THE

BOOK OF BUTTERFLIES,

SPHINGES, AND MOTHS.

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THE

BOOK OF BUTTERFLIES,

SPHINGES & MOTHS.

VOL. III.

O Happy! if ye knew your happy state,
Ye rangers of the fields; —— ——
Somervile

LONDON,
PRINTED FOR WHITTAKER & Co.
and Waugh & Innes Edinburgh
1834.

THE

BOOK OF BUTTERFLIES,

SPHINGES, AND MOTHS;

ILLUSTRATED BY

ONE HUNDRED AND FORTY-FOUR
ENGRAVINGS,

COLOURED AFTER NATURE.

BY

CAPTAIN THOMAS BROWN,

FELLOW OF THE LINNÆAN SOCIETY, MEMBER OF THE WERNERIAN,
KIRWANIAN, AND PHRENOLOGICAL SOCIETIES, AND
PRESIDENT OF THE ROYAL PHYSICAL SOCIETY.

IN THREE VOLUMES.

VOL. III.

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A MORAL

FOR

CAPTAIN BROWN'S BOOK OF BUTTERFLIES,

BY

CHARLES DOYNE SILLERY, ESQ.

AUTHOR OF "VALLERY," &c.

Minions of Nature!—Creatures of the skies!
Ye bright-wing'd flutterers! sunborn butterflies!
From flower to flower o'er nectar'd fields ye go,
Peerless in beauty! atoms of the bow!

Ye living gems! ye fairy-formed things!
Floating in bliss, on gold-bespangled wings!
Oh! how enraptured would this spirit be,
Freely to soar through ambient heavens, as ye!

Where is the silken shroud? the grov'ling worm?
Where now the veil which once enshrined each form?
Where the cold, lifeless chrysalis of clay?
In gold! in glory! in the blaze of day!

I pause and ponder here.—Like you, mankind
Are born, frail insect! ignorant and blind;
Man's mind—his heart, in dust and darkness furl'd,
His bright soul's clouded by a wintry world.

But when this dream of life hath pass'd away—
When this pure spirit bursts her bonds of clay;
Ah! then what hope to trembling man is given—
The bless'd shall mingle with the blaze of heaven!

THE

BOOK OF BUTTERFLIES.

MODERN ARRANGEMENT OF LEPIDOPTEROUS INSECTS.

According to the classification of the celebrated Latreille, the Papilionaceous, or Lepidopterous insects are comprehended in his Ninth Order, under the title of Lepidoptera.

ORDER LEPIDOPTERA, Linnæus.

Lepidopterous insects have four membranaceous wings, covered with a farina, composed of small scales, and are provided with a trunk rolled up in a spiral form at the mouth.

Tribe I.—DIURNA.

Wings always free in repose, placed perpendicular to the plane of position, and destitute of a bridle or scaly bristle at the base of the lower wings; the antennæ in many of the species terminated in a small club or button, more or less conical or triangular; in others, slender and hooked at tip.

The insects of this tribe fly and feed by day. The caterpillars have sixteen feet, and live on vegetables. The pupæ are generally naked, or destitute of a cocoon, fixed to substances by the posterior extremity of the body, and in many by a silky fillet, forming a kind of half ring at the upper part of the body.

Family I.—Papilionides.

With four wings, elevated perpendicularly in a state of repose; the antennæ having a club-shaped termination, or almost filiform, without hooks at the tip, with the exception of one genus, in which they are setaceous and plumose in one of the sexes; the legs are provided with one pair of spurs or spines.

Subdivision I. Third joint of the labial palpi very small and hardly perceptible, or very apparent, and furnished with scales; hooks at the end of the tarsi projecting; caterpillar elongated, subcylindrical; chrysalis of an angular shape.

Subdivision II. Six feet, formed for walking, or nearly similar in both sexes; chrysalis fixed by a silky band by its posterior extremity, or inclosed in a thick cocoon; central areola of the lower wings posteriorly closed.

1. *Hexapoda.*

A. Internal margin of the lower wings concave.

The genera are Papilio, Parnassius, and Thais.

B. Internal margin of the lower wings arched, and projecting over the abdomen to form a canal.

The genera are Colias and Pieris.

I. The two anterior feet shorter than the others, folded, not ambulatory, in both sexes, or in the males only; chrysalis fixed by its posterior extremity, and suspended with the head downwards; central areola of the lower wings open posteriorly in many species.

A. The central areola of the lower wings is always posteriorly closed; the two anterior feet, although small and folded, very similar to the others; the lower wings in general scarcely embracing the abdomen below; labial palpi slightly elevated above the hood, much separated, slender, cylindrical.

The genera are Danaus, Idea, Heliconius, and Acrea.

B. Central areola of the lower wings open in many species; two anterior feet often minute and concealed, or apparent and very hairy; lower wings embracing the abdomen below; labial palpi rising above the hood, slender and cylindrical, and not distant.

a. Central areola of the lower wings open posteriorly.

* The labial palpi are either separated through their whole length, or merely at their extremity, and abruptly terminated by a slender and a circular joint.

2. *Perlata.*

The genera are Cethosia and Argynnis.

** The inferior palpi are contiguous through all their extent, and not terminated abruptly by a slender and acicular joint.

† The antennæ are terminated in a small club, in the form of a button, short, turbinated, or ovoid; caterpillar thickly beset with spines.

Contains one genus, Vanessa.

†† Antennæ terminated in an elongated club, or nearly filiform; caterpillar naked or slightly spinous, with the posterior extremity terminated in a bifid point.

The genera are Libythea, Biblis, Nymphalis, and Morpho.

b. The central areola of the lower wings posteriorly closed.
The genera are Pavonia, Brassolus, Euribius, and Satyrus.

In the Dutch work, *De Wonderen Gods*, we have the following interesting information concerning the transformations of the Alderman Butterfly, *Ammiralis Atalanta* of Rennie, by J. C. Sepp of Amsterdam:—

"Like all other butterflies, this species originates from an egg, which, however, is very rarely met with, because it is very small and green; almost indeed of the same colour as the stinging nettle, (*Urtica dioica*,) on which it is laid by the mother butterfly, and therefore easily overlooked.

"Although I had found, for many years successively, and in considerable numbers, the caterpillars and the butterflies of this species, I was long unsuccessful in procuring any of the eggs; but at last I succeeded, having found one on the 6th of July, at the very moment the mother butterfly had laid it, and it hatched as well as any other of this class. I found others afterwards, which had perhaps been longer deposited, and they likewise hatched, and I reared butterflies from them; so that now I know their whole manner of life, and their several transformations, and am enabled to detail these to the reader from my own observation.

"As soon as the infant caterpillar is hatched, it begins to eat directly, and to look out for a place to live in. Providence has given it the faculty of spinning certain threads; and, after selecting a leaf, it draws it together, by means of these, into a roundish hollow form, leaving for the most part an opening into the interior before and behind. The leaf, when thus drawn together, serves as a house or tent for the little creature, and at the same time furnishes it with food; and hence the longer it lives in it the more perforated it becomes. When at length it has gnawed so much of the leaf as renders it so full of holes that it becomes useless, the caterpillar quits it, and goes to another leaf, proceeding in the same way as it did with the first. Accordingly, when we are desirous of finding these caterpillars, we must search for them on those nettle leaves which are drawn together. I may mention, however, that not more than one caterpillar will be found on a single leaf.

"The circumstance of hiding within a folded leaf, is not usual with every spiny caterpillar; and it appears to me, that this species does so, more from a peculiar liking to live solitary than from any fear of danger, inasmuch as they are exposed to no more danger or hardship than other spiny caterpillars, which roam about freely and openly on the leaves. This species, besides, is quite as hardy as the others, with respect to enduring cold and heat; and they are as much persecuted by parasite flies, (*Ichneumonidæ,*) which lay eggs in their bodies, as are other spiny caterpillars; nor is their dwelling in the folded leaf so securely constructed, as to prevent the intrusion of such unwelcome visiters, a circumstance always attended with a mortal result."

Professor Rennie mentions a similar circumstance. He says, "We happened to see a remarkable instance of this last summer, (1828,) in the case of one of the Lilac caterpillars, which had changed into a chrysalis within the closely folded leaf. A small ichneumon, aware, it should seem, of the very spot where the chrysalis lay within the leaf, was seen boring through it with her ovipositor, and introducing her eggs, through the punctures thus made, into the body of the dormant insect. We allowed her to lay all her eggs, about six in number, and then put the leaf under an inverted glass. In a few days the eggs of the Cuckoo Fly were hatched, the grubs devoured the lilac chrysalis, and finally changed into pupæ, in a case of yellow silk, and into perfect insects like their parent." *

"There must then," continues M. Sepp, "I think, be some other reason for these caterpillars hiding themselves in this manner, and I am inclined to believe it can be no other than their desire to be solitary. In accordance with this view, we find the eggs always laid singly and apart; and it is well known to naturalists, that all cater-

* *Insect Architecture*, p. 174.

pillars originating from eggs thus deposited are solitary, as those originating from clustered eggs are gregarious. The latter moreover remain in company so long as they are in the caterpillar state, while the former always occur dispersed, and lead a solitary life. In this manner, then, the caterpillars under notice live from the time they are hatched, and even exhibit the same disposition when they prepare for their change into the chrysalis state, as we shall afterwards see.

"As to their manner of growth, such caterpillars differ widely from other animals which grow regularly in all their parts as they are supplied with nourishment; but our caterpillars, on the contrary, grow only in their inward parts, whose increase puffs out the skin or outer covering that does not grow, and hence becomes too small, so that at length it must give way. In fact, it actually does so, and this happens more than once during its life; a circumstance which I term the casting of the skin, and which is thus performed: A few days before the skin is cast, the caterpillar remains nearly stationary in the same place, and leaves off eating. About this period, the neck or hind part of the head may be observed to swell, in consequence of which the old skin becomes more stretched, the inner skin is separated from the outer, and in some smooth caterpillars the head may be decerned shining through. The old skin becomes gradually detached, and at length bursts asunder; the head with its new skin appearing through the opening, and successively the fore parts of the body, and the feet. Afterwards, by repeated movements, the caterpillar strips off the old skin altogether, and appears in a new dress, which, as far as regards the one under our notice, differs little from the old one in colour and appearance. The head, however, is a little larger, as are the spines and small hairs.

"With respect to the latter, it is remarkable that the new spines and hairs appear to have been inserted in the old ones as in sheaths, from which they are drawn out when the skin is cast. I infer from this circumstance, that these spines and hairs are hollow, though in consequence of their minuteness, some of them being barely visible to the naked eye, we cannot well demonstrate this otherwise. Who, I may ask, does not perceive in this wonderful fact, the incomprehensible operations of an all-powerful CREATOR! and where is the man who could imitate these astonishing productions?

"Our caterpillar, after casting its skin and resting a little, begins again to eat the leaves of the nettle. I may mention, that all caterpillars do not cast their skins the same number of times; but with respect to the present ones, they cast their skins four times, and as they grow quickly, the castings closely follow each other, at due intervals between. I have traced this in two of these caterpillars, which were hatched from eggs the 12th of July, in the following order. Their first casting of the skins occurred on the 14th, the second on the 17th, the third on the 21st, and the fourth on the 26th. They then continued to eat and grow till the 15th of August, when, having completed their growth, and reached their full age as caterpillars, they left off eating, and prepared for entering upon their second stage of life, namely, that of chrysalis, which has no resemblance to the caterpillar. This change took place on the 17th of August.

" It hence appears, that the first stage of life, or the caterpillar state of this insect, only lasts for five complete weeks ; but I must remark, that in rearing the caterpillars for the purpose of observing their changes, they must have fresh food every day, and in a warm day twice, otherwise they will not thrive.

" The cover of the box where they are kept, ought to have small holes in it for the admission of fresh air ; or it may be covered with crape or gauze. It ought not to be shallow ; for if so, the wings of the butterfly, when it comes forth, may be bent or injured.

" We have thus seen our insect in its first stages of life ; but it is destined to arrive at a higher stage of existence, and is born to be admired, though it does not reach this stage till it has undergone sickness and suffering, with hardly any apparent sign of life. In a short time, however, it awakes from its trance, and appears full of animation, and is richly ornamented."*

II. Having the third or last joint of the labial palpi very distinct, naked, or less furnished with scales or hairs than the preceding; hooks of the tarsi scarcely visible; caterpillar oval; chrysalis destitute of eminences or angular projections.

3. *Argus.*

1. The antennæ are terminated by an inflation, and are beardless.

The genera are MYRINE, POLYOMMATUS, and ERYCINA.

The Myrines are remarkable for the length and projection of the labial palpi. The Polyommati with the antennæ terminating in a cylindrico-oval and elongated club, form the genus *Thecla* of Fabricius.

2. With the antennæ either setaceous or plumose, or moniliform at the termination.

The genera are BARBICORNIS and ZEPHYRIUS.

Genus PAPILIO, Latreille.

Chrysalis naked, angular, fixed by the tail and by a silky band disposed transversely, and terminating on each side on the plane of position; perfect insect with six feet formed for walking in both sexes.

This genus is subdivided as follows:—

* *Lower wings prolonged into a tail.*

** *Lower wings not prolonged.*

* *The Field Naturalist's Magazine*, vol. i. p. 8.

Genus VANESSA, Latreille.

Antennæ terminated by an abrupt short club; palpi contiguous, even at the extremity, the two combined, resembling a rostrum; anterior pair of feet in both sexes, short and very hairy; the two posterior pairs of tarsi, with double nails.

Genus POLYOMMATUS, Latreille.

Palpi longer than the head, and nearly parallel, having three joints clothed with scales above, the first of which is short and curved, the second long, the third as long as the first, and destitute of hairs; the antennæ are rather short, and provided with more than thirty joints, with an abrupt flattish clubbed tip, ending in a point placed edgeways: these in some species are downy, and not so in others; legs alike in both sexes; feet provided with very short cushions; beyond which are minute undivided claws; the wings are entire, the upper ones triangular, and somewhat wedge-shaped; under wings ovo-triangular, and hardly indented at the posterior angle.

FAMILY II.—HESPERIDES.

The posterior legs are provided with two pairs of spurs; the lower wings are nearly horizontal while in repose; the antennæ, in some species, are terminated by a club or button, hooked at the end; in others they are filiform, with the extremity slender, bent, and pointed.

The genera are HESPERIA and URANIA.

The Hesperides differ in their metamorphosis from that of the Papilionides. The caterpillars resemble those of many nocturnal Lepidoptera. They are almost naked, tapering at the two extremities, or fusiform, with a globular head. They are found between leaves, which they fix together with their silky filaments. The pupæ also resemble those of the nocturnal Lepidoptera. They have no eminences or angular projections, and are inclosed in a slight web, and frequently on leaves.

Genus HESPERIA, Latreille.

Antennæ terminated in a club; inferior palpi short, consisting of three joints, broad, and provided with scales anteriorly; body short and thick; wings triangular, thick, generally horizontal in repose; abdomen short, nearly conical; feet strong, and the posterior legs with two spines more than the others; tarsi terminated by two small, simple, and arched hooks.

This genus is subdivided as follows:—

* *Inferior wings prolonged into a tail.*

** *Inferior wings not prolonged.*

TRIBE II.—CREPUSCULARIA.

The exterior border of the lower wings generally provided with a strong, pointed, stiff, horny bristle near its origin, which enters into a groove below the upper ones, and retains the four in a horizontal situation during repose; the antennæ are in the form of an elongated club, those of many males, and sometimes both sexes, pectinated or serrated; caterpillars being always provided with sixteen feet.

Family I.—Hesperi-Sphinges, Latreille.

The antennæ are always simple, with a claviform termination, the extremity being hooked, and without a tuft of scales.

The genera are Coronis, Castnia, and Agaristus.

Genus Castnia, Latreille.

Antennæ with a terminal elongated club; palpi subcylindrical, adpressed, not contiguous, furnished with short scales, and distinctly three jointed.

Family II.—Sphingides, Latreille.

The antennæ are always terminated by a small scaly tuft in a prismatic club, commencing near the middle of their length; lower palpi broad, thickly covered with scales; the third joint smaller, and generally indistinct.

The genera are Smerinthus, Acheronthia, Sphinx, and Macroglossum.

Genus Sphinx, Latreille.

The lower palpi having but two apparent joints, the third being minute, contiguous, and scaly; the club of the antennæ commencing near the centre, simple, or with three transverse striæ, bearded, and never strongly serrated; the tongue very distinct, and corneous; the body short and thick; the eyes are large; the wings nearly horizontal, forming a triangle with the body; the abdomen conical; the feet thick, with two simple hooks at the end of the tarsi.

The insects of this genus are decorated with lively and agreeable colours. They congregate and fly lightly, about sunset, flitting from flower to flower, sucking melliferous liquids with their long proboscis. The caterpillars have sixteen feet, their skin is smooth or ganulated, and without hairs. Almost all of them have a kind of bent horn on the eleventh ring, the use of which is not known. Among the caterpillars, that which is found on the lilac and ligustrum is remarkable for the singularity of its attitude. It is generally fixed to a branch by its membranous feet, with the body elevated perpendicularly and the head inclined, in which position it remains for hours. In this attitude it is conceived to resemble the figures of the fabulous sphinx, hence the name of the genus.

Family III.—Zygænides, Latreille.

The antennæ of the greater number are destitute of tufted scales at the extremity, fusiform, or sometimes like a ram's horn; the labial palpi are slender, compressed, cylindrical or conical, with the third joint very distinct.

The caterpillars in this family have all sixteen feet, and are destitute of a horn at the posterior extremity of the body. Some inhabit the interior of vegetables; others are naked and hairy.

I. Antennæ simple in both sexes.
The genera are Sesia, Ægocera, Thyris, Zygæna, and Syntomis.

II. Antennæ bipectinated in the males, simple in the females.
The genera are Procris and Atychia.

III. Antennæ bipectinated in both sexes.
The genera are Glaucopis, Aglaope, and Stygia.

Genus Zygæna, Fabricius.

