some of his experiments of this kind by placing the Caterpillar for a few days in pure alcohol, which he found to produce the same effect as boiling water, though not so quickly.

In these investigations the wings were found to be spirally folded, the antennæ and proboscis curiously packed against the inner front of the head, and the legs, though so different in form,

were encased in the six pectoral legs of the Caterpillar. The skin and other external portions of the Caterpillar are therefore little more than a kind of shell, and the Caterpillar, in fact, a "walking egg." It is also a walking egg which has the still more unusual faculty of eating; not merely taking in nourishment by absorption, as some eggs are known to do, but by means of a positive mouth and mandibles of a formidable description; which, in the case of the Caterpillars of Butterflies, form a striking contrast with the delicate feeding-trunk of the perfect creature. But it is time to consider Caterpillars of various kinds in some detail, and with reference to the form and structure of their various members, as well as the different functions of those members, which will, with the instincts of their possessors, afford opportunities for much curious and interesting observation.

In these investigations the general term larva will be more convenient than that of Caterpillar, as applying to the *second* stage of all classes of insects, especially as that popular term is, as I have stated before, generally confined to the larvæ of Butterflies and Moths. The popular name, "Grubs," by which the larvæ of the Beetle section of the insect family are distinguished, is exceedingly expressive of their mode

of life, which is generally passed in the earth. But for the races of aquatic larvæ, whose appearance and habits are much less known, we have no convenient popular name at all. The generic term larvæ, therefore, as applicable to all classes, will be the only one I shall use in the remainder of this Chapter.

The larvæ of insects, on first escaping from the egg, are of three kinds: first, such as are nearly of their full size when first hatched; that is to say, that do not grow materially in the larva stage, and have pretty nearly the same form as in their perfect state.

The second class are also of nearly their full size when first hatched, and always perfect in general form, with the exception of the wings, which are developed by degrees.

The third class contains those larvæ which, when first hatched, are of very minute size, in proportion to that which they are destined to attain, and which exhibit in their larva state little or no resemblance to the form of the perfect insect. To this class belong most insects which undergo what has been termed the perfect metamorphosis.

Larvæ may be said to be of no sex, though, as in the case of the eggs of birds, a certain number are so organized as to become males and

the others females. But it is somewhat extraordinary that in the cases where the male and female insect, in their perfect state, are of strikingly different forms—the female, for instance, being a creeping creature, perfectly apterous or wingless, and with a heavy, cumbrous body, while the male is light in form, and provided with broad and richly-tinted wings—even in such cases, no appreciable difference is discernible in the larva state.

It may be stated here that several attempts have been made to class Caterpillars in a more detailed and closely defined manner than that suggested by the three classes just named. Mr. Macleay, for instance, in his “*Høræ Entomologicæ*,” has sought to create homogeneous groups and families founded on the resemblance of certain larvæ to the forms exhibited by other classes of animal life, terming those “chilognatiform,” for instance, which more or less resemble the Centipede family. This system has been partly followed by Messrs. Kirby and Spence in their valuable “*Introduction to Entomology*,” but it seems to me that, except as far as a convenient set of terms is concerned, such a system of classification will be useless; as the main classification of insects must always be that founded on their *perfect* forms, and not on peculiarities

existing only in the *larva* state. M. Lacordaire, the author of several volumes of the "Suites à Buffon," appears to be of this opinion, stating, moreover, that for any detailed classification of larvæ we have not at present sufficient materials; the larvæ even of European insects being as yet but imperfectly known, excepting perhaps as regards those of Moths and Butterflies; while of those of exotic insects we know comparatively nothing. There is, indeed, a field of entomological research still open as regards the detection of the forms and habits of exotic larvæ, which may lead to very brilliant discoveries, and the most valuable results as regards the general principles of classification in that branch of natural science.

The larvæ of the first division, in the kind of general classification which I have adopted, can hardly be considered larvæ at all, in the true acceptance of the term, in so far as that term expresses a *masked* stage of existence, for, with the exception of their external covering becoming more firm, and in some instances subject to a change of colour, they do not present any material difference of aspect to that which they present in their perfect state. They are therefore not strictly larvæ, but only insects in a stage of development closely analogous to that of

true larvæ. The larvæ of the second class referred to, generally belonging to the great insect divisions termed *Hemiptera* and *Orthoptera*, are also of nearly the same form when born as that which they are eventually destined to wear, with the exception of the wings, which at each casting of the skin appear in a more advanced state. These have been called semi- or half-larvæ, as not being entirely different from their eventual form, and as not having the worm-like character which generally distinguishes a true larva. They are also distinguished by the gradual change by means of which they arrive at perfection, without any sudden and remarkable change, or metamorphosis. In this class it is very easy to discover the future form of the Cricket or Grasshopper, and other insects, even in its earliest larva stages, though some undergo very considerable change.

The larvæ of the third class, composed in general of those of Beetles, Butterflies, and Moths, and perhaps some *Neuroptera*, do not in any case, in their appearance in that state, suggest the nature of the form which they are destined eventually to develop. There are, however, exceptions in this respect even among the well-defined larvæ of Butterflies and Moths; for instance, in that of a small species of

Moth of the genus *Psyche*, the female still retains, after the last change, nearly the same appearance as it did in the larva state. The *Staphylides*, a class of Beetles, have also the peculiarity, very rare in their order, of presenting nearly the same appearance in the larva as in the perfect state.

Coleopterous larvæ have been popularly termed Grubs, as I have said, and those of *Lepidoptera*, Caterpillars; while a class very closely allied to these last have been termed "False Caterpillars." These are the larvæ of some divisions of the order *Hymenoptera* (or Clear Wings)—of the Saw-flies, for instance.

Larvæ, with the exception of the head and pectoral feet, which are generally of a horny nature, are almost invariably of a softer character than perfect insects. In the *Staphylides*, however, the first three segments, which represent the trunk of the perfect insect, are horny. The larvæ of the Water Beetles have horny plates protecting the first nine segments; and in some few instances even the skin of the true Caterpillar, generally so velvety in its texture, is entirely of a crisp, horny nature, as in the larva of *Vanessa Polychlorus*, the beautiful Elm Tortoise-shell Butterfly. A few of the larvæ of Beetles are also entirely horny in this manner,

especially those of some exotic kinds destined to live under the bark of trees, the pressure of which they are enabled to resist by this defence. The larva of our native Moth, the *Cossus Ligniperda*, has a horny clothing of similar character, which protects it while eating its way through the trunks of trees. These characteristics are, however, rare.

Most larvæ are opaque, though some, even among those of the *Lepidoptera*, are nearly transparent; and the body of a water larva, that of *Tipula Crystallina*, is positively as clear as glass, insomuch that it is scarcely distinguishable from the element in which it lives.

The segmental divisions of the body are common to classes of larvæ in general, all the various kinds having their bodies more or less distinctly marked transversely by the joints of these segments or divisions. In some of the earth larvæ, and others of the Grub class, however, the wrinkles of the soft skin conceal the marks of these articulations, which are generally twelve in number, exclusive of the head. These segments are individually of much larger proportion in some species than in others, as the form of the larva exhibits a long and slender, or robust and compact form. The general form of larvæ is cylindrical, though some are much

flatter than others, as in many of the *Curculionidæ* among Beetles, and the onisciform or Wood Louse-shaped larvæ among Butterflies. Some are large at the head and tapering to the tail, as in those of the Water Beetle; while the most marked character of those of Butterflies and Moths is, that they are of the same thickness from end to end, terminating abruptly at the tail as well as the head, no neck being visible; except in rare instances, as in the larvæ of *Pieris Brassicæ*, for instance, where something like a short neck may be observed when the head is stretched forward. Some few are convex above and flat beneath, and a few others are of such anomalous forms, like that of the "Lobster-moth," so named from the appearance of its Caterpillar, that it is not easy to define or classify them; the Caterpillar, for instance, of a Lepidopterous insect (*Adolius Acanthea*) being so curiously decorated by unusual looking spinose excrescences, beautifully feathered, as to present almost the appearance of a Star-fish.

THE HEAD, in nearly all kinds of larvæ, is, as I have said, of a horny nature. It is indeed necessarily so, in order to afford a bearing for the formidable mandibles, and give them the necessary leverage required for cutting through tough leaves

and other similar substances, which form their food, while the other parts of the body are soft, to enable them to bend to the forms of the foliage or branches to which they adhere. In the larvæ of *Diptera*, however, which are almost invariably aquatic, and take liquid food, great strength in the frame of the head becomes unnecessary, and it is found in most instances to be only membranous. In some Dipterous larvæ the head is indeed elastic, and can be put in any form which the position of the insect while feeding may require. Some of the Beetle larvæ have the power of withdrawing the head nearly within the first segment of the trunk; and that of a small Gnat, *Leminobea Replicata*, has the power of drawing in its head so completely that it has in that state quite the appearance of a headless body. In some Caterpillars the diameter of the head is the same as the body; in a few cases it is larger, but in the greater number somewhat smaller.

The head in the larvæ of Lepidopterous insects is generally composed of two lobes, round at the top, and dividing as they descend so as to leave a triangle, within which are arranged the mandibles and other features of the eating apparatus. In some instances, however, as in the case of the Caterpillar of the Purple Emperor, and a few others, the lobes,

instead of being round at the top, ascend in two remarkable points.

In many exotic species the head of the larva is armed with spines of different kinds, which give the creature a very formidable appearance. Madame Merian, in her "Insects of Surinam," has engraved some extraordinary forms of this kind. The Caterpillar of *Morpho Menelaus*, one of the most splendid Butterflies known, is very remarkable in this particular; the lobes of the head not only ascending like those of the Purple Emperor, but acuminate into positive horns. The larva of *Brassolis Cassiæ* has three firm spines attached to its head, that of *Peridromia Amphinome* a crown of eight spines, and that of *Morpho Teucer* seven rays or spines. Such appendages, though rare upon the head, are not infrequent upon the first segments, as in the case of the larva of *Phalæna Regia*, in our Plate VIII., the effect of which is as though they issued from the head itself. In common British species similar spines are found on that and other parts of the body, to be spoken of when describing some of our British Butterflies and their larvæ.

THE EYES of larvæ are generally very minute, and in some cases they are absent altogether, as in the Lamecorn and Longicorn groups of *Coleoptera*,

and in *Diptera*, in nearly all cases where the head is only of a membranous texture. In *Coleoptera*, eyes are generally found to exist among the carnivorous and herbivorous feeders, and in *Diptera* among the Gnat classes. Some larvæ of *Hymenoptera* and *Lepidoptera*, that is, of the clear-winged, and scale-winged families, composed respectively of the Bee tribe, and of Butterflies and Moths, are also without eyes; but most of the Lepidopterous larvæ are well provided with these organs.

In a few of the water larvæ the eyes are numerously facettèd like those of the perfect insect, as in the larvæ of the Dragon-fly; but, with these exceptions, the eyes of larvæ are generally simple, and consist of very small globules, which in many cases are only visible with the assistance of the microscope.

The number of eyes is variable. In the *Telephoroides*, a class of Beetles, and in some of the Saw-flies, the larvæ have but one eye; those of the *Cassida*, another family of Beetles, have three; the larvæ of another set of Beetles, the *Staphylides*, have four; and some Coleopterous larvæ have five or six. When there are several eyes, they sometimes differ very conspicuously in size, and also in other respects, the smallest having neither pupil nor iris. In the larvæ of *Lepido-*

ptera the eyes are commonly six in number, and no instances are known in which that number is exceeded. The disposition of the eyes varies considerably, but they are generally arranged in a circle.

THE ANTENNÆ, or horns, as they are vulgarly called, which form so conspicuous a feature in perfect insects, especially Butterflies and Moths, and many of the Beetle tribes, are far less prominent in the larva; still, rudimentally, or in a less noticeable form, they are almost always present, and are generally situated near the base of the mandibles. In *Neuroptera* indeed, that is, the Dragon-fly tribe, they closely resemble those of the perfect insect; but in most other orders this is by no means the case. Sometimes they are so minute as not to be perceptible without the assistance of the microscope; but it would seem, as before stated, that they are never entirely absent, as that accurate observer, Macleay, discovered them in many cases where they were supposed not to exist; in fact, in every larva which he examined with a view to their detection.

The Caterpillars of *Lepidoptera*, however, exhibit them on a very minute scale compared with the prominent dimensions of those of the perfect insect; yet there are some few cases in which this rule is reversed, as in those of some of the *Ephe-*

merides, in which the antennæ of the larvæ are as conspicuous in the preparatory as in the perfect form.

The antennæ of larvæ have sometimes a peculiarity of structure which is very remarkable, and not found in those of the perfect insect; this peculiarity enables them to be drawn in or lengthened at the will of the larva. Those of the *Cossus* Caterpillar, for instance, according to Lyonnet, are capable of being entirely withdrawn into the first joint, so that it appears as though altogether deprived of this appendage.

THE MOUTH of most larvæ is very similar in structure to that of the perfect insect, with the remarkable exception of the Butterfly and Moth tribe, in which the mandibles of the larva entirely disappear in the perfect insect, to be replaced by a feeding apparatus of an entirely distinct kind. To this exception may be added one of a somewhat analogous description, which occurs in some few *Neuroptera* and *Diptera*.

THE TRUNK AND ABDOMEN together are generally composed of twelve segments, occasionally fourteen, but never more. In the larva of the Water Beetle the segments forming the trunk are longer than the others, while in most *Lepidoptera* they are shorter.

THE FEET of larvæ are of two kinds, both of which are especially remarkable in the larvæ of Moths and Butterflies; but in some classes, as that to which Bees belong, and that in which the Gnat tribes find their place, legs are altogether absent, with a few exceptions. One special class of Beetle larvæ is also without legs; those of the *Curculionidæ*, for example, which, like the footless class named above, are of course mere worms, with the exception of certain rudimental and somewhat gelatinous tentacles in the form of small tubercular excrescences, which assist the balance in moving.

Of the two kinds of feet referred to, the first are the six feet attached to those segments of the body, most commonly three in number, which form the trunk. These feet are regularly jointed, and are, in fact, the only true feet, or *pedes veri*, as they have been termed, within which the legs of the perfect insect may be said to be contained.

The second kind are those merely membranous feet attached to the abdominal portion of the body, and commonly called ventral feet; also *pro-pedes* and *pedes spurii*; that is to say, membranous substitutes for feet, or spurious feet. These spurious feet generally commence on the sixth segment, and the four pairs are placed on that and the next three

segments. Then occur two segments without feet, and then another pair on the anal or last segment.

Some of the "False Caterpillars," as they have been termed, have as many as fourteen and sixteen spurious feet (or *pro-legs*, or *pro-feet*), as in the cases of *Tenthredo cerasi* and other kinds of *Tenthredo*; while a large class of true Lepidopterous larvæ is entirely without the pro-feet of the ventral segments. These are the "Loopers;" the Half-loopers having only two pairs. The absence of the ventral legs in the true Loopers obliges the larva, when in motion, to bring up those situated at the anal segments close to the segments which are furnished with the pectoral legs, thus forming the body into a loop, and then advancing the anterior portion of the body till it becomes straight, the anal pro-legs being again brought up as before. It is this action which has suggested the name of *Earth Measurers* or *Geometræ*.

Some Caterpillars walk much more swiftly than others, while some, it is said, can even leap. De Geer and Roesel mention the Caterpillars of *Lithosia Quadra* and *Herminia Rostralis* as having this power. This depends, doubtless, on the formation of the pro-feet, which differ much in structure, some having hooks, others none. There are some curious

exceptions to the ordinary arrangement of pro-legs and true-legs; for instance, though in almost all cases the pectoral or true feet of Lepidopterous insects are much shorter in the larva than in the perfect insect, yet in that anomalous Caterpillar popularly known as the Lobster (see Plate V. No. 3), the pectoral legs are as long, or longer, than in the perfect insect; this form being required, it is said, in order to enable it to spin its complicated cocoon. In the larva of Beetles the pro-legs seldom occur, or are, at all events, not well developed.

Some kinds of larvæ are furnished with other appendages, in addition to their feet, to aid them in locomotion, such as the hooks on the back of the larva of a little Beetle, *Cicindela Hybrida*, which assist it in ascending the hole in which it lives; the fringes which assist water larvæ in guiding their course; and a similar appendage by means of which the larvæ of the great Water Beetle are enabled to suspend themselves at the top of the water to take in air.

THE SPIRACLES or BREATHING PLACES never occur in the head, nor in connection with the mouth, as in the higher animals, but are arranged along the sides in the perfect larvæ, and sometimes along the back or underneath in the larvæ of insects

which do not undergo a perfect metamorphosis. In the larvæ of Butterflies and Moths they are very conspicuously situated above the feet in the side of each segment, and generally surrounded by an iris of a very distinct colour; they are in Caterpillars generally eighteen in number. In the larva of the Gnat, however, and also in many that have the fore part of the body buried while feeding, the breathing apparatus is situated near the tail.

The aquatic larvæ of some of the *Ephemeræ* breathe by means of delicate feather-like branchiæ analogous to those of certain *Molluscs*. These branchial organs are sometimes arranged along the sides, and in others placed at the tail, as in the case of the larva of the purple-winged Dragon-fly. In these arrangements there are many modifications, and the branchiæ serve occasionally the double purpose of a breathing apparatus and a fin-like means of locomotion.

THE MEANS OF DEFENCE of larvæ are in some instances curious. Some have the faculty of dropping from a branch as though dead when approached, spinning at the same time a web like that of a Spider, either to break their fall or to serve as a means of re-ascent when the danger is over, though I have never observed the web to be made

use of in this way. Some merely curl up, presenting a circle of silky spines (if of the hirsute kind), after the manner of a Hedgehog. Some of the Loopers extend their bodies in a straight line at nearly a right angle from the branch on which they are resting, looking so exactly like a small dead branch, as to be often passed over without notice, even when close to the eye, though a hungry bird is seldom so easily deceived as the entomologist, and darts upon them without hesitation.

A small Lepidopterous larva, that of *Dicranura Vinula*, has on the segment next the head a small forked excrescence, each point of which is furnished with a kind of rose like that of a watering-pan, through which it can squirt to some distance a little shower of acrid fluid, which causes for a short time acute pain if it fall in the eye. This singular larva has also another defence. It can put forth from their cases near the tail two red filaments, which it has the power of whisking about in every direction, and is thereby enabled to drive off a special enemy in the form of an Ichneumon, which continually seeks to deposit its eggs in the skin of this fierce little Caterpillar. Other Caterpillars, figured by Merian and Horsefield, have, in appearance, somewhat similar appendages to those last named, and so

have those of the Puss-moth tribe; but it is not known how far they have the same powers to use them for the same purposes.

Some Caterpillars have the power of exuding globules of a fluid which emits a foetid odour, serving as a defence, and which is re-absorbed, to serve on another occasion, directly the present danger is over. In some of the larvæ of the genus *Papilio* the fork on the first segment only emits an odour, without any fluid.

In speaking of means of attack or defence, the curious mask of the larva of the Dragon-fly should not be omitted. This curious appendage conceals the formidable jaws of the creature as it is stealing upon its foe; and being raised, not only gives them full play when the moment for action arrives, but also closes upon the victim when seized, and prevents the possibility of escape.

THE SPINNING POWER, by means of which the cocoon is formed by the Silk-worm and many other kinds of larvæ, is generally situated in the head, but in some at the other extremity of the body.

THE SKIN varies in hardness, as I have said before. In some of the Grub kind it is very soft, except at the head, or trunk segments; in others, it is horny, and in some, transparent. In true Caterpil-

lars, such as those of Butterflies and Moths, it is often beautifully variegated with the richest colours and most exquisite markings, and also in some kinds with beautiful silky hairs, which sometimes clothe the whole body, and in other cases are arranged in tassel-like tufts of various kinds. Others have curiously branching spines issuing from each segment, the use of which is unknown, but which are often very beautiful. The skins, or rather furs, are cast several times, as previously described, each of their skins having, as shown by Swammerdam, existed under the other from the beginning.

It has been considered somewhat inexplicable that the external markings and colouring of the Caterpillar seldom foreshadow, in the slightest degree, the colours of the perfect insect. Some of the most dingy Caterpillars, for instance, produce the most splendid Moths; and, on the other hand, magnificent Caterpillars—and some of them are well worthy of that term—often produce, to the great disappointment of those who have reared them, simple dark-hued insects, of the most inconspicuous character as to colour and markings. Some American Caterpillars, it has been remarked, are so precisely like certain of our own in external appearance, that they have been taken for the same species,

and have yet produced Moths, or Butterflies, as different as possible from those produced by the English species which they so closely resembled. There are, however, instances of an opposite kind, which make the whole arrangement appear still more capricious. The Caterpillar of the Currant-moth, for instance, is white, spotted with black and orange, like the perfect insect; and several other instances might be cited, but they form a very small minority.

THE GROWTH of Caterpillars is sometimes very rapid—at other times quite the reverse. In some cases the increase of size after hatching is enormous; the weight of the Cossus, when full grown, as we are told by Lyonnet, being 72,000 times greater than when first hatched; but then he is very long lived.

The growth takes place most rapidly after each moult or change of skin. “The head of the Silk-worm, after casting its skin, becomes almost immediately four times its previous size,” says Malpighi; but then it is a voracious feeder, and consumes in thirty days above an ounce of leaves, thus devouring above 60,000 times its own original weight, which is, when hatched, only about the hundredth part of a grain. I may here suggest that the Vivarium is exceedingly well calculated for the

rearing of Silk-worms during their feeding period, as it would secure them against those sudden atmospheric changes which are very injurious to them, and be the means of a great economy of food ; for by placing the lower end of a branch of Mulberry in one of the water-bottles, the leaves would be kept fresh till all consumed, and at the same time be rendered more healthy for the Caterpillars to feed upon than half-withered ones. The greatest rapidity of growth, however, is perhaps that which takes place in a class of larvæ which do not “moult” —those of the House-flies, which, says Redi, become from 140 to 200 times their original weight in the first twenty-four hours after hatching.

Some small larvæ become larger insects in their perfect state than those of greater dimensions, while some of much larger size produce, after their final change, insects strikingly smaller than their proportion would lead us to expect.

THE DURATION OF THE LARVA STAGE varies exceedingly. That of the well-known Butterfly *Argynnis Paphia* changes to the pupa state in fourteen days ; Bees remain about twenty days in the larva stage. The Cossus and the May-bug are said to pass three years in the larva state ; and the Beetle *Oryctes Nasicornis* four years. The larva

of the Stag Beetle, does not change for six years ; while some of the wood-eating larvæ are supposed to live in that stage very much longer.

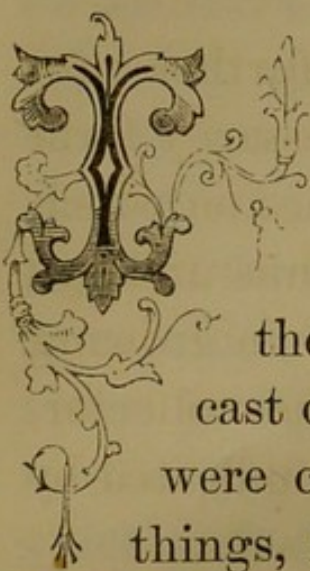
In the "Linnæan Transactions," for instance, there is an interesting account by Mr. Marsham of the coming forth of the perfect form of *Buprestis Splendens*, an exotic insect, which is a wood-borer in its larva stage, and which he infers, from the following circumstances, must have passed full twenty years in the larva state:—In the year 1810, the perfect insect emerged from the wood of a desk made of foreign wood, for a public office, in 1788-9, from which the long period of its larva existence seems pretty clearly shown. It would seem that meat-eating larvæ undergo their change most quickly, and that those feeding under ground, or in wood, are the most tardy in their transformation ; while those which are leaf-feeders, such as those of Butterflies, etc., hold a medium place.

Among water larvæ it may be noticed that those of Gnats change in a few weeks ; those of the Dragon-fly tribe, according to De Rambur, in about a year ; while some of the *Ephemæræ*, as though to compensate for the exceeding brevity of their existence in their winged state, live several years in that of an aquatic Grub. The manner in which

larvæ, when about to enter the pupa state, prepare for that change by the construction of complicated cocoons, and by many other preparatory arrangements, the result of their peculiar instincts, must form the subject of the next Chapter, in which I intend to give some account of the pupa stage of insect life.

CHAPTER VI.

THE PUPA OR CHRYSALIS—PREPARATION TO ENTER INTO THE PUPA STATE—ITS CHARACTER, ETC.



THE perfect chrysalis was called a “pupa” by Linnæus from the Latin *pupa*, an infant, because he considered it like a young infant “swathed” after the continental manner, and destined to cast off its swathing at a proper age. They were called “chrysalides,” or golden-hued things, from the peculiar metallic and golden gloss which some exhibit, as described in another place.

When the Caterpillar, or any kind of larva, feels itself about to enter into the pupa state, the signs of the approaching change being always correctly interpreted by an unerring instinct, it generally seeks some situation in which it is likely to remain secure during the period of its dormant and defenceless state. Many of the larva of the Beetle tribe, and those of *Hymenoptera*, allied to the Bee family,

however, sink gradually into a torpid state when they are full grown, without making any preparation for the change, their secure situation rendering it unnecessary. This security occurs, especially in the case of Bees, from each larva finding itself in a cell prepared for it, even before its birth, in which to pass the first three stages of its life—that of the egg, the larva, and the pupa.

Most of the root-feeders seek no further protection than the hollow which they necessarily form in eating their way through the substance on which they feed. The larva of many Beetles thus undergo their change either in old and rotten or in growing wood, where they may be sought by the collector, as their place of retreat will always be indicated by the effect produced in their previous ravages.

Others, in a less secure situation, appear to have the instinct to protect themselves from accident during their pupa state by timely preparation; but many of these, after a period of restlessness and apparently a vague search, seem to content themselves, in despair of doing better, with a heap of dead leaves or a slit in a tree, or beneath a flake of decaying bark, where I have sometimes found huddled together several chrysalides of the Red-underwing Moth. Others seem at last to determine upon

burying themselves at a considerable depth in the earth, as the most secure position in which to undergo their change, and often make themselves a kind of vault, by consolidating the surrounding soil with a mucous fluid. The larva of the Meat-fly quits the scene of its repast when full grown, and seeks at some considerable distance a fit place for its change; but a heap of dust, or any kind of dry rubbish, generally suits its purpose, as it is not particularly fastidious in its choice.

Many, having found what appears to them a suitable retreat, take no more precautions, like those whose position is naturally secure at the time, from the nature of their habits. Others, like the larvæ of the *Syrphus* and Lady-bird tribes, merely secure themselves by a few threads, spun at the caudal extremity, by means of which they remain firmly attached to the leaf they have selected as the scene of their transformation, in the position in which the chrysalis of *Chrysomela Tremulæ* is represented in Plate VII. No. 6.

Some small insects, as *Harpya Fagi*, masticate portions of wood from the tree on which they feed, for the purpose of forming a pupa-house, mixing with it a fluid furnished by the mouth, which causes the composition to solidify very rapidly, and the

little cocoon becomes eventually so hard that a knife will scarcely make an incision in it.

Aquatic larvæ, such as that of the Water Beetle, *Dyticus Marginalis*, burrow in the banks at or near the surface of the water, and there undergo their change in a well-made cocoon of earth, which they construct with much skill, and in which the larva, gradually shortening and changing in all its proportions, by degrees becomes a perfect Beetle (during what Linnæus has termed the *nymph* state, to distinguish it from that of the true chrysalis), but it is still white and soft in all its members, even more so than in the Caterpillar stage, till the hardening process begins. Some of the earth cocoons, or rather cases, of this kind are very compact and hard; others comparatively brittle and easily injured. The aquatic larva of the Dragon-fly has the faculty, as stated in another place, of preparing for its future destiny by actually quitting its native element, and preparing to undergo its change to the pupa state, while clinging to a rush or reed just above the surface of the water, but without any protection whatever.

The most interesting cocoons, and other protective habitations for undergoing the transformation to the pupa state, are those constructed by the

larvæ of Butterflies and Moths, from that of the Silk-worm down to the most minute grub of the *Tineæ*. Those of the wood-feeding class have, however, more affinity in their habits, at this period of their existence, to the larvæ of Beetles. The Cossus, being a long-lived larva, makes itself each winter a sleeping-room, similar to that which it eventually forms for its abode during its change to the winged state, which it effects by webbing together, with the silky secretion it is furnished with for that purpose, the fragments of wood produced by its own depredations.

Some of the small Moths, among the *Tortrices* and *Tineæ*, also make themselves abodes for their period of change from the *débris* which they have created. Some of the same class of small Moths unite several leaves to form a protection, and others make one leaf serve their purpose, by skilfully forming it into a hollow roll, in the interior of which, within a slightly webbed cocoon, they pass through the pupa state in tolerable security. These are termed the Leaf-rollers.

The process pursued by the Leaf-rollers is very curious, and was first observed in all its complications by the indefatigable naturalist Bonnet. I have not space for his interesting description, but

the summary of it is as follows:—The larva first attaches a series of threads, at regular distances, to the part of the leaf which is to be rolled over. Having completed this part of its work, it begins to pull them one by one, till by degrees, drawn by these gossamer cables, the leaf begins to turn over in the direction required. If the leaf be of too stiff a texture, refusing to yield to all the tension its means can exert, the little larva gnaws through portions of the veins, or eats away part of the surface of the leaf, till the causes of resistance are thus weakened, and the green bed-curtain which is to shelter its long slumber is drawn closely round in the direction required.

Other larvæ of the same class, instead of rolling, cut off portions of the leaf, to form the sides and top of the dwelling, the floor being supplied by the part of the same leaf not mutilated. Reaumur carefully watched the progress of another minute larva, the *Tineæ*, in the act of splitting the upper from the lower surfaces of rose-leaves, and making its sleeping-room between; and if, in the course of the process, any portion became too far divided or rent, it was refastened with a web so neatly, that the repair was scarcely visible to the naked eye. Other kinds make leaf habitations by sewing

together pieces of peculiar shapes, as cunningly as a tailor fashions the back of a coat; and in this work the seams, too, are as neat and regular. Many other methods are followed by these small larvæ in constructing leaf houses, in which as much ingenuity and geometrical precision is displayed as that which the Bee exhibits in the plan and execution of the wonderful "honeycomb."