The antennæ are simple in both sexes, terminating abruptly in a convoluted club, at least in one of the sexes, and destitute of a tuft at the extremity; the lower palpi are cylindrico-conical, rising above the hood; abdomen nearly cylindrical and obtuse; wings sloped; spines at the extremity of the legs very small.

The insects of this genus fly seldom, and that to very short distances, and are inactive in their habits; usually found on the plants where the female deposits her ova. Both sexes live in the perfect state only for the time necessary for reproduction. The caterpillars have sixteen feet. They are smooth, slightly hairy, and have not, like those of the Sphinges, a horny appendage on the last segment. Before changing into pupæ they inclose themselves in a solid cocoon, which they form along a branch or leaf, and the perfect insect is produced in a short time after.

Tribe III.—NOCTURNA.

All the wings are horizontal or inclined in repose; the antennæ are setaceous.

With the exception of a small number, the lower wings in this tribe are furnished with a bridle, formed by a strong and sharp horny bristle, or a bundle of setæ adapted to a groove in the upper wings, and keeping them horizontal when at rest. The chrysalis is almost always inclosed in a cocoon rounded before, or without angles. The number of membranaceous feet varies in the caterpillar.

Family I.—Bombycites, Latreille.

The antennæ are pectinated or serrated, at least in the males; the trunk spiral and very short, or almost none; body generally woolly and thick in the females; wings often extended, and when they are inclined, the lower ones margin the other two, or are turned up; caterpillars provided with sixteen feet.

I. Wings broad, either extended or inclined like a roof, the lower ones in this case bordering the upper; caterpillars living exposed, on leaves.

The genera are Attacus, Lasiocampus, and Bombyx.

II. Wings oblong, narrow, always inclined, the lower ones entirely covered; caterpillars living in the interior of vegetables, or concealed in the earth and gnawing their roots.

This section has but one genus, Hepialus.

Genus Bombyx, Fabricius.

The wings are entire, horizontally extended or inclined, forming a triangle with the body; the superior palpi are concealed, the lower ones very small, in the form of tubercles, cylindrical or conical, and tapering towards their point; they have either no tongue, or it is very indistinct; the antennæ are pectinated, at least in the males; abdomen very large in the females; caterpillar with fourteen or sixteen feet; in those with fourteen feet, they have a forked tail in place of the last two.

Linnæus included this genus among his Phalæna, and formed one of its divisions. The body of the Bombices is, however, always thicker than the Phalænæ, and they live in the perfect state for a much shorter time than the other nocturnal lepidopterous insects. Incapable of imbibing nourishment in this state, being destitute of a tongue and trunk, the winged insect exists only for the purpose of reproduction.

Family II.—Noctuo-Bombycites.

I. The caterpillars are always smooth, with sixteen feet, inhabiting the interior of different vegetables, generally ligneous ones. The margins of the segments of the abdomen of the chrysalis are either dentated or spinous; the trunk is spiral in the perfect insect, always very short, or almost none; antennæ of some males furnished interiorly with a double row of beards; those of the females, and of both sexes in others, having a series of short rounded teeth in all their length.

The genera are Cossus and Zeuzera.

II. The caterpillars always living exposed naked, and smooth, with fourteen feet, the anal ones wanting; posterior extremity of the body pointed, forked, or entire and truncated;

antennæ of the males always pectinated, and terminated by a simple filament.

1. Spiral trunk very short and indistinct.

   It has but one genus, Cerura.

2. Spiral trunk distinct, perceptibly prolonged when unrolled beyond the palpi.

   The genera are Dicranoura and Platypteryx.

III. The caterpillars always living exposed, and with sixteen feet, the anal ones never wanting.

1. Having almost no spiral trunk, or very short, concealed between the palpi, and useless in manducation.

A. Caterpillars never forming a portable tube of vegetable matters.

a. Caterpillars elongated ; upper part of the skin of the segments not forming a vaulted arch over the body.

* All the individuals with wings proper for flight.

   The genera are Notodontes and Sericaria.

** Females apterous, or without wings.

   It has but one genus, Orgya.

b. Caterpillars oval; upper part of the skin beginning at the second ring, forming a solid arch, under which the head and the first segment may be retracted; feet scaly, retractile, the membranous ones exuding a viscid fluid.

   It has but one genus, Limacodes.

B. Caterpillars inclosed in portable tubes, which they form with fragments of vegetables, and bind together with their silk.

2. Spiral trunk very apparent, projecting beyond the palpi, and proper for suction.

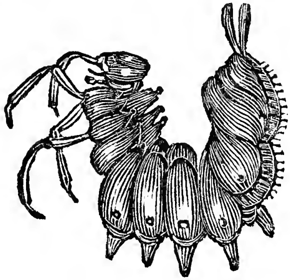
   The genera are Chelonia and Callimorpha.

Genus Cossus, Latreille.

Having no tongue ; exterior palpi cylindrical, rather thick, covered with scales; antennæ setaceous, as long as the head and trunk, with a series of short transverse and obtuse dentations along the interior side; wings inclined.

The caterpillars of this genus are very prejudicial to trees, gnawing the roots, and even their substance. Preparatory to undergoing their change into the chrysalis state, they construct a cocoon with earth, or the fragments of the substances which they gnaw. These we have more particularly described at page 107, vol. ii., and given a representation of a nest of the Earth Mason Caterpillar, the Water Betony Moth.*

Some of the caterpillars of this family present remarkable forms, as that of the Puss Moth, *Cerura Vinula*, and another called the Lobster by collectors, which is the larva of the ***Stauropus Fagi*** of Germar. This curious species is sometimes, although rarely, found in Britain. This larva, unlike almost all the rest of its tribe, has very long legs, and assumes an attitude somewhat like that of the larva of the Puss Moth, with its tail cocked up, and its head and feet erected in the manner of a person praying. The following is a representation of this remarkable larva:



* Vol. ii. page 101. First Edition.

This singular creature is of a rich orange colour; and has frequently caused great alarms amongst the ignorant and superstitious, from the praying attitude which it assumes.

Family III.—Tineites, Latreille.

The caterpillars are provided with sixteen feet, or sometimes more, living for the most part in fixed or portable tubes, formed of the substances they gnaw agglutinated together; but some are without this covering; upper wings narrow and long, the lower broad and plicated, sometimes resting horizontally on the body, or hanging nearly vertically on the sides, and raised upwards behind; body cylindrical, or narrow and elongated; the labial palpi in some species short, almost cylindrical, in others thrown backwards in the form of horns; the antennæ are generally simple.

The insects of this family are very small, but often ornamented with brilliant colours. The margins of their wings are fringed. The caterpillars have generally sixteen feet, and they live under cover, some in tubes, which they fabricate, and others, which have in consequence received the name of miners, in galleries formed in the interior of leaves. The species which destroy woollen cloths, furs, &c. inhabit portable tubes. The miners furrow the parenchyma of leaves, and are sometimes very destructive to fruits and seeds.

I. Antennæ and eyes serrated.

1. A distinct and elongated spiral trunk.

A. Wings resting horizontally on the body, or forming a rounded slope; labial palpi not longer than the head.

The genera are Lithosia, Yponomeuta.

B. Wings pendant; labial palpi much longer than the head, and thrown backwards above the thorax.

It has but one genus, ŒCOPHORA.

2. Tongue very short, or almost none; a tuft of scales or hairs on the head.

A. Labial palpi large, projecting.

The genera are EUPLOCAMPUS, PHYCIS.

B. Labial palpi small, not projecting.

· It consists but of one genus, TINEA.

II. Antennæ (very long) and eyes almost contiguous.

Is has but one genus, ADELA.

Genus TINEA, Latreille.

The antennæ are setaceous, simple or ciliated, distant; wings linear, rolled around the body; proboscis very short, or none; having two short hairy cylindrical palpi; a tuft of scales on the front.

The insects of this genus and its congeners are very destructive to woollen cloths and furs. Inclosed in a tube, composed of the materials in which they are found, the caterpillars perforate, eat, and digest these substances. At the commencement of spring they change into pupæ, and remain in this form about twenty days. After coupling, the female deposits her ova in the substances upon which the young are afterwards to feed, and the caterpillars are hatched in fifteen days after. Many means have been proposed to prevent the ravages of these small insects; but the most effectual is oil of turpentine. A piece of cloth or paper saturated with this oil, and placed in the trunks, closets, or wardrobes, to be protected from their depredations, soon kills them. A solution of corrosive sublimate and spirit of wine is also found to be an effectual preventive against the depredations of moths. Spirit of wine or tobacco smoke are equally effectual ; but the one soon evaporates, and the application of the other is difficult.

Family IV.—Noctuælites.

The species are always nocturnal, with the wings entire, horizontally extended or sloping, and forming a triangle with the body ; tarsi and labial palpi bent, compressed, furnished with scales, and terminated abruptly by a joint shorter and more slender than the preceding.

The caterpillars of this tribe are always naked, and never want the anal feet. The general number of their feet is sixteen, but some have only twelve. The perfect insect has always a spiral proboscis, and triangular wings proper for flight, in some separated, in others lying upon one another, or sloping. In a great number the hairs or scales above the thorax, and often on the abdomen, form a kind of crests or dentations. The males of many species have pectinated antennæ.

I. Caterpillars with sixteen feet.

1. Labial palpi of medium size.

The genera are Erebus and Noctua.

2. Labial palpi large.

The genera are Calyptra and Gonopterus.

II. Caterpillars with twelve feet.

1. Labial palpi large.

It has but one genus, Chrysopterus.

2. Labial palpi of medium size.

It has but one genus, Plusia.

Genus Noctua, Fabricius.

The antennæ are setaceous, generally simple; tongue long, horny, rolled up in a spiral form; upper palpi very small, concealed, the two under ones bent, with the second joint very large, compressed, and furnished with scales, and the last very small; body covered with small scales, the abdomen conical; thorax frequently tufted; wings sloping in the greater number.

The insects of this genus, like all the other Lepidoptera, have their wings covered with a scaly dust, which is removed by the slightest touch; the lower wings are plicated longitudinally on their internal side. They are commonly found in woods, gardens, and meadows, about the plants where the females deposit their ova. They fly abroad generally about sunset, remaining during the day concealed under leaves, on branches, or fixed upon walls. They couple almost as soon as they change from the pupa state. The male dies after coupling, and the female when she has insured the continuance of the species by the deposition of the ova. The species of this numerous genus are found on bushes and trees of various kinds.

Family V.—Tortrices. Latreille.

Caterpillars some with fourteen, but the greater number with sixteen feet, the anal ones never wanting; labial palpi sometimes short and cylindrical, sometimes recurved above the head, pointed, or in the form of horns.

The caterpillars in this family roll themselves up in leaves or flowers, or live in the interior of fruits. The wings of the insect in repose are slightly sloped or horizontal, and form with the body a broad and short triangle.

The genera are Pyralis, Volucra, Xylopoda, Proceras and Herminia.

The caterpillar provided with fourteen feet.

Genus Pyralis, Latreille.

The antennæ are setaceous; the wings are short, broad at their base, forming with the body a truncated ellipse or triangle, of which the opposite sides are arched near their junction.

Family VI.—Phalænites, Latreille.

The caterpillars with ten or twelve feet, the anal ones never wanting; body naked, glabrous, generally long or linear, the two extremities approximated in walking, and the intermediate portion curved upwards in an annular form; chrysalis slightly enveloped, or the cocoon with but little silky matter; body of the insect often slender, with wings extended, or in a flattened slope; spiral trunk none, or minute; many of the males having pectinated antennæ.

I. Caterpillars with twelve feet.

It has but one genus, Metrocampus.

II. Caterpillars with ten feet.

1. Males and females with wings formed for flight.

It has but one genus, Phalæna.

2. Females apterous or semi-apterous, and unable to fly.

It has but one genus, Hybernia.

Genus Phalæna, Latreille.

The antennæ are setaceous, short, simple, pectinated or plumose in both sexes, or in the males only; tongue often small; lower palpi almost concealing the upper, nearly cylindrical or conical, short, and covered with small scales; wings large, extended horizontally, or slightly sloped, and the posterior border in many species angular or dentated.

This genus comprehends nearly that division of the Linnæan genus ***Phalæna*** termed *Geometra.* Almost all the caterpillars are smooth, with a slender elongated body, and on the backs of many are eminences or warts resembling the knots or buds of a small branch. They live solitarily, and feed on vegetables. Some eat only the leaves of certain trees, while others feed indiscriminately on many. They walk by approximating the feet of both extremities, and raising the intermediate portion of their body into a ring or arch. Their progression is accomplished by measured projections of their anterior feet, the posterior ones being brought close up to the others at every step, the body rising at same time into an arch. This mode of walking has given rise to the application of the term *Geometræ*, or measurers of land, by which the genus has been characterised. These caterpillars are farther remarkable for the manner in which many of them attach themselves to the branches of trees, and which proves them to be possessed of muscular strength in a great degree. Some fix their posterior feet on a small branch with the body placed vertically, and remain immovable in this position for hours, and others appear in attitudes which require the exertion of still greater muscular power. When the leaf is touched upon which one of these caterpillars is placed, it drops off, but does not fall to the ground, having always a silken thread of extreme tenuity; this it has the power of lengthening at will, by which it swings itself to the ground, and ascends at pleasure. The species destitute of posterior feet, suspend themselves by the extremity of the body like the caterpillars of some butterflies. The time which the Phalænæ remain in the chrysalis form, varies in different species. A great number become perfect insects towards the end of summer. These all perish after having secured the reproduction of their ova; but those which do not undergo their metamorphosis till autumn, continue during winter in the pupa state, and assume the imago or perfect condition in the following spring.

Family VII.—Crambites, Latreille.

I. Wings in a flattened slope, and forming a triangle with the body.

The genera are Botys, Hydrocampus, Aglossa, and Ilithya.

II. Wings hanging almost vertically on each side of the body, and ascending posteriorly, or rolled around it; the upper ones long, narrow, and the lower broad.

The genera are Galleria, Crambus, and Alucita.

Genus Crambus, Latreille.

Insects are provided with four palpi, the lower ones large and projecting; wings rolled around the body in a cylindrical form; antennæ setaceous.

Family VIII.—Pterophorites, Latreille.

Wings, or at least two of them, cleft, or digitate; body slender and elongated; feet long; antennæ simple; spiral proboscis distinct; wings sometimes distant from the body, at others inclined and close. Caterpillars with sixteen feet; in the greater number of species the chrysalis is naked, coloured, and suspended by a thread; in the others it is inclosed in a transparent cocoon.

The genera are Pterophorus and Orneodes.

Genus Pterophorus, Latreille.

The antennæ are setaceous, simple; wings divided; palpi scarcely longer than the head, and covered with scales; body narrow and elongated; wings distant from the body, in the form of arms, and the legs are spinous.

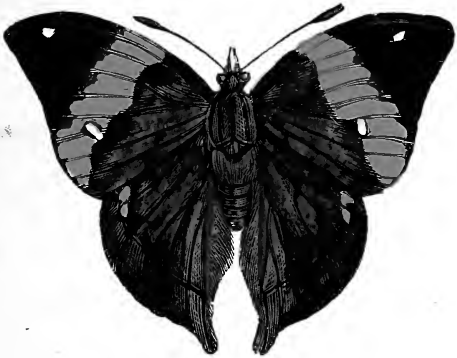
THE PARALECTA BUTTERFLY.

Papilio Paralecta.

PLATE I.

Paphia Paralecta, *Horsfield's Descriptive Catalogue of Lepidopterous Insects in the Museum of the East India Company*, pl. 6. fig. 4.

The extent of the wings of this beautiful insect, from the tip of the one to that of the other, is three inches and a half; and its total length two inches and three quarters. Its general colour on the upper surface is of a deep azure blue, which changes to purple by the play of light. The upper wings have a broad bright fulvous sesquialterous band, with undulated margins; the space between which and the extreme tips of the wings is of a deep brownish black; the anterior margin, betwixt the sesquialterous band and the body of the insect, is slightly tinged with green; the head and back deep blue; eyes and sides of the thorax, as well as the abdomen and interior margins of the lower wings, is of a burnt umber brown; the upper pair of wings are each provided with two white spots, the one situated in the lower margin of the sesquialterous band, and the other towards the tips of the wings; the lower wings have two fulvous



1.

THE PARALEKTA BUTTERFLY.
Papilio Paralekta.—Java.

spots in each, placed towards the exterior margin, immediately below the upper wings; the abdomen, just below the thorax, is furnished with longish brown hairs.

The butterfly inhabits Java.

THE IDALIA BUTTERFLY.

Papilio Idalia.

PLATE II.

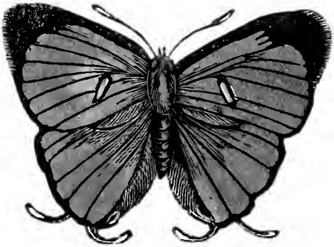
Papilio Idalia, *Fabr. Sp. In.* ii. p. 109.—*Drury, Ins.* i. pl. 13, figs. 1, 2, 3.—*Shaw's Nat. Mis.* pl. 1035.

The breadth of the Idalia Butterfly is four inches and an eighth in extent; the wings are of a deep rusty brown in the centre, with variously-shaped blotches of black, around which the whole are broadly bordered with black, and spotted with equidistant triangular white marks, with a row of these on the posterior margin; the lower wings are of an intense bluish black, with large, pale, cream-coloured, somewhat square-shaped spots; the margins are indented, and have a row of white crescent-shaped spots near their edges; a streak of brown extends from the insertion of the wings to nearly their centre; the head, eyes, and thorax, are of a burnt umber brown colour; the abdomen deep Antwerp blue, and the sides provided with brown downy hairs. The under surface of the wings have silvery spots.

This butterfly is a native of many parts of North America.

2.

THE IDALIA BUTTERFLY.
Papilio Idalia.—NORTH AMERICA.



3.

THE VIDURA BUTTERFLY.
Papilio Vidura.—Java.

THE VIDURA BUTTERFLY.

Papilio Vidura.

PLATE III.

Amblypodia vidura, *Horsfield's Des. Cat. Lepidopterous Insects*, p. 111, pl. 1, fig. 6, 6 a.

"The wings in the male, bright azure blue above, with a snowy refulgence, spread as a delicate white powder over the surface, while the ground colour assumes, in a different aspect, a pale sea green cast; the superior wings are ornamented with a delicate white, silky, brush-like appendage, reflected and closely applied to a blackish spot on the middle of the disc; the margins are black, gradually increasing in breadth to the tip, being separated by a curved boundary from the azure ground; in the lower wings the posterior border is marked with a black thread, extending to the anal appendage, which bears besides a black lunule; the extreme fringe is gray; the exterior margin is provided with a hemispherical denudated silvery spot, corresponding with a delicate brush of lengthened hairs, in the under side of the upper wings; the interior border is covered with a delicate whitish down, slightly fringed with gray; underneath, the wings are grayish brown, with a very faint livid lustre; a strongly marked broad snow white band passes in a straight line through the middle of both pairs to the anal region of the lower wings, where it becomes narrower, and, after several minute curves, stretches obliquely to the interior margin; between this and the hinder margin is a very delicate blackish thread, composed of small linear fragments, in close contact, arranged in a regular curve across the fore wings, slightly interrupted and curved in the hinder, forming in the anal region a delicate edge along the medial white band; the lower wings are besides marked, within the posterior margin, with a row of oblong spots of the ground colour, inclosed within a double series of white lunules, and continued to the anal region by two very large black ocellate spots, the exterior one being surmounted by a large oblong patch of a bright orange tint, abruptly terminated at its contact with the black striga, the interior one occupying the anal appendage, being covered internally with a white arc sending off a short oblique line along the inner margin; the space between the ocellated spots is gray, irregularly irrorated with black, and marked in the middle by an indistinct white lunule; a brilliant white thread passes along the entire anal region, exterior to which is a continued black marginal thread, and the whole terminated by a grayish fringe. The body with a varying bluish or sea green tint above, covered with a yellowish down underneath ; the antennæ are brown, with a closely catenulated lateral white line extending to the origin of the club, the tip of which is ferruginous ; the tail black, with a white tip and grayish fringe."

Inhabits India ; and is very rarely met with on the Island of Java.

THE THYRIA BUTTERFLY.

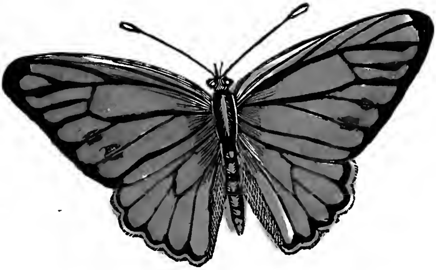
Papilio Thyria.

PLATE IV.

Pieris Thyria, *MM. Latreille and Geoffroy, Ency. Meth. Hist. Nat.* ix. p. 147.—Pontia Thyria, *Horsfield, in Zool. Journ.* vol. v. p. 69, pl. 4, fig. 2.

The Thyria butterfly is two inches in breadth, and of an uniform rich orange coloured brown; the anterior margins towards the shoulders of the upper wings tinged with yellow, and the interior margins of the lower wings of the same colour, with their posterior margins scalloped and edged with a border of yellow, above which, is a scalloped border of black; the external sides of the upper wings have a black border; the body is yellowish brown.

Dr Horsfield says, "The male, in our insect, is distinguished by a more rich and saturated colour above, by very prominent blackish nervures, and by a very faint posterior border. In the female, both wings have a distinct broad blackish posterior border, and the anterior pair has, besides, a band of the same colour, near the outer apical angle, passing obliquely from the middle of the costa, towards the margin, being succeeded by several indistinct arcs. The tint in the female is less brilliant;



4.

THE THYRIA BUTTERFLY.

Papilio Thyria.—Java.

underneath, both pairs have a saturated sulphureous orange colour, which assumes an obscure vermilion tint, in the medial and basal areas of the fore wings. In the female, the surface is variegated by the transmission of the marks of the upper side, and the grayish irrorations towards the margins. The thorax, in both sexes, is clothed above with a greenish, and underneath, with a yellowish down. The body blackish above, and gray underneath.

The Thyria butterfly inhabits the Island of Java. It is a rare insect.

THE EBULE BUTTERFLY.

Papilio Ebule.

PLATE V.

Papilio Ebule, *Shaw's Nat. Mis.* pl. 1018.—*Cramer's Desc. des Pap.* ii. pl. 120, fig. E. F.—*Edwards*, pl. 304.

THE whole upper surface of this butterfly is of a rich yellow colour, marked along the margin with black specks, and beneath by a double ferruginous silvery spot.

The caterpillar is of a rich gamboge yellow, with a double row of green spots along the sides. It feeds on the leaves of the dwarf cassia.

The pupa is of a fine rose colour, having two streaks of green.

The Ebule butterfly is a native of Virginia and Georgia.

5.

THE EBULE BUTTERFLY.
Papilio Ebule.—GEORGIA.

6.

THE ATYMNUS BUTTERFLY.
Papilio Atymnus.—JAVA.

THE ATYMNUS BUTTERFLY.

Papilio Atymnus.

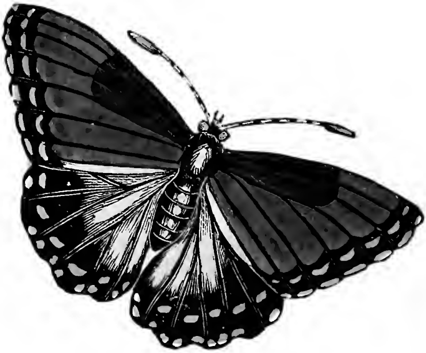
PLATE VI.

Papilio P. R. Atymnus, *Fab. Mant. Ins.* tom. ii. p. 70, No. 662.—Myrina Atymnus, *MM. Latreille and Geoffroy, Ency. Meth. Hist. Nat.* ix. p. 574.

The wings above, are fulvous in both sexes, varying in intensity of tint in different individuals, from high-toned orange, to pale saffron yellow; the anterior, with the exterior borders, blackish brown, the intermediate boundary being regular, and passing in an arch from the middle of the costa to the inner apical angle, leaving the greatest breadth at the tip; posterior, with a narrower and paler apical border, whose inner edge is slightly dentate, and gradually diffused in the ground colour of the surface, or entirely covered with a diluted yellowish tint; the inner margin is dirty grayish and downy, lengthened in the direction of the anal appendage, which is irrorated with dusky white; underneath, it is covered with a yellow ochraceous pulverulent tint, which is uniformly diffused over the whole surface, marked with four brownish parallel strigæ, the two interior ones being very obsolete, and apparent only in fresh and well conditioned specimens;

the third, extending over the middle of both pairs, is the most distinct, and composed of darkish lunules in close succession; the fourth, just within the margin, is faint and interrupted; the transverse anal extremity is marked with a brownish band, consisting of three confluent spots, which are covered along the margin with whitish irrorations, the inner spot being diffused over the rounded extremity of the anal appendage. The body is broadish above, with a slight admixture of yellow; the thorax bears delicate silky hairs; underneath, these parts are covered with a short, close, whitish down. The antennæ are brown; the tail is pale fulvous, with an obscure brownish margin, and a whitish tip.

This Papilio inhabits India.



7.

THE HECKUBA BUTTERFLY.
Papilio Heckuba.—South America.

THE HECKUBA BUTTERFLY.

Papilio Heckuba.

PLATE VII.

Papilio Heckuba, *Shaw's Nat. Mis.* pl. 167.—*Gmelin's Linnæus Systema Naturæ*, p. 2247.

The upper wings are of a very rich ferruginous red colour; on the anterior margin there is an acutely triangular mark, extending from the insertion of the wing, nearly two-thirds across it, widening as it extends outwards, and of a deep sanguinous red, with dusky scalloped edges, and a double border of crescent-shaped, deep straw coloured spots; the lower wings are black, of an ochre yellow towards their base; they are considerably more indented than the upper ones, and provided with a double border of oblong ovate deep straw coloured spots, those next the edge of the wings being set in pairs; the body is blackish gray, somewhat ochre coloured above; the whole under surface of the wings is undulated with different shades of brown, black, gray, and rust colour, and marked by several eyelike spots, or annulets of similar colours.

This superb insect is one of the largest of its tribe, measuring five inches and a half from the tip of one wing to that of the other. It is a native of South America.

8.

THE DIOMEDES BUTTERFLY.
Papilio Diomedes.—Java.

THE DIOMEDES BUTTERFLY.

Papilio Diomedes.

PLATE VIII.

Papilio Diomedes, *Shaw's Nat. Mis.* pl. 296.—*Cramer's Descr. des Pap.* pl. 122, fig A.—*Linn. Syst. Nat.* p. 749.—*Gmelin's Linné*, pl. 2236.

The wings above, of this butterfly, are black, having their disc unequally radiated with blue, with a large round spot of black on the centre of the upper wings, and their edges with a border of equidistant white spots; the lower wings with a margin of crescent-shaped white spots, and each provided with a subcaudal black appendage; the internal margins of both wings with a tinge of yellowish green; the body is short, of a reddish brown, and the eyes are red.

The Diomedes butterfly is one of the larger species, and measures five inches and a half from the tip of one wing to that of the other.

This insect is a native of China.

THE SAKUNI BUTTERFLY.

Papilio Sakuni.

PLATE IX.

Polyommatus Petavius, *Ency. Meth. Hist. Nat.* ix. 676.—Petavia Sakune, *Horsfields's Des. Cat. Mus. East India Company*, pl. 2. fig 1. 1.

The upper surface of the wings is of a dark burnt umber-coloured brown, the superior pair with a large orange patch towards their exterior edges; the whole are surrounded by an equidistant spotted border of paler brown of the same colour; the body is also dark umber brown; the eyes are blackish brown. The whole under surface of the wings is of a rich brownish yellow, with irregular spots of gray. The antennæ have no visible club at their termination.

This insect inhabits India.

9.

THE SAKUNI BUTTERFLY.
Papilio Sakuni.—Java.

10.

THE SUGRIVA BUTTERFLY.
Papilio Sugriva.—JAVA.

THE SUGRIVA BUTTERFLY.

Papilio Sugriva.

PLATE X.

Theckla Sugriva, *Horsfield's Illustrations of Lepidopterous Insects, Museum of the East India Company*, pl. 1, fig. 10. 10.

The superior surface of both the upper and lower wings are black, as well as the body and antennæ; the lower wings have an oblong patch of deep ultramarine blue; the caudate wings extend about an inch beyond the lower wings, and have a slight flexure towards their centre; they are, together with the wings, a considerable way above them, of a pale fawn colour; the inner point of the wings having a crescent-shaped black spot on each; the under side is of a rich fawn colour, clouded and streaked with dark brown, and having some black eyelike spots, with a circular margin of rich golden yellow. Extent of wings one inch and five-eighths; total length of both wings, including the caudate wings, two inches and an eighth.

This rare and curious insect inhabits India.

THE AMERICAN COMMA BUTTERFLY.

Papilio C. Aureum.

PLATE XI.

Papilio C. Aureum, *Shaw's Nat. Mis.* pl. 1046.—*Smith's and Abbot's Insects of America*, pl. 11.

The superior wings, and upper half of the lower ones, are of a bright orange red, spotted with variously-shaped marks of black; the lower ones with a large circular black comma-like spot in the middle of the orange; the upper wings are deeply indented and scalloped on their edges, and have a broad margin of black, within which is a border of small white dots; the under half of the lower wings are black, with longitudinal clouds of dark steel gray, approaching to blue in some species; they are also deeply indented and scalloped on their edges, with short subcaudate wings; the body is olive green, and the eyes orange.

The Papilio *C. Aureum* inhabits Virginia and Georgia, where its caterpillar feeds on the leaves of the white lime-tree; it changes to a chrysalis in the month of May, and emerges the complete insect in June.

11.

AMERICAN COMMA BUTTERFLY.
Papilio C. aureum.—VIRGINIA.

12.

THE GOLDEN-COPPER BUTTERFLY.
Papilio Chryseis.—BRITAIN.

THE GOLDEN COPPER BUTTERFLY.

Papilio Chryseis.

PLATE XII.

Papilio Chryseis, *Leach's Zoological Miscellany*, pl. 13, page 27.—*Fab. Mont. Ins.* ii. p. 79, No. 725.—*Gmelin's Linn. Systema Naturæ*, p. 2359, No. 815.—*Wein. Schmetterl.* 181, No. 3.

The wings of the male are yellow orange above, with black margins, and a black spot on the upper ones, which are of a blue colour; the female is orange above, clouded and spotted with black. Both are brown beneath, with twenty-seven eye-like spots, or annulets. The wings extend one inch and five-twelfths to half an inch. It appears in the winged state in August and September.

This pretty insect was first introduced to the notice of the British entomologist by Dr Leach in his "Zoological Miscellany," and was caught by Mr Plasted of Chelsea, in Ashdown Forest, Sussex, and also near Epping, and is a very rare insect.

THE RAVINDRA BUTTERFLY.

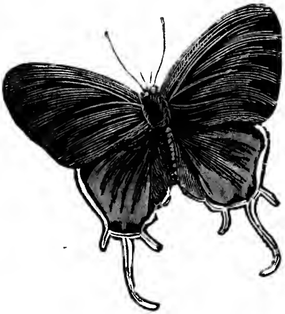
Papilio Ravindra.

PLATE XIII.

Mijena Ravindra, *Horsfield's Illus. Lep. Inst. Mus. East India Company*, p. 117. pl. 1, fig 11, 11.

The superior wings are brown above, being more saturated in the male; in which the lower wings are of a pulverulent glossy hue, changing by the play of light to sea green, deepening towards the lower margin; the latter with a snow white fringe, extending to the paler inner margin. In the female these wings are nearly all brown, having only a few diffuse bluish crescent-shaped spots; the superior wings are grayish brown beneath, with a grayish white anal area; the lower wings are white, and marked on the base and disc with oblong black spots. The body is brown above, and hoary underneath; the antennæ are brown, with a ferruginous tip, delicately crenulated with white along the lateral groove; the legs are white, having distant black bands on the tibiæ, and numerous bands on the tarsi; the caudate wings white, with a medial black striga.

The Ravindra butterfly inhabits India.



13.

THE RAVINDRA BUTTERFLY.
Papilio Ravindra.—JAVA.

14.

THE AGNOR BUTTERFLY.
Papilio Agnor.—ASIA.

THE AGNOR BUTTERFLY.

Papilio Agnor.

PLATE XIV.

Papilio Agnor, *Linnæus Systema Naturæ*, ii. p. 747.—*Clerk, ic. Ins. Rar.* pl. 15.—*Cramer Desc. des Pap.* i. pl. 8, fig. A, B.—*Shaw's Nat. Mis.* pl. 500.

THE upper wings of the *Papilio Agnor* are brownish black, having broad streaks of deep black, and with a large and small elongated triangular scarlet spot towards their insertion, and placed near the anterior margin; the upper one being greatly larger than the under one; the lower wings are brownish black on the upper half, and white on the disc, with longitudinal broad black veins, between each of which is a large upright oblong ovate black spot; both upper and lower wings are considerably dentated; the antennæ are provided with pretty large club-shaped tips; the body is black and downy.

This insect measures three inches and six-eighths from the tip of one wing to that of the other, and is an inhabitant of several parts of Asia.

THE ARJUNA BUTTERFLY.

Papilio Arjuna.

PLATE XV.

Papilio Arjuna, *Horsfield's Descriptive Catalogue of Lep Insects, Mis. East India Company*, pl. 1. fig. 14. 14.

The upper and under wings of the *Papilio Arjuna* are of a deep fulvous brown, thickly besprinkled with minute greenish dots; the lower wings with a broad transverse green patch, occupying about a third of the wings. This patch is liable to a changebility of colour from the play of light; at the interior lower angle of this green patch is an eyelike spot of black, its upper edge being surmounted by a semilunar yellow stripe, above which is a similarly shaped stripe of blue; the upper wings are slightly, and the lower ones deeply, indented, and provided with subcaudal appendages, directed outwards. The under surface of both wings are of a raw umber colour; the upper ones with a broad transverse oblique band of pale straw yellow, extending entirely across them; the lower wings with a black border, having in each of the hollows a crescent-shaped white spot, surmounted by an acutely semilunar spot of yellow, ferruginous in

15.

THE ARJUNA BUTTERFLY.
Papilio Arjuna.—Java.

the centre; above which are similarly shaped spots of azure blue. The body is blackish brown.

This insects measures four inches across the wings, and inhabits several of the Indian islands.

THE SINGLE SPOT BUTTERFLY.

Papilio Spondiæ.

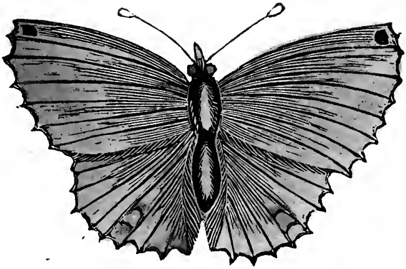
PLATE XVI.

Papilio Spondiæ, *Merian's Insects of Surinam*, pl. 13.—*Shaw's Nat. Mis.* pl. 806.

The whole upper surface of this butterfly is of an uniform bright verditer blue, with a black spot on each of the upper wings towards their tips, and a yellow transparent spot near the centre, towards the posterior margins of the lower wings; the under surface of both wings is of a deep umber brown, each provided with a waved grayish white sesquialterous band, and the lower wings with a yellow spot in the same situation as above; the body is brown beneath, and azure blue above.

The caterpillar of this insect, according to Madam Merian, is of a very voracious nature, and feeds on the leaves of the *Spondias lutea*, or American plumb; it is of a deep green colour, and thickly beset with long hairs, each having a little circular ball at its tip. It changes to a chrysalis in the beginning of April, and transforms into the perfect butterfly in the end of the same month.

The Single Spot butterfly is a native of Surinam.



16.

THE SINGLE-SPOT BUTTERFLY.

Papilio Spondiæ.—SURINAM.

17.

THE WHITE ADMIRABLE BUTTERFLY.
Papilio Camilla.—Britain.

THE WHITE ADMIRABLE BUTTERFLY.

Papilio Camilla.

PLATE XVII.