The *Tinea Sersatilla* makes its house entirely of the silken web, which it spins in a similar manner to that of the Silk-worm; in this case, however, it is not merely a cocoon in which the transformation is to take place, but at the same time a little tent, which serves it for a locomotive living house before it becomes a temporary tomb. This tent is carefully pitched at a certain spot, where the pulpy surface of the leaf seems most inviting, and there secured by far-stretching threads, similar to those of an ordinary camp tent.

When all the surface beneath this shelter has been consumed, the tent is removed; till at last, when the larva has ceased to desire food, and is about to change, the little tent serves as the protection for the pupa or chrysalis. The minute silky excrescences often seen on the backs of pear leaves are the tents of this little larva, and on

examination would be found to contain either a minute chrysalis or a little yellow grub with a black head, which is the larva of the *Tinea* in question.

The larva of the *Tinea Paliatella* makes a similar kind of tent, with the exception that the webbing is so disposed as to look like a roof of small white tiles, or rather scales.

In the Beetle tribe some of the larvæ, when about to change, cement portions of the surrounding earth together, so as to form a secure retreat, as in the case of *Clythra Longimana*. In some instances these cases are lined with a silky substance, or, as it were, varnished with a slimy secretion.

A larva that infests Beehives constructs for itself a kind of gallery or covered way as it goes forward, the interior of which is lined with a smooth web, so tough that Bees in vain attempt to expel the intruder by piercing it with their stings. It is proof against all their efforts, and they frequently desert their hive in despair at being unable to get rid of the invader. This constructor of sting-proof galleries has received from Fabricius the characteristic generic name "*Galleria*," to which is added the specific denomination "*Cereana*," in al-

lusion to its destruction of the wax of the honeycomb. The *Galleria* genus contains no other British species.

Most of the habitations framed by larvæ for protection during the pupa state are, more or less, nearly close fitting, and these may perhaps be considered rather in the light of clothing, while others more roomy may rather be considered as residences.

The woollen tubes formed by the larvæ of various small Moths of the *Tinean* family are very curious, and an interesting effect may be produced by guiding their industry after a certain manner. For instance, by carefully placing the larvæ successively on cloths of different colours, their case will become variegated by the new material, each time they enlarge it to suit their increased growth. A very richly coloured tube is thus produced by the successive addition of blue, red, green, white, or any other coloured cloth that may have been selected. The garment of many colours so formed is a very pretty object when examined with the aid of a powerful microscope, and the experiment is well worth trying.

Some of the small larvæ which feed on the blossoms of the kind of willows that generally grow on the banks of ponds or streams, make their houses

of the down that covers the seed-vessels of this tribe of trees. The little Caterpillars know how to render their so-formed structure completely water-proof, by " felting " it with a fluid with which Nature has furnished them for that purpose. The house therefore serves them, in time of need, as a boat also, if unluckily blown by the March or April winds from the branches where they feed into the water below ; in which case they float securely to shore in their little life-boat. Branches of willow might be sought when in blossom in the early spring, on which some of these interesting little architects and ship-builders would be pretty sure to be found ; and by placing the said branches, with the stalks in water, in the Vivarium, their transformations might be watched. The branches might also be made to lean over the tank, and some of the larvæ shaken into it for the purpose of observing their escape in the little floating houses.

Among the better known cocoons or chrysalis-houses of the larger Moths, the first place must always be given to that of the Silk-worm, the finely spun web of which has for several thousands of years furnished the silk of commerce to Oriental nations, though the knowledge of the Worm and the method of procuring its silk has only been generally

known in Europe since the thirteenth century. In proof of the extremely early manufacture of silk in the East, it may be stated that at the time in which the earliest kind of Chinese writing was in use, which was a pictorial hieroglyphic character very similar to that of Egypt, silk was expressed by a sign in the shape of a twisted hank of that substance, in the very form in which it is manufactured in China at the present day. And as the earliest class of this writing did not remain in use later than about 3000 B. C., it proves that manufactured silk was a well known product at that early epoch. The cocoon of the Silk-worm, however, though of great interest, is too well known to require description here; it will suffice to remark that many cocoons of very similar character are produced by the larvæ of other Moths, which have at different times been thought capable of yielding an equally valuable silk, although the experiments upon them for that purpose have hitherto always failed.

The large silk-like cocoon of the handsome Moth *Saturnia Spini* is of an entirely different nature, not being formed of spun silk, but of the silky hairs from the body of the larva, which are woven, or rather felted together, instead of forming a con-

tinuous web like that of the Silk-worm. *Saturnia Carpini*, another of the family, however, makes a very pretty cocoon of true silk, as do the larvæ of many British Moths; while others mix with the silk other substances, which they weave along with it. *Chelonia Villica* weaves a cocoon of very loose, open thread; the Fox-moth, a close semi-transparent tube, closed at each end and bent in the form of a crescent, much larger than the chrysalis. This cocoon has somewhat the consistency of tissue-paper, and within it the chrysalis is said to move about, as described when speaking of the power of movement in chrysalides.

The Burnet-moth Caterpillar also makes a cocoon of singularly compact paper-like tissue, as do some others; while the handsome Caterpillar of the common Moth, *Clisiocampa Neustria*, weaves a woolly-looking yellow cocoon, which appears covered with a substance like powdered sulphur.

The small larvæ of one of the Moths of the *Tortrix* family, *Tortrix Prasinana*, forms a compact brown cocoon of a curious boat-like shape; and endless other varieties of form and general character occur.

Although it has been shown what comfortable houses of silk, and other analogous substances, the larvæ of Moths form for themselves as retreats in

which to undergo their pupa stage, those of Butterflies scarcely ever provide any sort of protection for this state. When the larvæ are full grown and cease to feed, they betray the same uneasiness which is common to other larvæ, and frequently quit, as in disgust, the plant on the foliage of which they have been nourished, in search of some situation deemed more secure, as may be witnessed by placing the Caterpillars of two or three common species in the Vivarium, such as that of the "Cabbage White," and that of the small Tortoise-shell or Peacock Butterflies. Notwithstanding this apparent anxiety however, they are at last content merely to fasten themselves to some place which their instinct suggests to them as convenient, by means of a loop formed of a few threads of a web which they have the means of spinning.

The process is effected in the following manner:—The Caterpillar of the common Cabbage White Butterfly, when for this purpose it has taken its post against a branch or wall, or piece of paling—for it seems to prefer a solid support—first spins from its mouth a small knot of silky thread, which it fastens on one side of its body near the front pair of ventral legs. Then, passing the head over to the other side, it carries a thread with it and attaches it

to the wall or branch in a corresponding position on the opposite side of its body. In this way a loop is formed which will effectually prevent the Caterpillar from falling as he sinks into a dormant state. But it is not yet strong enough, the thread being of excessive fineness, and therefore the process is repeated about fifty times, as observed by Reaumur, when the number of threads is generally deemed sufficient. In order to secure a sufficient degree of slackness in the loop, to allow for the thickening of the body in the chrysalis state, Reaumur describes, at considerable length, a process by means of which that necessity is ingeniously secured; but I have, nevertheless, observed that the loop round the chrysalis often appears uncomfortably tight, nearly cutting a dent into the external skin, as represented in Plate III.

A different method is pursued by the Caterpillar of the Great Swallow-tail Butterfly, the handsomest of our native species, in consequence of the comparative want of flexibility in its more robust body. Not being able to turn the head freely backward to form a loop across the middle of its body, it makes the loop immediately in front of its head, into which, when complete, it gradually forces its body, segment by segment, till it has attained the position in

reference to the loop which is best calculated to afford an even balance, and then, like the larva of the White Butterfly, it holds itself still, and in a straight position, to await the impending transformation. Sometimes, in spite of the beautiful accuracy with which it performs its work, the head gets entangled in passing through the loop formed of forty or fifty threads, which causes great labour to the unfortunate larva. Generally, however, after repeated efforts, it manages to extricate itself and complete its preparation ; but in the contrary case, it always perishes without the transformation being accomplished.

A third method of forming this loop is practised by the short, Wood Louse-formed Caterpillars of the pretty little Butterflies of the *Thecla* family. These Caterpillars, the shape of which may be judged of by that of one of the *Argus* family, in Plate II. No. 7, place the loop just over the head, instead of in the front of it like the larvæ of the Swallow-tail, and afterwards force the body forward till the loop is nearly in the middle.

The larvæ of another class of our native Butterflies, instead of securing themselves by means of a loop round the centre of the body, suspend themselves by a kind of web, which attaches the tail to

the under surface of some conveniently placed leaf, and they thus hang suspended, head downwards, to undergo their transformation, as shown in the suspended chrysalis in Plate II. No. 3. This mode of undergoing the change to the pupa state is common to most of the larvæ of the handsome species of the genus *Vanessa*, among which are the Peacock, the Red Admiral, the Painted Lady, etc. The larva of the Purple Emperor also suspends itself, as do those of our pretty Fritillaries and Meadow Butterflies.

When the case of the pupa is completely formed inside the last skin of the Caterpillar, which soon afterwards splits and falls off, another skin is cast, inside, by the insect within the pupa-case; and this skin remains in the shell, where it may be found after the perfect insect has escaped.

Some larvæ, after forming the cocoon, change almost immediately to the chrysalis state, while others remain within the cocoon for months still in the larva form. The *Cossus*, for instance, when it spins its cocoon for change in autumn, remains in the Caterpillar state within it till the following June, when it becomes rapidly a chrysalis, and the perfect insect comes forth in a few weeks.

There are many different kinds of pupæ, but

they may be divided into three tolerably distinct classes:—

First, those which so closely resemble the larva stage, that the precise time of transition is scarcely perceptible.

Secondly, those partially resembling the larva, but having rudimental wings appearing more conspicuously than in the preceding state.

Thirdly, those in which the form of the larva entirely disappears in the case or perfect chrysalis, or becomes a form of the nymph kind.

Or they may be divided into two divisions only; those which are active during the pupa or nymph stage, as Grasshoppers, etc., and continue to eat; and those which sink into a partly dormant state, as those of Butterflies and Moths, certain Beetles, Dragon-flies, etc.

Within the case, the pupa itself exhibits, at a comparatively early stage of its progress, nearly all the parts of the perfect insect very distinctly. In such pupa cases as those of the Dragon-fly, which enclose each principal member separately, the eventual forms quickly assume, with the exception of the wings, nearly their full proportions and natural position, though in a soft state. In the complete chrysalis, where all the members are tightly

enclosed within one entire shell, they are very curiously folded close to the trunk, either against the sides like the wings, underneath the body, like the antennæ of Butterflies, or over the back, like the slender oviduct of the Ichneumons. I may mention here, that the legs of *Tipulæ*—the Harry-long-legs tribe—are triply folded in a very beautiful manner, and that the pupæ of some Beetles exhibit curious excrescences, which entirely disappear when the change is complete.

We must, however, devote the principal part of our attention to the true chrysalides, such as those of Butterflies and Moths, as more likely to be interesting to the general reader. Many a naturalist, indeed, has had his attention first called to the subject by the sight of a single chrysalis, that curious and evidently living thing, yet without any apparent power of taking nourishment, without sight, and without means of locomotion, and yet which contains, as he is told, a perfect Butterfly—a creature that will in due season break forth from the shell, and expand its wide and beautiful wings, uninjured by their close folding within that narrow prison. De Rambur, in fact, states in one of his works, that the first sight of a chrysalis, when a boy, at once made him an entomological student for life.

A chrysalis must be carefully examined before all its interest can be fully appreciated. Each delicate line and wrinkle on the nearly even surface of that of a Moth, for instance—marks which appear to the unobservant only so many accidental ridges or indentations—form, in fact, the outlines or immediate encasings of the enclosed members of the Moth itself; and to each of these features, in the shell of the chrysalis, the late Mr. Kirby assigned a fitting name.

The only part endowed with any power of motion is the segmental portion which encloses the abdomen of the insect within. This jointed portion of the chrysalis Mr. Kirby termed the *gastrotheca*, from the Greek words, *gaster*, the abdomen or stomach, and *theké*, a case or receptacle.

The other extremity, which, with a little examination, will be seen to indicate the forms of the head, of which it is a kind of close horny helmet, was called the *cephalotheca*, or head-case; and a portion of this, fitting the eyes, the form of which may be traced in the two raised gobules, was called *ophthalmotheca*, or eye-case. Passing from beneath the head are two delicately raised ridges, very gracefully curved, which contain the antennæ, and have, therefore, received the name, respectively, of *cerathecæ*; while the main portion, in which

the form of the trunk or fore part of the body of the Moth may be traced, is called *glossotheca*. At each side of the *glossotheca*, the student will perceive a series of radiated markings, forming, with the outline against which they abut, a shape not unlike that of a half-expanded fan, the narrow end or handle of which is underneath the trunk, leaving the radiations to spread upwards. These are the portions of the general sheath which enclose the embryo wings, the outline of which, as they exist in miniature within the shell, is plainly indicated. These, therefore, have been each termed a *pterotheca*, or wing-case. If the student will take the trouble to examine a chrysalis thus carefully, before placing it in his Vivarium to await its change to the perfect state, an intimacy with many delicately marked features, that might easily have been passed by unobserved, will have been so established as to give much additional zest to the eventual disclosure of those inner forms of which they indicate so beautifully the leading characteristics.

The chrysalis selected for the foregoing description of all its parts was that of an ordinary Moth, the chrysalides of that division of the pupæ of *Lepidoptera* being comparatively smooth, as shown in the empty case, Plate IV. No. 2. Those of the

Butterfly division, on the other hand, offer much greater variety of form, nearly all having curious little points at intervals along their ridges, and being in general of an angular rather than a conical form, as shown in the suspended chrysalis, Plate II. No. 3. Of these angularities, the chrysalis engraved in the work of Madame Merian, of the magnificent Butterfly *Morpho Idomeneus*, may be cited as an extreme example; as is also that of *Ornithoptera Heliakon*, figured by Horsefield in his fine work on the insects of Java, still incomplete. For the extreme angularity of the entire form, that of *Callidrias Eubalus*, figured by Stoll, may be cited, the part containing the head dipping downwards in a nearly vertical direction, while the tail portion shoots off from the root of the wing-case in a nearly horizontal line. The chrysalis of our pretty native Butterfly the Orange Tip, *Euchloe Cardamines*, is of somewhat similar formation, and therefore assigned to a class popularly called "boat-shaped" chrysalides.

The small and perfectly oval chrysalides so often found are those of the *Syrphus* tribe, and of common House-flies, etc., of which there are many modifications of form. That of *Syrphus Pinastri* is shaped like a small flask, or, as Reaumur poetically

expresses it, like a "tear." In some instances, the extremity terminates in a slender tail-like appendage, either forked or simple.

Some chrysalides have, like nymphs, or semi-pupæ, a means of locomotion, though very restricted in its character. This means is generally furnished by such spines as those on the sides of that of the *Cossus Ligniperda*, which are said to enable it to force itself partly out of the hole in a tree in which it has lain, just in time and just sufficiently to allow the winged insect, when the shell opens, to escape without injury to its wings; and that of the hop-feeding *Hepialus*, the Common Swift, is said to be furnished with similar appendages, by means of which it is enabled to move about in its spacious cocoon; while the chrysalis of the handsome Moth *Lasiocampa Quercus* is said to move up and down its long crescent-shaped cocoon (similar to that of the Fox-moth) like a chimney-sweep, getting up with considerable labour, but coming down much more rapidly.

Other chrysalides, though necessarily, as it would seem, so inert from the nature of their structure, have yet positively the power of leaping. This was observed by the indefatigable Reaumur in some small chrysalides, which, by holding them-

selves bent, and then suddenly curving in the opposite direction, are enabled to leap a distance of two or three inches and even more. It unfortunately happened that they had all been victims to a small kind of Ichneumon, so that he never knew precisely to what class of insects to assign them.

IN COLOUR, chrysalides in general do not offer either such brilliancy or variety as caterpillars. The shell-less nymphs, or imperfect pupæ, are generally of different shades of dusky white; while the perfect chrysalides of the smooth conical kind are most commonly dark brown or black. The angular chrysalides of Butterflies are, however, not only prettily spotted with minute specks, but sometimes often variegated with small metallic patches of light orange colour that have the lustre of gold. The boat-shaped chrysalis of *Euchloe Cardamines* is bright green, as is that of the Purple Emperor, while some of the angular chrysalides of the genus *Vanessa* are almost entirely of a bright metallic golden hue, from which the general terms Chrysalis and Aurelia are derived, from the Greek words krysos (κρυσος), gold, or krysalis (κρυσαλλis), golden coloured, and from the Latin *aurum*, gold, or *aurea*, golden. The early collectors, who then, as now, generally began their

entomological collection with a single chrysalis, or aurelia, were, in fact, called "Aurelians." Reaumur explains that this golden appearance is caused by the more solid texture of the chrysalis being of a rich yellow colour, and clothed with an external and transparent membrane, beneath which is a layer of fluid, which gives the metallic effect. If, in fact, a newly formed chrysalis of a *Vanessa* be turned about, the gold patches will be found to move with the fluid by which they are caused, and, when old and dry, the golden hues disappear altogether. The chrysalides of Moths are, as I have said, almost invariably of various shades of brown, from a light foxy tone to nearly black, but some few are of more striking colours. That of *Geometra Alniaria*, for example, is of a glaucous blue; that of *Catocala Sponsa* of a light lilac; that of *C. Pacta* of a delicate blue, arising from a kind of bloom with which it is covered. This bloom is easily brushed off, but reappears again in a short time.

Some few have the wing-cases of a different colour to that of the shell; and the chrysalis of *Pygæra Anastomosis* has two red stripes on the back.

The duration of the pupa stage is from a few

days to two or three or more years, the smaller kinds, in general, undergoing their changes more rapidly than the large ones. The influence of temperature is much more apparent in the case of chrysalides than it is with eggs, as satisfactorily proved by Reaumur. He placed a number of chrysalides in a hot-house in January, which under natural circumstances would not have given forth the perfect insect till May; but which, influenced by the artificial heat, opened within fourteen days. A contrary experiment was equally successful; a number of chrysalides placed in an ice-house being retarded during a whole year. It should be stated that those raised by heat were all healthy, and bred and laid their eggs, which were successfully hatched. This sufficiently demonstrates the possibility of rearing splendid tropical species with the assistance of artificial heat, as described in my Chapter upon that subject.

To return to the consideration of the time passed in the pupa state under ordinary circumstances, I may remark here that seemingly inexplicable variations in this respect occur in the same species. Out of a batch of chrysalides, of the same brood, the great majority will open at the usual time; but some few will invariably remain in the

chrysalis state during irregular periods afterwards, a few not expanding till the following season. Lacordaire mentions a particular case of this kind in Cayenne, where, out of a brood of the fine Moth *Saturnia Paphia*, which he had reared, the greater part only remained in the chrysalis state fourteen days, while a few continued for several months in that state, afterwards producing the matured insect in a perfectly healthy state. This would appear to be a providential arrangement to prevent a species from becoming extinct by any sweeping calamity, such as a storm, change of temperature, or insect epidemic, which might sweep off a whole species if all came out precisely at the same time. In such a case, the reserve, safely secured from the calamity in the pupa, would come forth at a more propitious season and restore an otherwise lost species.

While speaking of the coming out of a particular kind at an exact season, I ought to mention some of the *Ephemeræ*, one species of which, according to Reaumur, invariably appears between the 10th and 18th of August, and at no other time. Fishermen are well acquainted with this fact, and are never disappointed in the appearance of these aquatic flies, which they sometimes use as attractive baits. Swammerdam had previously observed simi-

lar facts concerning the *Ephemeræ* common in the Rhine.

The broods described by Reaumur not only appeared at a precise season but at a particular hour, which was invariably between eight and ten o'clock in the evening, at which time they filled the air in vast multitudes, regardless of the state of the temperature, or of wind or rain-storm. Their appearance and disappearance are both very sudden, not a single individual being visible an hour before or an hour afterwards.

Other insects have also particular hours of preference, as it would seem, for the entrance upon their most brilliant, but brief and final period of existence. The *Bombyx* of the Mulberry never emerges from its chrysalis but at the hour of sunrise; the Lime Hawk-moth, *Smerinthus Tiliæ*, at midday; the Death's-head Hawk-moth, *Acherontia Atropos*, according to Schroeter, always making its escape from the chrysalis between four and seven in the afternoon. But with regard to other kinds, either they are altogether irregular in this respect, or the observations of our naturalists have not yet furnished us with a sufficient number of data on the subject to enable us to decide the question.

The method by which different insects escape

from the chrysalis are very various. In the case of Butterflies and Moths, which do not make a cocoon in which to pass the chrysalis state, the manner of coming forth is very simple. The skin of the chrysalis splits up the back so soon as the imago attains its full size, and the rent being increased by the effort of the imprisoned insect, the escape is easy. It is much the same with Dragon-flies, though the chrysalis is of a different kind.

In several other classes of insects, however, the means by which the escape is effected are exceedingly curious. Many kinds of flies burst open the top of their little egg-shaped prison by a very singular application of the principle of atmospheric pressure. They possess the means of inflating a membrane on the top of the head till it assumes the appearance of a bladder, much larger than the head itself. The pressure exerted by this means on the upper part of the shell forces it open, and then, the only purpose of the membrane in question having been carried into effect, it is immediately shed, like the dried skin of a cicatrized wound, and no vestige of such an appendage remains. Other flies, by somewhat analogous means, force out the opposite end of the pupa case.

The pupa of the pretty Beetle *Cetonia Aurata*,

the larva of which forms a very compact earthy cocoon, waits till its wings are become hard before it can effect its escape, which it does by constantly rubbing them against his earthen sarcophagus, and is sometimes fourteen or fifteen days in effecting his escape. The May-bug is said to be a whole month making his way out of his own house ; and, according to Roesel, the Stag Beetle is about three weeks.

The larva of a small *Tinea* pierces a grain of wheat with a very minute puncture, and after making its way in by this modest little door, very soon becomes too fat on the rich farinaceous food to think of getting out the same way. Before entering into the pupa state, however, it takes the precaution to eat away a small circular portion so close to the last external cuticle, that when the perfect insect emerges from the chrysalis, it easily forces its way out. Bonnet, who was the first, I believe, to describe this process, mentions similar means adopted by other small Moths on escaping from their chrysalides, when similarly situated.

The escape from the cocoon is also effected in other ways. In some instances the larva forms a lid to the cocoon, by means of which the perfect insect easily makes its way out, as is the case with

the fine Moth *Saturnia Spini*, and a small *Tortrix*; while the Moth of the Silk-worm positively breaks its way out of its silky enclosure by means of its "eyes," these being at the time the only hardened part of its body; and their raised facets, acting like little files, soon clear a passage for the more tender parts of the body and wings. It is on this account that it becomes necessary to destroy the Moth in its chrysalis, by scalding, when it is wished to preserve the silk, which would otherwise be rendered worthless.

Among Ants, the "Workers" have the instinctive duty assigned to them of letting out their congeners from their chrysalides when the proper time arrives. This they do by biting through a ligament which makes the shell so solid, that the young Ant would never be able to make his way out unaided; and the worker, whose duty it is to attend to this essential business, never mistakes the precisely proper time for this operation.

The Caddis Worm, when about to pass to the pupa state, covers up each end of its house with a silken tissue. When the time of pupation is over, the insect appears to become furnished with false mandibles, with which it cuts through the silk in front of the head, which it then puts forth,

and by the action of the pectoral legs swims to the surface.

The escaping insect, as he emerges, uses the pupa case as a kind of raft, on which it puts forth its wings without injury from wet ; and by the time it has completed its toilet, all traces of the mandibles, by means of which the silken door of the prison was cut open, have disappeared. This pretty Moth-like insect undergoes yet another change, or extraordinary kind of moult, before it is ready to pass in full costume the two or three hours of existence assigned to its winged state. This consists in divesting itself of an extra skin which covers the wings and every other member, and which, when left on the branch where the operation was performed, seems so like the fly itself which has just quitted it, that a careless observer would certainly be deceived, for the deserted sheath is still an entire, unbroken piece.

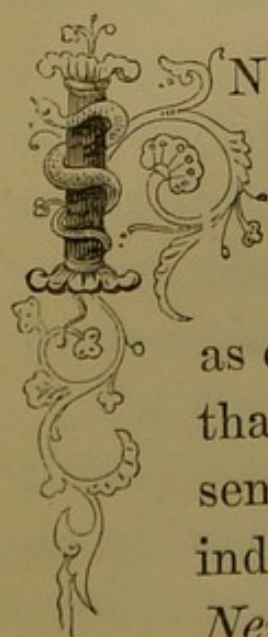
The Gnat is enabled to emerge from its chrysalis without wetting, in consequence of a portion of the corslet being covered with a greasy secretion, which keeps it dry, and prevents the whole from sinking while the Gnat escapes. It floats, though heavier than the water, upon the same principle that a dry needle does, for a short time. When the shell first opens and shows an interior skin still, which enve-

lops the whole insect, the air rushes in, and getting between the skin and body of the Gnat, shines like quicksilver, thus producing an effect precisely analogous to that which gives the shining, golden effect to the chrysalides of the *Vanessa* tribe.

A description of the appearance of Butterflies and Moths as first issuing from the chrysalis must be deferred till the next ensuing Chapters, VII. and VIII.

CHAPTER VII.

OF INSECTS IN THEIR PERFECT OR "IMAGO" STATE, ESPECIALLY THOSE OF THE ORDER LEPIDOPTERA—THEIR ESCAPE FROM THE CHRYSALIS—THE SUDDEN GROWTH OF THEIR WINGS ON ISSUING FROM THE SHELL, THE DURATION OF THEIR EXISTENCE IN THE PERFECT STATE—AND THE DESCRIPTION OF THE BUTTERFLIES ENGRAVED IN PLATE II.



IN speaking of the transition of insects from the chrysalis to the perfect state, I shall confine myself principally to that of Butterflies, Moths, and Beetles, as exhibiting a much more striking change than that of such insects as only undergo a semi-metamorphosis. It will be found, indeed, that these, with a few of the order *Neuroptera*, will always form the chief attraction of an Insect Vivarium, and of these, Butterflies and Moths will be the favourites, from the great beauty of many of the larvæ, as well as the often striking forms of the chrysalides; while



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1. *Vanessa Io*—The Peacock Butterfly.

2. The Caterpillar of the Peacock Butterfly.

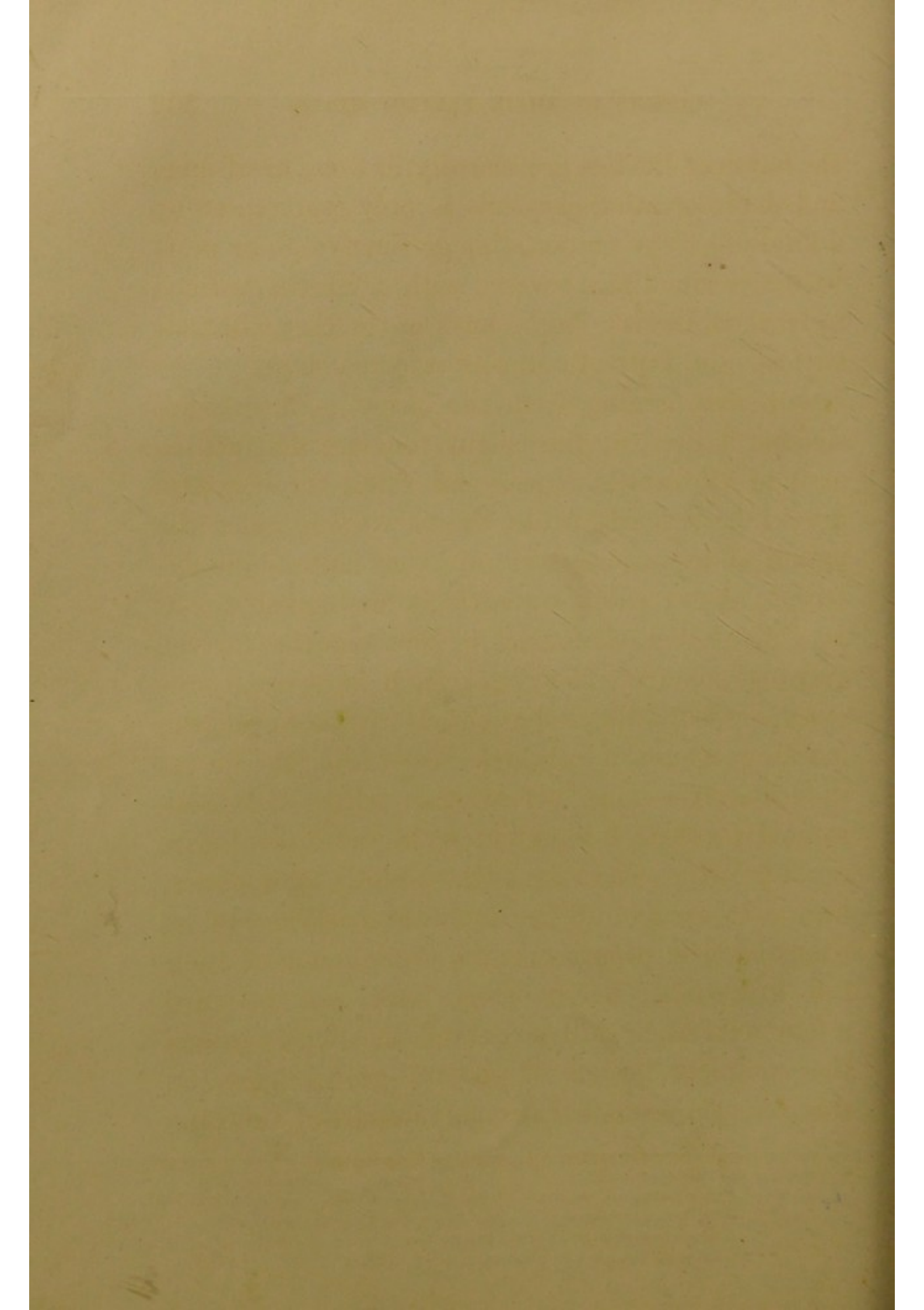
3. The Chrysalis of the Peacock Butterfly.

4. *Polyommatus Alexis*—The Common Blue Butterfly.

5. The Female of the Common Blue Butterfly, showing the underside of the wings.

6. A singular variety of the Common Blue Butterfly, with the wings of both sexes.

7. The Caterpillar, and 8, the Chrysalis, of the Common Blue Butterfly.



the larvæ of Beetles are scarcely, if ever, handsome, and the interesting chrysalis is only represented by a kind of earthy cocoon, though the nymph or pupa within is sometimes covered with a cuticle destined to be shed, like the horny husk of the chrysalis that encloses the Butterfly during its pupa stage.

On first issuing from the chrysalis, insects are seldom, if ever, of the colour they are destined to assume afterwards. Bees and Flies, for instance, are at first nearly white, but very soon, under the action of the atmospheric air, they assume the different colours which respectively distinguish them. In Dragon-flies, the length of time required for the eventual colouring to develop itself is especially remarkable.* In Butterflies and Moths, however, the markings assume a certain degree of intensity almost immediately,—long before the wings have expanded to their full extent, in their miraculously rapid growth. The Privet Hawk-moth, for instance, begins to exhibit all the intricate markings of its wings in their proper colours, though not of their full brightness, before they have yet attained a fourth of their full size; and the appearance of the complete design of the full-grown wing, on this reduced scale, is extremely beautiful and inte-

* See Chapter XI., on the *Neuroptera*.

resting, as I have endeavoured to show in a Moth of this species just escaped from the chrysalis, in Plate IV. No. 2.

A similar effect may be observed in the wings of the Peacock Butterfly—the fine ocellated marks of which have a very charming effect when in this state; forming an exquisite miniature model of the grand and gorgeously tinted design they are so soon destined to exhibit. These are the phenomena that must be eagerly watched for in the Vivarium; they are among the most interesting spectacles it can offer, and the student must therefore take care that, for want of proper attention, they do not pass over without notice; for a few hours at certain seasons may make a great change in a collection of chrysalides.

By careful observation, the colours, or rather markings of the wings may be distinguished through the shell of the chrysalis, which, as the time approaches for the insect to escape from its prison, appear to become partially transparent—at all events in some kinds of Butterflies—though the more opaque pupa case of Moths do not so frequently exhibit this kind of change. In Butterflies, however, by this and other indications, the species may often be detected through the shell of the chrysalis. Moses Harris, one of our enthusiastic ento-

mologists of the last century, detected, in the form of a chrysalis which he had never seen before, certain characters which induced him to believe that it must be that of the Purple Emperor Butterfly, though he had no idea either of the colour or form of the pupa of that insect. But he knew that in the perfect state its under wings extend in an unusual manner beyond the upper ones, and in the pterotheca, or wing case portion of the chrysalis, he perceived a line, beyond the usual termination of this feature, which at once induced him to declare the chrysalis which he had reared to be that of the Purple Emperor, *Apatura Iris*; and he soon afterwards began to perceive the well-known white bands of the wings showing through the semi-transparent shell. The old Lepidopterist expresses his enthusiasm so genuinely on the occasion, that the main features of the passage in which he relates how he became possessed of the Caterpillars, and how unceasingly he watched all their changes, are well worth transcribing. The larvæ were given to him, it appears, by Mr. Drury, the well-known English naturalist; that "ingenious Aurelian," as he is termed by his friend Harris, having, while searching for caterpillars on the 26th of May, in the year 1758, beaten them from off the Sallow,

near Brentwood, in Essex.” Mr. Drury appears to have thus captured four caterpillars, which were entirely new to him, and to have presented them to Moses Harris as the person most likely to rear them successfully. “They were,” says our author, “different from any hitherto discovered, being furnished with two horns like the telescopes of the snail.” He then describes very minutely the food he gave them, their growth, and their eventual change to the pupa state, stating that the chrysalides were of a “bright pea-green with a bloom of peach colour.” After many other particulars concerning one of these cherished chrysalides, he says, “on the 22nd of June, 1758, at eight in the evening, to my unspeakable pleasure it produced the Purple Emperor;” and he proceeds at once to express his unbounded gratitude to Mr. Drury, giving to that “ingenious gentleman” the credit of having enabled him to discover “the caterpillar of one of the most beautiful flies in the universe, which had hitherto escaped the search of the most skilful and industrious Aurelians.”

The enlargement of the little wings with which a Butterfly first issues from its chrysalis, as the phenomenon must have been noticed by Moses Harris, is amazingly rapid, but it varies in different

kinds. In most *Lepidoptera* the whole growth generally takes place within an hour, often in half that time. In others of that class, a whole day is sometimes occupied in the completion of the wing-growth, as in the case of the Humming-bird Moth, *Macroglossa Stellatorum*, and some others.

In the *Ephemeræ*, and also in Gnats, the expansion may almost be termed sudden—a beautiful provision, so ordered for the purpose of preserving them from the risk they would run during a slower process of wing-growth, as they first enter upon their perfect state upon the surface of the water, where they are not for a moment safe, after they have emerged from the chrysalis, until their wings are perfected.

The *Ephemeræ* exhibit a peculiarity, previously alluded to, consisting in a kind of moult, almost as sudden as the growth of the wings. No sooner are these insects able to fly, than they flutter to some conveniently situated reed, and there shed a skin or film which encased even the wings, the parts covering which being furnished with the same coating of minute scales as the surface of the wings themselves; so that when the insect has, with extraordinary skill, issued from this close-fitting vestment, the skin left behind is

so exactly like the living insect which has just quitted it, that when seen at a little distance it is often mistaken for it by anglers seeking the fly for a bait, until they are close upon it, and just about to seize their fancied prize. Those who would wish to hear more concerning this rapid growth of the wings of insects on their escape from the chrysalis, may consult, on this interesting subject, the works of Carus, Herold, and Chabrier, where they will find many curious details very fully and graphically described.

With the exception of the wings, insects may be said not to grow at all after they have passed from the pupa state, and assumed their final form. The bodies of some of the *Syrphus* tribe, however, *expand*, as it were, in a very curious manner, after they come from the shell, becoming rapidly twice the size which they seemed at first. This apparently sudden growth was first noticed by Goëdard, and is explained by Reaumur in the following manner:—The pupa case of this class of insects, and of common flies, is, as it is well known, remarkably small in proportion to the dimensions of the perfect insect. Within this very small apartment, the abdomen, by means of its annular structure, is compressed to two-thirds of its size; but

no sooner is it relieved from this pressure, than the elastic air it contains expands it to its full dimensions, and hence the appearance of what has been supposed a sudden growth.

On first taking flight, many insects, especially Butterflies and Moths, exude one or more drops of pinkish or sometimes deep crimson fluid, the nature of which has not been explained. In certain seasons, insects are known to come forth in vast swarms; and when, in their first flight, flights of this kind drop these crimson globules, an effect similar to that which fancy might picture as a "shower of blood" takes place; a phenomenon which produced in former times the greatest alarm, being deemed an evil omen of the very worst character, and the circumstance invariably led to prognostications of the most alarming description. The ridiculous superstitions attached to this phenomenon received their *coup de grace*, however, as long ago as 1608, when Pereist announced his discovery that the supposed shower of blood was produced, in a very natural way, by an unusually large flight of Butterflies. The effects attending the emission of this crimson fluid by newly developed Lepidopterous insects have also been described by Jurine.

After having watched the long progress and various metamorphoses of an insect, from the egg to its complete or final state, an interesting question arises as to how long the perfected creatures are destined to enjoy the existence for which such elaborate preparations have been made. The answer, from our imperfect knowledge and appreciation of the wonderful code of the divinely created laws of Nature, appears at a glance singularly unsatisfactory; and when we are told that the *Ephemerae*, after passing several years in their preparatory larva state, are destined, in their perfect form, only to exist a *few hours*! we are but too apt to express an ignorant surprise. Such surprise, however, will not serve to explain the mystery.

The common House-fly exhibits an apparent discrepancy almost as great in the opposite direction. After passing most rapidly through the egg, larva, and pupa states to the imago, in three or four days, it lives several weeks in its perfect state; and those which come forth late in autumn even live through the winter, though in a semi-dormant state, to come from their retreats with the early spring weather, and live a second period of their perfected existence in another season.

The common Cabbage Butterfly, *Pieris Brassicæ*, and the large Goat Moth, *Cossus Ligniperda*, both live about three weeks in their perfect state, though their length of life in the larva stage is so different; that of the Moth being two, and sometimes three years, while the larva of the Butterfly lives about as many weeks.

The female Moth, or Butterfly, generally expires the moment she has laid her eggs, but it is said that by keeping the sexes apart their existence may be considerably prolonged. Several kinds, however, such as the "Peacock," the "Small Tortoise-shell," the "Red Admiral," and some others, naturally live through the winter when they are of late autumnal broods.

The change of the Beetle from the larva to the perfect state is much less striking than that of the Butterfly, though the metamorphosis may be considered very complete. After it has made its cocoon, or sought the proper place to undergo the change, however, the alteration of form is so gradual that it can scarcely be considered to assume a special pupa form like the *Lepidoptera*, in their chrysalis. The larva of the Beetle, when the change commences, becomes gradually shorter, the wing-cases and wings begin to appear, and the legs, antennæ,

and abdomen to assume by slow progressive growth their eventual forms. In this state the insect is generally quite white, even when destined to become the blackest of Beetles—and appears of the consistence and colour of a skinned almond. It is not till the full size of the wing-cases has been attained, and till after their partial hardening to the proper horny texture, that the insect is enabled to make its escape from its cocoon, when it still remains, for some time after its exposure to the air, nearly white; the proper colour being, however, soon assumed. In the insects which have no decided metamorphosis, the three stages of larva, of active pupa or nymph state, and the acquiring of the final form, are so blended one into the other, that it is difficult to assign a special period at which the one terminates and the other begins.

Having now traced the course of several classes of insects from the egg, to the perfect or imago state, I shall proceed at once to speak of Butterflies in that phase of their beautiful existence. The term *imago* was adopted by Linnæus in extreme contradistinction to that of *larva*. The last-named term expressing the idea that the caterpillar was a *masked** stage of existence, while in the winged

* See *ante*, page 64.

state, the *mask* was finally removed, and the *imago*, or true "image" exposed.

The term *Lepidoptera*, adopted by the same classifier for that large section of the insect family comprising Butterflies and Moths, is, as before explained, from the Greek words, *lepis*, a scale, making *lepidos*, scales, in the plural, and *pteron*, a wing, or rather *ptera*, wings; from which we may easily (dropping the *s* for euphony) construct the word *Lepidoptera*, that is, those creatures having the wings covered with scales. Clairville proposed to make the term *Lepidioptera*, but the author of the article "*Lepidoptera*," in Cuvier's "Dictionnaire des Sciences Naturelles," expresses his astonishment that M. Clairville should have proposed such defective orthography.

Aldrovandus, one of the old Italian naturalists, a contemporary of Shakespeare, adopted a similar idea to that of Linnæus, as the best mode of distinguishing Moths and Butterflies as a homogeneous order. He classed them as those having *alæ farinosæ*, that is, farinaceous or floury wings; which is, however, less correctly descriptive than the Linnæan term "scaly-winged." But Aldrovandus wrote before the invention of the microscope, which has enabled later naturalists to make such extraordinary progress in

describing the more minute portions of insect structure. The appearance of that instrument, in fact, led almost immediately to the production of such works as those of our own Dr. Hook, and several similar publications by continental authors.

It will be observed that the system adopted by Linnæus, of classifying insects according to the structure of their wings, was in some sort a return to the methods of the earlier naturalists, to the exclusion of that of his more immediate predecessors, which was founded on the different kinds of metamorphosis; a system which was, in fact, still pursued by some long after his time.

Another recent naturalist, Fabricius, rejecting, like Linnæus, the kinds of metamorphosis as a basis of classification, and deriving his distinction from the structure of the perfect insect, has yet not taken the wings as the foundation of his method, but having discovered that another peculiarity existed, as distinct as that of scaled wings, which served to keep the same class of insects equally separate from others, took that feature as his distinctive character. That feature is their peculiar *proboscis* or trunk; and using the Greek name of that member, he proposed to substitute for the Linnæan term *Lepidoptera*, that of *Glossata*; thus proposing to call Butterflies the

tongued tribe, instead of the *scaly-winged* tribe. The Linnæan term and the Linnæan system have, however, prevailed, as the names of all the insect orders at once show by the universal termination *ptera* (wings)—as *Neuroptera*, those with reticulated wings; *Hymenoptera*, those with transparent wings; *Diptera*, those with only two wings; and so on, through all the orders, even to those without wings, which are of course termed *aptera*, that is, wingless insects.

Having examined the modern scientific terms by which the order *Lepidoptera* has been distinguished, we have next to consider the manner in which it is subdivided. Linnæus made three grand divisions—*Papilio*, which included the Butterflies, or day-flyers; *Sphinx*, which included the Hawk-moths, or twilight-flyers; and *Phalæna*, which included all the regular Moths, or night-flyers. These terms have since been superseded as those of divisions, though still preserved as the titles of simple genera; and in the grand divisions of the order, the form of the antennæ has been definitively adopted as the best mode of forming the leading sections, now reduced to only two. Thus *Rhopolocera* includes all the Butterflies, that is, those with clubbed antennæ, like those of Butterflies; and *Heterocera*, those

with various kinds of antennæ, such as are found among Moths—divisional terms which will be more fully explained in the opening of the Chapter on Moths, previous to describing Plate IV. In the mean time, as the term *Papilio* was preserved by Fabricius in his “Systema Glossatorum,” and is still used to designate a “family” by the title *Papilionidæ*, the first genus of which is still *Papilio*—and as it is, in the form of *Papillon*, the popular French name of all Lepidopterous insects, it will not be uninteresting to trace, if possible, its origin in its Latin form, as well as that of other ancient names given to the Butterfly family.

With the Greeks we find that the term *Psyche* prevailed as the common name of the Butterfly, being the same word as that signifying either “the soul” or “the breath of life.” It is thus evident that the poetic Greeks must have closely watched the career of the Caterpillar, toiling, like man, on the surface of the earth for a time, and feeding on its productions—and eventually burying itself in the earth, or enclosing itself in a sculpture-like sarcophagus in apparent death, from which it arose, in due time, a glorious winged creature, to enjoy what seemed a higher kind of existence. Having observed these singular changes, and the seeming

resurrection after death, they called the Butterfly by the same name as the soul, and no doubt looked upon the issue of the beautiful insect from the sarcophagus of the dead caterpillar as one among many other extraordinary evidences of a future state after death. In their personification of the soul, or human spirit—among a series of divinities founded on a system of embodying in divine forms the human passions and aspirations, and even the general powers of nature—they gave to the divinity representing the soul, the wings of a Butterfly; thus carrying out the popular feeling; and the deified personage also bore the same name of the “soul.” In the exquisite story of Psyche we may trace, also, the poetic theory of a spirit gradually purified by passions and misfortunes for the eventual enjoyment of true and pure happiness.

Sir Humphry Davy, in his “*Salmonia*,” a little volume full of beautiful reflections, has a remarkable passage on this subject, in which he refers to the poetical view of the Greeks, and afterwards goes on to dilate, in his own vein, on the transformations of insects as remarkable evidences of the truth of our belief in a future state for Man. “If,” he reasons, “an insect, recently a sordid worm, and buried with no sign of life in the earth, should in

an instant be made entirely to change its form, and rise into the blue heavens to enjoy the glorious sunbeams, how much more easy does it seem that a being whose most earnest pursuits here have been after an undying name, and after the acquisition of intellectual power and knowledge, should be raised hereafter to a state of being where immortality is no longer a name, and ascend to the source of unbounded power and infinite wisdom."

I recollect being once very much struck with an old print in which a Butterfly was represented as fluttering out of the mouth of a dead body, that of a Man, which appeared to have just yielded up its last breath. I could not understand the meaning at the time, but have long since known, that the old engraver, following out the Greek feeling, had intended in that way to illustrate the separation of the soul, or spirit from the material form.

There must also have been some other Greek name for the Butterfly tribe, from which the common Latin name *Papilio* is derived. It has been suggested that this word was the same as *Papiliōn*, (*παπιλιων*), which was a kind of tent* used by several Numidian tribes. It was also that of the cloth

* The French term *Pavillon*, a tent, is thus derived, as our own name for a small tent-like summer-house.

of which the tents were made; and this cloth may have been made from the *Papyrus* plant and the name have been originally *Papayriōn*. At all events, it seems probable that the appearance of a *cloth-like* texture exhibited by the wings of a White Butterfly may have led to the adoption of a name from this or a similar origin, which may have been the root of the Latin word *Papilio*, as used by Pliny to designate the Butterfly. It has also been suggested that the Greek term *Papiliōn* meant likewise a sail (perhaps of a cloth like that of the tent), to which the wings of the White Butterfly may justly be compared. Indeed, at a later period of the Roman Empire, when the term *Papilio* had long been established as the popular name of the Butterfly, Vegetius, in his work on the "Art of War," dedicated to the Emperor Valentinian, speaks of a kind of sails which were doubtless, as explained in the glossary, those which by their position resembled the wings of a Butterfly, just as do the modern *lateen* sails still used in the Mediterranean, which certainly recall the form of those of the common White Butterfly when about half expanded.

Thus it is pretty plain that we have received from the Greeks both a poetic and prosaic term for the Butterfly; the first founded on the mystery of

its metamorphosis, the second on the cloth-like or sail-like texture and form of the wings.

Our own term Butterfly—a term which exists in the Saxon and Flemish in nearly the same form, and with precisely the same meaning—has no doubt arisen from a buttery kind of softness in the wings of this class of insects, the surface of which, from the nature of the minute scales, gives way under the touch exactly as the surface of butter does, though from another cause. That a certain kind of softness was often compared to butter we have an instance in the well-known passage in the Psalms, “his words are softer than butter;”—and many similar examples might be cited.

The French term, *Papillon*, is directly derived from the Latin *Papilio*, and applied both to Butterflies and Moths, the latter being merely distinguished as *Papillons de nuit*, or night Butterflies, the French language possessing no term precisely equivalent to our “Moth.”

Among the group of Butterflies represented as established in our Insect Vivarium, in Plate II., the first is the well-known Peacock Butterfly, *Vanessa Io*, whose brilliant colouring makes him a general favourite. It was this Butterfly, more especially, whose wings were assigned to Psyche by the

Greeks, as we know by the indication, on many existing statues, of the beautiful *ocellæ* or eye-like spots, which distinguish both the upper and under wings.

The best way of procuring fine specimens of this beautiful native insect is to look among beds of nettles, about the beginning of July, for the Caterpillars; which, clothed in their suit of rich sable velvet delicately spotted with specks of white, as with minute pearls, and ornamented with their curious branching spines, are very conspicuous objects, that may be distinguished even from a distance in such situations, feeding in large companies on their favourite vegetable; their colour and number making them at once remarkable. (See Plate II. No. 2.) Some of the nettles, not the young shoots, but those parts with matured foliage, should be placed in the Vivarium with them, and they will always prefer nettles from their native bed, some larvæ refusing any foliage, even of the same kind, except of the identical plant on which they were hatched. Those of *Vanessa Io*, however, are not so particular; they will in general feed greedily if the food be fresh; and, after a certain number of times casting the skin, will suspend themselves by the tail in their own

ingenious fashion to undergo the change to the chrysalis, which will remain suspended after the Caterpillar skin drops off, as represented at No. 3, in the same Plate.

The small Blue Butterfly (No. 4) in the same Plate, is one of our numerous *Polyommata**, a pretty genus, so named from the Argus-like number of eyes, or rather eye-like marks, on the under side of their wings. It is the species named *Polyommatus Alexis*, the common blue Butterfly. The Caterpillar of this pretty insect feeds upon different plants of the trefoil family, the one engraved being the cultivated Lucerne, *Medicago Sativo*, remarkable, like all its genus, for the curious twisting of the seed-vessels.

No. 5, in the same Plate, is the female of *P. Alexis*, which wears a robe of matronly brown, instead of the bright azure of its mate. Its wings are represented as raised, in order to exhibit the disposition of the eye-like markings which have given the name to this genus.

At No. 6 is represented an example of a curious aberration which this family is subject to. It is an individual of the species *Polyommatus Alexis*, having on one side of the body the azure

* From *pōlus* (πολυς) many, and *omma* (ομμα) an eye.

wings of the male, and on the other the dusky brown ones of the female. This curious monstrosity is not very infrequent. I once had a specimen myself, and have seen several in the collection in the British Museum, and elsewhere. The appearance, however, is so singular, that I had great trouble in getting the drawing cut by the wood-engraver as I had drawn it, the block having been sent back to me when half engraved, with a note stating that I had forgotten to finish one pair of wings of the small Butterfly No. 6.

A similar misapprehension occurred in an Article on this family of Butterflies which I contributed to the "National Magazine," illustrated with a drawing of this curious *lusus naturæ*. The engraver was, in that instance, so convinced of a mistake, that without troubling me on the subject, he actually set one of his draughtsmen to make both the wings match, and it was so printed, before I discovered the extraordinary correction to which my work had been subjected.

The Caterpillar of this species, which is one of the onisciform or Wood Louse-shaped kind, is represented at No. 7, and the little chrysalis at No. 8 in the same Plate.

It may be observed here that the male *Poly-*

ommatus Alexis is a most pugnacious little fellow, often engaging successfully in combat with the large Red Admiral, or rather "*Admirable*," for so the popular name of this large and handsome insect is spelt by Moses Harris, who was no doubt thoroughly "up" in the popular nomenclature of our native insects at a period when many of the names were first conferred.

In the next Chapter, I shall give an account of other kinds of British Butterflies that may be reared in the Insect Vivarium, but more especially of those represented in Plate III.



PLATE III.



1. The Caterpillar of the Great White Butterfly.

2. The Chrysalis of the Great White Butterfly.

3. *Pieris Brassicae*—The Great White Butterfly.

4. The Caterpillar of the Clifden Blue Butterfly.

5. The Chrysalis of the Clifden Blue Butterfly.

6. *Polyommatus Adonis*—The Clifden Blue Butterfly.

7. The Female of the Clifden Blue Butterfly.

8. *Polyommatus Corydon*—The Chalk-hill Blue Butterfly.

9. The Chrysalides of the *Ichneumon* in the Caterpillar of Great White Butterfly.

CHAPTER VIII.

OF THE GREAT WHITE BUTTERFLY AND OTHER
BUTTERFLIES REPRESENTED IN PLATE III.

ORDSWORTH, among his intimate sympathies with the wild beauties of simple Nature, has not forgotten the Butterfly. He has called it the Minister of Infancy, because the sight of one of these elegant creatures, with wings pale white as a summer snow-flake, or gorgeously illuminated like the glowing page of a painted school, never failed to recall to him the joyous time of childhood, when the first sight of a Butterfly was an inspiration on the imagination which is never forgotten.

The Butterfly is, per excellence, the insect of beauty. It feeds on the sweet juices of their own flowers, and is itself a delicate perfume; and when, in the evening, it comes forth, almost like another moon, its pale wings are as delicately thin and silky

wings. It might seem to a fanciful reasoner, that feeding exclusively on the "delicate juices of flowers," the Butterfly becomes like them in form and aspect, as though a general tendency existed in all things to produce their similitude. Gerard, the quaint old herbalist, had evidently some such notion, when rhapsodizing, after his peculiar manner, on the influence of flowers, he is led to make his reflections on these beautiful insects; and he does not stand alone in his notion, for in a foot-note to one of the "Letters of Gilbert White," by Mr. Mitford, we find the annotator asking the question whether the circumstance mentioned by Mr. Pegge be true, "that Butterflies partake of the colour of the flowers they feed on."

Without overstraining the fancy to create relations and sympathies which do not exist, there is sufficient analogy between floral and insect development to allow of many poetic associations, such as need not trench upon the positive domain of fact. The egg of the parent insect is, both in aspect and size, much like the seed of a plant; and in its principle of life the seed exhibits a still stronger resemblance, inasmuch as it contains within it the already traceable forms of the future tree or flower. Then, the cotyledons, or "seed leaves," as they have been

termed, are as different from those of the future tree as is the form of the Caterpillar, as it first issues from the egg, to that of the perfect insect. In the plant, the leaves precede the flower, which is a higher form of development, just as the Caterpillar form precedes the more perfect or blossom-form of the insect. Then, it is that final, complete, or blossom-form which, both in the plant and the insect, is alone destined to reproduce the germ or egg from which another plant or insect will in its turn be developed; and it may be asserted that similar, if not such clearly defined, analogies are traceable in every kind of organized existence.

There is not a more genial and pleasing sign of opening summer than the first appearance of the Great White Butterfly. The delicate flakes of creamy white that form the wings of this beautiful insect are evidently unfit to contend with the rude winds and storms of winter; they are those of a creature of early summer, and we hail their appearance as an assurance that its bright and balmy days have at last commenced.

The new visitant is even more attractive than the early flowers, and the urchin cowslip-gatherer lays down his half-completed nosegay to pursue and capture the newer attraction. In its seem-

ingly objectless and careless flittings, how skilfully it eludes the grasp of its pursuer, without effort or any apparent contrivance, always escaping just by a hand's-breadth, and gaily fluttering on till we are glad to see the little hunter fairly beaten, and watch with secret satisfaction his return to his deserted handful of flowers.

But though so many take a general kind of interest in the common White Butterfly, *Pieris Brassicæ*, and hail his advent with pleasure, as a harbinger of the coming time of our brief but beautiful summer, there are few who have taken the trouble to examine his aspect in detail, and acquire more definite ideas respecting his beautiful structure.

I would call upon such to notice, on the earliest opportunity, first, his slender antennæ, tipped with those peculiar little knobs which distinguish the antennæ of Butterflies from those of the Moth tribe. Then the delicate tube which serves to extract the juices from the deep nectaries of flowers, and which is held so gracefully coiled beneath the palpi till its use is required. I would next call attention to the creamy white surface of the wings, and the microscopic beauty of the feather-like scales by means of which that surface is formed; and next, to the dark tone of the tip of each of the

anterior wings, which gives such striking relief to the softness of the almost snowy cream-colour, into which it is softened by several shades of ashy gray that might seem the work of a skilful artist, if pencil could be found sufficiently delicate for the work. A similar shade of gray, but paler, occurs at the base of the wings near the body, and then there is a delicate streak of orange down the front edge of the wing, and a careful observer may note that in some specimens, such as in that represented in our Plate, for instance, the middle of the upper wings, which are often perfectly immaculate, are marked with two conspicuous black spots, shaded off with gray like the patches at the tips. The student need not be ashamed of coming to the decision that those marked in that manner are probably a distinct species, nor of being told that they are not so, and that they are simply the females who have been favoured with this extra decoration—a fact which stands in rather curious contradistinction to the more general prevalence of superior beauty in the markings of the males. The tyro need not be ashamed, as I have said, of imagining the different markings of male and female Butterflies to be the signs of distinct species, for the great Linnæus, before him, fell into a similar error on more than a

single occasion ; one of his mistakes of this kind, in reference to a species of the present genus *Papilio*, having been only recently corrected by the aid of recent discoveries of fresh specimens of both sexes.

The underside of the wings of the common White Butterfly are as well worthy of remark as the upper, and they are in many respects different in the markings. The black tip of the anterior wings on the upper surface, for instance, is replaced underneath by a similarly shaped mark of delicate yellowish buff; and the underside of the posterior wings is entirely of this warm yellowish buff colour, so minutely powdered with black specks that it requires some care and an eye accustomed to close observation to detect this extra and seemingly superfluous decoration. These are but a few of the delicate beauties that might be pointed out in the common White Butterfly, whose dress to common eyes is simply white, and nothing more.

The specimen figured in Plate III. may be supposed to be a female, captured in the first days of May, and placed in the Vivarium just as she was ready to deposit her eggs. This she will in most cases do, undisturbed by her new position.

The common White Butterfly was the one selected by Swammerdam as well fitted to illustrate

his history of "an animal within an animal, or the Butterfly hidden in the Caterpillar." The minute dissections and observations of this indefatigable naturalist, had for their main object the definite and positive proof of the natural production of insects from eggs laid by parents of the same species, and of the perfectly natural progression in the so-called "metamorphoses" of insects; and it is not possible to conceive a more complete refutation of the old theories of spontaneous generation, and absolute "metamorphosis," than the richly illustrated essays which he published as the result of his labours.

The eggs of the captive Butterfly, when observed under the microscope, will be found to accord precisely with the description given of them by Swammerdam. A tolerably strong glass will exhibit the oval form with fifteen small longitudinal ridges converging to the centre of the smaller extremity, the spaces between them being also divided cross-wise by regular grooves or channels. We may suppose the eggs to have been deposited by the parent upon the small leaves of a branch of cabbage just going into flower, which should be furnished for the purpose, and kept fresh by placing the stalk in one of the little water bottles.

In a few days the eggs will be hatched, the minute Caterpillars coming forth, already variegated with green, yellow, and black, as in their full-grown state, though the markings are so minute as to be rather indistinct to the naked eye. In about three weeks or rather more, and after casting their skin several times, these Caterpillars will have attained their full size, and in that state they are remarkably handsome, as shown at No. 1, in Plate III.