Papilio Camilla, *Linn. Syst. Nat.* ii. p. 781. No. 187.—*Roes,* iii. tab. 33, figs. 3, 4.—*Donovan's Brit. Ins.* vii. p. 75. pl. 244.—*Harris's Aurel.* p. 56, pl. 30. fig. m. n.

The antennæ are club-shaped at their termination, the wings erect when at rest; they extend two inches, to two inches and one-sixth, and are of an uniform dark blackish brown on the upper side, indented with a white band and spots; between which, and the base, is an ashy crescent-shaped disc, and four white dots, with a double parallel series of obscure, black marginal spots. The under side of the wings is of a rich orange yellow, with a white band and spots.

The caterpillar of the White Admirable butterfly is green, and feeds upon the common honeysuckle and woodbine.

The chrysalis is green, spotted with golden metallic spots, forked in front. The fly is found in the months of June and July on the skirts of woods It localizes in the south-eastern counties of England, particularly in Sussex, Essex, Kent, Berks, Hants, Middlesex, and Suffolk.

THE ARTAXERXES BUTTERFLY.

Papilio Artaxerxes.—BRITAIN.

PLATE XVIII.

Papilio Artaxerxes, *Fab. Ent. Sys.* t. 3, p. 1. 297-129.—*Donovan's Brit. Ins.* xv. p. 1, pl. 541.—*Rennie's Consp. of But.* p. 19.

THE antennæ are elevated at the tip; the wings are entire, sooty black, or brownish black, with a white dot on the middle of the superior pair, and with rufous lunules on the inferior ones; margins beneath white, with rufous dots; the under surface is of a pale brown, with numerous white eyelets, black in the centre. The male is lighter than the female. The extent of the wings is from one inch to an inch and a sixth. It appears in the winged state at the end of July.

This insect was first discovered on Arthur Seat, near Edinburgh, by Dr Leach, and also on the Pentland Hills, near Edinburgh, by the same gentleman. Till that period, it was esteemed as the highest possible rarity. It has also been found at Dumfries and in Devonshire.

The *Papilio Artaxerxes* is by no means striking in its appearance, but valuable on account of its rarity.

18.

THE ARTEXERSES BUTTERFLY.
Papilio Artexerses.—BRITAIN.

19.

THE AZURE-BLUE BUTTERFLY.
Papilio Argiolus.—BRITAIN.

THE AZURE-BLUE BUTTERFLY.

Papilio Argiolus.—Britain.

PLATE XIX.

Gmelin's Linné, i. p. 5. 2350, No. 234.—*Donovan's Brit. Ins.* xiv, p. 39, pl. 418.—Polyommatus Argiolus, *Stephens.*—*Rennie's Conspectus*, p. 17.

The extent of the wings is from an inch and a sixth to an inch and a half, of a deep azure blue; the superior ones with a broad transverse band of black on their outer side, and a margin of black and white dots; the lower wings are dotted with black, and a deep line of black towards their lower extremities; the under side of the wings is light gray.

The female has more black at the tip of the wings, which are bluish, inclining to purple; the under surface of both male and female is of a very pale sky blue, dotted with black. This insect is not uncommon, appearing about the middle of the day, in sunny weather, on the skirts of meadows.

The larva of this butterfly is rarely to be met with; it feeds on grass, and is hairy; of a yellowish green colour, with a bright green line down the back, and the head and legs are black; it feeds on buckthorn and holly.

The chrysalis is smooth, of a brown and green colour, with a black line down the back.

There are two broods of the Azure-Blue butterfly, one of which appears in the month of June or July, and another in the latter end of August. It inhabits the neighbourhood of London, Suffolk, Norfolk, Kent, Hampshire, and Devonshire.

20.

DRURY'S SPHINX.
Sphinx Druræi.—BRITAIN.

DRURY'S SPHINX

Sphinx Drurœi.

PLATE XX.

Papilio Druræi, *Drury*, vol. 1, pl. 25, fig. 42.—*Donovan's Brit. Ins.* xiv. p. 1, pl. 469.

The wings are entire; the superior pair grayish brown, setaceous and clouded, with a distinct fuscous blotch in the middle; the anterior wings are rose coloured, with three waved transverse black bands; on the back are two eyelike blue spots; the back is the same colour as the superior wings, and the abdomen rich crimson, with transverse bands of black on each segment, and a longitudinal stripe of brown down its centre.

This sphinx is supposed to have been imported from America.

THE CLEAR WINGED HUMMING SPHINX.

Sphinx Fusiformis.

PLATE XXI.

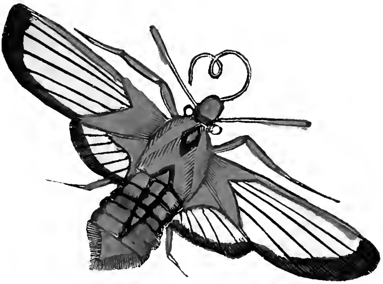
Linn. Syst. Nat. ii. p. 803, No. 28.—Sesia Fusiformis, *Fab. Sp. Ins.* ii. p. 156, No. 11.—*Don. Brit. Insects*, vol. iii. p. 37, pl. 87.

The antennæ are blackish brown; the head and thorax of a bright chrome yellow; the body rich brown, except the last segments, which are yellow; the abdomen is bearded with black; the wings are transparent, with a broad dark brown border.

The caterpillar of this insect feeds on the wood of willows, and is concealed within the solid substance of the trunk, in the same manner as the larva of the *Sphinx apiformis* and *Sphinx tipuliformis* are concealed within the wood of a poplar, and stalks of currant bushes.

Fabricius describes the caterpillar as green, with a lateral line of yellow, and having a red spine at the end of the body. Harris says, that in the winged state the fly is found in gardens, on flowers, in May. Fabricius says it feeds on the honeysuckle.

It is a very rare insect, especially in Britain, and has been found in Epping Forest.



21.

THE CLEAR-WINGED HUMMING SPHINX.

Sphinx Fusiformis.—BRITAIN.

22.

THE CONVOLVULUS SPHINX.
Sphinx Convolvuli.—Britain.

THE CONVOLVULUS SPHINX.

Sphinx Convolvuli.—Britain.

PLATE XXII.

Sphinx Convolvuli, *Linn. Syst. Nat.* ii. p. 798, Note.—*Cramer Desc. des Pap.* iii. p. 19. t. 225. fig. d.—*Donovan's Brit. Ins.* vii. p. 31. pl. 228.

The antennæ are thickest in the middle; the wings are entire, varying in the male from four inches and one-third to four and a half inches; and in the female from four inches and a half to two-thirds; deflexed when at rest; they are of a pale brownish yellow, beautifully clouded and streaked with zigzag markings of blackish brown; the lower wings with zigzag transverse bands. The head is ash coloured; the thorax ashy brown, with indistinct dark lines; abdomen with transverse fillets of alternate black and pink.

This is the largest species of Hawk Moth which inhabits Great Britain, with the exception of the *Sphinx Ligustri* and the *Sphinx Atropos.* It is rarely taken in this country, but is common in Germany.

A beautiful variety of this insect is found in North America; the wings are more richly varied with different shades of bright brown than the

European kind; the posterior wings are of a fine rose colour.

The caterpillars are of two colours; the one green, with stripes of yellow and spots of black; the other brown, with ochre coloured stripes, and sides of the same, and the horn dingy; it feeds on the greater and lesser bind-weed. Abbot figures a caterpillar of this insect, with a rose coloured seam on the side. It is four inches in length; the pupa measures two inches, and is of a reddish brown colour. It is rather rare, and is found to inhabit Caithness in Scotland, York, South Wales, Cambridge, Cumberland, Surrey, Middlesex, Cornwall, and Kent.

23.

THE LIME HAWK MOTH.

Sphinx Tiliæ.—BRITAIN.

THE LIME HAWK MOTH.

Sphinx Tiliæ.

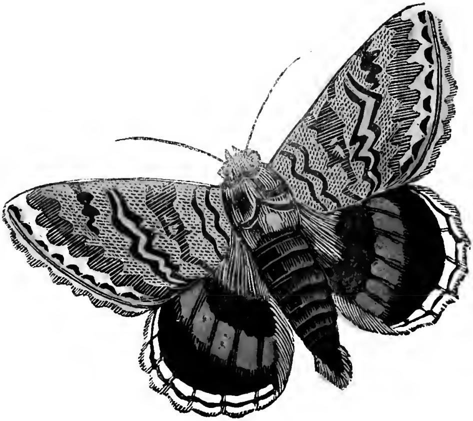
PLATE XXIII.

Sphinx Tiliæ, *Linn. Syst. Nat.* ii. p. 797.—*Merian's Ins.* ii. p. 80, No. 2.—*Donovan's Brit. Ins.* x. p. 3, pl. 325. —Smerinthus Tiliæ, *Latreille.*

The antennæ are thickest in the middle; the wings are angulated, the superior ones of a fine rose colour, with two square patches of green on each, and a broad band of green at their exterior sides, and margined with crimson; the thorax and abdomen are also green, and a yellowish triangular patch on the back; the lower wings are of a rich yellowish brown, margined with crimson. The wings of the male are two inches and one-sixth to one inch and two-thirds; the female is from two inches and a third to three inches; they are somewhat three-lobed in form.

The caterpillar is emerald green, and solitary in its habits; the segments banded, spotted with crimson and yellow, and thickly covered with punctured white dots. It feeds on the lime-tree, alder, elm, oak, and birch, and changes in September to the pupa state, and remains in that condition during the winter. It is of a dusky brown, and is transformed into the perfect sphinx in May.

It is plentiful in Devonshire, Hertfordshire, Essex, Surrey, and Yorkshire.



24.

THE CLIFDEN NONPAREIL MOTH.

Phalæna Fraxina.—BRITAIN.

THE CLIFDEN NONPAREIL MOTH.

Phalæna Fraxini.

PLATE XXIV.

Phalæna Fraxini, *Linn. Syst. Nat.* ii. p. 843, No. 125.—*Wilk's Pap.* No. 45, tab. i. A 2.—*Merian's Insects of Europe*, pl. 4.—*Roes.* iv. pl. 28, fig. 1.—*Donovan's Brit. Ins.* vol. v. p. 89, pl. 171.—Catocala Fraxini, *Curtis.*

The wings are from three inches and five-sixths to four inches in extent; they are scalloped. Superior ones ashen gray, covered with numerous zigzag markings of a darker colour; under wings blue, with transverse bands of black. The wings are deflexed when at rest; the antennæ taper from the base; the thorax is crested.

The under side is of a dull cream yellow, with many black cloud-like bands crossing the wings.

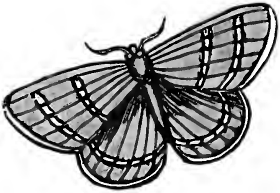
The male is easily distinguished from the female by its smaller size. This moth is subject to considerable variety, both in the markings and arrangement of the spots, as well as in the degree of intensity in the colours of both upper and lower wings. We have examined some specimens from the north of Europe, which were comparatively null in their colours to those of Britain.

The larva feeds on the ash-tree, the poplar, oak, and elm; and is found in Yorkshire, Kent, Suffolk, and Surrey; it changes to the pupa state in June. The chrysalis is of a pale raw umber brown, and is slightly covered with hairs. The perfect moth emerges in July.

The English name given to this very beautiful moth, was in consequence of its having been first taken at Clifden in Buckinghamshire, in the month of July. It was discovered hanging against the pedestal of a statue, having just emerged from the chrysalis, and was in the act of drying its wings.

It is extremely probable that this elegant butterfly was originally introduced into Britain in the egg or pupa condition, among continental plants.

It is one of the rarest, as well as the largest of the British lepidoptera, and is much less uncommon in Germany, and other parts of the continent, than in Britain.



25.

THE DARTFORD EMERALD MOTH.
Phalæna Lucidata.—BRITAIN.

THE DARTFORD EMERALD MOTH.

Phalæna Lucidata.

PLATE XXV.

Phalæna lucidata, *Donovan's British Insects*, iii. p. 67. pl. 97.—*Rennie's Conspectus*, p. 17.

This pretty insect is of a fine lucid emerald green, with two waves across the upper, and one across the under wings. The wings extend one inch and one-fourth, to five-twelfths.

Donovan says, "This species we have ever found peculiar to the woods about two or three miles beyond Dartford, in Kent, particularly on the skirts of Darnwood, and near the banks of the river Thames, at Queenhithe. It has probably never been taken elsewhere, or the name Dartford Emerald would not have been so generally adopted by collectors.

"I am not certain whether in the larva state it feeds on the convolvulus, although I found it on a plant of that kind, as its climbing stalks and tendrils were so intricated with branches of white thorns, oak, and brooms, as to prelude any accurate determination."

The head of the caterpillar is gray, with black jaws, and is concealed beneath two reddish horns or projections of the same green colour as the back. It feeds on the oak, sloe, &c.

The pupa is of a dull brown, betwixt a bistre colour and raw umber.

This is a very rare British moth, and has only been found in Kent and Surrey, and in the latter locality very sparingly.

26.

THE PROSERPINA MOTH.

Phalæna Proserpina.—North America.

THE PROSERPINA MOTH.

Phalæna Proserpina.

PLATE XXVI.

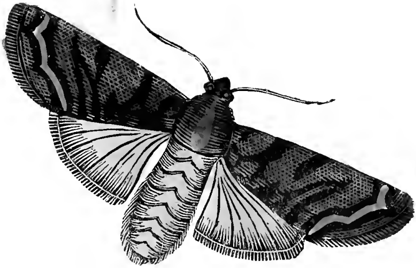
Phalæna Proserpina, *Shaw's Naturalist's Miscellany*, pl. 998.

The whole wings of this interesting phalæna are of a deep black, which changes into a beautiful glossy blue by the reflection of light; both the upper and lower wings are provided with a very broad sesquialterous waved band of pale straw yellow, which is greatly broader on the lower ones; both sets of wings have a crescent-shaped black spot, with an ochre coloured centre, situated in the bands; those of the superior wings are placed near the top of the upper inner margins, and those of the lower wings towards the interior margins; the entire exterior margins of the wings, are supplied with a fine fringe; the body is the same colour as the wings, with four transverse tufts of a colour between scarlet and orange. The head and upper part of the thorax is pale straw yellow; the antennæ are fringed, and of an ochre yellow.

The caterpillar is of a pale gamboge yellow, with a crimson head and tail, and each side of the upper surface furnished with an undulated, longitudinal, black band, from the sides of which project branched filaments set in pairs. It feeds on the leaves of several species of American oak.

The pupa is of a dull umber brown.

This moth inhabits Georgia and Virginia.



27.

THE BROOM MOTH.

Phalæna Pisi.—BRITAIN.

THE BROOM MOTH.

Phalæna Pisi.

PLATE XXVII.

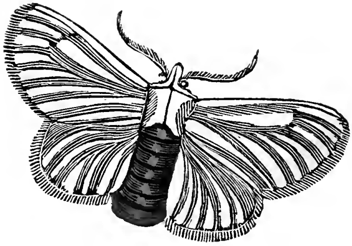
Phalæna Pisi, *Linn, Syst. Nat.* ii. p. 854, No. 172.—*Merian's Europ.* tab. 50.—*Donovan's Brit. Ins.* ii. p. 39, pl. 51.

The superior wings are from half an inch to two-thirds; of a reddish brown, clouded with darker grayish brown, with a gamboge and yellowish-gray undulated lines near their exterior margins. The lower wings in the male are of a light brown, with a broad shade of grayish; and in the female they are ash coloured at the base.

The caterpillars of this species will indiscriminately eat the leaves of the knot-grass, pease, the broom, &c. It is from the latter food which the moth takes its name. The caterpillar has a pale pink head; the body is dark reddish brown, with two longitudinal rich yellow stripes on each side; the belly and feet are of a raw umber brown. It is found in July and August, and descends into the ground late in September, or the first week in October, and the fly comes forth in July.

Caterpillars that enter the earth in the larva form, pass to the chrysalis, and issue forth in the perfect fly state, have no occasion for a web to protect them; and therefore few species prepare one. But among those which remain exposed in the open air, a very small proportion neglect to weave a web with the utmost skill and industry.

It is found in Ireland, near Dublin, at Durham, Essex, Derbyshire, Middlesex, and Surrey.



28.

THE BROWN-TAIL MOTH—FEMALE.
Phalæna Phæorrhoea.—BRITAIN.

THE BROWN TAIL MOTH.

Phalæna Phæorrhœa.—Britain.

PLATE XXVIII.

Phalæna Phæorrhœa, *Curtis's Hist.* 1782.—*Marsh, Linn. Tr.* v. p. 68.—*Donovan's Brit. Ins.* xvi. p. 39, pl. 555.

The antennæ taper from the base; the wings of the male are yellowish, or cream yellow, and from one inch and a third to one and a half inch; the female is from one inch and a half to two-thirds, and pure white above. The first pair of wings have a dusky cloud on the upper edge in the male; the antennæ ferruginous; the abdomen dark umber brown, with the last segment of an orange brown.

The caterpillar is black, with longitudinal double lines of red along the back; and each segment spotted with white along the sides. The pupa is brownish black.

The history of this little moth is very interesting, and was given at considerable length by Mr W. Curtis, author of the "Flora Londinensis."

In the year 1782, the inhabitants of London and its vicinity were thrown into the utmost consternation by the appearance of a phenomenon far from usual in the northern regions of the earth,—a host of insects, in numbers like the locusts of the deserts, were observed at once to pervade the whole face of vegetation, and despoil the herbage in many places for miles, of every trace of verdure. These were no other than the larvæ of an insignificant moth, the subject of our present plate.