When thus full grown they will cease feeding, and secure themselves with a loop of silken web round the middle, for changing to the Chrysalis state, as already described. The Chrysalides so secured in some convenient situation, will form pretty objects in the Vivarium for a period of from seven or eight to sixteen days, according to the heat of the weather. (See Plate III. No. 2.) After that time the back of the Chrysalis will split by the expansion of the insect within, as described in Chapter VII., and the student will enjoy the interesting spectacle of the escape of the perfect insect from its prison, with all its attendant phenomena. The females of the brood produced at this time (that is, in July) lay eggs in their turn, the Caterpillars of which do not attain their full growth and enter upon the chrysalis stage till late in the autumn;

so that the insect within, unstimulated by the summer warmth, remains in the dormant or pupa state all through the winter, to come forth in the first genial days of May. It is said that very late broods of Caterpillars, not full grown before the cold weather, are able to hybernate in a similar manner; and it is asserted by several naturalists that those Caterpillars of the common White Butterfly which are destined to outlive the winter are sometimes so completely frozen as to break, when bent, like a strip of glass, and yet recover their usual state with milder weather, without apparently having received any material injury. There are, indeed, many species of the Caterpillars of Moths, the late broods of which live through the winter in a similar manner, and which will be described (if space should permit) in the Chapter devoted to that section of the order *Lepidoptera*.

Many young entomologists, in the first season of their experience, have been very much surprised by an apparent metamorphosis in the Caterpillar of the Cabbage White Butterfly, of an entirely different character to that which they naturally expected to take place. This singular phenomenon could hardly take place with Caterpillars hatched within the Vivarium; but we will imagine that a few have been

taken from the garden as particularly fine specimens, and added to those artificially reared. It is very probable that one out of four or five so added would exhibit the curious transformation about to be described. The Caterpillar in question, not presenting any appearance of an unusual character to the inexperienced eye, will suspend itself for changing in the usual manner; but when the student is expecting the skin of the larva to be thrust off by the expansion of the Chrysalis within, it is simply rent or spread open, and a number of small cocoons of yellow silk are seen attached to its inner surface. Each of these cocoons contains a small oval Chrysalis, from each of which in a few days (if the Caterpillar was of the early brood) a small Fly will issue, whose scientific name is *Microgaster Glomeratus*. Thus from the body of a single Caterpillar issues a whole flight of little Flies, creatures belonging to quite a distinct class of insects. This must indeed have been an inexplicable surprise to a young entomologist in his first season of experiments, and one which would almost induce him to throw over the discoveries of Swammerdam and Reaumur, and return to the theories of spontaneous generation—thus proved, as it seemed, under his own observations.

The unremitting and watchful researches of naturalists have, however, fully explained the seeming mystery, and in its explanation brought to light another wonderful provision in the beautiful economy of Nature, by means of which the balance of numbers in many classes of animal life is preserved or restored. Mr. Haworth observes that in dry seasons the larvæ of the White Butterfly multiply in such a manner as to commit great havoc, but that the same causes produce also an unusual number of the small Ichneumon fly, *Microgaster Glommeratus*, whose instinct it is to pierce the skin of these Caterpillars in several places, depositing an egg in each incision. These eggs, rapidly hatched by the internal heat of the body of the victim, produce small footless grubs which live upon the fatty portions only of the Caterpillar's body, who continues to feed more voraciously than ever for their supply, as though unconscious of the presence of the destructive intruders. When, however, the time for change arrives, and the Caterpillar slings itself up to pass to the next stage of its existence, the larvæ of the Ichneumon rapidly consume all the remaining interior, leaving nothing but the external skin, which, when they have perfected their cocoons for undergoing their own change, is burst by their increased

bulk, exposing the little oval masses of yellow silk, as shown in Plate III. No. 9.

Thus the more than usual number of this Caterpillar are kept down in certain seasons, and many other kinds of Caterpillars, equally likely to be produced occasionally in great numbers, have each their peculiar Ichneumon, some of which actually attack the Caterpillar in the egg state, as described in a previous Chapter.

Having learnt something of the short biography of the White Butterfly, and the vicissitudes to which its existence is subject, the young entomologist must not fancy that he now knows all about White Butterflies. I must suggest to him that there are many other kinds, quite distinct from that just described, which are equally worthy of his careful attention. First, there is a species closely resembling *Pieris Brassicæ*, but invariably smaller, and which generally appears full a fortnight earlier than the larger species. This kind, though by some considered only a permanent variety, is by most entomologists accepted as a distinct species, to which has been assigned the name of *Pieris Chaniclea*. In this species the fringe at the edges of the wings is yellow, the dark patch at the tips of the anterior wings grayer, and the buff-colour of the under sur-

face of the posterior wings deeper and more conspicuously freckled with minute black specks. The black markings of the Caterpillar are somewhat less distinct than in the large kind.

Other kinds of White Butterflies are, however, of a much more distinct character, though formerly considered the same. There can, however, be no doubt of their forming entirely distinct species, and the student would find it interesting to obtain a thorough knowledge of all the species of the whole genus *Pieris* in his first season, as an exercise of his powers of accurate discrimination.

First, there is *Pieris Rapæ*, once thought by ignorant collectors to be the young of the Great White Butterfly, while it is now well known that insects having once attained their perfect state never grow. It is, however, certainly very like the "Large White," but still, having very obvious marks of distinction, quite unmistakable when once detected; the male, for instance, instead of having the centre of the anterior wings quite immaculate, has one bright black spot on the upper surface, and two, less conspicuous, on the under surface; the female having two small spots like the female of the larger kind. The Caterpillar is still more distinct than the perfect insect. It is dusky yellow under-

neath, and of a soft velvety green above, with a narrow yellow stripe down the centre of the back, and no black markings whatever. It is more injurious to cabbages than even the Caterpillar of *P. Brassicæ*, as it feeds upon the young internal leaves of the heart, and has been thence termed by the French the *Ver du cœur*.

There is a variety of this species, by some called *Pieris Metra*, which is smaller still, and having the white of the upper side more dusky, and the buff on the underside of the hind-wings very much deeper in colour ; indeed, almost brown. In other respects, with exception of a supposed greater degree of slenderness in the form of the wings, it does not differ in appearance from *Pieris Rapæ*. The Caterpillar has not yet been observed.

Another species, *Pieris Napi*, is still more distinct than *P. Rapæ*, its popular name, the "Green-veined White," indicating one of its main distinctions from either of the preceding species ; with this very remarkable difference, it very closely resembles *P. Rapæ*, but the beautiful bright green mottlings, on either side of each of the veins on the under surface of the hind-wings, forms an all-sufficient distinction. The Caterpillar may be distinguished from that of *P. Rapæ*, which it closely

resembles, by being without the narrow dorsal line of yellow.

There is a smaller and darker variety of this kind, the Caterpillar of which is at present undescribed, in which the green mottlings of the undersides of the hind-wings are of a much deeper green, nearly approaching a tone of olive-brown.

But the rarest and most beautiful of the genus *Pieris* is that rarely-captured prize of the collector, *Pieris Daplidicæ*, popularly known as the Bath White, and which is only taken in the vicinity of the sea. The tips of the front or upper-wings are marked with a small patch of bright black, chequered with squarish blotches of white, and in the centre of the same wings is a largish black mark, divided by a white vein, these marks being green on the under surface. The hind-wings are semi-transparent, showing the shadowy form of the bright green markings which decorate their under surface. The Caterpillar is green, with fine stripes of yellow, between which the green is spotted with black.

In other genera there are also species of "White Butterflies," which the careless observer might confound with the Common Whites of the genus *Pieris*. For instance, *Euchloe Cardamines*, the pretty "Orange-tip"—the female of which, being without

the broad orange mark at the points of the forewings, might be mistaken for the male of *Pieris Napi*. But then the form of the wings is much rounder, and the green mottling of the under surface of the hind-wings is much more scattered over the whole wing, and not confined to the edges of the veins, as in *P. Napi*; while in the male the beautiful orange mark is an all-sufficient distinction. Then there is the pretty little "Wood White," *Leptoria Candida*; much smaller than any other of our White Butterflies, and with much narrower though more rounded wings. It is of a soft creamy white both on the upper and under surface, except at the tips of the anterior wings, which are ornamented with a soft roundish blotch of deep blackish-brown, quite different in form to the similarly-situated markings in the genus *Pieris*, the blotch being rounded convexly towards the body, while those of all the species of *Pieris* are concave in their internal outline.

There is yet another kind of White Butterfly, which, like the last two, is also of a distinct genus, though so similar in general aspect, till closely examined. It is a rare insect in this country, known as the Black-veined White (*Aporia Crataegi*). It may be easily distinguished by the semi-transparent

appearance of the wings, and their bright black veins, which are quite free from the downy coating of scales which usually conceals them in other species; the veins of the female are brown. These veins are especially remarkable where they form the external boundary of the wing, which is entirely without the silky fringe almost invariably found in all the families of Butterflies.

From the foregoing series of brief descriptions, it will be seen that a great variety of beautiful insects would, by the careless observer, be considered as no more than ordinary White Butterflies, although such an observer might incidentally notice that at some times or seasons the insect appeared a little smaller or a little larger, a little darker or a little lighter, than usual. Perseverance for a short time, however, in habits of accurate observation would soon render the most careless in such matters no longer contented with vague conclusions, and tend generally to give to the mind a more definite tone of thought, not only in matters connected with natural history, but also on all other subjects.

The pretty Blue Butterfly in the upper part of Plate III., *Polyommatus Adonis*, is the most delicately toned of all the *Argus*, or *Polyommatus* tribe. It is of the purest possible azure, without the slightest

tinge of violet; of a most lovely, shining, silvery azure; the white fringe and black line within it giving an exquisite finish to the delicate effect of the light blue. The female is deep brown, with only a slight flash of blue; but, in exchange for the bright azure of the male, she has a pretty orange border, with black spots at the edge of the hind-wings. The underside, nearly alike in both sexes, is similar, though handsomer, to that of the more common *P. Alexis*, figured in Plate II., Nos. 4, 5, and 6.

This has always been one of the most coveted prizes of our entomological weavers—intelligent working-men who enjoyed the study of insects long before the beautiful works of Kirby and Spence, and others, made it popular among the superior classes. At the close of a week's ceaseless toil, the Spital-fields weaver would, after work hours, take his net and collecting-case, and trudge off his score of miles in the long summer evenings to Darenth or Birch Wood, arriving time enough to capture a rich harvest of twilight-flying Moths, without fear of interruption from lords of the manor or their gamekeepers; for, as Crabbe says, in one of his inimitable poems—

“He fears no bailiff's wrath, no baron's blame;
His is untaxed and undisputed game.”

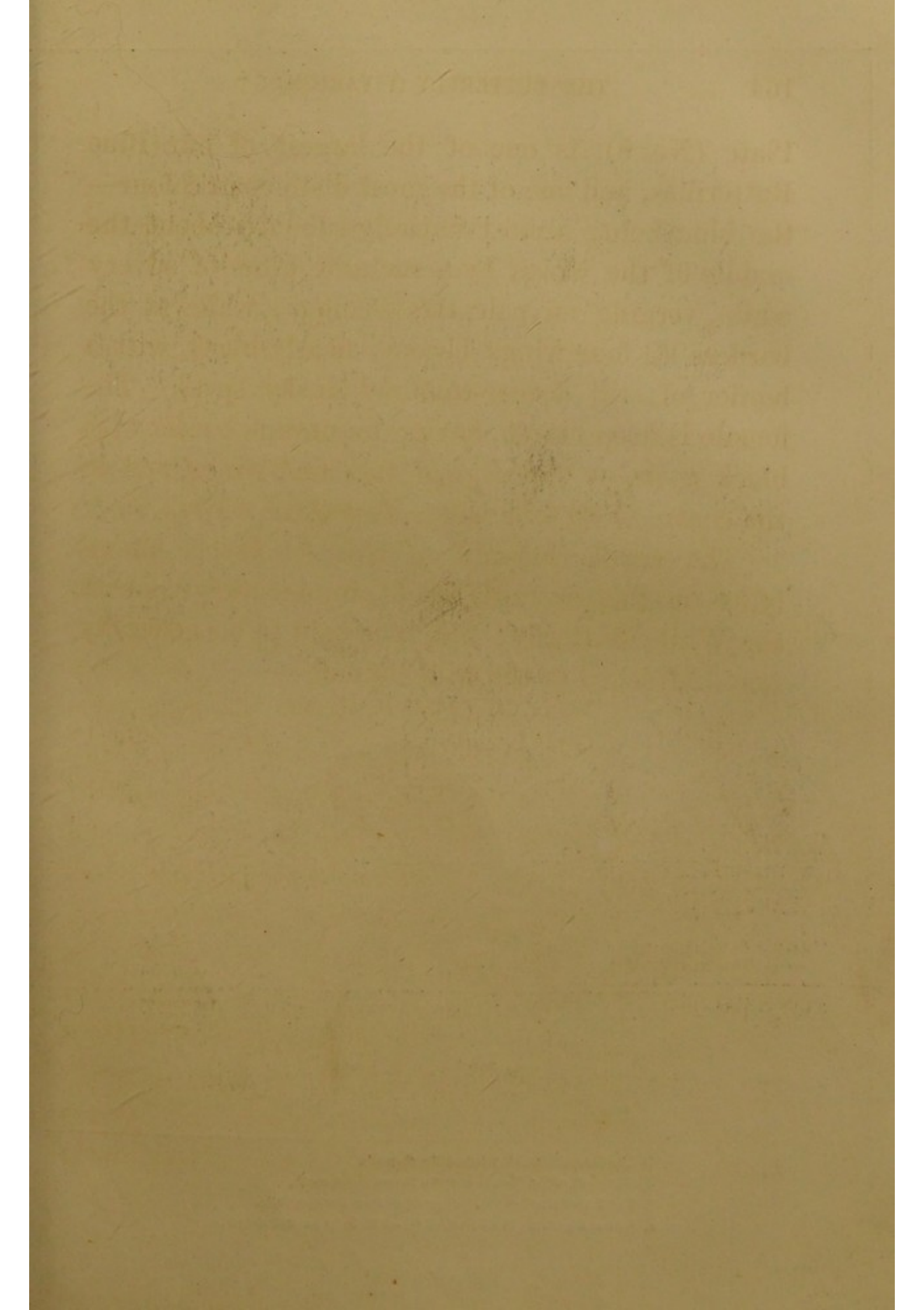
Daniel Bydder was once one of the most industrious of these collectors, as Mr. Westwood informs us, and was employed by Dr. Leach, at that time one of the principal curators in the British Museum, to collect for him in the New Forest, where he was so fortunate as to discover and capture for the first time in England the rare insects *Platypus Cylindrus* and *Cicada Anglica*. He was also the first among the weavers to attempt a scientific arrangement of his collection, but many afterwards followed his example; and they have now a scientific society of their own as "Practical Entomologists," with a well-arranged collection, and general meetings on fixed evenings, like those of the more ambitious associations of the richer classes.

The Caterpillar of the *Polyommatus Adonis*, or Clifden Blue, as it is popularly called, is not well known, but is certainly of the kind termed onisci-form, or Wood Louse-shaped, like those of the whole *Argus* family. It has been described by Fabricius as being green, with rows of fulvous spots along the back.

The Caterpillar of an allied species, *Polyommatus Corydon*, engraved in this Plate (Pl. III. No. 4), will give a good idea of its general appearance. *Polyommatus Corydon*, figured just below in the same

Plate (No. 8), is one of the largest of our Blue Butterflies, and one of the most distinct in colour—the blue being almost entirely subdued about the middle of the wings by a metallic gloss of silvery white, verging on pale straw-colour; while at the borders all four wings become nearly black, with a border of still deeper-coloured dusky spots. The female is deep brown, having an orange border with black spots at the edge of the hind-wings, and in the centre of all four wings a speck of white.

The small chrysalis of this species is shown lying on the ground (No. 5), immediately beneath the White Butterfly; but it is said to be generally found attached to the wild thyme.



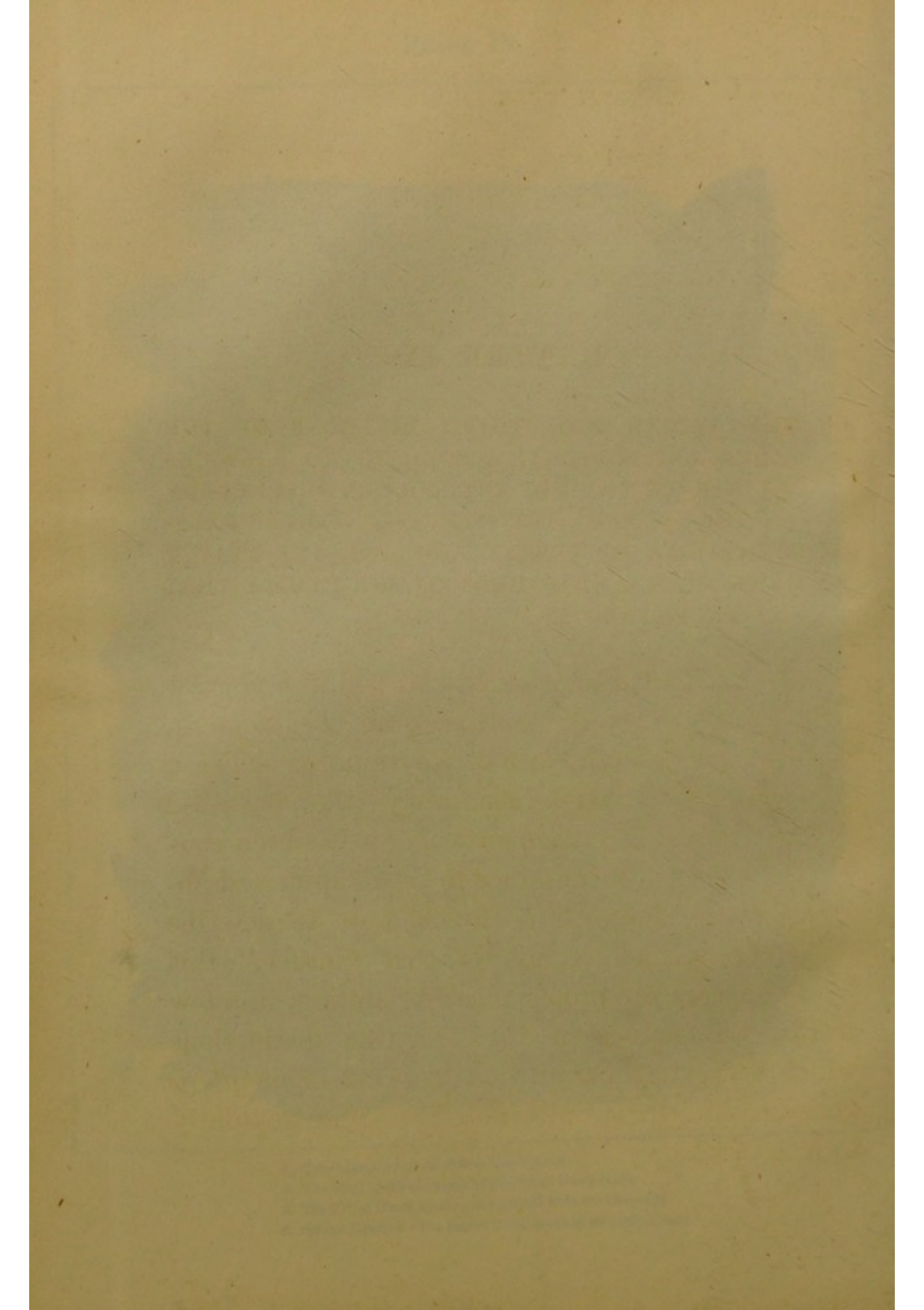


1. The Caterpillar of the Privet Hawk-moth.
2. The Shell of the Chrysalis of the Privet Hawk-moth.
3. The Privet Hawk-moth, just emerged from the Chrysalis.
4. *Sphinx Ligustris*—The Privet Hawk-moth in its perfect state.

CHAPTER IX

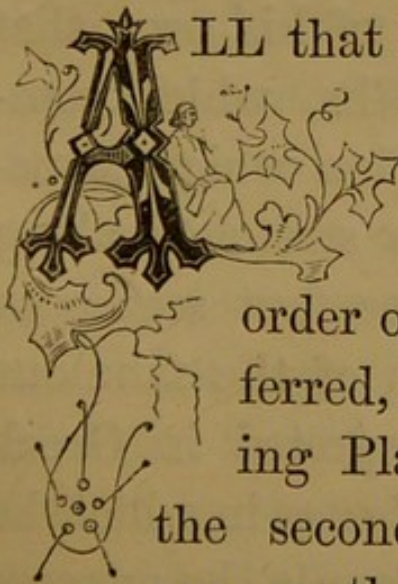
THE SECOND AND THIRD DIVISIONS OF THE ORDER LEPIDOPTERA, ACCORDING TO LINNÆUS AND OTHERS; AND OF THE NOCTURNAL SPECIES OF THE SECOND DIVISION.—OF THE VARIATIONS OF SPECIES, ESPECIALLY THE VARIETY HAWK-EYE, AND OTHERS OF THE FAMILY THAT MAY BE FOUND IN AMERICA.

It is now necessary to consider a number of the most remarkable and interesting species of the order Lepidoptera, which are found in America. The first of these is the Hawk-eye, or Noctua hawkeya, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The second is the Common Hawk-eye, or Noctua communis, which is also found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The third is the Great Hawk-eye, or Noctua grandis, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The fourth is the Small Hawk-eye, or Noctua parva, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The fifth is the Great Hawk-eye, or Noctua grandis, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The sixth is the Small Hawk-eye, or Noctua parva, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The seventh is the Great Hawk-eye, or Noctua grandis, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The eighth is the Small Hawk-eye, or Noctua parva, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The ninth is the Great Hawk-eye, or Noctua grandis, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings. The tenth is the Small Hawk-eye, or Noctua parva, which is found in all the northern parts of the continent. It is a very common species, and is distinguished by its large size and its beautiful markings.



CHAPTER IX.

OF THE SECOND AND THIRD DIVISIONS OF THE ORDER LEPIDOPTERA, ACCORDING TO LINNÆUS AND OTHERS ; AND OF THE MODERN SUPPRESSION OF THE SECOND DIVISION.—OF THE TRANSFORMATIONS OF SPHINX LIGUSTRI, THE PRIVET HAWK-MOTH, AND OTHERS OF THE FAMILY THAT MAY BE REARED IN A VIVARIUM.



ALL that is necessary to be said in a popular work on the term *Lepidoptera*, and also of its value as defining very accurately the beautiful order of insects on which it has been conferred, is contained in the Chapter describing Plate II. Having now to describe the second section of that “order,” this appears the proper place for stating, in a few words, the nature of the scientific distinctions which serve to separate that class of *Lepidoptera* generally known as Butterflies from those popularly termed Moths.

Linnaeus made, as it has been stated, three grand divisions of the order *Lepidoptera*, the first of which he named *Papilio*, containing all the Butterflies, or day-flyers; the second *Sphinx*, containing all those which were generally supposed to fly by twilight; the third *Phalæna*, or the night-flyers; our true Moths.

In the formation of the last two of these terms, as in many others of his "Systema Naturæ," he is extremely imaginative and fanciful. The first he simply adopted as the ancient Latin term by which Lepidopterous insects in general, but more especially Butterflies, were denominated; the second, however, he founded upon a fancy of his own, that the Caterpillars of the Hawk-moths, which compose that division, had—in a position which is peculiar to them, when the body is stretched along a branch, and the head and three first segments raised—somewhat the appearance of the fabulous sphinx, as we find its form interpreted in Greek sculpture. The third name, *Phalæna*, in which he included all the rest of the Moth family, he appears to have derived from the Greek word *Φαλαίνα*, which means either a Glow-worm or any insect giving out light, and thus rendered conspicuous by night; or, an insect which flies towards a candle at

night. He appears to have accepted the term in its last meaning, or at all events as having reference to creatures more remarkable by night than day, which might very fairly be applied to that section of the Moth family generally considered to fly during the night, and to remain dormant or concealed during the day.

Latreille accepted the principle of division by the time of flight which had been thus put forward by Linnæus, but abandoned the fanciful terms of the great Swedish naturalist, and adopted more descriptive ones; calling the first division *Diurna*, or day-flyers, from the Latin *diurnus*, meaning that which is done in the daytime, or belonging to the day; the second, the *Crepuscularia*, or twilight-flyers, from the Latin *crepusculum*, the twilight; and the third, the *Nocturna*, or night-flyers, from the Latin *nocturnus*, appertaining to the night.

It has since been found, however, that the time of flight is not an infallible method of distinction, except in the first class, several species, both of the second and third classes, having been found to fly by day as well as night. The principle recently proposed by Dr. Boisduval to separate the order *Lepidoptera* only into *two* great classes, founded on distinctions of the antennæ, has therefore been

very generally adopted. The first division he makes *Rhopolocera*, or those with clubbed antennæ, from the Greek *ropolon* (ροπολον), a club or knob, which includes the whole of the Butterflies; all the genera and species of the family being distinguished by a small but well-defined knob at the end of each antenna. The second division he calls *Heterocera*, consisting of all such as have various kinds of antennæ, from the Greek *eteros* (ετερος), different or dissimilar. This definition includes, very naturally, the whole Moth family, the various genera of which have many different kinds of antennæ, but in no instance knobbed or clubbed ones, like those of Butterflies. We possess, as I have stated before, in our popular nomenclature, two terms which serve as very excellent general distinctions for these two grand divisions, Butterflies and Moths; while the French language has no popular term corresponding to our Moth, the place being supplied by the compound word *Papillon de nuit*, or Night-Butterfly.

The popular English term "Moth" did not originally refer to the perfect insect, but rather to the larva, more especially that of the common House-moth. It is derived from the Saxon *moð*, which belongs to the same root as the Scandinavian

matha, a worm or grub; and the term "Moth-eaten" is sufficient to prove that the term "Moth" originally applied to the larva and not to the perfect insect, as in the winged state Moths are not furnished with mandibles which would enable them to devour cloth, or any substance of that kind.

In describing the Hawk-moths and other Moths in Plates IV. and V., I shall have occasion to point out the peculiarities of the antennæ, by means of which the whole Moth class is so distinctly divided from the Butterfly section of the order. Moths have the antennæ or feelers generally tapering from the base to the point, which in some instances is as slender as a hair. The class of *Sphingidæ*, however, to which the Privet Hawk-moth engraved in Plate IV. belongs, have the antennæ slightly thickened towards the end, though decidedly not *clubbed*, as in Butterflies; as may be seen by referring to those of any of the Butterflies in Plates II. and III. This thickening of the extremities of the antennæ in the *Sphingidæ*, or Sphinx family, has naturally caused them to be placed next the Butterflies, as a kind of link between the two divisions; and it may be noticed, *en passant*, that in some of the group, especially in the genus *Deilephila*, the thickening towards the

end of the antennæ is much more remarkable than in the case of the Privet Hawk-moth. There is an exotic group, in which the approach to the Butterfly character is still more decisive, but, as containing none but foreign insects, it need not be more particularly referred to here.

Though the names of the great Linnæus, *Sphinx* and *Phalæna* are no longer used as the titles of great divisions, they have been respectfully preserved in other positions. *Papilio* is still the name of the first genus of Butterflies though not of the whole diurnal division, and forms also the family title of a number of genera closely allied to *Papilio*, as *Papilionidæ*; while *Sphinx*, though no longer distinguishing all the supposed twilight-flyers, is still the title of a genus the Caterpillars of which first suggested the term; and also of a family group of the most nearly allied genera, as *Sphingidæ*. Even the still more fanciful term *Phalæna* has been partially retained in a similar manner. I must now proceed to describe the transformations of the Privet Hawk-moth, as shown in Plate IV. I have supposed the magnificent Caterpillar to have been captured on some privet hedge in the garden of the student towards the close of summer. The conspicuous appearance of this larva,

with its dorsal horn or tail, peculiar to the larvæ of all the *Sphingidæ*, and its diagonal stripes of violet and white on a ground of bright apple green, could not fail to attract the notice of any one in search of insects. I have therefore imagined the prize captured and placed in the Vivarium, and there provided with a fresh sprig of privet, placed in one of the water-bottles every day to furnish fitting food. Such a Caterpillar attains its full growth towards the end of August or beginning of September, when it will be found to leave off feeding. After a little uneasy rambling, and having become of a dirty red colour, it will then proceed to burrow into the earth to undergo its change. It should be left undisturbed in its subterranean retreat till the following June or July, when the large brown chrysalis may be taken out and placed in a moist and shady part of the Vivarium, where the first symptoms of the cracking of the pupa and the appearance of the Moth may be conveniently observed. It is true that this disturbance of the nest and of the natural position of the pupa may in some degree interfere with its perfectly healthy development, but yet the spectacle of the exit of the Moth from its prison must not be lost; and we will suppose that a few other chrysalides of the same kind are still left in the

earth to undergo their final change in a perfectly natural manner, for where there is one Caterpillar, others are sure to be found if properly sought for.

To return to the coming forth of the Moth. The first symptom will be the appearance of a crack, and then a wider opening down the back of the chrysalis; as this widens, the head and thorax of the Moth will be seen struggling to extricate themselves, the antennæ still closely packed underneath. By the assistance of the legs, when once freed, the whole of the body is soon drawn out, and the insect generally remains for a short time on the external wall of his prison to rest after his exertions. The wings are at that time still smaller than those represented at No. 3 in Plate IV.; but as the newly-formed Moth gathers strength and creeps away from the empty shell, as shown at No. 2, it begins to lift its wings gently, and their growth becomes very rapid, showing every marking in a minute form, as in an accurate miniature model.

Every movement of the newly-born "imago" is now highly interesting, till at last the full proportion of the fine wings is attained, and the truly splendid insect attempts to take its first flight, as shown at No. 4 in the same Plate.

There are many other Moths of the *Sphinx* tribe equally remarkable, both in size and general aspect, the transformations of which might with equal success be made the subject of observation in the Vivarium. The *Sphinx Convolvulus*, for instance, in certain seasons when it is abundant, as in 1856, when, after having been for a long time one of the collector's greatest rarities, it was observed in considerable numbers. The Caterpillars of the Poplar Hawk-moth, *Smerinthus Populi*, which are somewhat less in size and devoid of the violet tone in their lateral stripes, may be found each season if well looked for, as well as those of the Lime Hawk-moth, *Smerinthus Tiliæ*, and also those of the handsome *Sphinx Ocellatus*, all of which must be searched for towards the close of summer or beginning of autumn.

Then there is the giant of the *Sphingidæ*, the well-known Death's-head Moth, the splendid larva of which should always be procured if possible. This fine insect, the only English species of the genus *Atropos*, deserves describing at some length.

My attention was especially recalled to this magnificent insect by the discovery in my garden, about the middle of September last, of a remarkably fine larva, of unusual size even for this large species.

It was turned up while digging potatoes, on the foliage of which (its favourite food) it had evidently feasted till full grown, and then buried itself in the earth to undergo its change to the chrysalis and eventual winged state. I immediately made a careful drawing of the Caterpillar, to add to my collection of drawings of that kind. When fully extended, it was more than five inches in length, the colouring being a bright apple-green, shading to yellow as it approached the dark diagonal stripes. The three sections next the head, and the one next the tail, were of a bluer green than the rest of the body, and devoid of the small black tubercles that are thickly sprinkled with symmetrical precision over the other divisions. The dark diagonal stripes of rich violet have a streak of white behind them, and shade off in front to a pale bluish tone. The spiracles, or breathing pores, situated above each foot, are black, surrounded by a ring of white, while the singular caudal appendage, or tail, is of a dull orange. When in motion, this beautiful Caterpillar exhibits its markings to great advantage; the alternate extension and compression of the ridges of each segment giving a beautiful play to the maculations, almost such as one observes in the skin of the Tiger when he paces his den with that sin-

gular undulating motion peculiar to the feline race, and noticeable even in the domestic Cat. I find myself making this comparison without any reference to one of the popular names of this insect—the Great Tiger Hawk-moth—a name given in consequence of the black stripes which mark the tawny body of the perfect insect.

After making my drawing, I took the measures which I thought most likely to insure the successful metamorphosis of this remarkable creature to its pupa and winged states.

I had heard that many attempts to rear a perfect Moth from the Caterpillar of this species had failed, the insect almost invariably perishing in the pupa or chrysalis stage. Thinking that this might be caused by the over dryness of the earth in which it was placed, or, at all events, from its not retaining the same constantly equal state of moisture that would exist at the depth to which the Caterpillar generally burrows, I took the following precautions: A large flower-pot being selected, I stopped up the hole with a cork, taking care to pass a quill, open at both ends, through the cork, to serve as an escape-pipe for superfluous wet, and yet not being large enough to allow of the escape of the Caterpillar.

Having put in a layer of pieces of broken pots, to secure sufficient general drainage, the pot was nearly filled with light garden mould, and the insect having been placed at about the mid-depth, a piece of strong canvas was then tied tightly over the pot, when the pot was plunged up to its rim in a sheltered part of the garden.

About a fortnight afterwards I carefully removed a portion of the mould in the pot, and had the satisfaction of discovering near the bottom a well-formed chrysalis, nearly three inches in length, which moved briskly on being touched. I covered it up quickly, hoping very shortly to be gratified by the sight of the perfect insect issuing from the earth; for this singular species is said to emerge from the pupa almost immediately, that is to say, within a few weeks, instead of remaining during the winter in its chrysalis state, like others of the *Sphinx* family, and, indeed, nearly all our large native Moths. Week after week went by, however, without any sign; at length, after three months and more had passed, I again uncovered the chrysalis, fully expecting to find it rigid and dead; but, to my surprise, it was still alive, which leads me to suppose that the early broods of this insect may undergo their metamorphoses the same season,

while a later brood may remain in the pupa state through the winter. I have not yet, therefore (even in April), given up the hope of obtaining a magnificent specimen of the giant *Acherontia Atropos*.

I have more than once used the term giant in reference to this insect, for the Death's-head Moth is indeed of noble proportions, and by far the largest of our native *Lepidoptera*. It owes both its popular and scientific names to the singular resemblance of the markings on the anterior part of the body to a human skull—a peculiarity which also gave rise to the superstitions connected with its appearance, for this harmless insect has always been considered a creature of ill omen.

Linnaeus, who classed it with the *Sphinx* family, following out his fanciful scheme of specific denomination, named it *Sphinx Atropos*—Atropos being, according to Hesiod, the Fate whose special business it was to cut the thread of life, spun and directed by her sisters, Clotho and Lachesis. Modern naturalists, finding it necessary to separate the species *Atropos* from the genus *Sphinx*, though still retaining it in the Hawk-moth family, have preserved the specific name conferred by Linnaeus, and added a generic one of corresponding character. This name, *Acherontia*,

that is to say, pertaining to the river Acheron, one of the streams which, according to the Greek mythology, had to be passed on entering the infernal regions, was intended to embody, after a classical fashion, the popular superstition that death—or, in other words, the speedy passage of the fatal stream in question—was foretold to the unlucky individual favoured with a visit from one of these insects bearing the mark of the ominous skull between its shoulders. Thus its modern name, *Acherontia Atropos*, may be interpreted as the Acherontian messenger of Atropos.

The singular manner in which the Moth emerges from the earth, on its escape from the pupa, has no doubt strengthened the superstitious notions connected with it; and it may be easily imagined that in a more ignorant age, when a creature so peculiarly marked was dug up at a considerable depth, or seen emerging mysteriously from the earth, that singular forebodings might arise. Latreille states that it appeared in great numbers one season in some parts of Brittany, during the time that an epidemic happened to be raging, and that the fatal character assumed by the disease was popularly believed to be entirely owing to the appearance of these dreaded insects.

A low wailing sound emitted by this Moth may also have added to these superstitious terrors. The mode of producing this sound has given rise to many hitherto futile discussions among naturalists; and it has been supposed to inspire terror in insects as well as men, for it is known that while producing this low wailing cry, it will fearlessly enter a beehive, and rifle the cells of their honey, in defiance of the seemingly paralysed Bees. Sometimes, however, the robber is boldly attacked and stung to death, in which case a singular display of instinct not unfrequently takes place. The Moth having died with extended wings, it is found impossible to eject him by the opening of the hive, which he had entered with his wings partially closed; and the Bees, apparently aware that the decay of so large a body within their dwelling would render it unhealthy, proceed at once to coat it with wax, and thus, as it were, embalmed, the Moth remains in its waxen sere-cloth, perfectly innoxious for any space of time.

The exotic species of *Acherontia*, distributed over nearly all parts of the globe, are inferior both in size and beauty to our native insect; and in no instance are the curious skull-like markings on the thorax so well defined as in the European Death's-head Moth.

I would recommend the young curator of an Insect Vivarium to try his luck each season in the rearing of this splendid Moth from the Caterpillar state, as it is the only way of procuring really fine specimens of the perfect insect, which, if of unusual size, would cost something like a guinea each, but which may thus be added to a collection at the cost of a little care, and the gain of much instruction and amusement.

The Caterpillars of the genus *Deilephila*, also of the *Sphingidæ*, or Hawk-moth family, must be diligently sought for, especially those of the beautiful insect *Deilephila Euphorbiæ* (the Spotted Hawk-moth), which in certain seasons have been found so plentifully on some parts of the coast of Devonshire as to attract birds from a distance to feed upon them. They are very conspicuous, both for their size and colour, and feed upon the *Euphorbia Paralias*, or Sea-spurge, which grows in great abundance in the neighbourhood of Barnstaple. Mr. Raddon, the well-known eminent engraver, who was also an enthusiastic entomologist, published at that time an interesting account of this larva in all its stages, accompanied by a fine illustrative plate. Mr. Raddon states that in 1814 these Caterpillars were so plentiful in the neighbourhood just referred to,

that he found no less than one hundred minute larvæ upon a single armful of Spurge which had been cut at dusk on the preceding evening.

It is said that there is considerable difficulty in rearing these larvæ successfully, so as to obtain perfect specimens of the Moth ; and Mr. Westwood informs us that the late Mr. Fuseli, the Royal Academician, who, like Northcote, was a zealous entomologist, was only able to obtain a single perfect Moth from twenty Caterpillars, all of which appeared to have entered the pupa stage in a healthy condition. Though extremely rare, or at all events capricious in their appearance in England, the chrysalides, or eggs, or young Caterpillars might be obtained any season from the Continent ; and with the convenient appliances of the Insect Vivarium, I feel convinced that any one would, with due care, obtain a much more successful result with a batch of Caterpillars than that arrived at by Fuseli, in whose time the conditions necessary to ensure complete success were much less perfectly understood.

Eggs or pupæ of the Oleander Hawk-moth (*Charocampa Nerii*) should also be procured from the Continent ; the exquisite tinting and intricate maculations of pink, green, and olive on the wings of the perfect insect rendering it one of the most

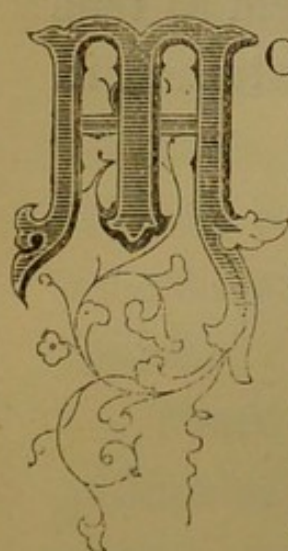
beautiful of the *Sphinx* family. It is occasionally found in England, but some have thought that the specimens of this fine Moth taken at Dover in 1833, and at Brighton more recently, may have been blown over from the French coast. Its claim to be accepted as a native species is, however, better founded in the capture of one of the Caterpillars, which was discovered in a garden at Teignmouth. If eggs or Caterpillars of the Oleander Hawk-moth are obtained from the Continent, they should be fed on some plant of the *Vinca* family nearly allied to the Oleander, and more particularly on the lesser Periwinkle, which was plentiful in the garden at Teignmouth, where the solitary English Caterpillar was found.

There is much to tell of the form of the Caterpillars of this genus, and the derivation of their name, with many other interesting particulars. But I am compelled to pass rapidly to the consideration of a few of the most remarkable of the larger Moths of the other groups, just suggesting, before quitting the Moths of this and the more nearly allied kinds, that the collector should look after the wood-boring larvæ of the Clear-wings, such as the Hornet Hawk-moths, *Sphecia Apiformis* and *S. Zembeciformis*. Also those of the other Clear-wings,

especially those of the Bee Hawk-moths, *Sesia Bombyliiformis* and *S. Fuciformis*, which are much more like the ordinary Caterpillars of the *Sphingidæ* than those of the Hornet Hawk-moths, and feed upon different kinds of *Galium*. These Moths will at first appear to a casual observer much more like Bees or Hornets than Moths, from their wings being without the usual scales, and consequently transparent, except at the borders. The detection of the indubitable characteristics which mark them as true Moths will serve as useful lessons to the student in acquiring habits of accurate observation.

CHAPTER X.

DESCRIPTION OF THE MOTHS AND THEIR CATERPILLARS IN PLATE V^d AND OF OTHER MOTHS AND CATERPILLARS SUITABLE FOR THE VIVARIUM.



MOST conspicuous, by far, among the British Moth tribes are the Hawk-moths. I have devoted an entire Chapter to their consideration, yet without being able in that space to do more than give a tolerably full account of two species only, with a few brief remarks on the rest of the family.

In the present Chapter, therefore, which is all the space I can allot myself in this volume to speak of the other families, genera, and species of British Moths, it is evident that it will only be practicable, in addition to those represented in Plate V., to select for description some half-dozen species belonging to widely different families, leaving the reader who desires a more intimate knowledge of



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1. The Caterpillar of the Puss-moth.
2. *Cerura Vinula*—The Puss-moth.
3. The Caterpillar of the Lobster-moth.

4. *Stauropus Fagi*—The Lobster-moth.
5. *Lampyrus Noctiluca*—The Female Glow-worm.
6. The Male Glow-worm.



our native Moths to seek it in works more especially devoted to the subject.*

The Caterpillar, Plate V. No. 1, is that of *Cerura Vinula*, the Puss-moth. It is a very remarkable larva, both in form and colour, and attracted the attention of many of our early naturalists long before entomology existed as a science. Old Isaac Walton, the accomplished angler, whose biographies of George Herbert the well-known poet, and others of his cotemporaries, are sufficient proof that his taste and skill were not confined to a successful exercise of the gentle craft of the rod and line, has given in one of those charming little outbursts of his love of Nature that occur continually in his book on angling, an elaborate description, exquisite in its nice perception of form and colour, of this Caterpillar, the name of which he did not know, but which is so faithfully described that it is impossible to mistake it.

Though so singular in form—the anal prolegs being absent and replaced by two curious tail-like appendages—and also so remarkable by its size and tinting, it is by no means rare; indeed it

* In my "Genera of British Moths," now publishing in monthly parts, by Mr. Jerrard, 171, Fleet Street, the young student will probably find all the information he requires.

may be said to be absolutely abundant, though those who have not schooled themselves to watch for the occurrence of such objects during their country walks may never have seen it. The two horn-like appendages at the tail have been taken as the character of the genus, the name of which, *Cerura*, is founded on the Greek word *κερας*, a horn or antenna. I once reared a large brood of the larvæ of *Cerura Vinula*, from eggs laid by a female which I had captured in the perfect state; and the appearance of the little Caterpillars when first hatched, as well as in their different stages, was very interesting. The markings and general appearance as to colour changed several times, and even in their full-grown state differed very considerably; some having the saddle-shaped mark on the back beautifully tinted with white and pink, while in others the same portion, as shown in Plate V., was entirely of a dark olive, variegated with delicate veinings of black. The Caterpillar is found about August, feeding on Willow or Poplar, and when full-grown burrows in dry ground or loose rubbish to undergo its change to the pupa state, forming a cocoon of small chips or other matters glued together so compactly that it is difficult to make any impression upon it with a sharp knife;

the perfect insect appearing in the beginning of the following summer.

The Moth, represented in the same Plate (No. 2), is very prettily waved and brindled with shades of gray, not unlike the markings, when well defined, of a gray tabby cat. This, with the furry character of the body, which is of the same colours, and marked in a similar manner, has obtained for it the popular denomination of the Puss-moth, under which name it has long been a favourite with young collectors. There is a variety, by some thought a distinct species, in which the body is whiter, and marked on the thorax with little black points like those of ermine, from which it has received the specific name of "*Erminia*."

The antennæ in this genus are in both sexes bipectinated, that is, formed like a double *comb*, gradually attenuating to the point. This is one of the various forms of antennæ never occurring among Butterflies, which has caused the whole of the Moth tribe to be classed in one division as *heterocera*, from having *variously* formed antennæ, while those of Butterflies are of one constant form, as we have seen, with a small club at the extremity.*

It would form an interesting task to a young

* See page 168.

collector to endeavour, in his collection of larvæ and perfect insects, to complete the genus *Cerura*, of which there are four or five distinct species, some say seven, all about half the size of the great Puss-moth or the Ermined variety. These smaller species are popularly called "kittens;" *Cerura Bicuspis*, the first of the small species, is a very pretty Moth, the ground of the wings white, with a broad band of deep gray-brown bordered with black across the centre of the anterior wings, and a narrower band, broadest at the front and narrowing to the back, nearer to the edge. The last-named band is slightly scalloped, and there is a row of dots at the edge of both front and hind-wings; the hind-wings being in other respects white, with only a slight shadowy band of gray towards the edge. Then there are *C. Integra*, *C. Furcula*, *C. Arcuata*, *C. Latifascia*, *C. Bifida*, and *C. Fuscinula*, each distinguished by some tolerably well-defined character. They have all been considered distinct species by continental entomologists, and some of them have been found in England, while the reported capture of others is disputed. The Caterpillars have all the curiously forked tail-like appendages at the end segment instead of the usual last pair of legs; and one or two of the kinds are far from uncom-

mon. As some of the species are disputed as British, it would be interesting to settle the matter by their capture, or rearing them from the Caterpillar state.

The Caterpillar in Plate V. No. 3 is that of the rare Moth *Stauropus Fagi*. It is popularly called the "Lobster," and is more unusual in form and general appearance than even the one last described. The pectoral legs, instead of being of the usual short proportion, terminating, after two very short joints, in a horny point, as in those of the Puss-moth Caterpillar just referred to, are lengthened in a most extraordinary manner, so as to exceed in length even those of the perfect insect—a peculiarity that does not exist in any other British Caterpillar. The form of these curiously angulated legs, which in some positions suggest the idea of a crossed palisade or *chevaux-de-frise*, has no doubt given rise to the generic name of *Stauropus*, from the Greek words *stauros* (σταυρος), a palisaded fence, and *pous* (πους), a foot.

The popular name of "Lobster" is, however, more graphically descriptive, as the skin, or rather shell, of the Caterpillar has a shining surface, and varies from a kind of fawn colour to a tone approaching the rich scarlet of a boiled lobster. The

overlapping of the skin in the last segments of the body, which are generally bent over the back, serves to complete the resemblance, being very similar to the scale-like jointing of the lobster's tail. Like the Caterpillar of the Puss-moth, the anal pro-legs are absent, their position being occupied by two horn-like appendages, the use of which is not known. The long pectoral legs, however, are said to be necessary to the larva in the formation of its somewhat peculiar cocoon, the texture of which is not unlike that of tissue paper. It will be observed that the first pair of these singular legs, next to the head, are very slender, and to a certain extent rudimental, the full development being confined to the second and third pair. This formation, however, disappears in the perfect Moth, in which the six legs are equal. There is a curious analogy with this arrangement in the legs of certain Butterflies, as in those of the genus *Vanessa*, described in Chapter VII.; but in that instance it is the front pair of legs of the *perfect insect* that are rudimental, while in the *Caterpillar* state there is no indication of such a peculiarity.

The "Lobster" Caterpillar feeds on *Fagus Sylvatica*, the Common Beech, and also on other forest trees, as Alder, Hazel, Sloe, etc. It is found in

autumn, and the Moth appears in the following June, having passed the winter and spring in the chrysalis state within its comfortable papyrian cocoon. The perfect Moth, Plate V. No. 4, presents nothing so particular in its aspect as one might expect from the extraordinary formation of the Caterpillar, but the antennæ are one of the many examples of the variety of forms to which this feature is subject in the Moth tribe. They are only *pectinated*, that is, toothed like a comb for about three-fourths of their length, the extremity being smooth, and terminating in a fine point—a feature which is not very well expressed in my illustration. In the female, the antennæ are entirely devoid of pectinations—a characteristic which we shall find very general in many families of Moths.

This Moth is very rare, the localities of its occurrence being nearly all in the south of England. I recollect an enthusiastic entomologist telling me once how he captured a specimen fluttering round one of the lamps on Clapham Common, and the dangers he incurred in the adventure. First, in order to have any chance of securing the prize, it became absolutely necessary to climb the lamp-post. When this had been effected, not without

some damage to his knees, and a good deal of exertion, he held on by the ladder-rest with his left hand, while with his right he made the best use of his hat, in which, after many unsuccessful sweeps, he had at last the satisfaction of making good his capture, and he slid down the iron post in triumph. He had scarcely reached the ground, however, when he found himself in the arms of a stalwart policeman; but he was at first too much absorbed to pay much attention to this interruption, and shaking himself free, all but his collar, which the policeman kept a firm hold upon, he proceeded to secure the treasure, and place it in his small collecting-case, which he always carried with him, regardless of the persistent questions of the policeman as to "what he meant by damaging the lamps?" "what he was after?" and many other forms of interrogation in which the official continued to indulge. At last, just as he was depositing the tin-case in his breast-pocket, the policeman put his question either in a form more intelligible to the excited entomologist, or in a way that appealed more forcibly to the set of feelings just then in most powerful action, "What have you got there?" he said. This was a plain question, and to the point; for the entomologist well knew "what he had got there," and, with a smile

of triumphant satisfaction, replied at once—"A lobster!" This was deemed by the official a piece of impertinence not to be submitted to—perhaps some new bit of slang that he was not "up to"—and so he determined to take the lamp-breaker and his "lobster" to the station-house; and it was not till after considerable explanation, backed, I believe, by a metallic form of argument more current, and generally more potent than words, that "58 G" allowed my entomological friend to depart in peace with his prize.

It occurs to me here to suggest that the establishment of an Insect Vivarium would offer an excellent opportunity for rearing some specimens of the beautiful *Endromis Versicolor* from the egg. This Moth, popularly known among collectors as the "Glory of Kent," from its being rarely found except in one or two localities of that county, and even there very sparingly, has recently been taken in great abundance in the north of Scotland, among the Birch forests of a remote part of Perthshire. It is more especially in the woods of Rannoch that this great entomological "*find*" has taken place; and I saw in the cases of Mr. Turner, the professional collector, after his return from his successful tour, several dozens of splendid specimens, male and female, of

this fine insect, which had been hitherto deemed one of our greatest entomological rarities.

Eggs were brought from Rannoch last season by another professional collector, Mr. Harding, of York Street, Shoreditch, who announces, in the "Entomologists' Weekly Intelligencer," * that he has been successful in rearing a number of larvæ from the eggs of last season. The Vivarium would afford unusual advantages for rearing these beautiful Caterpillars, which somewhat resemble those of the *Sphingidæ*, but that the oblique lines at the sides lean in the opposite direction. Eggs might, no doubt, be procured either from Mr. Turner or Mr. Harding; and the pleasure of seeing this fine native insect, hitherto so rare, in all its stages, would amply repay any time or care bestowed upon the necessary arrangements.

In speaking of recent additions to the list of our native Moths, though I have only room to name a few of the most conspicuous, I must not omit the handsome new Burnet Moth, *Anthrocera Minos*, taken in the west of Ireland, which has the crimson markings of its wings much larger than in the common kinds, and of a wedge-like form, instead of being oval spots.

* For April 8, 1858.

Such discoveries as these seem strange after our entomologists have been so long hard at work. It might, indeed, be thought that their persevering investigations during the last ten or twelve years would hardly have resulted in the detection of any conspicuous native insect left unregistered and described by their industrious predecessors; and yet new species are turning up every season. At one time it is Mr. Doubleday, at another, Mr. Stephens, at another, Mr. Douglas, who in turn bring to light some fine insect to be added to the British catalogue. The most recent discovery is that of the fine Moth *Petasia Nubeculosa*, never before found in England, and very rarely on the Continent, which has recently been captured in Scotland by Mr. Cooper, of Liverpool, and since by Mr. Fox of London. So great was the excitement on the occasion of this entomological surprise among the enthusiastic cultivators of the science, that one of the first specimens was positively sold for the sum of £7! It appears that Mr. Cooper had gone to Scotland to collect, unusually early in the season, so early, indeed, that few specimens of the insect he was in search of had appeared; but he was rewarded for his disappointment by finding himself just in time, it being the middle of March, for the

appearance of a species the very existence of which, in the British Isles, he did not even suspect. The capture of the first specimen of *Petasia Nubeculosa* was, indeed, quite a triumph. The only other British species of this genus is *Petasia Cassinia*, a much smaller kind, popularly known as "The Sprawler;" a name which has been given also to the new species, which is already spoken of as the "Rannoch Sprawler," from the fact of its having been first captured at that place.

The Caterpillar is found in April, and feeds on the Birch; it is therefore inferred that the noble Birch woods of Balmoral, a closely neighbouring region, may be found abounding with this handsome native insect, which has hitherto been supposed to be confined to the Continent. Esper has figured it in his valuable work as a native of France and Germany. It was during the same season that *Endromis Versicolor* was found in such abundance in that part of Scotland, while in the localities hitherto recorded as places of its capture—the woods of Kent and some of the southern counties—it has almost disappeared. It is presumed that both these entomological prizes are to be found in the extensive Birch woods of Balmoral; and if so, there is but little doubt that the

Prince Consort and the Prince of Wales, who are both collectors, have already been out in search of them, and most likely with complete success.

But although there is all the pleasant excitement of novelty about these discoveries, we must not in an Insect Vivarium forget the old-established favourites. There is, for example, the handsome Caterpillar of the *Lackey-Moth*, so called from the stripings of red and white, on a gray ground, that have the effect of the lacings on the rich livery of a lackey. This larva may always be found in great abundance, indeed it is a real garden pest in June. It is a sad destroyer of the foliage of fruit trees, but will form a very pretty addition to the Vivarium; and the Moth, *Clisiocampa Neustria*, can scarcely be procured in any other way, for it is exclusively a night-flyer, and its flight is extremely rapid.

Then there are the fine fur-clothed Caterpillars of the genus *Lasiocampa*, a name formed from the Greek words *lasios* (λασιος), hairy, and *campe* (καμπε), a caterpillar. Nearly all these are very handsome, and should be carefully looked for. Among them is that of *Lasiocampa Quercus*, the Oak Egger Moth. The name of "Egger" having been popularly conferred in consequence of the Cater-

pillar forming with great regularity a cocoon of egg-like form. This fine large Moth differs considerably in the colouring of the males and the females, the males having the base of the wings, next the body, of a rich dark brown, in which is a white spot; beyond which is a broad border, reaching to the edge, of bright yellowish ochre; the female is still larger, but of paler colouring, exhibiting only two shades of fawn, and the antennæ are simple, instead of being pectinated like those of the male.

If the collector should be fortunate in securing a female of this species, he may capture as many males as he wishes; for on going out with the captive female into any locality in which these Moths are found, the males will immediately appear, sometimes in considerable numbers, and are occasionally so bold that they will follow the box containing the female even into the pocket of the collector, or into any trap he may contrive for their capture. Then there is *Lasiocampa Rubi*, the Fox Moth, of similar but more ruddy tone and colouring, the Caterpillar of which forms the long semi-transparent cocoon previously described. This Caterpillar is clothed with rich foxy fur, the joints of the segments, when stretched out, looking like interstices of black velvet.

Early in the spring the common Caterpillar of the Tiger-moth will be found abundantly. It is well known to village children as the "Woolly Bear," and is remarkably handsome. These Caterpillars will form their cocoons in June, and the Moths will appear in July. This Moth (*Arctia Caja*) is one of the handsomest of our native insects. The upper-wings are of a soft pale cream colour, beautifully varied with large solid patches of warm brown. The form of these patches varies considerably, sometimes being so large and close as to make nearly the whole wing brown, and are at other times so scanty as to leave the cream-coloured ground almost pure. These extreme varieties are, however, very rare, and it is well worth rearing a number of the Caterpillars in order, if possible, to obtain them. The under-wings and body are of the most vivid scarlet, with fine markings of purple black.

These brilliant colours, combined with the size of the Moth, sometimes three inches across the expanded wings, render it, though one of the commonest, at the same time one of the most remarkable of our native Moths; and it is particularly adapted for the Vivarium, as it appears to have but little desire to fly, beyond seeking its mate, and in the day it remains perfectly quiescent, with the

wings half closed, in which state it forms a most beautiful object.

As early as the first signs of herbage begin to clothe the banks in spring, the Caterpillar of another of the genus may be found, that of *Arctia Villica*, the "Cream-spot Tiger," a Moth which, though less in size, is perhaps still more attractive in colour. The Caterpillar, however, is far less beautiful, being of a dull black, and only partially clothed with the fine fur that distinguishes its relative.

The *Tussocks*, or Tasselled Caterpillars, must not be neglected, as they form very beautiful objects for the Vivarium, especially those of the Vapourer-moth, of the Dagger-moths, and of *Dasychira Pudibunda*, the Pale Tussock, the last being a most beautiful straw-coloured Caterpillar, with tussocks of pale orange, and showing at the opened segments interstices of the intensest black.

The most interesting among the transformations of the "Tussocks" are perhaps those of the "Vapourer-moths," *Orgyia Antiqua* and *Orgyia Gonostigma*. In both these species the female is wingless, and so unlike a Moth in general appearance that a tyro in entomology would not dream of placing it in the order *Lepidoptera*, as it has neither scales, nor wings to bear them. The males of these Moths are

distinguished by beautifully pectinated antennæ, while those of the females are only in the form of two minute hairs.

The Shark-moths, so named from their grayish tone, and the shape of their wings like the sharp fin of a shark, have very handsome Caterpillars, which should be looked for on the *Verbascum*, where their delicate blue-green colour, varied with yellow and black spots renders them conspicuous, and enables the collector to recognize them at once from other kinds.

The Caterpillars of the *Plusia* family must not be omitted—not for their own beauty, for few of them are remarkable, but for that of the Moths, which, when they first come forth from the chrysalis with their fine markings and patches of gold, bright as real metal, are most strikingly beautiful objects, as some of their popular names imply. There is, for instance, “The Beautiful Golden Y,” the form of that letter appearing in gold on the anterior wings, “The Burnished Brass,” “The Scarce Burnished Brass,” “The Gold Spangle,” and others.

Then, making another great skip, we come to some other large and beautiful species, the *Mormo Maura*, for instance, or Old Lady, and the magnificent genus *Catocala*, or Red Underwings.

These last I must pause to consider for a moment, but in this place space will not allow of many details, though they are among the gems of a collection of British *Lepidoptera*. First comes the "Clifton Nonpareil," or Lilac Underwing, *Catocalus Fraxini*, four inches across the wings; the capture of which, by Mr. S. Stephens, in his garden at Hammersmith, I well recollect his describing to me. It was taken sitting at rest on the bark of an apple-tree which had been sugared by way of bait, a means by which many rare Moths may be taken. Then there is the Common Red Underwing, also a fine large insect, three inches and a half across the extended anterior wings, the under-wings being of a rich warm crimson, barred with black; and *Catocala Sponsa*, with the under-wings rather deeper and less bright in colour. The two somewhat smaller species, *C. Promissa* and *C. Conjuncta*, are perhaps still richer in colour, and more strikingly marked on the ashy fore-wings than the larger kinds. They are, at all events, notwithstanding their inferior size, well worth rearing in the Vivarium. The Caterpillars of the commoner kinds, which are much flattened on the under side, and have the edge fringed with a fine line of hairs, or ciliæ, are easily procured; but that of *Fraxini*, unless imported,

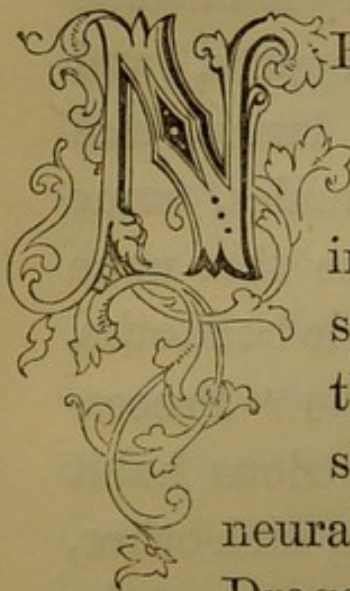
will prove a prize beyond the reach of most collectors.