The ravages committed by this insect were assuredly less considerable than the vulgar were inclined to believe. True to their natural instinct, some particular vegetables were preferred to others, and these they devoured with impunity, while others were only partially attacked, as though eaten with reluctance in the general scarcity of their natural food; and again, others being still less palatable, entirely escaped their devastations. The aspect of vegetation was nevertheless such as might justly create alarm: plants, hedges, nay, whole plantations of fruit-trees, as well as trees of the forest, shared in the general havoc, presenting their leafless branches in the midst of summer, as though stricken and destroyed by the blasts of winter. An appearance so extraordinary was calculated to create terror: it was naturally interpreted as a visitation from heaven, ordained to destroy all the sources of vegetable life, to deprive men and cattle of their most essential food, and finally leave them a prey to famine. Such were the vulgar fears; but, thanks to Providence, the destroying powers of these creatures were restricted to their instincts; their attacks were principally directed against the oak, the hawthorn, the elm, and fruit-trees; the fodder for the cattle, and the harvest for mankind, remained untouched. The appearance of such a host of little depredators, seems, however, to have afforded a seasonable admonition, evincing to an unthinking multitude, how easy the comforts, nay, even the existence of man, may be assailed by a creature so insignificant, had not the limits of its ravages been prescribed by HIM "who wills, and is obeyed;"—its intrusions certainly created alarm, but did little serious injury.

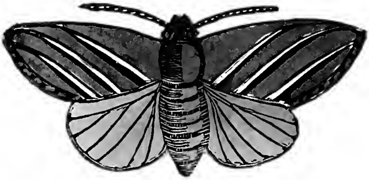
This is no exaggerated picture of the public mind on the occasion to which we refer; its alarm was so powerful, and prevailed to such an extent, that prayers were publicly offered up in the churches to avert the calamity it was supposed they were intended to produce. The webs containing the larvæ were collected in many places about the metropolis by order of the parish officers, who allowed a certain prize to the poor for gathering them, and superintended the burning of them in large heaps with coal and fagots. At this precise period the tract by Mr Curtis, as above related, appeared. In this memoir the history, manners, and propensities of this little creature were explained, and the information it afforded must have undoubtedly contributed in an essential manner to calm the terror before excited. Its publication was useful in another point of view; for by its means the pursuits of the entomologist, then confessedly in a state of infancy in this country, were looked upon with more respect, and we have no doubt contributed in an eminent degree to the advancement of the science.

"The attention of the public," says Mr Curtis, "has of late been strongly excited by the unusual appearance of infinite numbers of large white webs, containing caterpillars, conspicuous on almost every hedge, tree, and shrub, in the vicinity of the metropolis; respecting which advertisements, paragraphs, letters, &c., almost without number, have appeared in the several newspapers, most of which, though written with a good intention, have tended greatly to alarm the minds of the people, especially the weak and the timid. Some of these writers have gone so far as to assert, that they were an usual presage of the plague; others, that their numbers were great enough to render the air pestilential, and that they would mangle and destroy every kind of vegetable, and starve the cattle in the fields. From these alarming misrepresentations, almost every one ignorant of their history has been under dismal apprehensions concerning them.

"Some idea may be formed of their numbers from the following circumstances: — In many parishes about London subscriptions have been opened, and the poor employed to cut off and collect the webs at one shilling per bushel, which were burned under the inspection of the churchwardens, overseers, or beadles of the parish; at the first onset of this business, fourscore bushels, as I was most credibly informed, were collected in one day in the parish of Clapham."

The Brown-tail Moth is found in many parts of Europe. Albin, who published in 1720, says the caterpillars lay themselves up in webs all the winter, and as soon as the buds open they come forth, and devour them in such a manner, that whole trees, and sometimes hedges, for a great way together, are absolutely bare. Geoffroy describes it as the most common of all insects about Paris, where it is found on most of the trees, which it often strips entirely of their foliage in the spring. It is also noticed by Ray.

These caterpillars have happily many enemies, they are eagerly devoured by birds; the ichneumon fly destroys them by myriads; and it is supposed that the absence of the latter, from some unknown cause, might have contributed, for one or two seasons, to their immense increase. As soon as they quit the egg they begin spinning the web, and, having formed a small one, they proceed to feed on the foliage, by eating, like most other larvæ, the upper surface and fleshy part of the leaf. In these webs they are progressively increased in size, as necessity requires; they live in societies till they attain their last skin, when each spins a separate web or cocoon for itself; in this it passes to the pupa condition about the beginning of May, and, after remaining about three weeks in the chrysalis state, it changes to the perfect moth. There is more than one brood a year, the species being found in the winged state in July and August.



29.

THE COMMON SILVER LINE MOTH.

Phalæna Fagana.—BRITAIN.

COMMON SILVER-LINE MOTH.

Phalæna Fagana.

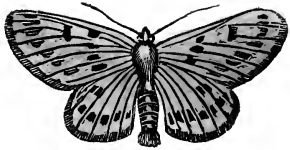
PLATE XXIX.

Phalæna fagana, *Don. Brit. Ins.* — Chlœphora Fagana, *Stephens.*—*Rennie's Conspectus*, page 155.

The antennæ taper from the base; the wings are deflexed when at rest; they extend one inch and three-fourths to five-sixths; the superior ones of a deep yellow green, having three oblique white silvery stripes across each; the lower wings and abdomen are of a pale yellow green. The male differs from the female in having the lower wings yellowish green, with a thicker snow white margin.

The Phalæna Fagana is not one of the rarest British Moths, and claims attention from its beautiful and gay appearance. The larva is found feeding on the oak in August and September. In the beginning of October it spins a very extraordinary kind of covering in the leaf of the oak, and changes to the pupa within it. This covering somewhat resembles a tent, or rather an inverted boat, being shuttle-formed, and having a keel or longitudinal ridge along the upper part; its colour is yellowish brown; the caterpillar is of a pale willow green, with three longitudinal stripes of yellow along the sides; the pupa underneath is purple.

It transforms into the perfect moth in the end of May.



30.

THE GREY-SCOLLOPED BAR-MOTH.

Phalæna Flavillacerius.—BRITAIN.

THE GRAY SCOLLOPED BAR MOTH.

Phalæna Flavillacearius.

PLATE XXX.

Phalæna Flavillacearius, *Harris's Aurelian*, pl. xxxiii. fig. M. page 64.—Mæsia flavillacearius, *Rennie's Conspectus*, page 102.

The wings of the male one inch and five-twelfths, to seven-twelfths; the female one inch one-third, to one-half. The whole insect is of a pale ashy-gray, with two interrupted sesquialterous bands or bars crossing the upper wings, having black spots in the centre, and one on each of the lower ones, with two black spots. All the wings are provided with a fringe. The antennæ are filiform and tapering, and the tail broad and fringed.

This moth was first described by Harris in his *Aurelian*. He received it from Mr Bolton of Halifax, in Yorkshire, and also in Hampshire. It is a scarce British moth, and appears in the winged state in June.

THE GREAT EGGER MOTH.

Phalæna Quercus.

PLATE XXXI.

Phalæna Quercus, *Merian's Insects of Europe*, i. t. 10.—*Harris's Aurel.* pl. 29, fig. a, b, c, d, e. f.—*Donovan's Brit. Ins.* iii. p. 83, pl. 103 and 104.—Lasiocampa Quercus, (*Schrank*,) *Rennie's Conspectus*, page 37.

The antennæ of the male are feathered, the wings are of a dark reddish brown, with a bright yellow bar across each, and a clear white spot on the centre of each of the superior wings. The female has the same markings as the male, but of a paler colour. The wings of the male are two inches and one-half to five sixths; those of the female three inches one-twelfth to one-fourth.

In the caterpillar condition it is hardly possible to distinguish the male from the female, except that the former is smaller than the latter; they are of a pale yellow, with black lines, and slanting white streaks on the sides; but in the last state their colours are entirely different, the female being of a pale yellowish tint, inclining to fox colour; the male is of a rich brown.

The caterpillars of the Great Egger Moth feed on the white and black thorn, ash, birch, oak, wil-

31.

THE GREAT EGGER MOTH.

Phalæna Quercus.—BRITAIN.

low, hornbeam, and broom, together with several other herbaceous plants. It has been observed to thrive better in the breeding cage, when regularly supplied with fresh grass, to keep the former in a proper state of moisture.

The female deposits her eggs in June or July, and the caterpillars are hatched in autumn, the time depending on the state of the atmosphere. They remain in the larva state all winter, and spin a large brown case about the middle of May, within which they pass to the pupa condition, and emerge the perfect insect in June.

The eggs resemble those of a hen in shape, but are prettily mottled with dark brown.

The caterpillars cast their skins several times, and always thereafter assume a new appearance, though the general colours and character of the species may be traced through every stage.

This species is common in Darent Wood, Dartford, New Forest, Devonshire, near London, and in the vicinity of Dublin, in Ireland.

THE GOLDEN YELLOW MOTH.

Phalæna Flaviolata.

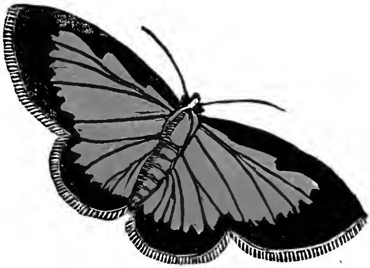
PLATE XXXII.

Phalæna flaviolata, *Cramer Des. de Pap.* i. p. 139. pl. lxxxviii. fig. C.—*Linn. Syst. Nat.* p. 867. No. 240.—Phalæna Geometræ, *Seba*, iv. t. 7. fig. 7, and 8, and t. 13, fig. 3 and 4.

THE upper under wings, and body of this moth, are of a very rich golden yellow, with a very broad border of deep black, irregularly vandyked on its anterior edge; the shoulders and head are black; the antennæ short and filiform; and the eyes scarlet.

The under side the same as the upper side.

This moth inhabits India.



32.

THE GOLDEN YELLOW MOTH.
Phalæna Flaviolata.—India.

33.

THE PEPPERED MOTH.
Phalæna Betularia.—BRITAIN.

THE PEPPERED MOTH.

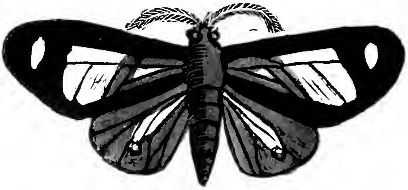
Phalæna Betularia.

PLATE XXXIII.

Phalæna Betularia, *Linn. Syst. Nat.* ii. p. 862, No. 217.—*Fab. Spec. Inst.* ii. p. 252, No. 56.—*Donovan's British Insects*, vol. vii. p. 55. pl. 237.—Biston Betularius, (*Leach*,) *Rennie's Conspectus*, p. 104.

The wings are entirely of an ashen gray, speckled all over with black; the margins with a clouded border, and each wing is provided with a zigzag line. The wings are in general deflexed when at rest; and in the male extend from one inch and a half to five-sixths, and in the female from two inches and one-fourth to one-third. The lower wings have sometimes a black wavy streak behind the centre; body grayish; white corslet, with a black fillet.

In the larva condition, it feeds on the lime, willow, and elm; it is of a dark burnt umber brown colour, spotted with lilac, having a reddish line on the back; or sometimes ashy gray, with two warts on the eighth segment, and two on the eleventh; and changes to the pupa state in September. The pupa is of a deep chocolate brown, with a few obscure spots, and a long spine at the tip; some are of a deep olive green colour, while others are nearly black. It transforms into the perfect moth in the month of May, and is common in Yorkshire, Durham, Cambridgeshire, and in the neighbourhood of Edinburgh, and other parts of Scotland.



34.

THE MICILIA MOTH.

Phalæna Micilia.—SURINAM.

THE MICILIA MOTH.

Phalæna Micilia.

PLATE XXXIV.

Phalæna Micilia, *Cram. Desc. des Pap.* iii. p. 62. pl. 228, fig. G.

The upper surface of the superior wings are black, with an elongated triangular white spot, widening externally, and occupying three fourths of the surface of the wings; this spot has a triangular azure blue streak towards its internal angle, and white in the middle; beyond the larger spot, near the point of the wing, is another white upright oblong-ovate spot; the lower wings and body are of a fine azure blue, the former white in the centre; the antennæ are fringed, and the eyes crimson; the white parts of the wings are clear and transparent.

This insect inhabits Surinam.

THE EMPEROR MOTH.

Phalæna Pavonia.

PLATE XXXV.

Phalæna pavonia, *Donovan's Brit. Ins.* i. p. 5, pl. 1.—*Harris's Aurelian*, pl. xxv. fig. g, h, p. 43.—*Linn. Syst. Nat.* ii. p. 816.—Saturnia Pavonea Minor, (*Schrank*,) *Rennie's Conspectus*, p. 36.

The antennæ are feathered; it has no trunk; the wings are expanded, horizontal, rounded, entire, with a large eyelike spot in the centre of each; the first reddish brown, waved; the second orange. Those of the male two inches and a half to five-sixths, and in the female two inches and a half to three inches and a half, and of a gray colour. The upper wings have a half-closed eyelet, the tip purplish, with one or two red spots; the lower wings with a half-closed eyelet, and having a gray posterior band, and the lower margin somewhat purple. The antennæ of the male are broader than in the female, and the wings of the female larger, waved with black and white, and bordered with yellow. Length, an inch; breadth, two inches and a half.

The caterpillar is green above, the segments marked by black rings, in which are a row of yellow

35.

THE EMPEROR MOTH.

Phalæna Pavonia.—BRITAIN.

punctated dots, from whence emanate short fasciculi of very fine hairs; along each side is a longitudinal yellow line; the belly is rusty brown, and the feet are black. They are subject to considerable variety of appearance, as they progress towards maturity. When young, they are yellowish; the tubercles black, with a stripe of the same colour as the segments of the joints. After this, the yellow bands become orange, and the transverse black stripes appear interrupted with longitudinal bands of pale green. Some are entirely green except the tubercles, which are yellow, and a small black speck on each joint; and others are green, chequered with black, and marked on the side with a row of similar spots. In the winged state, however, we find no permanent and characteristic distinctions.

In the earlier state the caterpillars are gregarious.

The chrysalis is black, and very blunted in shape.

The conformity and likeness which prevails between the male and the female throughout the greater part of the animal kingdom, cannot, however, in insects be depended on; the difference is frequently such as to deceive even the most expert entomologists. The difference between the male and female Emperor Moth is strikingly obvious; the male is smaller than the female, and the colours in general darker; the lower wings also are orange in the male, and not so in the female; and finally, the two sexes may be determined by the structure of the antennæ; those of the male being nearly oval, and very deeply feathered or pectinated, and those of the female also pectinated, but so slightly as to appear setaceous. As the structure of the antennæ is an unerring criterion by which the sexes are ascertained, the *Phalæna Pavonia Minor* is a phenomenon in entomology; for both the male and female so perfectly resemble the female Emperor Moth, *Phalæna Pavonia Media*, that it may be mistaken for the same species; the female differs in no respect from it, and the male only in the form of the antennæ.

Linnæus, and after him Fabricius, describes three varieties of Phalæna Pavonia. 1. Minor. 2. Media. 3. Major. The first is the variety found in this country, and in the north of Europe.

We are informed by Latreille, that a manufactory of silk from the cocoons of this caterpillar has been established in Germany.

Albin says, that in a specimen which he preserved, the male seemed to have changed to the aurelia state on the 16th July, and in March following it emerged the perfect moth. But the time of their appearance depends on the proportion of heat or cold; Albin's subject was preserved from the severity of winter in a warm room. The usual time to find them in the caterpillar state is in the month of August, and in the end of April they transform into the perfect fly.

The Emperor Moth is not by any means rare in Britain, and is to be found in Kent, Sussex, Norfolk, and Devonshire.

The singular provision which Nature makes for the protection of this moth, deserves particular notice. When the time of its continuation in the caterpillar state is expired, by much labour it forms a kind of bag or purse of a very tough substance. This it fixes against the trunks of trees, &c., by a number of hairs or filaments, which remain on the external surface. It lines the outer case by one of a firm texture, the top of which is closed by several bristles that unite in the centre, exactly representing a cap, and excludes almost the possibility of its receiving an injury during this defenceless state. In this bag it passes to the aurelia state, and remains until it transforms the perfect insect.

Authors instance many plants as the food of the Emperor Moth; it will live on the rose, the elm, alder, oak, the willow, and on thorns and brambles particularly.

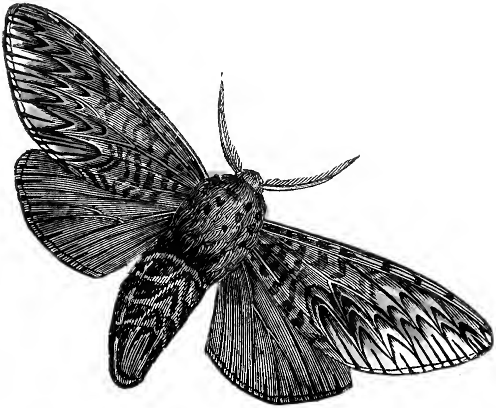
THE PUSS MOTH.

Phalæna Vinula.

PLATE XXXVI.

Phalæna vinula, *Linn. Syst. Nat.* ii. p. 815. No. 29.—*Wilk's Pap.* tab. 13. fig. 1. E 1.—*Donovan's Brit. Ins.* iii. p. 33. pl. 85.—Cerura vinula, (*Schrank*,) *Rennie's Conspectus*, p. 32.

The antennæ are feathered; the wings gray, streaked, and waved with dull black zigzag lines, somewhat diaphanous; the thorax and abdomen are gray, spotted with black. The wings of the male are from two inches and a half to two inches and three quarters in extent, while those of the female are from three inches and a twelfth to a third. They are of an ashy gray colour; the first pair with the upper edge spotted with black; the nervures are yellow; they have two convergent and slanting rows of black spots near the base, followed by a brown waved streak; towards the middle a black crescent pointing outwards, between which and the tip are two very acutely waved brownish slanting streaks. The second pair of wings have a dingy crescent spot on the disc, and one or two spots on the hinder margin, towards the posterior angle.



36.

THE PUSS MOTH.

Phalæna Vinula.—BRITAIN.

The caterpillar from which this moth is produced is solitary, and is of a very extraordinary form, and has rather the appearance of a formidable or venomous creature than the larva of a moth. It is of a bluish purple on the back, covered with small black punctated dots. This back appears like a mantle in which the animal is invested; the sides and belly are of a rich green, and each segment is provided with a small ovate rich yellow dot; the head is short and thick, dark burnt umber brown; it has two tails of crimson filaments at the extremity of the body, and these can be protruded or concealed within the base at the creature's pleasure; when protruded, they have a continual writhing, vibratory motion; it feeds on willows, sallows, and poplars, and is generally found in great plenty where those trees grow, and in the month of July.

The larva, when attacked, defends itself by ejecting an acrid fluid from an opening in the under part of the neck.

The pupa is brown, inclosed in a hard case.

The Puss Moth passes to the pupa state in August, in which condition it remains all the winter, and appears in the winged state about the latter end of May, or early in June following. It is found near London, in Yorkshire, and Cambridgeshire.

THE PEBBLE PROMINENT MOTH.

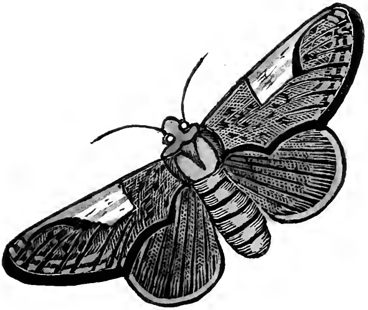
Phalæna Ziczac.

PLATE XXXVII.

Phalæna ziczac, *Linn. Syst. Nat.* ii. p. 827. No. 61.—*Merian's Europ.* t. 147.—*Donovan's Brit Ins.* iv. p. 29. pl. 119.—Notodonto ziczac, (*Ochsenheimer,*) *Rennie's Conspectus*, p. 33.

This pretty moth is brown and white clouded, like an agate, having a large clouded eyelike spot next to the exterior margin of the superior wings; the wings of the male extend from an inch and two-thirds to three quarters; those of the female from an inch and five-sixths to eleven-twelfths; and the interior margin is provided with a tuft, or appendage; the antennæ are feathered, purplish, and intersected with dashes of black, and a marginal black streak; and the fringe is brown, dotted with white; the lower wings are of an ashy gray, with a black marginal line, and a whitish fringe, of a dark brown colour towards the posterior angle.

The caterpillar of the Pebble Prominent Moth is very beautiful, and at the same time very singular

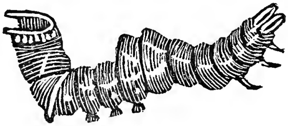


37.

THE PEBBLE PROMINENT MOTH.

Phalæna Ziczac.

in its forms, which will be better understood by the following figure:—



The head is dark brown; the body of a delicate rose colour, each segment being traversed by a longitudinal pale yellowish band; and the four next the perpendicular tail have punctated pink dots; the tail segments are of a deep crimson, very wide and open at the termination, with three golden yellow spots at the extreme edge, and a circular dot of the same colour near the body; the feet are brown. It feeds upon the willow early in June, and changes to the pupa state in the same month; it is of a dark brown colour, and it lies in this condition within a fine brownish web, which it spins between two leaves. The perfect moth comes forth in August.

The Pebble Prominent Moth inhabits Yorkshire. Kent, Surrey, and Norfolk; and in Ireland, near Dublin.

THE LINCEA MOTH.

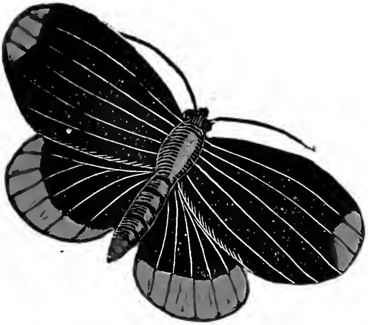
Phalæna Lincea.

PLATE XXXVIII.

Papilio Lincea, *Cramer's Desc. des Ins.* ii. p. 6, pl. 228, fig. B.

The upper wings are of a deep black, which changes to an intense blue by the play of light; the upper half of the lower wings are of the same colour, and the lower half of a deep and rich orange, the upper wings being tipped with the same colour; the body is of a pinkish brown; the tail orange; the antennæ are filiform and tapering; the eyes are scarlet.

This moth is the same beneath as above, and is an inhabitant of China.



38.

THE LINCEA MOTH.

Phalæna Lincea.—China.

39.

THE SPRINKLING MOTH.

Phalæna Liboria.—Sierra Leone.

THE SPRINKLING MOTH.

Phalæna Liboria.

PLATE XXXIX.

Papilio Liboria, *Cramer's Desc. des Insects,* iv. p. 106, pl. 345, fig. D.

The upper wings are of an intense crimson or marone colour, with a very broad border of black, internally undulated; and the exterior margins are also black; the lower wings are of a reddish fawn colour on their upper half, and black on the lower half, with two lines of black on the fawn colour; the head and shoulders are of the same fawn colour as the lower wings; the rest of the body is intense black; the eyes are scarlet, the antennæ filiform, and the tail fringed, and somewhat fan-shaped.

This moth inhabits the coasts of Africa, particularly Sierra Leone.

THE EUPHEMIA MOTH.

Phalæna Euphemia.

PLATE XL.

Phalæna Euphemia, *Cramer's Desc. des Pap.* iv. p. 105, pl. 345, fig. A.

The upper wings are black clouded, and spotted with yellowish fawn colour; the lower wings are deep crimson, with a broad border of intense black; the whole are provided with a fine fringe; the body is reddish brown, with transverse bands of blackish brown; the antennæ are filiform and tapering; the eyes pink; and the tail fan-shaped and fringed.

This curious moth inhabits the Molluccas, and also Amboyna.

40.

THE EUPHEMIA MOTH.

Phalæna Euphemia.—Amboyna.

41

THE MEDARDA MOTH.

Phalæna Medarda.—SURINAM.

THE MEDARDA MOTH.

Phalæna Medarda.

PLATE XLI.

Phalæna Medarda, *Cramer's Desc. des Pap.* iv. p. 107, pl. 345, fig. F.

The wings are of a very intense blackish brown; the lower ones having two streaks of a rich yellowish orange or umber colour, the one on the upper and the other on the lower edge of the wings; the antennæ are filiform, somewhat long; the thorax black; the abdomen orange, and the same tone as the wings, with a black line down the centre; the eyes are green.

The Medarda Moth inhabits Surinam.

THE BUTTERFLY MOTH.

Phalæna Papilionaris.

PLATE XLII.

Phalæna Papilionaris, *Cramer's Desc. des Pap.* i. p. 45, pl. 29, fig. A.—*Drury's Insects*, ii. pl. 2, fig. 4.

Both the upper and lower wings of this moth are black, studded with interrupted bands of straw yellow, and having a row of spots of the same colour near the posterior margins of all the wings; the upper pair have a band or belt of azure blue on their anterior margin, extending from the body to nearly the tip of the wings; the body is black; the thorax having a white transverse band across the shoulders, and a blue circular spot beneath, below which is a triangular azure spot; each segment of the abdomen has a blue transverse band.

The antennæ are setaceous, and the eyes red.

This moth greatly resembles a butterfly; hence its name.

42.

THE BUTTERFLY MOTH.

Phalæna Papilionaris.

43.

THE SOLDIER MOTH.

Phalæna Militaris.—China.

THE SOLDIER MOTH.

Phalæna Militaris.

PLATE XLIII.

Papilio Militaris, *Cramer's Desc. des Pap.* i. p. 46, pl 29, fig. B.

The upper wings of this moth are of a dull citron yellow in the half next the body, with variously shaped large spots of black; they are black the other half, with three irregularly shaped gray marks, which are quite transparent; the lower wings and body are of the same citron yellow as the inner half of the upper wings, with large spots of black on different parts; the thorax is egg-shaped, with four small black spots across the shoulders, and a black transverse band beneath; the antennæ are rather short, and slightly setaceous; the eyes are scarlet. There is a peculiarity in the upper wings of this moth, in being considerably less than the under ones.

This insect well deserves the name of a beautiful moth, although it has none of the dazzling colours for which many of its congeners are remarkable. It inhabits China.

THE MEON MOTH.

Phalæna Meon.

PLATE XLIV.

Phalæna Meon, *Cramer's Desc. des Pap.* i. p. 113, pl. 71, fig. E.

The wings and body of the Meon Moth are of a deep velvet black, variously spotted with white; towards the anterior margin are three square crimson spots; the antennæ are setaceous, and the eyes deep crimson; the tail is terminated by a funnel-shaped process.

The Meon Moth is a very rare insect, and inhabits Berbice.

44.

THE MEON MOTH.

Phalæna Meon.—Berbice.

45.

THE LECTRIX MOTH.

Phalæna Lectrix.—China.

THE LECTRIX MOTH.

Phalæna Lectrix.

PLATE XLV.

Phalæna Lectrix, *Cramer's Desc. des Pap.* ii. p. 145, pl. 129, fig. c.—*Linn. Syst. Nat.* ii p. 834, No. 89.—*Houltnin, Nat. Hist.* I. D. xi.—*Stiek*, p. 598, pl. 92, fig. 5.

Both upper and under wings of this moth are black, the upper ones having three large irregular patches of straw colour, and a smaller circular spot of the same colour towards the insertion of the wings; they are also provided with a large triangular spot of white on the base, towards the shoulders, with two small ovate white spots near the anterior margin, and a row of somewhat oval spots, forming an interrupted zone, a little distance from the margins, in both wings; the lower wings have a patch of orange at their insertion, and several differently shaped ones beneath; the thorax is large, ovate, and of a black colour, with fine straw coloured spots above; the abdomen is orange, with transverse black bands on each annulation; the head is black, and the eyes scarlet; the antennæ are filiform, and somewhat long.

This moth is subject to considerable variety in the markings. It inhabits China.

THE WHITE SPOTTED MOTH.

Phalæna Albomaculata.

PLATE XLVI.

Phalæna Albomaculata, *Cramer's Desc. des Pap.* iv. p. 160. pl. 345. fig. c.

Both upper and lower wings of this moth are black, the former having two large straw coloured patches on each; the lower wings with two grayish white spots; the thorax is large, sub-ovate; gray across the shoulders; yellow on the sides, and of a raw umber brown in the middle, the body being of the same colour; the antennæ are short and filamentary, and the eyes scarlet.

This rare insect inhabits the coasts of Guinea.

46.

THE WHITE SPOTTED MOTH.

Phalæna Albomaculata.—Guinea.

47.

THE BRISK MOTH.

Phalæna Lepida.—Bengal.

THE BRISK MOTH.

Phalæna Lepida.

PLATE XLVII.

Phalæna Lepida, *Cramer's Desc. des Pap.* iii. p. 50, pl. 130, fig. E.

The upper wings of the *Phalæna Lepida* are black at their insertion, with a very broad green band across the middle, and a broad or umber brown border; the lower wings are entirely of this last colour, as well as the abdomen; the head and body are green, the antennæ filamentary and short, and the eyes crimson.

The *Phalæna Lepida* is a rare moth, and inhabits Bengal.

THE TUSSEH SILKWORM MOTH.

Phalæna Paphia.

PLATE XLVIII.

Phalæna paphia, *Cramer's Desc. des Pap.* pl. 146, f. A. pl. 147, f. A. B. pl. 148, f. A.; *Linn. Trans.* vii. p. 33.—Phalæna mylitta, *Drury*, ii. pl. 5, fig. 1. Male.—Bombyx mylitta, *Fab. Ent. Syst.* 3 A. p. 411, 11.

The following description of this insect in its various stages was collected and drawn up by Dr Roxburgh,* who spent many years in India, and had an opportunity of witnessing the animal.

"The EGGS are white, round, compressed, with a depression or pit in the centre, on each side; the circumference crossed with rugæ, corresponding with the rings of the inclosed animal. They hatch in from two to four weeks, according to the state of the weather."

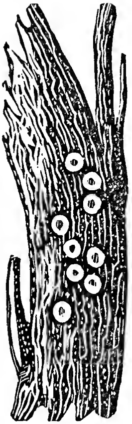
The following FIGURE represents the eggs the size

* *Linnean Transactions*, vii. p. 33.

48.

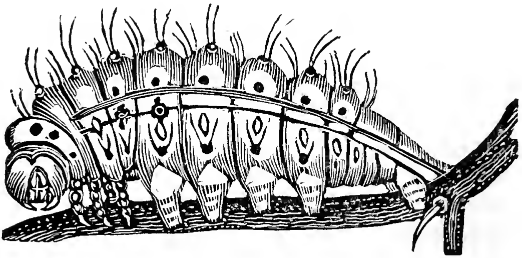
THE TUSSEH SILKWORM MOTH.
Phalæna Paphia.—INDIA.

of nature, deposited on the branch of the Jujube or Byer tree.

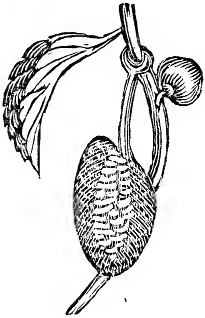


"The LARVÆ or caterpillars acquire their full size, which is about four inches in length, and three in circumference, in about six weeks; they are nearly the colour of the leaves they feed on, and are composed of ten segments, of which the posterior one is in some degree bifid. There is a light yellowish-coloured stripe on each side, which runs from the second or third anterior segment to the fissure of the last; immediately under these stripes the middle five, six, or seven segments are marked with an oblong gold-coloured speck. The back is also marked with a few round darker-coloured spots, and a few long, coarse, distinct hairs issue from these spots, with others of á smaller size scattered over the insect. They are furnished with eight pairs of legs. The pectoral or anterior three pairs end in a single claw each. The abdominal four pairs, are very thick, and truncated like the feet of an elephant. The caudal pair is similar to the abdominal. When the larvæ approach near to their full size, they are too heavy to crawl in search of their food with the back up, as is usual with most caterpillars, but traverse suspended by the feet."

The above cut represents the caterpillar the size of nature, the day after that on which it emerged from the egg, and the following shows its appearance when full grown, but only half the size of life:



"The CHRYSALIS. When the caterpillars are ready to spin the cases in which they are to pass this state of their existence, each of them connects, by means of the recent glutinous filament of which the case is made, two or three leaves into an exterior envelope, which serves as a basis to spin the complete case or cocoon in; besides, the case is suspended from a branch of the tree in a wonderful manner by a thick strong consolidated cord, spun of the same materials from the bowels of the animal, 'as represented in the following figure, which is a



third of the size of the cocoon inhabited by the female insect.' This case is of an exact oval shape, and exceeding firm texture: in it the animal remains dormant and perfectly protected for about the space of nine months, viz. from October until July, so that they make their appearance in time for the caterpillars to come into existence, when Providence has furnished them with the greatest plenty of proper food, viz. during the months of August, September, and October. When the insect is prepared to make its escape, and be changed to its perfect state, it discharges from its mouth a large quantity of liquid, with which the upper end of the case is so perfectly softened as to enable the moth to work its way out in a very short space of time; an operation which is always performed during the night.

"The IMAGO. In their perfect state they are wholly taken up in providing for a continuation of the species, and do not exist more than from six to twelve days when confined; how long they may live when at liberty is hard to say, but I imagine nearly the same as when restrained. While in this state of perfection, they receive no nourishment whatever, nor have they any mouth or channel by which food can be received. When the female is impregnated, she deposits her eggs on the branches of the tree she may be resting on, to which they adhere firmly by means of the gluten they are covered with when newly laid.

"The wings of the male expand five or six inches, and those of the female from six to eight: the following part of the description applies to both:—

"The head scarcely projecting beyond the anterior margin of the first pair of wings; eyes large, of a dark brown colour; antennæ pectinated; of the male oval, of the female lanceolate; palpi four, the exterior two ascending, hairy, covering the inner vesicular, cream coloured, deflected pair, which hide a concavity where the mouth is generally situated in other species; mouth none, nor is there any kind of proboscis or tube; thorax oval, completely clothed with long fine hair, of nearly the prevailing colour of the wings hereafter to be mentioned; abdomen oblong, (of the female much larger,) composed of seven segments, and clothed with much long fine hair, like the thorax; legs six, hairy, nearly equal; the tarsi with a pair of long, strong, incurved claws; all the articulations are much contracted; wings horizontal, expanded, slightly striped in the directions of the tendons; superior, or first pair, of a cream orange buff, or brownish colour, or a mixture of these; first, all the anterior margins rather concave, beyond that much curved, and bounded with a beautiful light bluish gray coloured belt; posterior (fan) edges somewhat concave, scolloped, and ornamented with a pretty broad, beautiful, circumscribed, scolloped border, of sometimes a darker, sometimes a lighter, colour than the rest of the wings; inner or abdominal edges nearly straight; in the centre of each wing there is a remarkable eye, with the large pupil of micaceous transparency, and a beautiful party-coloured iris; inferior, or second pair, are in point of colour like the first pair; the posterior margins are also scolloped, and with a similar border, but convex; the eye in the centre of each is also the same; all are clothed with much soft hair, which becomes longer and longer towards the shoulder or points of insertion.

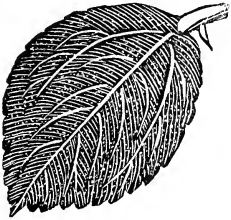
"The following interesting history of these most beautiful as well as most useful animals, I have had the good fortune to procure, by means of Mr William Pope of Mahometpore, and with the writer (Mr Atkinson's) permission, I transcribe in this place:—

'I have an opportunity of consulting two of the hill people, in whose neighbourhood a good deal of Tusseh silk is produced, and whom I have questioned on points imperfectly known to myself. To reply to the Doctor's questions regularly:—

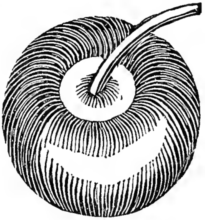
'1st. The cocoons of the insect, which feeds on the Byer leaf, are called by the natives Bughy, producing a Tusseh silk. They are annual, and are said to remain in the cocoon nine months, and to be three months in the egg and worm state

'2d. This species cannot be domesticated. I am informed that the natives cannot even retain any of it for seed. The hill people say that they go into jungles, and under the Byer and Asseen trees they find the excrement of the insect; on which they examine the tree, and, on discovering the small worms, they cut off branches of the tree sufficient for their purpose, with the young brood on the branches; these they carry to convenient situations near their houses, and distribute the branches on the Asseen tree in proportion to the size thereof, but they put none on the Byer tree. The Parieahs, or hill people, guard the insects night and day while in the worm state, to preserve them from crows and other birds by day, and from bats by night.