Then there are the curious Caterpillars of the *Geometræ*, well worthy a place in the collection for their singular method of locomotion, and the curiously stiff positions in which some of them remain, having all the appearance, from their singular colour and surface, of pieces of dried stick. Some very handsome Moths—as the Currant-moth, the Peppers, and others—exhibit this formation in their larvæ, and many species of them have wingless females, some of which are such very singular creatures that none but entomologists would ever guess them to be Moths.

Then there are the Caterpillars of the “Processionary Moth,” so called from the curious habit which the Caterpillars exhibit in following each other, step by step, in whatever direction the caprice of the leader chooses to conduct them. In the entomological department of the British Museum there was recently to be seen a living brood of these curious larvæ, which exhibited their processional instincts quite undisturbed by the artificial position in which they found themselves. But as I shall have occasion to speak of these larvæ again when describing the best methods of rearing foreign species, I must not say more of them here.

CHAPTER XI.

OF DRAGON-FLIES AND OTHER INSECTS BELONGING TO THE ORDER NEUROPTERA.

EUROPTERA is the general term applied to the interesting tribe of "Dragon-flies," and other families of insects, in consequence of the beautiful system of delicate nervures by which their large transparent wings are strengthened and supported. These neurations, as exhibited in the wings of the Dragon-fly class, form a most intricate network, or rather lace-work, which at once appears a sufficiently remarkable distinction to form the basis of a natural order which might receive the name "*Neuroptera*," a term formed of the Greek words, *neuron* (νευρον), a nerve, and *ptera* (πτερα), wings. There are, however, a few insects included in the order in which this peculiarity is so concealed by a clothing of small coloured scales, like those of the wings of Moths, that some have

THE HISTORY OF THE
CITY OF BOSTON

FROM 1630 TO 1800

BY

JOHN

W. COOPER

OF THE

BAR

AT

BOSTON

AND

NEW-YORK

1800

CHAPTER XI.

OF THE STRUCTURE AND FUNCTION OF THE
RESPIRATORY SYSTEM.

The respiratory system is the system of organs by which the body is supplied with oxygen and gets rid of carbon dioxide.

The respiratory system is divided into the upper and lower respiratory tracts.

The upper respiratory tract consists of the nose, mouth, and pharynx.

The lower respiratory tract consists of the larynx, trachea, bronchi, and lungs.

The lungs are the organs in which the exchange of gases takes place.

The blood is carried to the lungs by the pulmonary artery and returns by the pulmonary vein.

The blood is carried from the lungs to the rest of the body by the aorta.

The blood returns from the rest of the body to the lungs by the inferior vena cava.

The respiratory system is a part of the circulatory system.

The respiratory system is a part of the excretory system.

The respiratory system is a part of the digestive system.

The respiratory system is a part of the reproductive system.

The respiratory system is a part of the nervous system.

The respiratory system is a part of the muscular system.

The respiratory system is a part of the skeletal system.

The respiratory system is a part of the endocrine system.

The respiratory system is a part of the immune system.



1. The Larva of the Common Flat-bodied Dragon-fly.
2. *Libellula Depressa*—The Common Flat-bodied Dragon-fly.
3. The Larva of the Purple-winged Dragon-fly.
4. *Calopteryx Virgo*—The Purple-winged Dragon-fly.
5. The Purple-winged Dragon-fly escaping from its Chrysalis.
6. A variety of the Purple-winged Dragon-fly.
- 7, 8, and 9. The Larva of the Common Lady-bird, or Lady-cow, devouring the aphides on a rose leaf.
10. *Coccinella Dispar*—The Female, commonly called the Six-spot Lady-bird.
11. *Coccinella Dispar*—The Male, commonly called the Two-spot Lady-bird.

thought of removing this section of *Neuroptera* to the order *Lepidoptera*; however, other characters seem to dispose the majority of entomologists to retain them in their present situation in the order *Neuroptera*. From this it will be seen that a general system of classification is not very easily carried out in all matters of detail without encountering many discrepancies, for the endless varieties of nature have evidently not been created with a view to the convenience of ticketing and labelling in cabinets. We must therefore be content with the best systems of classification we can get, and be contented with the immense assistance they afford us in our studies, without longing for "perfect" ones, which are impossible.

The Dragon-fly family, as containing the most conspicuous class of Neuropterous insects, and more especially, such as are likely to add variety and interest to Vivaria by the singularity of their transformations, must receive our almost exclusive attention in this Chapter, though one or two other genera may come in for a small share of notice.

The Dragon-fly family have been divided into two divisions, *Libellulidæ* and *Agrionidæ*, the title of the first division being derived from the name of the

first, and best defined genera, *Libellula*. The term *Libellula*, one of the fanciful denominations invented by Linnæus, is said to be derived from the name of a kind of water engine, consisting of a long lever, working by means of a balanced weight at one end; and as a Dragon-fly sits at rest on some aquatic plant its long slender tail extending over the water, it has certainly some resemblance, in miniature, to such an engine.

The detection of the facts which have allied the existence of the graceful and glittering Dragon-fly with that of a creeping aquatic creature of sombre hue and generally repulsive appearance, is of comparatively recent occurrence. The impulse to observe the transformations of insects having been once given, the changes of the ugly aquatic larva referred to, first into pupa stage, and then to the development of the perfect insect, were no doubt watched and discovered independently by several naturalists of the seventeenth and eighteenth centuries, each fancying himself the first discoverer. Goëdart was, no doubt, among the first of these, and the detailed account which he published of the extraordinary metamorphoses he detected, as he witnessed them for the first time, are very striking, though detailed with the utmost simplicity of style. He called his work

“Metamorphoses et Historia Naturalis Insectorum,” and the account of the preparations pursued for watching the progress of each expected metamorphosis he termed “experiments,” and so indeed they were to him, as he had no previous grounds for knowing the results which might be disclosed to his persevering observations. His preparations for watching the progress of the larva of the Dragon-fly rank as his “*Experimentum decimum-septimum*” (his seventeenth experiment), and it was doubtless one of those which proved to him the most interesting and astonishing. We may imagine the enthusiastic naturalist, on the day when he first captured the Dragon-fly larva, as he went forth into the fields, seeking the borders of clear brooks and ponds, and admiring with curious and eager eye the singular forms which he saw dimly flitting beneath the veil of water; and his triumph at successfully dredging up some of the curious creatures so eagerly sought, such as Nos. 1 and 3 in Plate VI., just in the way that a modern student, wishing to fill his modern Vivarium, must go about collecting a similar harvest. We may imagine the new treasures of old Gœdart carried home in triumph and placed carefully in some glass vessel, the better to observe the habits and expected changes of

his freshly-captured pets, for doubtless his sixteen previous experiments had taught him to look for something most highly curious and wonderful in their eventual transformations.

The reader may imagine the old naturalist in daily and almost hourly watch upon one or more such creatures as that represented at Nos. 1 and 3, Plate VI.; at first much smaller, but, even in their minutest stage, exhibiting extraordinary voracity, and devouring all insects of smaller dimensions than themselves as fast as they could be furnished to the crystal reservoir, until they attained their full size, which is represented in the illustration. To observe minutely their progress during that period required several months of careful watching; at the end of which time the naturalist, noticing that they began to feed less voraciously, and then ceased to take food altogether, no doubt came to the conclusion, from previous "experiments," that a change was about to take place. How curiously and anxiously he would watch them climb, by any support within reach, clean out of the water, and cling to the twig or other substance by means of which they had quitted their native element, becoming gradually motionless, and eventually hard and stiff, appearing perfectly dead! Indeed, had not the

sixteen other experiments preceded the *experimentum decimum-septimum*, one can imagine the disappointed naturalist throwing away the bodies of his prisoners, under the supposition that loss of liberty had impelled them to a determined suicide, by quitting the legitimate region of their existence, and thus eluding his intention of detecting the nature of their eventual destiny.

Forewarned, however, by experience, he no doubt patiently watched the dry remains of the aquatic creatures, until, after many days of unwearied attention, he perceived at last that the black horny skin of one of them began to split along the back, and that this split widened, and at last two shining emeralds seemed to emerge from the opening, which were soon perceived to be the eyes of a living creature, rapidly followed by the body, as shown in the engraving, No. 5, Plate VI. As the short semi-transparent blades of dusky brown at the shoulders of the insect (at first no longer than those represented) began rapidly to expand, and actually grew visibly under his observation, he soon saw them develop themselves into exquisitely neurated wings of a rich semi-transparent brown, destined to assume eventually the richest purple, and found that he had traced for the first time the history of the singular

metamorphoses of the purple-winged Dragon-fly, *Calopteryx Virgo*, the elegant and richly-tinted creature which is represented with tolerable accuracy in Plate VI. No. 4.

We have not the chance of experiencing the enthusiasm of the old Dutch naturalist, as the interest of the metamorphosis is no longer new; and yet a series of similar observations, in which many discoveries are yet to be made, would teach so much more, even to a modern student, than books can teach, that we cannot help recommending such of our readers as determine to set up an Insect Vivarium to make a series of such "experiments" for themselves, carefully and minutely noting down in detail the result of all their observations. It was thus that the first studies of the young Cuvier were made; and the manuscript memoranda thus prepared merely for his own use, were, greatly to their author's surprise, pronounced by Geoffroy St. Hilaire the foundation of a new code of Natural Science.

After the fresh-born Dragon-fly has succeeded in extracting his body, especially the long and slender tail or abdomen, from the prison in which it has been so closely packed, the wings, as described, attain their full size with amazing rapidity; but the presence of these new appendages does not appear to

astonish the insect in the least, and we may see them gently lifted, spread, lifted again, and then partially closed, with all the dexterity which nothing but either long practice or an intuitive instinct could accomplish. When, by exposure to the air, and this gentle and skilful exercise combined, they have become sufficiently hardened, for they are at first quite soft, the beautiful insect hesitates no longer, but at once rises into a new element—his powers of moving and sustaining himself in which form a singular contrast to those by means of which his dwelling at the bottom of muddy ponds was made easy and delightful to him. We are led to a curious train of reflections when we ask ourselves by what means the so-lately creeping creature, newly and suddenly gifted with the power of flight, knows at once the purpose of the beautifully-tinted fans which have issued from his shoulders, and hesitates not to use them with the boldness of a creature already practised in all the technicalities of the art of flying. We see a young bird, even when fully fledged, spread its feathered pinions in a vague, helpless kind of way, till the parent bird, flitting from branch to branch, tempts the pupil to follow, each time selecting a rather more distant point, till the use of the wing is gradually learnt, as it were, from

a professor. But the daring insect requires no teaching; he rises at once boldly into the new element, never doubting his powers, and sails off far over the bosom of the lake perfectly unconscious of any danger, as he takes what one might literally call "one of the boldest flights of intuitive genius."

In his fully expanded and mature state he may be seen in the same Plate VI., No. 4. His scientific name is *Calopteryx Virgo*, as I have stated, and he belongs to the class termed *Agrionidæ*. The name of the genus *Calopteryx* is evidently derived from the Greek words *καλος* (beautiful), and *πτερον* (a wing); all the three species which belong to it having their wings more or less enriched with striking colours, while those of the rest of the family are perfectly transparent, or only slightly tinted with colour. The term *Agrionidæ* is probably from the Greek *αγρευς* (a hunter), from the determination with which the living prey is pursued by these creatures. The term would, however, be equally applicable to the whole family.

I recollect last summer seeing certain parts of the Thames, a mile or two above Maidenhead Bridge, covered with vast swarms of the beautiful *Calopteryx Virgo*, which, being in many instances settled on the great sedges and rushes that fill the shallows

of that part of the river, made them appear as though covered with rich purple blossoms, which produced a most enchanting effect.

The individual represented in Plate VI. is a male, in its most mature state, after the wings have assumed their richest purple, the other sex being much more sober in its style of dress. The female of *Calopteryx* has indeed the body as brightly tinted as that of the male, with the difference that it is green instead of blue; but the wings are nearly transparent, being only just tinted with a suffusion of soft silky brown; and another distinction is that the neuration or net-work of the wings is decidedly more open in its character. The sexual differences of aspect of the graceful *Calopteryx Virgo*, as also analogous differences in many other insects, often led our early classifiers to make separate species of the two sexes; and in this way uselessly multiplying names and lists, and making endless confusion, which had to be set to rights by the slow means of gradual discoveries, of a kind which, as offering small reward, are only worked out by the labours of a few devoted enthusiasts.

There are also other circumstances connected with the beautiful *Calopteryx Virgo* which have led to the erroneous multiplication of species; first, the

changes in colour which it undergoes after its issue from the pupa; and, secondly, the curious modifications which it exhibits under the influence of climate.

As regards the changes of colour, they are the following, as first noticed and described by M. de Selys, of Liege, in a very recent work. It appears, from these accurate and curious observations, that when the insect first comes from the pupa case, the wings are almost colourless; that soon after they attain their full dimensions, they assume a ferruginous brown, not opaque, and somewhat resembling the brown wings of the mature female. In this stage Charpentier made it a distinct species, as *C. Vesta*. In the next change the brown becomes nearly opaque, and exhibits a fine flush of purple in some lights. In the last and mature stage the wings are opaque, except at the base and tip, and of the rich purple shown in Plate VI. No. 4.

Males of this species, in either of the younger stages, have had distinct names conferred upon them by our earlier entomologists, the different stages of the female leading to similar misapprehensions. The male, in its youngest state was made a distinct variety, as *Var. a*, and in its second stage, when the nervures begin to darken, it was made *Var. γ*.

The following variations from the effect of cli-

mate are mentioned by De Selys. That called *Hæmorrhoides* is found along the shores of the Mediterranean, and as far north as Lyons, which appears to be its extreme limit; and there are varieties in Spain, Italy, Algeria, and Asia Minor, all of which have received names as distinct species, though proved by connecting links to be merely varieties. The green variety named *Ludovicianum* by Leach, and described by De Rambur as of the "richest metallic green," is perhaps the same as the one I have placed in Plate VI. No. 6, which was, however, taken in England, where the species is, I conceive, also subject to vary in different localities, as I have found the males occasionally with green bodies like the females, instead of being of the ordinary blue. Some of the southern varieties have the opaque blue extending entirely to the tip of the wing, instead of leaving the small open space as in the English species.

The larva of *Calopteryx Virgo*,* as represented in Plate VI. No. 3, is much more slender in form than that of *Libellula Depressa*,* belonging to one of the first divisions of this beautiful family of insects, which in its broader and flatter and shorter body ex-

* For some account of the structure of these larva see Chapter V. page 71.

hibits exactly the analogy of proportion we should expect with the perfect insect, which is shown immediately above (No. 2). This insect—the Great Flat-bodied Dragon-fly—is among the most common, though one of the handsomest of the family. On fine summer days he may be seen in the evening in our gardens in pursuit of his insect prey. The graceful quivering of his silvery wings, as he hovers over some devoted victim, exhibits to perfection his skill in the art of flying, and the manner in which he sweeps off when disturbed or disappointed is really magnificent.

Though not so richly coloured as the kind last described, he is yet far from deficient in that respect, the soft lilac bloom of the body of the male forming a very pleasing contrast with the rich solid brown patches at the base of his exquisitely transparent wings. His eyes, of the kind termed compound, from being composed of an infinite number of brilliant facets, are very beautiful, even to the naked eye; but with the aid of a powerful glass they form very splendid objects, and the owner of a Vivarium should not fail to examine them before he gives the creature his liberty, or consigns him to the honour of a place in his cabinet, as the case may be. The female of this species is dis-

tinguished by a yellow body ; in other respects she closely resembles the male.

In order to encourage those who have set up an Insect Vivarium to pay especial attention to this tribe, and especially to watch their transformations, those of many of the family being as yet very imperfectly known, I will briefly describe a few of the most striking of the British genera and species.

The species standing first in the division is *Libellula Maculata*, a kind which has received its specific name from the brown maculations at the base of the wings, which are much larger and better defined than in the species just described ; but the body is not so conspicuous, being much more slender, though scarcely longer. It is, however, of the same soft lilac hue as that of *L. Depressa*. The female is distinguished by a yellow or rather lemon-coloured body, and by having the blotches at the base of the wings still larger than those of the male, while the transparent part is beautifully suffused with orange.

The three next species of this genus are all somewhat similar to those described, but having still narrower though not longer bodies, the last species being a considerably smaller insect.

Then follows a very elegant species, bearing the specific name of "*Flaveola*," from the beautiful pale

yellow tone which suffuses the basal portion of the anterior wings, and extends over nearly half the surface of the hinder pair.

The next genus is *Cordulia*, which is still of the short-bodied section. *C. Artisia* is a very pretty species, having its exquisitely clear wings finely suffused with brown, and yet remaining as clear as glass. The wings of the female are of a slightly richer tone than those of the male, but in other respects their general aspect is very similar, both having their bodies beautifully maculated with black and green, in the manner which is so conspicuous in the great long-tailed species which come next in the arrangement.

The first of this kind form the genus *Cordulegaster*, *C. Annulatus* having the long slender body very beautifully annulated or ringed with dark markings.

The genus *Aeshna* contains *Aeshna Cyanea*, the great long-tailed species, so commonly seen in our gardens, and known as the "Dragon-fly" *par excellence*. The females of *A. Cyanea* have the wings suffused with brown, like so many other species; but as the males have sometimes the same peculiarity, it is not, in this instance, a very characteristic distinction. The

form of the wings in this species have, however, a very marked difference in the two sexes, those of the male forming at the base a sharp angle towards the body, while those of the female are rounded off in the same part, and therefore quite free from the angle in question.

This, the most common of the Dragon-fly family, has been made the subject of many curious experiments: his wondrous eyes, with their endless number of convex facets, have been submitted to the microscope of every curious naturalist, and his voracity both in the larva and perfect state has been tested by experiments which might seem very cruel, but from our knowing that the sense of pain, as we conceive it, is, from their peculiar structure, almost absent in insects. Colonel Pringle decapitated several Dragon-flies, among other experiments, and a rather curious result followed, which was that several of them lived for four months without their heads, and one of the number for six months, though with their heads on he could never keep them alive beyond a few days. Mr. Haworth, a well-known writer on British entomology, made this Dragon-fly the means of proving to a friend the fact, that insects have not a nervous system, calculated for the transmission of a sense of

pain to a perceptive point corresponding with the human brain. Striking down one of these creatures with a stick, its long abdomen was severed from the trunk; but on being furnished with flies, it greedily devoured several. On attempting to fly, however, thus deprived of its balance-pole, it could not rise properly or guide itself; but on Mr. Haworth forming for it a false abdomen by means of a light piece of a geranium-stalk, the greedy *Aeshna*, after taking another couple of flies, flew off with great glee, evidently not aware of the injury it had sustained, and certainly not of the nature of the contrivance by which the present inconvenience, caused by the injury, was entirely obviated.

Aeshna Grandis has beautiful transparent brown wings in both sexes, but the same differences of form distinguish them as in the last species. While speaking of this genus, I may mention the fine continental species *A. Azurea*, a magnificent insect common in Hungary, which might easily be reared from the larva in a Vivarium, in which it would form a striking novelty.

We now come to the beautiful kinds contained in the *Agrionidæ*, of which we have already described one species, that with the entirely purple wings, *Calopteryx Virgo*. The next species, *Calopteryx*

Splendens, is, however, still more remarkable; the purple in the wings of the male being confined to a large oval blotch in the centre of each wing, the point and base remaining perfectly hyaline or translucent. In this species the neurations of the wings of the male, unlike those of *C. Virgo*, are much more open than in the wings of the female. In the last-named sex they are in this kind remarkably fine; in other respects the wings are like those of the female of the former species, being of a soft, silky brown tone, and semi-transparent, while the body also is green. This species, like *C. Virgo*, varies in colour at different ages, the blotches being pale blue while it is young.

Some of the exotic species of this division of the Dragon-fly family are very splendid, especially the Chinese kinds, which present some very curious anomalies, the anterior and posterior wings being of different colours, as among Moths and Butterflies. It would be expected that the front-wing in such cases would be the most brilliantly distinguished by colour, but instead of that the opposite is the case, the front-wings being perfectly transparent and colourless, while the hinder pair are of the same kind of solid metallic green or purple as that which distinguishes our own *C. Virgo*. To mention

a particular instance, the pretty species *Neurobasis Chinensis* may be cited, the anterior wings of which are of a pale transparent brown, while the posterior ones are of the richest metallic purple, with the exception of a large blotch of rich solid brown at the tip. In some cases, whether from difference of sex, difference of species, or mere accidental variety in the males, the purple portion of the wing is green, of the same dark, rich kind as that of my specimen of *C. Virgo* previously mentioned.

To return to our native Dragon-flies. I must remark, though I have not space to enumerate each species, that after the genus *Calopteryx* come the small slender-bodied, and delicately-winged kinds, many of which are as beautiful as those already described, and well worthy of study. The most beautiful exotic example of this section of the family I have ever seen is a solitary specimen in the British Museum, from the River Amazon. It is of the very smallest kind, not above an inch across the wings from tip to tip, but its gorgeous colouring makes ample amends for its diminutive size. It has the anterior wings transparent, like the Chinese species mentioned, but the hind-wings are a perfect blaze of brilliant hues, varying with every new play of the light. The generally prevailing effect, however, is,

that these hind-wings are of a shining metallic purple at the base, with a foil-like kind of gleam, which shades through imperceptible gradations of the richest olive into a brilliant orange, which towards the middle of the wing reaches the intensity of a refulgent scarlet, the whole surface having the texture and kind of radiation that is seen in leaf-gold.

As regards the Chinese species, I think the larva might be brought to England in well-contrived Vivaria, and that we might naturalize those magnificent insects in our brooks and rivers, as I shall explain more fully when treating of the culture of exotic insects in general, if space should permit. And before quitting the subject of Dragon-flies, I may suggest to such as wish to know more about them that they will find abundance of information in the works of Vanderlinden, Charpentier, Selys, and Pictet, accompanied by a very beautiful series of plates of all the species; and for a recent list of all the English species I may refer them to that by Dr. Haagen in "Stainton's Entomologist" for 1857.

The Caddis Worm tribe will form interesting subjects in the water of the Vivarium, and if the larvæ are secured at a period when they are near their change, the appearance of the moth-like ephemera would form an interesting event in the

Vivarium. There are several very distinct kinds, but I have not space to enumerate them here.

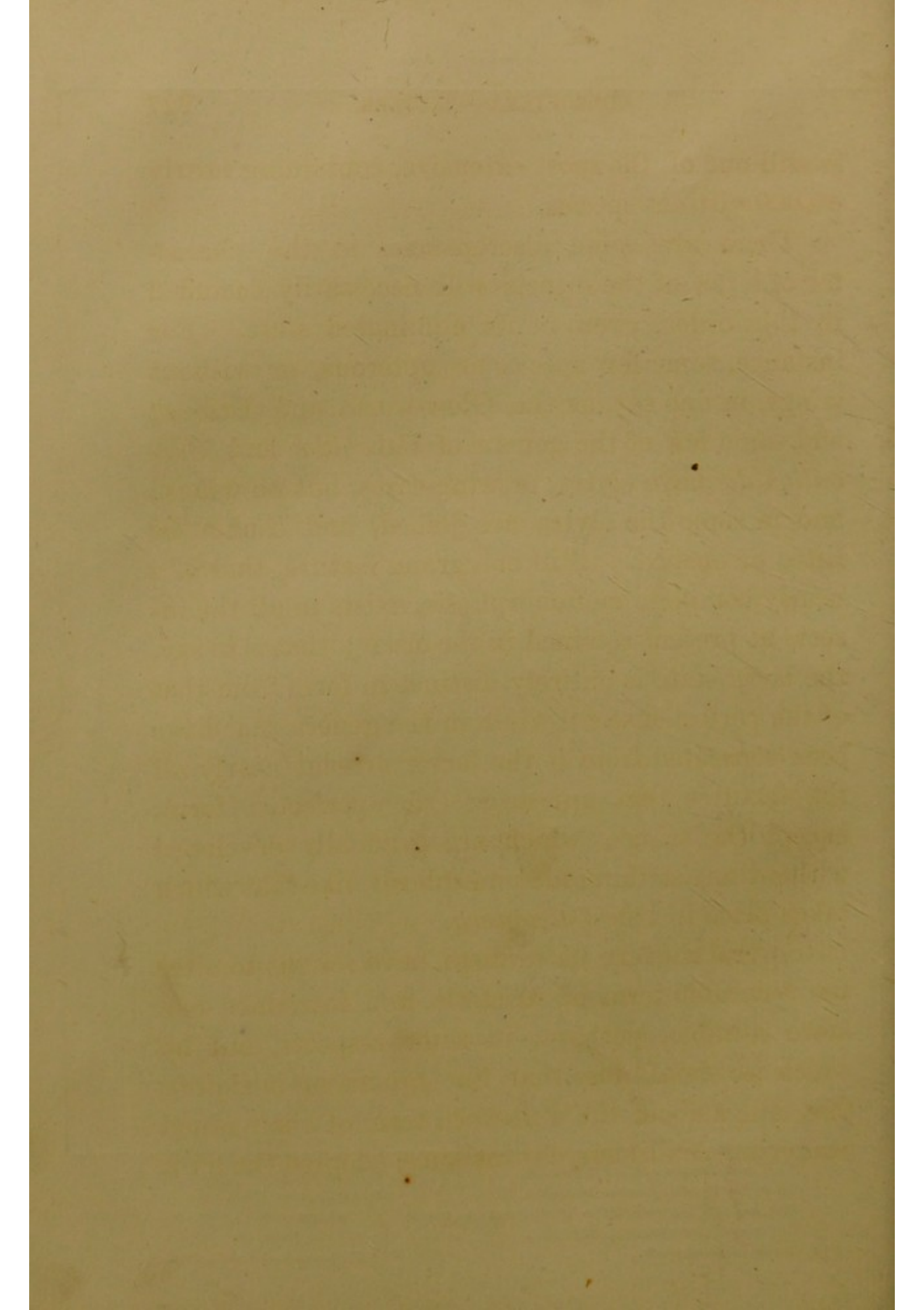
I must, indeed, only refer to one more family of Insects in the order *Neuroptera*—that of the pretty green insects with transparent wings seen fluttering about the shady parts of our gardens in the warm summer twilight. The most common species is *Chrysopa Perla*, both the generic and specific names of which convey the idea of its transparent wings with their opalline tinges of milky softness, flushed in different lights with prismatic hues, which have sometimes the effect of the nacreous colours of some of the most beautiful of the pearl-lined sea shells. The female *Chrysopa* should be placed in the Insect Vivarium, in order to secure an opportunity of seeing the curious disposition of the eggs at the top of slender filaments, as described in Chapter IV. The larvæ of this insect, when hatched, creep down the hair-like stilts upon the eggs, which have been placed as a security against predatory enemies, and immediately commence their own depredations among the *Aphides*, which are their natural prey. The larvæ of the genus *Chrysopa* resemble in general form, and in the nature of their food, those of the Lady-bird, to be described in another place, though the perfect insect belongs to such an entirely different class of insects.

Some of the exotic species of *Chrysopa* have larger wings than our native kinds, but are not more richly coloured. A species from the Amazon River, remarkable for the size of its beautiful wings, has been named by the eminent Continental entomologist, M. Guérin, *Chrysopa Marionella*, after the daughter of my esteemed friend Mr. Adam White, of the entomological department of the British Museum, to whose knowledge and experience I have been much indebted, not only during the preparation of this unpretending volume, but on many other occasions.



1. *Phyllium Scythe*—The Leaf-insect (female).
2. *Melolontha Fullo*—The Variegated May-bug.
3. The Larva of *Melolontha Vulgaris*—The Common May bug.
4. *Chrysomela Tremula* (strongly magnified).
5. The Larva of *Chrysomela*.

6. The Chrysalis of *Chrysomela Tremula*.
 7. *Acanthocinus Aedilis*.
 8. The Larva of *Acanthocinus Aedilis*.
 9. *Callidium Violaceum*.
- * The Larva No. 8 feeds in wood.



is still one of the most extensive, containing nearly 40,000 distinct species.

There are some discrepancies in the character of a few of the insects still necessarily included in this order, even in its eliminated state. For instance, some few species are apterous, or without wings, in one sex, as the Glow-worm and *Dribus*; and some few of the genera of *Carabidæ* and *Curculionidæ* have elytra, or wing-cases, but no wings; and in some the elytra are joined, and cannot be lifted or opened. Still one grand feature, that of a nearly complete metamorphosis, exists in all the insects at present retained in the order; that is to say, the larva state is entirely distinct in form from that of the perfect insect; while in the genera that have been separated from it the larvæ present nearly all the features that appear in the perfected form, except the wings, which are gradually developed without any striking metamorphosis, like that which takes place in true *Coleoptera*.

Several modern naturalists have sought to alter the venerable term of Aristotle, and introduce one more suitable, perhaps, in some respects, but by which we should lose that fine aroma of antiquity that clings about the well-worn term of the learned Stagyrte. Fabricius, for instance, adopted the term

Eleutherata, and Clairville that of *Elytroptera*, either of which might serve their intended purpose with great propriety; but the good old name, *Coleoptera*, still stands good, and is now too well established to fear erasure from a modern pen, however daring or innovative.

Speaking of Aristotle reminds me of an amusing and somewhat ridiculous misprint in the "Revue Zoologique," in which the credit intended to be given to the great Macedonian naturalist is rather curiously transferred to a celebrated Italian poet. It is in the preface to the "first part" of this work that M. Guérin de Manneville has allowed the error in question to escape his correction. It occurs when speaking of the vast range of the works of Cuvier, he calls him "cet *Arioste* des temps moderne," meaning, of course, "cet Aristote." Certainly Cuvier never expected, even accidentally, to be compared to the author of the "Orlando Furioso."