LEAF OF THE JUJUBE OR BYER TREE.



FRUIT OF THE JUJUBE OR BYER TREE.



'I myself have seen them thus watching the brood. This species cannot be confined, for so soon as the moth pierces the cocoon it gets away; and the people add, that it is impossible to keep it by any precaution whatever.

‘ 3d. To wind off these cocoons, they put them into a ley made of plantain ashes and water, for about two hours, after which they take them out of the ley, and put them in their wet state into an earthen pot; those which are properly softened are first applied to the reel, and so on, as the cocoons become soft, for four or five days, till the whole are wound off.

‘ The implement used for taking off the thread is a small common reel of four bars. The cocoons are laid in a smooth earthen dish, without water; the reel is turned by the right hand, whilst the thread of four or five cocoons passes over the left thigh of the spinner, and he gives the thread a twist with his left hand upon his thigh. The operation is this instant in my sight, with a thread of five cocoons, the produce of another species called Jarroo, and described below, but the reeling is exactly the same as that of the Bughy, and therefore one description answers for both. I must add, that the thread is exceedingly apt to come off double and treble for several yards together, which is not regarded by the natives, as breaking off double threads would diminish the produce, and, moreover, would occasion loss of time: a very even thread, however, may with care be reeled from either the Bughy or Jarroo cocoon.

4th. ‘ The Bughy silkworm feeds indifferently on Byer and on Asseen leaves, and is a species in every respect perfectly distinct from the insect of the Palma Christi, the latter being different in size, much less cultivated, and fed in houses as regularly as the mulberry worm. I shall not proceed to describe it, as the species is not at all included in Dr Roxburgh's questions.

'The Jarroo cocoons alluded to above, are so called from being produced in the coldest month of the year, say January; the Bughy being about a month before them. The Jarroo are likewise annual, and the history of them is nearly the same as that of the Bughy; they are however different, I am assured. The Jarroo will eat the Byer leaf if he cannot get the Asseen, but he will always prefer the latter, and produce a better cocoon when fed on it. His silk is more of a dull colour than that of the Bughy, which latter worm the hill people put on the Asseen alone, not because it prefers it to the Byer, but because they have greater plenty of Asseen than Byer, and, moreover, trim and dress out plots of Asseen on purpose for the worms. The principal difference between the above two species is, that the natives retain a part of the Jarroo cocoons for seed; these they hang out on the Asseen trees when the proper season of the moth arrives; when the moths come out, the male insects invariably all fly away, but the females remain on the trees. These are not impregnated by the males bred along with them, but, in ten or twelve hours, or perhaps one, two, or three days, a flight of males arrive, settle on the branches, and impregnate the females; by the bye, the hill people calculate good or ill fortune in proportion to the speedy or tardy arrival of the stranger males. These insects die as soon as the purposes of nature are effected, and the females live only to produce the eggs on the branches of the trees, and then expire. In regard to the Bughy species, they all take flight, females as well as males, and hence the natives firmly believe that they are all males, though I cannot see any physical reason for supposing them so. I have frequently endeavoured to detain the males of the Jarroo species, and have kept them locked up in a box for that purpose; but whether they did not like to make free with their female relations, or from what other cause I know not, but I could never obtain a breed in the domestic state, and the efforts of the male to escape were wonderful, and at last always effectual. The accounts given by the natives of the distance to which the male insects fly are very astonishing. I have put, at different times and occasions, innumerable questions to them on this subject, and they assure me that it is no uncommon practice amongst them to catch some of the male moths, and put a mark on their wings previous to letting them fly, the marks of different districts being known. I am told that it has been thus ascertained that male moths have come from a distance equal to a hundred miles and upwards. I of course cannot vouch for the truth of this, but have no hesitation in declaring that I believe it. The Jarroo worm is guarded on the trees in like manner as the Bughy; this I have had opportunities of seeing on the hills westward of me: the cocoons are darker coloured than the Bughy species, and are wound off as described above. The accompanying skein I had reeled off at my elbow this morning; it consists of five Jarroo cocoons at first, of four when one cocoon was finished, and of three when two cocoons were ended. I then stopped the reel; the three that remained of course gave a filament the entire length of the skein.

'There is still another species of wild silkworm produced in the Burbhoom hills, which I heard is more capable of being domesticated than the one above described; but I dare say you will excuse my saying any thing respecting it, as I can only speak from hearsay, the insect not being produced in these hills.

'I send you herewith,' says Mr Atkinson, in a subsequent communication for Dr Roxburgh, 'a specimen of Bughy Tusseh silk. I kept the cocoons by me several days after they had been steeped in the alkaline ley, and they reeled just as well as if they had been newly soaked. The cocoons do not, I think, differ from those of the Jarroo species, except that they are lighter coloured. I send one which the moth has pierced, and will send for more to take down with us. There are none of the Palma Christi species of Tusseh to be had here, but I have sent for some. I fancy this last is the most valuable kind, for the silk piece wove from it is uncommonly durable. The head sircar of the factory here has an outside cover of a palanquin, which, he tells me, has been worn eleven years; also some purdahs, which, he says, have been in constant use nine years, and are not much decayed yet. I remember examining the palanquin cover about five or six years ago.

'I have heard that there is another variation of the Tusseh silkworm in the hills near Bauglipore; its cocoon is said to be smaller than the cocoons of the Bughy and Jarroo species; perhaps this may be the kind furnished to Doctor Roxburgh by Major Hutchinson: but, after all, I confess it may be suspected that all the variations are derived from the same insect originally, and that they have assumed different habits by different modes of culture or food.

'When I return from Calcutta, I shall make particular inquiries on the subject.

'You will observe that the inclosed specimen is tinged of a deeper colour than the filament of the cocoon; this they say is from the alkaline ley.'

"Mr Atkinson has, since writing the foregoing letters, sent me large supplies of the cocoons of both the Bughy and Jarroo insects, and I have received parcels of them from other quarters. These have all produced their insects; and after minute investigation, I am not able to observe any difference, except in the size, and that is even trifling, so that I can at most only call them varieties of the same species. But very different is that which lives on the leaves of the Palma Christi plant, a species I am now able to give an account and drawings of, having often reared and conducted them through their various stages, in my own room, within these three years.

"This moth is called the *Bughy* by the natives of the Burbhōom hills, where the silk (which the same people call *Tusseh*) is manufactured.

"They are found in such abundance, over many parts of Bengal and the adjoining provinces, as to have afforded to the natives, from time immemorial, an abundant supply of a most durable, coarse, dark coloured silk, commonly called Tusseh silk, which is woven into a kind of cloth called Tusseh doot'hies, much worn by Bramins and other sects of Hindoos. This substance would, no doubt, be highly useful to the inhabitants of many parts of America and the south of Europe, where a cheap, light, cool, durable dress, such as this silk makes, is much wanted."

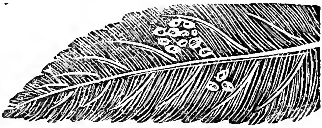
This cloth, though of a loose texture, is uncommonly durable, wearing constantly for fifteen or twenty years; a garment made of it is scarcely worn out in the life of one person, but often descends from mother to daughter; even the covers of palanquins made of it, though exposed to the influence of weather, last many years.

THE ARRINDY SILKWORM MOTH.

Phalæna Cynthia.

Phalæna Cynthia, *Cramer's Desc. des Pap.* i. pl. 39, fig. A.; *Drury's Ins.* ii. pl. 6, fig. 2.; *Linnean Trans.* vii. p. 42.

Dr Roxburgh gives the following account of this moth through its different stages :—*

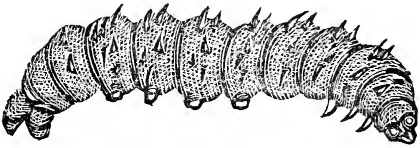


The EGGS of the Arrindy Silkworm Moth on the point of a leaf of the *Ricinis communis*, or common Palma Christi.

"The eggs are numerous, ovate, pure white ; size of a pretty large pin's head. Hatch in from ten to fifteen days, according to the temperature of the air.

The above figure is the size of the caterpillar of the *Phalæna Cynthia*, the day after it is hatched.

* *Linnean Transactions*, vii. p. 42.



The LARVA of the *Phalæna Cynthia*, two-thirds the size of the animal when it has arrived at its full size, and ready to spin.

" The larvæ arrive at their full size, which is from two and a half to three inches, in the space of about one month ; during which time they, like the caterpillars of the common silkworm, cast their skin three or four times. They are also composed of ten segments ; across the middle of each are several small, soft, conic-pointed tubercles ; otherwise they are smooth and delicately soft. The prevailing colour pale or sea green. In this state they are very voracious, devouring daily many times their own weight of food. Like the caterpillars of *P. paphia*, they are furnished with eight pairs of legs, viz. three pairs of pectoral, four pairs abdominal, and one pair of caudal.

" The chrysalis. The cocoon, or covering thereof, white or yellowish, of a very soft delicate texture ; in general about two inches long, and three in circumference, pointed at each end. Enveloped in this case the animal remains dormant from ten to twenty days, according to the state of the weather ; when, like the common Silk Moth, the now perfect insect, or

" The imago, issues forth from one end, and in this state exists from four to eight days, during which period it is wholly employed in the grand work of nature—generation ; remaining perfectly contented in its chamber, seldom attempting to fly away. In this respect it differs exceedingly from the Bughy and Jarroo Moths.

" The wings of the female expand from four to five inches ; those of the male considerably less.

In other respects the following description applies to both:—

"Head roundish; eyes large, bright, dark brown; antennæ pectinated, light brown; those of the male narrower; length equal to that of the head and thorax; palpi four, as in *P. paphia ;* mouth none; thorax oval, completely covered with long, fine, brownish hair, with a band of white down round the neck; abdomen oblong (in the female greatly larger), clothed with much fine white down above, and with alternate triangular spots of white and brown on the sides and belly; legs six; wings incumbent, expanded when at rest; superior, or first pair, falcated; prevailing colour brownish gray; a subdiaphanous, curved, white, and rust coloured band crosses from the centre of the anterior (sector) margin to near the middle of the inner slip or edge; from nearly the middle of which, on the inside, another short white bar runs to the posterior edge of the shoulder, and one to the inner part of the sector edge, forming a dark angular spot in the centre of the junction of these two small bars with the first mentioned long one. Adjoining to the fore part of this angular spot is a semilunar, somewhat pellucid speck, with a yellowish centre; near the rounded falcated apex of each wing is a small dark coloured eye, with the anterior margin thereof white; their posterior margins are entire, and concave towards the point, with a lighter coloured border; the inner margins are nearly straight and entire; both the angles are rounded; inferior, or second pair, are nearly of the same colour, with a whitish, horseshoe-shaped belt near the centre, opening on the inner, or slip edge, and enclosing a semilunar spot, like that of the first pair; exterior margins entire, convex, with a somewhat waved, lighter coloured yellowish border.

"Mr Atkinson, who furnished me with the most interesting parts of the history of Tusseh silkworms, has also contributed most of the following remarks on this species.

"They are, like the common silkworm, reared in a domestic state, and entirely fed on the leaves of the Palma Christi plant. Their cocoons are remarkably soft and white, or yellowish; the filament so exceedingly delicate as to render it impracticable to wind off the silk: it is therefore spun like cotton. The yarn thus manufactured, is wove into a coarse kind of white cloth, of a seemingly loose texture, but of incredible durability, the life of one person being seldom sufficient to wear out a garment made of it; so that the same piece descends from mother to daughter.

"'Since I last wrote to you,' says Mr Atkinson, 'I have reared two parcels of Palma Christi silkworms, with a view towards winding off the cocoons, but all my endeavours to obtain cocoons that would reel off were in vain. I even brought a man from the country where this species of silkworm is cultivated, and he laughed at my endeavours to get cocoons to reel; asserting that it was impossible, and that they were always spun off into a thread like cotton by the women only: he attempted to show me how, but made a very awkward hand of it, and a very bad specimen of thread: the operation, too, appeared tedious, so that I do not think that any thing is to be expected from this insect, except as a natural curiosity.'

"Mr John Glass, the surgeon at Bauglipore, writes to me as follows on the same subject:—

"'I am glad to hear you have got the worm that feeds on the *Ricinus*, but sorry to say there is no possibility of winding off the silk from the cones. Inclosed is a little of some I bred a few years ago, when I sent a quantity of it to the directors, but have never received an answer. I at the same time sent a little to my friends in England, and I understand that some manufacturers, to whom it was shown, seemed to think that we had been deceiving them by our accounts of the shawls being made from the wool of a goat; and that this Ricinus silk, if sent home, could be made into shawls equal to any manufactured in India.'"

Extract of a letter on the same subject from Henry Creighton, Esq. of Malda, dated 12th February, 1800.

Some of the silk of this worm, which was brought to this country, on being examined by British manufacturers, was at first by them erroneously believed to be the article employed in making the rich East India shawls; but, on examination, it proved to be of a much harsher nature, and to wear very rough, and has not been found applicable to any valuable purpose.

"The Palma Christi silkworm goes by the same name as the plant does among the natives, which is *Arrindy*. They accordingly call it *Arrindy-worm Arrindy-thread, Arrindy-cloth*, &c. They rear it in their houses much in the way the silkworm is reared. Their manner of spinning it is as follows:—Four or five of the cocoons are fastened to a stick stuck in the ground, or sometimes they hold it in their hand. These are united into one thread, and made fast to a piece of wood, with something heavy to make it spin round while suspended by the thread: when they let out sufficient of the cocoons from their hand, it is twisted by this piece of wood spinning round, and when well twisted it is wound round the wood, and another length let out from the hand. The cocoons are spun wet, but only with cold water. The cloth is woven in small pieces in a loom, and is as coarse as light vittree, but more open; and on being washed and beaten well, is made very soft and pliable. It is entirely confined to the districts of Dinagepore and Rungpore; no other place in Bengal having got it.

Its uses are for clothing, for both men and women. It will wear constantly ten, fifteen, or twenty years; the merchants also use it for packing fine cloths, silks, or shawls. It must, however, be always washed in cold water; if put into boiling water, it makes it tear like old rotten cloth. There is a cocoon produced wild upon the mango-tree, which they gather, and mix with Arrindy cocoons in spinning. I have only seen one caterpillar of it, and I did not succeed in rearing it. I shall inquire for some, and get a drawing made, if possible, as they cannot be sent or carried to any distance.

"This insect, known to the Hindoos by the *Arrindy* in some parts, in others *Arundi,* appears to be peculiar to the interior parts of Bengal; and, so far as I can learn, to two districts only, viz. Dinagepore and Rungpore, where the natives breed and rear it in a domestic state, as they do the common silkworm. The food of the caterpillar consists entirely of the leaves of the common *Ricinus,* or Palma Christi, which the natives of these districts call *Arrindy,* (hence the name of the insect,) and is abundantly reared over every part of India, on account of the oil obtained from the seed. Feeding these caterpillars with its leaves will, therefore, make it doubly valuable where they know how to spin and manufacture the silk.

"The late Sir William Jones mentions this animal in a letter to Dr Anderson, dated 17th May

1791, under the name of *Phalæna Ricini,* a name that I cannot well continue for fear of confounding it with Fabricius's *Bombyx Ricini,* which is certainly a very different species."

The cocoons of the Arrindy silkworm are always spun wet, but in cold water; the silk must also be washed in cold water; for, if put into hot water, it tears like old rotten cloth.

CHINESE MODE OF REARING SILK-WORMS.

Having given an account of the East Indian silkworms, we again revert to the more interesting and valuable species, the Common Silkworm, or *Phalæna Mori,* described in our second volume.

In the districts of the Chinese empire most congenial to the habits of silkworms, they remain quite free, feeding at will upon the leaves of the mulberry-trees, and undergoing their various metamorphoses without the aid of man. They are left quite unmolested until the cocoons are formed, when they are immediately appropriated by man, most of the *Aurelia* within them are destroyed, and the silk wound off them.

It has, however, been found, that silk made in this natural condition is not equal in quality and fineness to that produced by the worms which are sheltered and protected by the fostering hand of man. The Chinese have reached high perfection in the rearing and tendence of silkworms. One of the greatest difficulties with which they have to contend, is preventing the premature exclusion of the caterpillar from the eggs, to which they are extremely subject, owing to the dry and hot nature of the climate. This is effected by getting the moths to deposit their eggs on large sheets of paper, which are taken immediately after being extruded, and hung upon a beam of one of the rooms, while the windows are all thrown open, to expose them to the free circulation of the air. They are taken down, rolled up, with the eggs inside, and each separate sheet of paper is hung up for the summer and autumn. Towards the close of the season they are again taken down, and subjected to an immersion in cold water, in which a small quantity of salt has been dissolved. Here they are left two days, when they are taken out, dried, and rolled up more tightly than before, and each sheet of paper put into a distinct earthen pot. Some are in the habit of using a ley composed of the ashes of mulberry-trees, and subject the eggs to the cooling influence of snow water, or expose them on trees to snow and rain.

The object of all this is to prevent the exclusion of the caterpillar, till the leaves of the mulberry-tree have expanded. No sooner is this the case than the rolls of paper are taken from the vessels, and hung up in the sun's rays, the eggs being turned from them, but which are, however, transmitted to them through the paper. Every night the sheets of paper are rolled up, and deposited in a warm and dry place. Next day a repetition of the same process is adopted, and then the eggs become of a pale gray colour. After being a third day subjected to the same mode of treatment, they assume a much darker hue, approaching nearly to black; and on the next morning, when the paper is spread out, the larvæ are found to have burst from their confinement in the eggs, and are found moving about in a vivacious manner.

The Chinese have recourse to ovens for the simultaneous hatching the eggs of silkworms in the higher latitudes of that country; and the strictest attention is paid in preserving their receptacles for the worms, in high and dry situations; and every means is adopted to preserve the purity of the atmosphere, and the rooms are at the same time made quite air-tight. While the worms are yet young, they are very particular in preventing their being disturbed by noise; but this we believe to be an absurd fancy. The doors of the rooms in which the worms are kept, are always open to the south. The worms are fed on hurdles, which are placed in frames, ranged in tiers, eight or ten deep, above each other. Great attention is paid to the uniform temperature of the rooms; and this is effected either by carrying chafing dishes or stoves through the apartments, or by the use of stoves. Smoke and flame are carefully guarded against, and the contents of a cow-house are carefully dried in the sun, and used by this people in preference to every other kind of fuel.