Among the *Coleoptera*, of which I was just now speaking, the Water Beetles, though not quite the first in the order of arrangement, perhaps deserve the first notice in a work where fitness for a Vivarium is the principal object sought for. Most of the Water Beetles will form interesting objects in a Vivarium in which a small tank forms a leading

feature ; but among the *Dytiscidæ*, the typical genus *Dytiscus* must be avoided, or kept apart, on account of their voracious habits, as they will not only destroy other aquatic insects, but even small fish, where any are kept. The late Curator of the old "Physic Garden" at Chelsea is known to have complained that these predatory Water Beetles greatly annoyed him in the ponds of the garden by eating off the fins of gold and silver fish, even of large size. But notwithstanding these objections, *Dytiscus Marginalis* is worthy of a place in the Vivarium if he can be kept separate, for his activity in swimming is very attractive, and he is in some cases very long-lived. Esper cites a case in which a specimen was kept for three years and a half, being occasionally fed upon small pieces of meat. But Kirby and Spence attribute this degree of longevity to his having been kept solitary, and so not allowed to pair. Some of this tribe, *Acilius Sulcatus* and others, have the power of making a humming noise, which is not produced, as formerly supposed, by rubbing the elytra, or hard wing-cases, against the abdomen, but rather, as Mr. Westwood supposes, by the action of the air upon the *alulets*.

Water Beetles may be observed to remain deeper in the water as the weather becomes colder, and to

rise towards the surface in proportion to the increasing warmth, so that they may be made, by a course of accurate observations, a kind of living thermometer. On warm summer evenings they creep to the edge of the water, and emerging from what seems (judging by the nature of their fin-like and ciliated swimming-legs) their native element, they spread their wings and ascend almost perpendicularly into the air to such a height as to be no longer distinguishable. After a time they descend as vertically, dropping with considerable force into the water, towards which it would seem that they are guided by the light reflected from its surface; for it not unfrequently happens that they drop in a similar manner upon cucumber or melon frames, the light reflected from the bright surface of which they have evidently mistaken for that of water. Some of them are known to be attracted by the light of a candle at night; and when an intruder of this kind appears he may be easily captured and consigned to the tank of the Vivarium.

Among the prettiest of the Water Beetles may rank the *Gyrinidæ*, popularly called Whirligigs, and in French *Tourniquets*, from their curious spinning motion, in which action their bright wing-cases glitter like burnished metal. When they dive

they carry with them a small globule of air, something like that of the Water Spider, which, as they descend, glitters like a granule of quicksilver. Rosel succeeded in rearing a brood of larvæ of the Whirligigs, from eggs found upon the leaves of aquatic plants; an experiment that might be tried, with still better chance of success, in our Insect Home; and much information upon the subject might be gathered by such as wish to try the experiment, from the minutely detailed account given by Modeer of all their successive transformations.

The *Hydrophilidæ* have been separated from the *Dytiscidæ* on account of certain characteristics which I have not space to describe here. I can only call to the collector's recollection that *Hydrophilus Piceus* is the largest and handsomest of the Water Beetles, and, as he is comparatively harmless, he may be kept in a tank without fear of his injuring the other inmates. The eggs of *Hydrophilus Piceus* are gummed together by a substance spun by the female, by which means fifty or sixty are attached together, forming a mass something like a small turnip, which is always secured to some aquatic plant. When the eggs are hatched the shells still remain gummed together, and the mass having become detached from its anchorage,

and of course rendered much lighter, may often be seen floating on the surface of brooks and streams, puzzling the curious who have not made themselves acquainted with this part of the domestic economy of the female *Hydrophilus*. The larva of *Hydrophilus Piceus* feeds upon small molluscs, and manages to break their shells by a very singular contrivance. He, in fact, makes a table of his back, towards which he is able to bend over his head, in which position it is very interesting to watch him make the necessary preparations for his meal.

But I must leave my readers to learn more about Water Beetles from their own experience, or from works specially devoted to the subject, for I have not yet attended to the very first genus of *Coleoptera*, that of the pretty green and red spotted *Cicindela*, commonly called the Tiger Beetle, from the ferocity with which, both in the larva and perfect state, it pursues its miniature prey. The names of this pretty Beetle and of the Glow-worm were confounded by the naturalists of the last century, which led to many misconceptions, somewhat similar to those caused by the numerous *Homophones* which are now puzzling the decipherers of the cuneatic inscriptions of the Assyrians. It is curious

also, that in consequence of a knowledge of natural science not having been very generally diffused, the names of the Fire-fly and Glow-worm have, in translations from the classics, been confused in a somewhat similar manner.

M. Desmarest was the first to observe the method pursued by the larvæ of our pretty Tiger Beetles for capturing their prey. The larva, as described by that expert entomologist, makes a deep hole in the sandy soil, and by means of certain hook-like appendages with which it is furnished, is enabled to hold itself at the top of the hole, making its own broad flat head form a kind of trap-door to the treacherous *oubliette*. No sooner does some unwary insect attempt to pass over this seeming level surface, than it sinks beneath him, and he falls with his captor to the bottom of the horrible pit, where he is remorselessly devoured.

If any very sensitive young lady should establish an Insect Home, she will perhaps do well not to attempt to rear a brood of larvæ of *Cicindelidæ*, as she might be shocked at this treacherous and somewhat savage proceeding. But, for the comfort of those who would, but for a painful sympathy in the fate of the unwary traveller thus entrapped on his way, wish to keep the pretty *Cicindelidæ*, I may

here recall Livingstone's account of his being seized and torn by a lion, from the attack of which he had a miraculous escape. In describing this affair, he tells us that either the roar of the lion, or some peculiar shock communicated by the claws, produced an effect which appeared to prevent his feeling any pain, or even any sense of dread; and we may thence infer that the ordinary prey of the lion is paralysed by the attack in a similar manner, and that the fascinating glare of the bird-snake equally destroys all sense of pain or terror in the victim; and also that the larva of the Tiger Beetle is enabled to enjoy his legitimate meal without causing pain to the paralysed victim of his ingenious contrivance for replenishing his larder.

The larvæ of another Beetle, *Staphylinus Oleus*, provides himself with his necessary food in a somewhat similar, though more bold and less ingenious manner. He makes a hole some six or eight inches deep, at the entrance of which he takes his post, watching for the approach of his destined dinner. When the, perhaps long expected, traveller arrives, he darts boldly out, seizes his prey, and drags it to the bottom of the pit, from which there is no escape, even large snails becoming not unfrequently his victims.

The Burying Beetles, sometimes called the "Sextons," exhibit a very interesting kind of instinct in providing for their larvæ. These *Necrophori*, as they are sometimes called, are some of them very handsome, being most frequently red or orange-coloured, and finely spotted or barred with black. Gledetsch, in his "Recreations of Natural History," published in 1765, has given a very interesting account of their habits. He tells us that if a dead reptile or piece of flesh is placed as a bait for them at the proper season, they appear in an incredibly short time, guided no doubt by an extremely keen sense of smell, which enables them to scent it from a considerable distance. When they arrive, they appear to survey the object with a certain kind of deliberation, as though taking the measure of its dimensions; after which they at once commence digging underneath, and sometimes bury it above a foot deep, the whole operation occupying but a few hours. When the work is complete, the female deposits her eggs upon the object, and it is then covered up so as to leave but little trace of the performance.

An instance is recorded of the singular manner in which their instinct enables them to overcome unexpected difficulties when they occur. A Mole,

as it is said, was suspended to the upper end of a stick fixed firmly in the ground, and the scent of the carcase soon attracted the "Sextons," who appeared at first much disconcerted by the situation of the coveted supply of provender for their future progeny. After a kind of consultation, however, which appears to have been very much to the point, they proceeded to undermine the stick, which, yielding to a few hours' unceasing labour, at last fell, and the prize was secured and duly interred after the usual fashion.

But I believe I must now confine myself, or pretty nearly so, to a brief description of the Coleopterous insects represented in Plate VII., and the Lady-birds, and Glow-worm in Plates V. and VI., the last two being among the most attractive of the whole Beetle tribe, and well suited to a Vivarium. No. 2 in Plate VII. is a handsome species of the May-bug tribe, *Melolontha Fullo*, which, though rarely found in England, is common on the French coast, whence it might be procured and placed as a principal ornament in the Vivarium, where it might easily be kept in health, as it is in its perfect state a leaf-feeder. The larva of this handsome insect is very similar to that of the common May-bug, *Melolontha Vulgaris*, which is represented at No. 3

as burrowing under the turf. No. 4 is a highly magnified specimen of *Chrysomela Tremulæ*, nearly allied to the Lady-bird family, and No. 6 is an equally magnified representation of its Chrysalis. The larvæ are not, like those of many other families of Beetles, a kind of grub feeding under ground or in the trunks of trees, but are leaf-feeders, and very closely resemble the larvæ of Lady-birds. They are represented of the natural size on the leaf from which the pupa is suspended. This class of Beetles, in their larva and pupa stages, form a kind of link between the ordinary larvæ of Beetles and those of *Lepidoptera*, the pupa being a very near approach to the chrysalides of several kinds of Moths and Butterflies.

No. 7 is *Acanthocinus Ædilis*, the variegated pinkish-brown wing-cases of which, with the singularly graceful antennæ, form a very pleasing object. No. 8 is the larva of this pretty Beetle, which feeds on the wood of young trees, and is very destructive, being only placed, as shown in the Plate, for convenience. Ratzeburgh, in his "History of Forest Insects," especially all such as are injurious to timber, particularly mentions the ravages committed by the larva of *Acanthocinus Ædilis*.

No. 9 is *Callidium Violaceum*, a pretty insect,

whose wing-cases are of a bright shining violet-purple, which would create a very pleasing variety of colour in our little colony, especially when running over the plants of the Vivarium in the sunlight.

Then there is the brilliant *Cantharis Vesicatoria*, the "Blister Beetle" of our Materia Medica, which, with its rich green and golden metallic gloss, could not fail to be attractive. Few are aware that the *Cantharis* is a native, as the numbers imported by druggists are commonly called "Spanish-flies." These beautiful but destructive insects, however, appear occasionally in England in great numbers; and at Southend, a few seasons ago, so completely cleared the Lime-trees of their foliage that many of them did not recover their devastations.

No. 5 in Plate V. is the wingless female of the Glow-worm, *Lampyrus Noctiluca*; and No. 6 the winged male, flying towards its mate. The common and generally received fable, which describes the wingless female of *L. Noctiluca* as being furnished with a light, for the purpose of attracting her mate, regarding the male as being entirely without this singular light, has been long ago disproved by naturalists, though still clung to by poets as an elegant fancy, and far too valuable in poetic

machinery to be allowed to fall into disuse. The fact is, that the light emitted by the male is at a certain period nearly as bright as that of the female, but is only visible when the wings and wing-cases are expanded in flight; and the light is also present when the insect is in the larva state, in which stage of its existence it is of no sex.

It is, however, pretty certain that the light is most brightly shown at the pairing time, when both sexes have arrived at maturity, and thus the old fable, after all, is partly true; which is further proved by the singular formation of the head of the male, which is margined with a horny band, that prevents either upward or lateral vision, confining his sight entirely to objects below him in his flight, such, for instance, as the wingless female with her "lover's lamp," who, deprived of the means of flight, is never able to rise from the bank which has been her abode ever since she escaped from the shell of the minute egg deposited there by the parent.

Glow-worms are about twenty-one months in their progressive larva stages; that is to say, the larvæ hatched about August or September have not attained their full growth till the end of the following season, when they pass into the pupa state; and the second year, early in June, the perfect insects,

having completed their development, emerge from the pupa or nymphine state. At that season the females may be seen displaying their glowing spark of seeming fire in the mossy banks, while the males, in dim twilight, carry their little lanterns of paler light through the warm evening air, often flying together in considerable numbers.

At Eastcote, in the summer of 1856, while sitting in the drawing-room of a friend's house, about ten o'clock in the evening, we observed a great number of seeming sparks, of a pale bluish colour, that seemed to be driven towards the open window by the warm night wind. They came positively into the room, and appeared for a moment to fill the whole space, and were then suddenly extinguished; and the next instant the white table-cloth of the supper-table, my friend's shirt-front and my own, and every other light object were covered with swarms of a small narrow Beetle, which I at once recognized as the male Glow-worm.

During our walks that season, the female Glow-worms were very plentiful along the banks, especially in a lane leading from Eastbury to Watford, and we collected a great number, which were placed upon a range of artificial rock in my garden, when

we were gratified by their miniature illumination every fine evening for several weeks. I am inclined to think that this pretty and curious insect might be naturalized in a Vivarium, to which it would impart a great additional interest. With this intention, several females about to deposit their eggs should be placed in the case; and if any were hatched, it is most probable that they would be reared successfully, affording a convenient opportunity of observing at what period of their development the light was most brilliantly exhibited. Even in the egg state, however, it is known that the Glow-worm is already luminous, each egg appearing like a little ball of phosphorus. The larvæ even in the young stages are also luminous, as I have stated before; but De Geer asserts that the light of the larvæ is much paler. Even in the dormant epoch of the pupa stage the phosphorescent effect is visible at night; and thus the fable, which would have elevated our little Glow-worm into an insect Hero expecting her Leander, guided safely to her tower by her never-failing beacon, entirely falls to the ground. Her light, at all events, during her long, deep nymphine^{*} sleep, can only be considered as a kind of "night-light," while that of the equally drowsy

bachelor must sink into the mere rushlight of the invalid;* and thus, with the advance of science, many a pretty fable loses both its poetry and point, and becomes neglected and forgotten.

In the time of Gilbert White, however, entomological science had not yet stripped the Glow-worm of her raiment of poetry, and the concluding lines of a little poem that he addressed to a brother naturalist—the celebrated Pennant—are so neatly turned that I cannot resist the temptation of quoting them here :—

“The chilling night-dews fall: away, retire,
For see, the Glow-worm lights her amorous fire!
Thus, ere night’s veil had half obscured the sky,
Th’ impatient damsel hung her lamp on high;
True to the signal, by love’s meteor led,
Leander hasten’d to his Hero’s bed.”

It will not be uninteresting to follow the suggestion thus accidentally struck out by the poet of Selborne, which infers, though vaguely, the existence of some analogy between the Greek story of Hero and Leander, and the fable of the Glow-worm.

I believe that we have actually, in the story of the lovers of Sestos and Abydos, a somewhat

* It has been observed that the female Glow-worm in the height of the summer season extinguishes her light at about half-past eleven o’clock.

late version of a national myth as old as that of Cupid and Psyche, which, as I have stated in another place, was founded upon the transformations of the Butterfly;* while that of Hero and Leander in its original form, was very probably founded, in a precisely similar manner, upon the peculiarities exhibited by the singular organization of the Glow-worm as viewed by the same imaginative Hellenic race, who, no doubt, at a very early period became acquainted with the unusual phenomena presented by this curious insect.

The fable concerning the nocturnal light of the female, as being a beacon intended to guide the course of her mate in his aerial flight, might soon arise among any rustic population, who are invariably close observers of Nature, and who as invariably transform the phenomena they thus become acquainted with into signs and tokens which are soon interwoven with national superstitions and fables.

The next phase of all popular fables is their embellishment, by the language and fancies of the poet, and in this form we shall find so striking an analogy between the poem of Hero and Leander, and the rustic fable of the Glow-worm's light, that

* See page 136.

one feels compelled to admit that they are simply different versions of the same idea. In the first place Hero is made a priestess of Aphrodite—that is, of Love—and it is therefore as an emblem of that passion that she is represented as awaiting Leander, and guiding his course by her nocturnal beacon. Musæus, in his comparatively recent work, in order to suit the greater amount of realistic taste that always develops itself in the maturer stages of civilization, loses sight of the origin of the story, and the lamp is introduced in the trite form of that of the Light-house of Sestos; but in the original it was doubtless a light that gleamed from the temple of Aphrodite, that is to say, the altar of Love. Then, the lover does not approach the light in any ordinary manner, neither on foot nor on the swifter-footed steed, as in common romance; but, in order to preserve the analogy complete in all its bearings, he is made to clear his way through the medium of another element; and as the insect approaches its mate through the air, in which her more humble nature denied her the power to soar, so Leander reaches the lamp of Hero in a poetically analogous manner, through the waters of the Hellespont.

To make a *flying* youth would have been inconsistent with the artistic principles of the Greeks, it

would have been too glaring a deviation from Nature in a story, intended to enlist purely human sympathies; while the ingenious device of substituting the act of swimming for that of flying, at once preserves the analogy, and by its probability secures the sympathies of the reader.

As the ground-work for the conclusion of the story, we may conceive that on the approach of a sudden storm, a female Glow-worm, as instinct teaches her, withdraws her light; and on the following morning it is easy to imagine that some shepherd, leading his flock back to their pastures after the tempestuous night, and finding a male Glow-worm lying with out-spread wings, drenched and drowned by the way-side, would be led to conclude that the poor insect had fallen a victim to his daring and his constancy, and while disregarding the dangers of the tempest had fallen a victim to his ill-timed devotion. Here we seem to have the prototype of the catastrophe which occurred to Leander; the lamp trimmed by his love extinguished in the storm, and he, no longer guided by the beacon-light, perishing miserably among the breakers of the rugged shore of the Hellespont.

We have thus completed the companion picture to that of the story of Psyche, though occupying a

secondary position; but we may suppose that the poetic romance of Musæus was taken from some earlier work, containing much more of that true mythic character, which would impart to it a higher kind of interest.

Among our native Beetles, the Lady-bird has been almost as great a popular favourite as the Glow-worm; and as it is a great benefactor to our rose-trees, as well as being the means of ornamenting some of their leaves with its bright little masses of scarlet, more brilliant than their own buds, I shall devote my remaining space to some details connected with its general history and associations, in preference to speaking of other members of the Beetle tribe. Its generic name is *Coccinella*, from the Greek word, *κοκκινος*, scarlet, in allusion to the prevailing colour of most of the family. The popular English names are similar to those by which it is known on the Continent, our "Lady-cow" and "Lady-bird" being represented in French by "Vache-à-Dieu," "Bete de là Vierge," etc.; our term "Lady" clearly alluding to the Virgin Mary. In France the Lady-bird is also termed "Vole-midi," from its favourite time of flight being at mid-day; and sometimes as "Petite tortue," in allusion to its form, which might pass for a miniature

model of that of the small Land Tortoise. The terms “Lady-cow” and “Vache-à-Dieu” have arisen from the curious faculty possessed by this little insect of exuding a yellowish milky fluid, which was once deemed an almost miraculous cure for tooth-ache and cholic, for which purposes it formerly held a place in the “Materia Medica.” This fluid has a rather disagreeable odour, and is doubtless a means of defence, analogous to that possessed by many other insects, and some of the higher animals. The common Two-spotted and Six-spotted kinds are shown in Plate VI., both in the larva state and in the perfect form. These two apparently different insects are simply the two sexes of one kind, which were, however, described as distinct species by all the entomologists of the last generation, to whom *Coccinella Variabilis*, another species, is indebted for above twenty names from different authors. This extreme disposition to vary in colour and markings is now well known, and careful investigations have considerably reduced the supposed number of distinct species. The eggs of the best known species are bright yellow, small, flattish, and of oval form; they are deposited close together, in patches of twenty or thirty, and are to be found during the summer months glued to the leaves of various

plants, a leaf being always selected which is sure to become peopled with their future prey—the juicy and delicious *Aphides*. The larvæ are nearly black, with a few obscure red marks. After the formation of the chrysalis, which is somewhat in the form of that of *Chrysomela Tremulæ*, No. 6, Plate VII., the perfect insect comes forth in a few days. The insect in its perfect state still feeds voraciously on the *Aphides*, and generally retires to the under side of the leaf when its meal is completed. When the natural food fails, as the autumn advances, these insects retire in colonies beneath the bark of trees, or other places of shelter, for the winter. In the spring they soon pair, and deposit their eggs upon another year's crop of rose-leaves, and so another generation of Lady-birds is provided for.

These pretty little Beetles have given their names as a typical distinction to a large family of insects termed *Coccinellidæ*, which, calculating all the exotic kinds, contains twenty-two genera and above one hundred species, distributed in the five quarters, or rather divisions of the earth. Most of the foreign species are of rather dull colours, none surpassing the brilliancy of our little native scarlet kinds. In some seasons, when “the Fly,” a species of *Aphis*, is most numerous in hop-grounds, the Lady-birds

are generally equally abundant, though not always; and it would not be logical to infer that such arrangements are direct providential interferences to prevent the undue preponderance of a particular class of creatures, seeing that we are not in possession of a sufficient number of facts to grasp all the bearings of questions of that class, the most favourite of our hypotheses being sadly interfered with by such facts as the vegetation of half a continent being devastated by innumerable swarms of locusts whilst no counteracting influence can be detected.

The Lady-bird is very tenacious of life, and will live a considerable time when plunged in ardent spirits. It is said that the entomological studies of the Rev. William Kirby commenced with the interest excited by a Lady-bird which he had placed in spirits of wine, and which after twenty-four hours' immersion flew away upon being taken out of the spirit.

Among the prettiest kinds may be noted the Twenty-two-spotted (*Vigintiduo-punctata*) and the Eleven-spotted, having eleven spots, on a ground of yellow, on each wing. This last is a very elegant species.

Before quitting the subject of Beetles suited to the Vivarium, I must not omit to recommend

especially the Gold-chafer, or Rose-beetle, decidedly one of the most splendid of his tribe, and which has the additional advantage over most insects in its unusual longevity. A Rose-beetle was once known to go on living in apparent health, and rejoicing in the brilliancy of his bronze and golden armour even for eight years, as an insect pet, fed upon soaked crusts, etc.; and there are several recorded instances of one being kept for terms of three and four years. Some naturalists have accounted for this unusual length of existence on the ground of the insect having been solitary, and not allowed to pair. It is, in fact, well known that insects possess an extraordinary tenacity of life till the great end of their existence, the continuation of their species, has been effected. A female Moth about to deposit her eggs, for instance, cannot be destroyed by any amount of torture till she has laid the very last egg. She will continue her work of maternity undisturbed by half-a-dozen pins driven through her body, and any number of drops of prussic acid poured upon or around her.

Then there is the great Stag-beetle, the giant of our native *Coleoptera*, which might be tried in the Vivarium; and if it were not found to do mischief, it would form a conspicuous and striking figure in

the little landscape, stalking about a very Rhinoceros among the smaller game. A few of the pretty little Sun-beetles, with their dazzling coats of bronze, might be tried; and the glitter of their movements during a gleam of sunshine could not fail to be highly pleasing. But then I must caution the curator of the Vivarium against over-crowding, and particularly against exposing the case to the heat of the midday sun, which would infallibly destroy many of the tender-skinned Caterpillars.

CHAPTER XIII.

ON THE OTHER ORDERS OF INSECTS, WITH BRIEF ALLUSIONS TO SUCH AMONG THEM AS ARE FIT SUBJECTS FOR THE VIVARIUM.



COLEOPTERA, *Lepidoptera*, and *Neuroptera*, having been discussed at some length, considering the restricted form of this volume, as the three orders containing the classes of insects best fitted for the Vivarium, I can only briefly allude to those remaining orders which present fewer objects of popular interest. Nevertheless, in order to give a general view, however brief, of the manner in which the whole of the insect tribes, as far as known, are reduced to scientific order and arrangement, I must in this short Chapter just refer to the position of each order, and to the general characteristics of the insects which have been assigned to it.

I shall adopt, in this brief statement, the ge-

neral division and order of arrangement adopted by Mr. Westwood, in his modern "Classification of Insects," which though necessarily a voluminous work, exhibits the whole subject in a more compact, easily understood, and truly regular form than any work I am acquainted with.

1. The *Coleoptera*, or Beetles, occupy the place of honour, and stand at the head of the great phalanx of insect life.

2. Then comes a small order recently separated, and called *Euplexoptera*. It contains only the *Forficulida*, or Earwig tribe, which, from the peculiar formation of the broad, cheese-knife-shaped wing, has been considered very distinct to all other classes of the order *Orthoptera*, to which it was attached when first separated from *Coleoptera*.

3. Then follows the extensive order *Orthoptera*, termed *Deraloptera* by Clairville, and *Ulonata* by Fabricius. This order contains that class of insects which may be represented, in their general character, by the Cockroaches, Soothsayers, Walking-stick insects, Leaf-insects, Crickets, Locusts, etc. In their internal anatomy, many of the insects of this great and distinct order exhibit such a superior degree of development, as to have led the eminent French naturalist, M. Marcel de Serres, to

regard them as entitled to hold the foremost rank among insects, and occupy the first position in every method of classification. One of the most easily understood features in this order is the shortness of their horny wing-shields, which instead of extending from the point where they join the main part of the body, to the end of the abdomen, generally extend but a short distance along the back, and the wings fold beneath them in a very intricate and beautiful manner. But this leading feature varies, as indicated in the characters of the insects named as generally illustrating the order. Many of the species of *Orthoptera* are distinguished for their musical qualities, as Crickets and Grasshoppers, while others are remarkable as being among the largest of known insects. These last, however, principally belong to the tropics, and among them is the truly splendid *Metallyticus Splendens* from Malabar. The largest of our native *Orthoptera* is the Mole Cricket, a curious creature, which should be tried in the Vivarium, though he would be seldom visible; and the next, the Great Green Grasshopper.

4. The order *Thysanoptera* comprises only one family of minute insects, the characteristics of which I must not stay to describe.

5. The interesting order *Neuroptera* is the next in succession, but it has been already sufficiently described in Chapter XI., when describing our native and some of the exotic Dragon-flies.

6. The order *Trichoptera* comprises those singular insects, the wings of some of which are scaled like those of *Lepidoptera*, a few of the larvæ of which, with their curious cases of sand, shells, or chips, should find a place in the Vivarium. The whole number of the species of Caddis fly known to Olivier was only seventy-seven, while, by more persevering researches, M. Pictet of Geneva has discovered a hundred and twenty distinct kinds in Switzerland alone.

7. The order *Hymenoptera*—that is, the transparent-winged class—comprises a great number of insects, and in that respect rivals *Coleoptera*, but most of them are of rather small size. In many, as the Bees and Wasps, all of which may serve as types of this class, the larvæ are maggot-formed—that is to say, legless—but the larvæ of the Sand-flies very closely resemble the caterpillars of *Lepidoptera*, except in having a greater number of ventral legs. The legless larvæ of this order are provided with food by the parents, as before described, those of the Ichneumons being placed so

as to feed upon the bodies of other insects while in the larva or imperfect state. Among insects living in societies, these helpless larvæ are sometimes tended by the neuters, as among Ants and some kinds of Bees. This order formerly made part of *Neuroptera*, but Linnæus separated it, under the title of "*Gymnoptera*," or "naked-wings," a term which he subsequently abandoned in favour of the present name.

8. The order *Strepsiptera* consists, as the name implies, of insects having obsolete anterior wings, and large rounded posterior ones. They are a small and inconspicuous class.

9. The order *Lepidoptera* follows, which has been sufficiently described in Chapters VII. and VIII.

10. The order *Homoptera* contains a class of insects with clear wings, the anterior pair of which is larger than the posterior. Among this group of insects many singular forms occur. In European species, the musical *Cicadæ*, those curious and sometimes frightful-looking Lobster-headed Flies, whose pleasing song or chirp has been so often described by the Latin poets. The song of these creatures is said to be produced by a distended internal membrane, acted upon by powerful muscles, the sound issuing through two small apertures situated near

the last pair of legs. It has been noticed that the males only have the power of producing this sound, and hence the couplet—

“Happy the *Cicada* lives,
Since they all have voiceless wives.”

The female *Cicadæ* are furnished with a singularly powerful instrument, by means of which they bore holes in trees, in which they deposit their eggs. The curious Cuckoo-spit, the *Aphides*, and the *Coccidæ* also belong to this class, as well as those most singular of insects, the Lantern-flies of the tropics.

11. The order *Heteroptera* contains the Boat-flies and a few other aquatic insects, such as the Water Scorpion and the Water Runner, along with many tropical insects of singular forms.

12. The order *Aphaniptera* contains the family of *Pulicidæ*, or Fleas, which, as the name of the order implies, have no wings, or only rudimental ones. Many curious things are known concerning Fleas, and many singular enough anecdotes might be told about them; but, in deference to the delicacy of my female readers, I will abstain from any details concerning this family. It will, however, be interesting to state that this is one of the insects which Aristotle positively asserted to be produced from

the earth by spontaneous generation. Their Latin name, *Pulex*, too, is said to be derived from *pulvis*, dust, which shows that a similar popular idea was prevalent in Italy as well as Greece. Even in modern times, the learned Scaliger thought they were produced spontaneously from the humous matter about the roots of the hair of dogs. The female lays about twelve eggs, which become, when hatched, small, slender, worm-like larvæ. These enter into the usual pupa state, and at last the perfect Flea appears.

13. The order *Diptera* contains, as the name implies, those insects which have only two wings instead of four. As well-known examples, the tribe of Common House-flies may be cited. Among the Forest-flies, known as the *Hippoboscidae*, the egg passes to the larva and pupa state before it is laid, and is eventually deposited by the parent in the form of a small oval chrysalis, from which curious aberration it might have been inferred that this insect did not, like all others, pass through the usual stages of development, but was hatched from the egg in its perfect form, like a chicken. The term *Diptera* is one of those highly characteristic distinctive names invented by Aristotle, which is likely, as in the case of his picturesque term *Coleoptera*,

to continue in permanent use, notwithstanding the changes of nomenclature which modern entomologists are continually introducing. This last-named order was not a favourite one with mediæval entomologists, Moses Harris having been the first among English naturalists to pay much attention to it. Recent continental authors have, however, devoted much study to its illustration; as Macquart's fine monograph on the *Diptera* of the north of France, and Meigen's six portly volumes on the *Diptera* of Europe, are sufficient proof. The Gnat* families, the *Culicidæ*, are of this order, and also the genus *Chironomus Plumosus*, the singular thread-like larvæ of which are popularly known as Blood-worms, and found in stagnant waters. The well-known Daddy-long-legs and all his family, the *Tipulidæ*, are true *Diptera*, as are the *Strattonidæ*, those metallic-bodied Flies of rich colours, which have received their name from the Greek word meaning a soldier, in allusion to the bright uniform which they wear. The larvæ of some, but not all, of these are aquatic. The voracious *Empidæ* belong to this order, and also the Gad-flies.

14. The order *Syrphidæ* contains about thirty

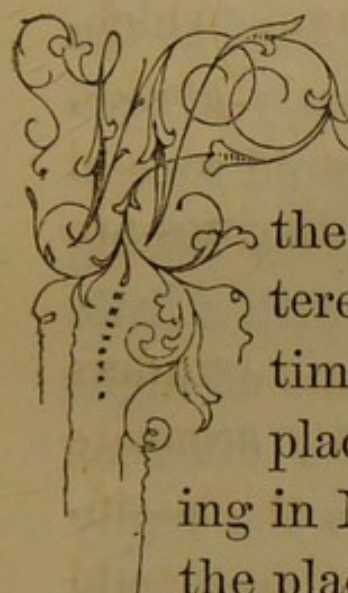
* It is only the female Gnat that is a blood-sucker, the males feeding on the nectar of flowers.

genera, consisting principally of a pretty class of Flies, which in their colour and markings closely resemble Bees and Wasps, from which they may be at once distinguished by their single pair of wings. They are also distinguished from *Diptera* by several tolerably well-marked characters, among which that of the sometimes brightly coloured larvæ, which, like those of the Lady-bird, feed upon *Aphides*, may be noted as the principal; but the short and robust form of the body and other peculiarities are amply sufficient to distinguish them.

This brief sketch of the entomological orders will enable the student to form a pretty accurate idea of the great outline of the method of classification that has been generally adopted; but should he wish to go more thoroughly into the subject, let him get some complete technical work on the subject—Mr. Westwood's two excellent volumes, for instance, on the "Modern Classification of Insects," which, as the first serious step, is the best I know of.

CHAPTER XIV.

OF THE TIMES, PLACES, AND SEASONS FOR COLLECTING INSECTS FOR THE VIVARIUM.



WITH a little watchfulness—not very difficult to acquire—the collector for the Vivarium will soon discover that interesting insects are to be found at all times and all seasons, and almost in all places. In the house, and on a dark evening in November would seem neither the time, the place, nor the season likely to be very propitious for the capture of beautiful specimens of *Lepidoptera*; and yet at that season, with the window just a little open and a light upon the table, *Pæcilocampa Populi*, the December Moth, a remarkably pretty insect, will be almost sure to make its appearance some time between seven and ten, if existing anywhere in the neighbourhood, not only in November, but even during part of December. *Petasia Cassinea* will perhaps follow, another pretty Moth, of which only one species was known till very recently; but it will possibly delay its visit

till one or two in the morning. Several other kinds may be taken at the same season.

But earlier in the autumn, and especially during the period of high summer, a good collection of Moths may be made any evening by sitting quietly in a well-lighted drawing-room; the only implement necessary being a light gauze net fixed at the end of a long slender handle. The scaly-winged visitors will not cease dropping in in rapid succession from early dusk till dawn, each species having its unvarying period of flight, so that, with a little practice, the watcher might tell the time of night pretty accurately by the arrival of the different species. Much amusement is afforded to the really interested student, by observing the peculiarly characteristic flight of each insect; some dart towards the ground, as *Pheosia Dictæa*, known as the "Swallow Prominent," in consequence of its resembling them in the swiftness of its flight and also in the tones of its colouring. It belongs to a class of Moths which have a slight prominence on the hinder margin of the anterior wings, and the Caterpillars having also curious humps on some of the segments; the class has been popularly distinguished by collectors as the "Prominents." One of these, in fact, bears the specific name of *Drome-*

darius, or the Dromedary, in allusion to the hump on the back of the Caterpillar.

There are others which invariably fly towards the ceiling, as *Agrotis Corticea*, a plain brown Moth. Others fly with a more even course, while the rare and pretty *Cosmia Pyralina* and *Clisiocampa Neustria* are very wild and violent, and dash recklessly from the light to the ceiling or the floor.

Ennomas Illustraria may be taken near a lamp placed in the open air, as it always rushes towards it and then falls down helpless, paralyzed by the glare. The great Death's-head Moth, the giant of our native *Lepidoptera*, was taken a few years ago by the cook in the kitchen of the Pavilion Hotel, at Folkestone; and another specimen by a baker at Canterbury, who had just been reading an account of it in some periodical. But the best sport in the way of Mothing may be secured by brushing on the trunks of garden trees or those of the wood or orchard, a strong solution of sugar, honey, and water, which attracts many kinds in great numbers, and they are generally so intent upon the banquet of sweets provided for them that they are easily captured.

At early dawn is the best time for taking specimens of the Hawk-moth family. I have heard Mr. H. Doubleday describe the capture of the beau-

tiful specimen of the *Galium* Hawk-moth just before sunrise, in his own garden, as it was flying swiftly over a group of rose-trees. It has been observed lately that this beautiful insect, since the introduction of the Petunia, is more often seen hovering about the flowers of that plant than any other. While the Elephant Hawk-moth, as Mr. Douglas states, appears to prefer the Rhododendron blossom. The Valerian is very attractive to many night-flying Moths, and the Jasmine is a favourite with many of the larger kinds; and often, as Shelley has it, its luscious perfume

“Makes faint, with too much sweet, those heavy-winged thieves.”

But it is for Caterpillars and groups of eggs that the collector for the Vivarium will be most anxious, in order to witness the progress of the metamorphoses. The larva of the *Galium* Hawk-moth seems to have taken to the Fuchsia, and must be looked for at the beginning of June. It is generally full fed at the end of the month, and the Moth appears in August. The larvæ of the large Brown Moth, *Mamestra Brassicæ*, will be found about the same time, on Cabbages. The larvæ of the Yellow Underwing Moths will generally be found at the roots of spring flowers, such as those of the Primrose tribe; but almost all kinds of trees and plants will

yield a rich harvest, if properly examined, in May, June, July, and August, before and after which periods the game is more scarce. The Oak generally yields a rich spoil of this kind. Two or three large sheets may be spread underneath while the branches are beaten with long rods, and the result will be an abundant harvest of several kinds of Lepidopterous larvæ, and probably some pretty *Coleoptera*. Many rare kinds of larvæ may be found on plants growing near the sea-shore, not to mention the splendid Caterpillars of the Spotted Hawk-moth found on the sea spurge on the coast of Devonshire. Mr. Douglas informs us that in November, 1849, he found on the Carline Thistle, near Folkestone, a number of larvæ then unknown to him, which in the following July produced the Moth since named *Parasia Carlinella*, a species before entirely new to English collectors. Many other species, doubtless, remain to be discovered in a similar manner; or, at all events, if the perfect insect should be known, the collector may be the means of settling the identity of the larvæ, which in many cases remain undescribed, even those of comparatively common species. The Caterpillar of *Pieris Daphnidicæ*, the scarce Bath-white Butterfly, must be sought near the shore, as the perfect insect has never been taken far from the sea.

In the winter season Caterpillars may be found hibernating under bark, among dead leaves, and in other warm retreats, but they are not abundant.

Chrysalides may be sought for at all seasons, especially by careful digging at the roots of trees. The bases of the Elm, Oak, Ash, Beech, and Willow appear to be the most favoured retreats, as there is seldom much found by digging about the Birch, Maple, or Chestnut. Pieces of loose bark on old stumps may be lifted up, and a perfect mine of entomological wealth may sometimes come to hand in that way. I recollect finding above sixty chrysalides of the fine Red Underwing beneath a piece of half-decayed willow bark, along with three or four of the hairy Caterpillars of the Tiger-moth, curled up in a dormant state for the winter months.

Beetles may be sought at all times. Beneath a piece of loose wall-grown moss, under a great stone that has lain long undisturbed, beneath a piece of timber lying by the wayside, which, when rolled over, will often disclose the retreats of many of our handsomest Beetles; but if late in the season, the captor must be very active, or the most coveted prizes will escape. In the winter they are much more easily secured.

Some of the sea-shore Beetles are very pretty,

such as *Aepus Marinus*, the *Robinii*, and the beautiful *Cicindelidæ*. Mr. Wollaston, in his notes on the "Coleoptera of South Devon," mentions the pleasing effect produced by the glittering *Cillemum Laterale* coming up minute holes in the sand, and running about in the sunshine with glittering brightness.

In woods, many beautiful Beetles may be found, though our native tribes of Forest Beetles are far less extensive than those of the Continent. To conceive the number, variety, and splendour of some of the forest *Coleoptera* of Continental Europe, the student should look over Ratzeburgh's magnificent work on the insects injurious to forest trees. We have, however, a sufficient variety of native Beetles to render their pursuit highly interesting. In the woods about April, the collector should not fail to look under the bark about the roots of Birch stumps for the singular larvæ of *Pyrochia Coccinea*. If they are placed in the Vivarium with a little of the bark and decayed wood, they will soon become pupæ, and the perfect Beetle will appear in the following June.

Many Beetles may be taken by the "sweeping-net" at night. This is a broad-mouthed net, strained over a flat bow at the lower side, and held by a stout handle. It is swept at each step with some-

thing like the action of mowing; and on being examined occasionally, many captures will be found to have taken place; the greatest portion of them worthless, but some prizes will constantly occur. This operation may be carried on from dusk till as late in the night as the collector chooses. It also answers in broad sunlight for another class of insects.

Parks and old meadows are the best places for sweeping; where the turf, having been long undisturbed, has become the permanent home of many kinds of insects.

A white sheet spread at night in a wood or park, with a light upon it, will lead to plentiful entomological sport; but I must dismiss this part of the subject, for it would be impossible to refer to half the devices invented for the capture of insects, or to one-hundredth part of the insects that may be so taken. Only let us consider the probable number of distinct species of insects already known to naturalists, and it will be seen how hopeless it would be in the confined space of this volume to attempt their descriptions, except in a few cases, in any other way than by sweeping generalizations.

Decandolle pursued the following method of arriving at an approximation to the total number

of distinct species of insects. He first took the number of the indigenous plants of France, few of which can now remain unknown, and they amounted to 7,194; while the insects of the same country amounted to the number of 15,000 known species. Then, estimating the total number of species of plants in the world, from our present knowledge, at 100,000 to 120,000, he found that, following the same relative proportion, the calculation would establish the total number of insects at about 300,000. We may, therefore, as well be contented at once with a small number of experiments in our little Vivarium, seeing that the inmates selected will be all the better off for not being over-crowded.

Many opinions exist as to the relative advantages or disadvantages of this vast world of insect life. Guilio Cordera, in a work on the subject, gravely informs us that they were created for our annoyance and punishment, after our expulsion from Paradise; and that they did not exist in the garden of Eden. Others, however, look upon them from an entirely opposite view, assuring us that they are intended for the exclusive benefit and enjoyment of man, so soon as he shall be wise enough to understand their uses; and the account to which we have turned the cocoon of the Silk-worm and the dye of the Cochi-

neal-insect are cited as but beginnings. The following are a few of the instances cited by different authors of the uses to which insects have been put in various countries.

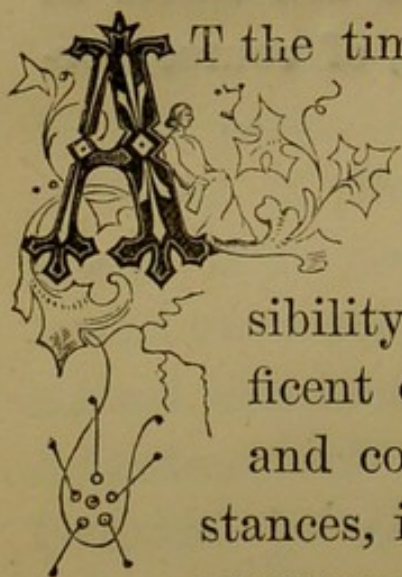
The larva of the *Cossus* was fed on flour by the Romans, and fattened to an enormous size, as a delicacy for the tables of the wealthy senators of the eternal city. Livingstone describes many kinds of larvæ which are eaten with extraordinary relish by the native negro races; and our own English colonists of Demerara, as I am informed by a friend who has partaken of the luxury, have learnt to consider the larva of large tropical Beetles a most delicious dish. These facts may shock the delicate sensibilities of many unaccustomed to such fare, and yet one would think that Shrimp-eaters, and, still more, Oyster-eaters, need not feel astonished even at the Chinese eaters of stewed Silkworm chrysalides, or at Arabian Locust-eaters.

Insects once formed a class of medicines which were considered highly effective in certain cases; and there was a time when three Gnats were taken as a dose, just as three grains of calomel might be taken now; while three drops of Lady-bird milk were formerly prescribed as seriously as a small dose of some fashionable medicine of the present day.

But to return to our Collecting: it will be found, I think, advantageous in the first season to confine our care to a very small circle of subjects, and in general it will be more convenient, and perhaps even more interesting, at all events on the score of beauty, to confine the inmates of the Vivarium to the larvæ and chrysalides of Butterflies and Moths, with the addition of a few larvæ of Dragon-flies in the water, and not, of course, forgetting our friends the Lady-birds.

CHAPTER XV.

OF THE REARING OF EXOTIC INSECTS FROM IMPORTED EGGS OR CHRYSALIDES.



At the time that I first published my work entitled "British Butterflies and their Transformations," now many years ago, I suggested the possibility of rearing some of the most magnificent of exotic insects in our hot-houses and conservatories, and even, in some instances, in the open air, with a view to their permanent establishment in the country.

On turning to my former volume, I find the following passage in the Preface: "Though we cannot transplant the flowers of the tropics to our bleaker soil, it appears by no means so impossible to naturalize some of their most splendid insects. Their system of hybernation in the pupa-case, in which state insects have been found to resist almost any degree of cold without injury, forming a natural means of shielding them from the effects



On going to my former room, I find the
following notice in the Register: "Though we
cannot transplant the flowers of the Republic to
America as we have done in Europe, it is not
impossible to transplant the principles of
their system of education to this country, and
which is the only way to secure the
future of our Republic to remain free."

PLATE VIII.



1. *Phalæna Regia*, a North American Moth.
2. The Caterpillar of *Phalæna Regia*.

our long winters; and from this state their development would not take place till the warmth of summer was sufficient. Taking advantage of this knowledge, we may, by means of imported eggs or pupæ, be gratified by the sight of tropical Butterflies flitting from flower to flower, a splendid novelty to our gardens, exhibiting colouring far more gorgeous than anything in the vegetable empire, and endowed moreover with the additional charm of motion."

At that time I received letters from many persons, in answer to my suggestion; among others, from one of our most enthusiastic naturalists, the Rev. W. T. Bree, of Allesley; and from the spirit in which the idea seemed to be taken up, especially with reference to rearing some of the more splendid tropical species in hot-houses, I expected, ere this, to have seen some of our most celebrated receptacles of exotic plants glittering with the far more brilliant colours of Brazilian or Australasian Butterflies. I calculated upon witnessing, within a few succeeding seasons, the noble *Papilio Priamus*, with its wings of golden metallic green, relieved with velvet black, flitting leisurely from flower to flower, or jostling in its flight with the gayer movements of some Brazilian

beauty of the *Morpho* family, which in its turn would dazzle the eyes with the resplendent silvery azure of its wings of shining satin.

I have, however, been destined to disappointment. With one brilliant exception, to be described in some detail in this Chapter, little has been yet done. I must, however, note a few exceptions to this sweeping assertion. Mr. H. Doubleday succeeded in rearing to maturity the eggs of the giant Moth, *Saturnia Pavonia Major*, sent over by his brother, who was at that time in America; and, turning them loose in Epping Forest, he hoped in that way to naturalize that magnificent species. He was, however, frustrated in his experiment, more than one of these large and conspicuous insects being caught and brought back to him, within a day or two, ready pinned through the body, and "set out" for preserving, the captor deeming that he had secured a most unusually valuable prize, for which he expected a proportionate reward. Some others of the brood were found dead and mutilated; probably by birds that feed principally upon winged insects. In short, the glorious *Saturnia Pavonia Major* has not become naturalized in Epping Forest—no single specimen having ever been seen since that season.

I was present at a little entomological dinner some few years ago, to witness the expansion of some two or three dozen chrysalides of the handsome continental Butterfly, *Papilio Podalirius*, from which the perfect insects were thought to be just upon the point of emerging. They had been brought from the Rhine country, where they are very plentiful, by our host, who was an enthusiastic collector. During the dessert, the progress of the chrysalides became very rapid, necessarily attracting all attention from the biscuits and decanters. We were in fact just in time to witness the escape of several of them from their pupa-cases. After trying their limp wings for a time, as if for the very purpose of exhibiting to us their lovely primrose colour variegated with black zebra-like stripes, they took flight through the open window, and we watched them out of sight, flitting over the flowers of the neighbouring gardens.

Nevertheless, no specimen of *Papilio Podalirius*, popularly known as the Scarce Swallow-tail, have ever since been found in that neighbourhood. These examples appear, at a glance, to show the hopelessness of any attempt to introduce foreign *Lepidoptera*; but I am still convinced—at all events in the case of *P. Podalirius* and many species

common in the north of France and Germany—that their introduction is still practicable; but then the experiment must be tried on a large scale, and the Chrysalides must be allowed to expand naturally in the open air; or, what is better, the insect should be introduced in the egg state; the eggs being allowed to hatch naturally in the open air, and the Caterpillar left at perfect liberty.

I recollect, when in Paris, seeing at the house of Dr. Boisduval, the well-known entomologist, the Caterpillar of an exotic Butterfly, the magnificent Jason, feeding on the leaves of an orange-tree in his *salon*. And I believe they were successfully reared; but whether any attempt was made to naturalize the species in the neighbourhood of Paris by that means I am not aware.

However, of this I am certain, from the result of a practical experiment about to be described, that if eggs of almost any kind of exotic Butterfly or Moth were imported and placed in a permanently suitable temperature, either in the ample area of a large conservatory, or the more limited space of such a Vivarium as the one described in this little volume, that a highly satisfactory result would, with due care, be almost inevitable. We find, in fact, that without care, and simply from increased

intercourse with other countries, that many new insects are establishing themselves as natives; as an instance of which I may mention the beautiful purple Beetle *Callidium Violaceum*, represented in Plate VII., which was once extremely rare; but since the vast importation of timber for railway purposes, in which the insect has come over in its larva state, it has become quite common.

I also suspect that many professional dealers have been exceedingly successful (under the rose) in introducing rare insects only vaguely reported as British, by means of imported eggs or larvæ, which they have placed in suitable situations, and then captured the perfect insect in actual flight—selling it at a high price as an extraordinary British rarity. If such should have been the case with the fine Moth, the “Kentish Glory,” hitherto so rare in England, the experiment must have been indeed triumphant, as the beech woods of Rannoch now absolutely swarm with them. This I believe, however, to have been a genuine “find” of the habitat of an extremely local insect. And yet it appears strange that a Moth so conspicuous, both for size and colouring, should have continued entirely unnoticed by Scotch entomologists, if it had always existed there in such abundance.

But I must at once proceed to describe the highly successful experiment upon which I chiefly ground my hopes of future success. I refer to the recent rearing of the beautiful and interesting Leaf-insect, *Phyllium Scythe*, which was successfully reared from the egg in one of the plant-houses of the Botanic Gardens of Edinburgh. Mrs. Blackwood, the wife of Major Blackwood, H.E.I.C.S., when residing with her husband in India, in the Assam district, where he had been stationed, found this insect plentiful in all its stages in the valleys below Cherra-Poonjie, in the Kasiah Hills which form part of the southern boundary of the low grounds of Assam. She collected specimens, and placed them on a Guava tree in front of her own residence, which they did not attempt to leave till they attained their perfect state.

On returning to Europe, Mrs. Blackwood endeavoured to bring some living specimens with her; but, after keeping them in health during greater part of the journey, they sickened and died while crossing the Mediterranean. But this enterprising lady-naturalist was not to be beaten by one defeat, and she immediately made an attempt to introduce the insect by means of imported eggs. These were duly procured, but the first batch was unsuccessful; and it was not till 1854 that some eggs, which had

arrived by post, were hatched, on the 9th and 10th of May, others continuing to come out till June. Two of the specimens thus hatched were entrusted to the care of Mr. M'Nab, the intelligent curator of the Edinburgh Botanic Gardens. They refused the leaves of the Guava, upon which they were first placed, and also of several other plants of the Myrtle family. They were then tried upon a Fuchsia with equally unfavourable results, but at last the common European Myrtle was tried, and this time the insects seemed to recognize suitable food, and soon became healthy and vigorous feeders, and never sought to leave the plant.

The appearance of the larva in its first stage is not altogether unlike that of the Lady-bird, having only six feet, disposed in a similar manner. It is, however, much larger, and the leafy character already shows itself in the upper joints of the legs, and slightly in the edge of the abdomen. It is at first of a brownish yellow colour, but when it has once settled to feed, it soon assumes a bright green colour. It bears its tail slightly curled up, just about as much as the curve of the Myrtle leaf; but the curve would be the wrong way, were it not that it walks back downwards, being found on the under side of the leaf, in which position it is so like the

leaves themselves that it is difficult to distinguish it. It has no wings in the first stage, while the antennæ are invariably in the female form, and the legs like those of a male. The Leaf-insect undergoes three moults. Those reared by Mr. M'Nab were hatched in June, 1854, and did not moult for the first time till ten months afterwards, in April, 1855. It was at first nearly one inch long, and not much larger when it underwent its first moult. It then, however, grew rapidly, and the antennæ increased their number of joints just as the joints of the *Myriapods* increase after each casting of the skin. It was noticed that the insect ate up its cast-off skin—a fact never before noticed in the natural history of insects, though Mr. T. Bell mentions, in his work on British Reptiles, a similar instance in the Toad.

The second ecdysis or moult took place on the 11th of the following July, after which the wings made their appearance, though very small. The third moult took place on the 17th of September, when full-grown wings and complete antennæ were produced. The insects were observed to be very lively the day before the moult, casting their bodies about in a singular manner, as though to loosen the skin.

After the last moult they increased very rapidly

in size; those portions of the body which first escaped from the skin expanded suddenly to one-fourth greater size than the parts remaining imprisoned in the old envelope, and in this state the insect appeared curiously one-sided. The increase in the size of the locust, after the last casting of the skin, is said to be equally remarkable. In the Leaf-insect under description, the wings, on escaping from their cases, were not more than one quarter of an inch long, but at once shot out to their full length in a very surprising manner. The entire creature, though so suddenly increased in general dimensions, was at first very soft and tender, and only very slowly acquired its proper consistency.

After the first two moults it had become each time more freshly and beautifully green; but after the last, the green was bordered with yellow, which gradually turned to brown, like the leaves of trees in the autumn; and by degrees the whole insect became brown, like a leaf about to fall. This is the sign of its decay, which seems, like its form, to have some extraordinary analogy with that of real leaves. During the rearing of the Leaf-insect, the plant-house in which it was placed was kept at 55 degrees as constantly and evenly as possible, that being about the temperature of its native climate.

Throughout the summer of 1855 the Botanic Garden was constantly crowded with visitors to see the "Leaf-insect," and at last Mr. M'Nab, the curator, was compelled to give notice that it would only be shown during four days of the week, as it was found that the continual disturbance was unfavourable to the health of the insect. During the principal part of its life, after the first moult, it so closely resembled the leaves of the plant, that many visitors declared they could see nothing, and the Phyllium had to be stirred and made to move, when they were convinced, by seeing it crawl from the plant on to the finger of the attendant.

Mr. Murray, who described the insect in the "Edinburgh Philosophical Journal," considers that the rearing of Leaving-insects will become a common amusement to those who have a love of natural history, and that these curious creatures will become as much the usual pets of our conservatories as Canary-birds are of our drawing-rooms; and it is evident that other kinds of beautiful insects might be reared as successfully, if the same care were bestowed.

The Leaf-insect appears to be peculiar to the Eastern World. Three of the thirteen known species have come from the Philippine Islands, three from

the East Indies and Ceylon, one from Java, one from the Mauritius, one from the Sechelle Islands, and four from unknown places in the East. Our species, *P. Scythe*, was first described by Mr. George Gray, from the fine specimen in the British Museum, which was received from Silhet, a district adjoining Assam.

There is much to be learned respecting the rearing of exotic insects from the work of Dr. Horsfield, who was led to the study of insects, in Java, while pursuing his botanical studies in that island. When at Surakarta, the seat of the chief of the Javanese princes, he instructed native artists to make drawings of the curious larvæ which were brought to him, in all their successive stages. Each Caterpillar, he tells us, was placed in a separate rearing-cage, which was numbered, and certain natives had the exclusive charge of keeping them clean and furnishing them daily with fresh provisions. As drawings of each Caterpillar were taken in all its stages, according to its number, so, when the perfect insect appeared, a drawing was made of it under the same number; and so the whole of the metamorphoses of a large number of splendid exotic insects, especially Butterflies, were ascertained beyond the possibility of error; many of which were

published in the first two numbers of Dr. Horsfield's beautiful work, which was unfortunately not completed. The extraordinary cession of the Island of Java to the Dutch, after the war, put a stop to Dr. Horsfield's researches in that quarter; as also to the still more important investigations of Sir Stamford Raffles, the discoverer of the now well-known giant "flower" named after him, *Rafflesia*, and which measured several feet across the disc.

Abbot, in the southern districts of the United States, especially in Georgia, was equally successful in rearing a great number of Butterflies and Moths from the egg and caterpillar stages; and in his magnificent work, "The Insects of Georgia," has given a series of remarkably beautiful plates, showing the insects in their various stages. It is quite evident, from the manner in which he describes his management of the rearing process, that it might be performed with equal success in England; and I recommend all who set up a Vivarium, or who have a conservatory that can be kept at a certain temperature, to write to their friends in the Brazils, in India, in China, at the Cape of Good Hope, or in Australia, or Demerara, or any other British settlement, to send them by post eggs of *Lepidoptera*, which can be easily procured from the natives;

and also to collect and forward chrysalides whenever an opportunity of safe and speedy transit occurs.

One of the most striking plates in Abbot's "Insects of Georgia" is that representing the transformation of a large and handsome Moth, to which he gives the old Linnæan name, *Phalæna Regia*, represented in my Plate VIII. Nos. 1 and 2. The singular Caterpillar of this Moth has been selected by Dr. Boisduval as one of the types which he has engraved in his well-known work on *Lepidoptera*. Abbot describes this Caterpillar as feeding on the Hicory, and as being much dreaded by the slaves of the Southern States, who called it "the horned devil," in consequence of its ferocious appearance. Nevertheless, it is perfectly harmless, though all the arguments in the world would not persuade the Negroes to that effect, even though Dr. Abbot handled it fearlessly in their presence. It is of a fine light green, the head and singular spines being finely variegated with orange. I recommend young entomologists to write at once to some friend in America to obtain eggs of this species; for a brood of these very magnificent larvæ, with their noble crest of spines, would form a group of such striking interest in a Vivarium as not to require the addition of any other attraction.

In proposing to attempt the rearing of exotic insects, one ought not to forget the Beetle tribe; and when something more is known of the larvæ of exotic Beetles, it may certainly be attempted with the same success as that which has attended the Orthopterous insect *Phyllium Scythe*. When this shall be attempted, what glorious things we shall be enabled to see expand before our eyes! Only let us imagine some of the *Curculionidæ*, just issuing fresh from the pupa state; *Præpodes Regalis*, for instance, a *Curculio* from St. Domingo, a specimen of which is preserved by the Linnæan Society, mounted as a gem, in a gold ring; or the Diamond Beetle, in all the fresh glory of his first escape from the nymphine prison. But I must say no more on exotic Beetles at present, or there would never be an end of talking—even of the superb *Curculionidæ* alone, of which the reader may be easily convinced when we refer him for further information to the work of Schœnherr on the genera and species of *Curculionidæ*, which extends to fourteen ponderous volumes.

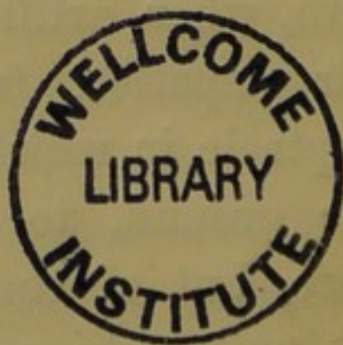
In conclusion, I recommend inexperienced entomologists establishing a Vivarium for the first time, to attempt one without water, as more easy to manage; and to confine themselves for the first

season entirely to the rearing of the larva of Moths and Butterflies. To be entirely successful in this department, it only requires a common degree of care in keeping the sun from the case when too powerful; in ensuring sufficient ventilation; providing fresh food continually, for which purpose it is better to gather the sprays with matured leaves, instead of young shoots; and, above all, to keep the case as clean as possible.

Some have raised objections to the introduction of water at all into a Butterfly Vivarium, as calculated to render the case too damp for any terrestrial larvæ; but, with a certain amount of open-work for ventilation, this would be impossible, as the evaporations would escape, and not be condensed and deposited again, as in close Fern-cases. The fact is, that the rearing of Caterpillars is more generally unsuccessful from too much *dryness* than from over *moisture*. For instance, the larvæ of the Death's-head Moth, when artificially reared, often die during their pupation from over-dryness; while, if the receptacle in which they are confined be buried in the ground, to ensure a constant degree of moisture, but of course not *wet*, their rearing is almost uniformly successful. I anticipate, therefore, that the addition of the tank, when

the management of an Insect-case or Vivarium is thoroughly understood, will be found not only unobjectionable, but, on the contrary, of great advantage to the whole economy of the little establishment, by keeping up a steady and yet but slight degree of moisture among the plants, and in the earth in which the larvæ burrow to undergo their change.

THE END.



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