Those practised in the rearing of silkworms say, that the sooner they can be brought to a state of maturity the better; and that the quantity of silk which they produce is more or less as they are able to effect this. It is considered that the worms are most productive when they are fully fed, in from twenty to twenty-five days; in which case that each drachm weight of eggs will eventually produce about twenty-five ounces of silk; and that, if their maturity is protracted till the twenty-eighth day, that only twenty-one ounces are produced by the same quantity of eggs; and if they are not full fed before the lapse of thirty or forty days, that not more than ten ounces of silk will be the produce of the above quantity of eggs.

The Chinese say that much depends upon the mode of feeding, in promoting or retarding the growth of silkworms. To ascertain this, we tried an experiment in the summer of 1833, on some caterpillars of the Cabbage Butterfly (*Pontia Brassicæ,*) the *Papilio Brassicæ,* volume first, page 186, which had been newly hatched. These we divided, and placed in two separate tumblers, and put them upon cabbage leaves. We supplied the larvæ in one of the tumblers plentifully twice a-day with fresh cabbage leaves, while those in the other tumbler had but a scanty supply, and even allowing them to be sometimes entirely without food. At the end of a week, those which had been well fed had acquired about a third more in bulk than them that were kept on short allowance. About the twelfth day we had carried our starving system so far, that we had forgot to put leaves to them for nearly twelve hours, after they had been completely exhausted; and next morning we found most of the caterpillars adhering to the sides of the tumbler, by very fine silky filaments. We were apprehensive, that, having not been long enough fed, that they might die in place of transforming into the chrysalis, and loosened them all from the sides of the tumbler, and gave them a fresh supply of leaves, which, in a few minutes, they began to devour very greedily. Next day, while in the act of supplying them with leaves, we found one of the larvæ again adhering by filaments to the piece of paper with which the tumbler was covered, and determined to leave it undisturbed. It continued in this state for upwards of a day; and when we next examined it we found that it had changed into the chrysalis condition, but was of a very small size, and had a thin transparent appearance. The caterpillars which had been properly supplied with food now refrained from eating, and prepared for transforming into chrysalides. Those which had been starved still continued to eat, and were much less in size—a little more than a fourth. When the full fed larvæ had all changed, we gave a plentiful supply of leaves, morning and evening, and in the course of four days several of them grew considerably, and prepared for their transformation, and in seven days all of them had assumed the pupa state. The whole of them in due time burst from their pupa form, and became perfect insects, except the one which had first become a pupa. On opening it, we found it entirely empty; all its vital parts having been completely dried up and absorbed. We carefully examined the various butterflies, but could perceive no difference in the size of those which had been ill fed, and those which had revelled in abundance.

From the above experiment, we proved that the period of transformation between the larva and pupa condition can be protracted.

In China very rigid attention is given to the caterpillars in the early stage of their existence, and they are fed by night as well as by day. The day on which they are hatched they are supplied with forty meals, thirty on the second day, and reduced by certain proportions for some days thereafter, till they come to twice a-day. When hazy or damp weather occurs during the feeding season, the appetites of the caterpillars are considerably affected by this change of the atmosphere. Those who tend them burn straw over the worms, which dries the air, warms it, and stimulates them to feed freely.

Cleanliness is considered of vital importance to the health and vigour of silkworm caterpillars; and next to this is plenty of free room for them to move about, the space being extended as they increase in size.

"When the insects are about to commence their spinning, mats are provided, in the centre of which a strip of rush, about an inch broad, is fixed, and extended in a spiral form, or in concentric circles, over the whole surface of the mat, having an area of about an inch broad between each circle. Here the worms fix themselves to spin; and it is found that these receptacles occasion less silk to be wasted by them in floss, than where more space is allotted wherein their first threads can be spun. At this time the whole room is carefully covered with mats, to exclude the outward air and the light, as it is believed that silkworms work more diligently in darkness." * This last idea, we have no doubt, is a vulgar error, for we should conceive the contrary to be the truth; and, indeed, closing up the rooms must have the effect of preventing the free circulation of air, and consequently of injuring the health of the caterpillars. Indeed Count Dandolo found, by strict observation, that this practice had a most pernicious effect. The Count says, that on visiting apartments where silkworms were reared, that on the side where the sun shone directly on the hurdles

* *Cabinet Library, Silk Manufacture,* p. 126.

wherein the caterpillars were kept, they were more numerous and stronger than where the edges of the hurdles were under the shade.

The worms take seven days to complete the cocoons, at which time they are collected into heaps, and those intended for continuing the breed, are selected and placed on hurdles in a dry and airy situation. "The next care is to destroy the chrysalides in those balls which are to be reeled. The most approved method of performing this, is to fill large earthen vessels with cocoons, in layers, throwing in one-fortieth part of their weight of salt upon each layer, covering the whole with large dry leaves resembling those of the water-lily, and then closely stopping the mouths of the vessels. In reeling their silk, the Chinese separate the thick and dark from the long and glittering white cocoons, as the produce is inferior." *

* *Cabinet Library, Silk Manufacture*, p. 126.

INDIAN METHOD OF TREATMENT.

So favourable is the climate of India to the constitution of the *Phalæna Mori,* or Common Silkworm, that they are reared in sheds, and not in houses as in China. They are constructed of lattice-work, with thatched roofs. They are generally fifteen feet broad, and their height from eight to nine feet, and length according to the number of worms to be reared. In the centre of the building, a path of convenient width is left for the free passage of those who tend them. On each side of this passage are erected twelve tiers of frame-work, made of bamboo, in the form of shallow boxes. In these the caterpillars are placed; and when they are fed their full time, and ready to spin their cocoons, they are separated, each into a cell formed of plaited stripes of bamboo; and when their cocoon is completed, they are subjected to nearly the same mode of treatment as in China.

DISEASES OF SILKWORMS.

In European climates the caterpillars of the silk-worm are liable to many diseases, probably the consequence of inexperience in their mode of treatment.

In France and Italy it has long been a common practice to give a certain quantity of silkworms to the peasantry to be reared, and in such hands, as might have been expected, the successful cultivation of these was long but imperfectly known; and it was not till the patriotic exertions of Count Dandolo, that distinct and settled notions were thought of for improving the rearing, and preserving, in a healthy condition, this most valuable of all insects. He diligently studied the habits of the silkworm in its various metamorphoses, and immediately made known every discovery he had made, either by his writings or by giving personal instructions to those concerned in the propagation of the worms. He published an enlightened treatise on the subject, which soon led to the formation of large establishments in Lombardy. These were named *Dandolières,* in honour of this patriotic nobleman.

Damp stagnant air, and the presence of carbonic acid gas, appears to be one of the proximate causes of disease in silkworms; but of these damp seems to be the most prejudicial, as will be seen by the following experiments:—"If a silkworm," says Dr Lardner, "is introduced into a receiver charged with carbonic acid gas, and in which a bird would instantly die, although the worm quickly exhibits signs of uneasiness and suffering, it will live for ten, fifteen, or perhaps twenty minutes. No warm-blooded animal could continue alive in such an atmosphere for half that time. If, after remaining a few minutes, the worm be withdrawn from the receiver, it will not exhibit any sign of injury, but will be apparently as healthy as before inhaling this pernicious gas. The silkworm appears endued with the power to seize upon the minutest portion of vital air which may be held by water, as it will live for some minutes immersed in this fluid, particularly in its first ages; and, even when seemingly dead, it will revive if taken out. It would seem, however, that when its power of breathing is obstructed, the worm instantly dies. If, instead of plunging it in carbonic acid gas, or in water, its eighteen breathing holes are sealed up with grease, it expires instantaneously.

"If a healthy silkworm be confined in a vessel, the air in which is charged with moisture, and heated to the temperature of 80° to 90°, it will very soon exhibit symptoms of indisposition, and reject food; the skin will slacken, and the muscles soften, and contraction cease. In a short time evaporation will be obstructed, the secretions indispensable to vitality, which are effected in this animal by means of contraction,* will be suspended, and erelong it will perish. A warm-blooded animal, on the contrary, if sufficiently supplied with pure air, can live without any suffering, and perform all its functions without inconvenience, in such a temperature, whatever be the attendant degree of moisture. This proves how different is the structure of these two classes of animals."

Silkworms are said to be extremely sensible of certain odours, and to be easily affected by them. Tobacco has been ascertained to be a deadly poison to silkworms. If a few grains of snuff is thrown on them, immediate pain seems to be felt, from the writhing of the animal; in about a minute convulsions will ensue, and death speedily follows. Before the caterpillar expires, it ejects from its mouth a watery liquid; and should another larvæ be touched with this fluid, it is certain to prove fatal.

There is a disease to which silkworms are very liable in the south of France, which is called the jaundice, from the yellow colour exhibited by the animal while labouring under the malady. This

* The skin of the silkworm has so great a power of contraction, that, on being cut through, it shrinks in the manner of an elastic substance that has been drawn out.

distemper is of a very contagious nature, and, consequently, as soon as it is perceived that a worm has been attacked by the disease, it is immediately removed from among others. An effectual preventive, invented by Abbé Eperic of Carpentras, has been in use for upwards of twenty years past. Quick lime is reduced to a fine powder, and the worms are dusted with it, and they are then supplied with mulberry leaves moistened with a few drops of wine, which they greedily devour. It has been found that all which are subjected to this treatment escape the malady. It would appear that the disease has its origin in mephitic vapours, arising from decayed leaves, and that the lime, which has a strong affinity for these gases, may absorb the vapour, and thus render the apartment healthy and pure; which is most satisfactorily proved by the experiments of Mons. Blanchard, which we shall give in his own words. He says, "Having procured four glass jars, nine inches in depth and five in diameter, and had cork stoppers fitted to them. In each of these I put twelve silkworms at the period of their second age; and these I had fed four times a-day, and confined them in this kind of prison during their lives, and never either removed their dead companions or the litter produced by them. I sprinkled the worms which were contained in two of these jars with lime, and kept the other two in their ordinary state to compare with them. Those without lime never produced more than three small and imperfect cocoons, while in those which were sprinkled with lime, I had very often twelve, and never fewer than nine full-sized cocoons." He found that even a large proportion of lime had no bad effect on the worms.

The method which Count Dandolo practised, was the fumigation of the apartments with chlorine gas, although this is attended with danger. Chlorade of lime, however, is less hazardous, and produces equally beneficial effects in clearing apartments of noxious vapours.

ON THE CHEMICAL PROPERTIES OF SILK.

The rich yellow colouring matter which tinges all silk, more or less in its raw state, is in combination with the gum. Immersing the cocoons in hot water will dissolve, to a certain extent, this gum, and leave a yellow tinge in the water. But the use of alcohol instead of water, will dissolve this matter in greater quantity. This tincture will retain its colour with little loss of intensity, even after being long exposed to the rays of the sun. The fact of this affinity of the colouring matter of silk for alcohol, suggested to Mons. Baumé the idea of bleaching silk in the following manner.

He constructed a twelve gallon stoneware vessel, of a form nearly conical, with a wide opening at the top, and a smaller one, of about an inch in diameter, at the bottom, which was stopped by a cork; through the centre of which was passed a glass tube, of a quarter of an inch diameter. This tube was always stopped by a cork, except at the time when the liquid required to be drawn off. The inside of the vessel was polished very smooth with pumice-stone, to prevent the roughness from breaking the threads in their first state.

In this vessel were placed six pound weight of yellow raw silk, over which he poured a composition, consisting of a mixture of forty-eight pounds of alcohol (whose specific gravity was 0.867), with twelve ounces of muriatic acid in its purest state, (of the specific gravity of 1.114.) The vessel was then closed tightly up, and the contents left to digest, until the liquor became of a dusky brown colour; which operation usually required about twenty-four hours. This liquor was then drawn off by means of the glass tube, and spirit of wine was constantly poured into the vessel, while the tube was left unstopped, till the liquor passed off perfectly clear, and totally free from colour. The silk was then allowed to drain, until it ceased to drop. Spirit of wine and muriatic acid of the same proportions were again poured on it, and the silk allowed to continue immersed for forty-eight hours; by which time it had parted with all its colouring matter, and had assumed a brilliant white.

With respect to the exact time required for the immersion of the silk in the alcohol and muriatic acid, much will depend on the original colour of the silk, and also the temperature; and M. Baumé ascertained, that the silk wound from those cocoons which had not been previously baked, to destroy the aureliæ, was much more easily bleached; and that, on the second immersion, the liquor, when drawn off, was of a much paler hue, and so slightly was its chemical properties changed, that by the addition of half the original portion of muriatic acid, the liquid might be employed for a first immersion of the raw silk.

The bleaching operation was completed by pouring upon the silk forty-eight pounds of pure spirit of wine, which was allowed to remain from twenty-four to thirty hours on the silk. There is great difficulty in freeing the muriatic acid from the silk, which can only be effectually done by subjecting it to a continued stream of running water for some hours.*

In England a different process is pursued, which is by immersing the silk in a solution of soap in river water, while it is kept at the boiling point for two or three hours; when it is taken out, well beaten either with a machine constructed for the purpose, or with a wooden mallet, and afterwards washed in river water. It is then wrung, and again immersed in soap and water, in a cold state, with the addition of a small portion of indigo, and brought to the boiling point; at which it is allowed to continue for a short time. It is then taken out, wrung, and shaken; and dried in a stove constructed for the purpose, over the fumes of burning sulphur, which render it of the most beautiful whiteness.

* See Ure's *Dict. of Chemistry*, article Bleaching, for a more full detail of this process.

Nitric acid has a strong influence upon silk; and, if mixed with alcohol, changes silk to a permanent bright golden yellow colour. The same acid, when concentrated and distilled off silk, yields by evaporation oxalic acid; and if the evaporation is still farther continued, the same acid, together with a quantity of yellow octohedron-sided truncated crystals are obtained. These are free from an acid taste, but of a strong bitter, and if applied to the skin leaves a deep yellow stain. When the remaining liquor is saturated with potash, and evaporated, the residue is a rather yellow salt, which detonates when placed on live coals, like nitre. Chemists suppose this to be a treble combination of the bitter principle above mentioned, together with nitrate of potash.

Silk is dissolved and corroded by the caustic alkalis; and chlorine renders it yellow. It yields a greater quantity of volatile alkali than almost any other substance. It was found by Tournefort to contain even more than hartshorn, as he obtained from fifteen ounces of silk two drachms of volatile salt. This preparation was at one time in high repute in England as a medicine; and was called English Drops, or "Guttæ Anglicanæ." The cocoons of silk were reduced into a powder by Pomet, and used as a medicine. In his History of Drugs he says, that silk thus prepared had "the virtues of cleansing the blood, making the spirits brisk, and the heart pleasant."

It is said, that if a thin silk veil is worn in countries where malaria is generated, that it will have the effect of counteracting its noxious qualities.

The water in which cocoons are immersed preparatory to reeling, acquires such a strong lathery consistence, that air-bells may be made with it, which are so flexible and strong that they have been known to remain without bursting for upwards of twenty-four hours. These bells exhibit the prismatic colours in as high a degree as those formed of soap-suds.

Count Rumford observed, that raw silk has a remarkable power of producing pure air from water. He found that, by introducing thirty grains of this substance, first washed in water, into a thin glass globe, four inches and a half in diameter, having a cylindrical neck three-fourths of an inch wide, and twelve inches long, inverting the globe in a jar filled with water, and exposing it to the action of the sun in the window; in less than ten minutes the silk became covered with an infinite number of air-bubbles, gradually increasing in size, till, at the end of two hours, the silk was buoyed up by their means to the top of the water. They separated themselves by degrees, and formed a collection of air in the upper part of the globe, which, when examined by the established test, appeared to be very pure. In three days he collected three and three quarters of a cubic inch of pure air, into which a wax taper being introduced, that had just before been blown out, the wick only remaining red, it instantly took fire, and burned with a bright and large flame. The water in the globe had acquired the smell of raw silk; it lost something of its transparency, and assumed a faint greenish cast.

It was observed, that when this experiment was made in the dark, only a few inconsiderable bubbles were formed, which remained attached to the silk; nor was it otherwise when the glass globe was removed into a German stove. In the latter case, indeed, some single bubbles had detached themselves from the silk, and ascended to the top, but the air was in too small a quantity to be either measured or proved.

Dr Lardner says, "The imperishable nature of silk, even under circumstances peculiarly unfavourable to the preservation of animal substances, forms another of its qualities which is deserving of remark. Some years ago, the sexton of the parish of Falkirk, in Stirlingshire, upon opening a grave in the churchyard, found a riband about the bone of an arm, and which, being washed, was found to be entire, and to have suffered no injury, although it had lain for more than eight years in the earth, and had been in contact with a body which had passed through every stage of putrefaction, until it was reduced to its kindred dust."

ELECTRICAL PROPERTIES OF SILK.

The distinction between those bodies which are capable of being excited to electricity, and those which are only capable of receiving it from the others, appears scarcely to have been even suspected till about the year 1729, when this great discovery was made by Mr Gray, a pensioner in the Charter-House. After some fruitless attempts to make metals attractive by heating, rubbing, and hammering, he conceived a suspicion, that, as a glass tube, when rubbed in the dark, communicated its light to various bodies, it might possibly, at the same time, communicate its power of attracting to them. In order to put this to the test, he provided himself with a tube three feet five inches long, and near an inch and one-fifth in diameter; the ends of the tube were stopped by cork; and he found that, when the tube was excited, a down feather was attracted as powerfully by the cork as by the tube itself. To convince himself more completely, he procured a small ivory ball, which he fixed at first to a stick of fir, four inches long, which was thrust into the cork, and found that it attracted and repelled the feather even with more vigour than the cork itself. He afterwards fixed the ball upon long sticks, and upon pieces of brass and iron wire, with the same success; and lastly attached it to a long piece of packthread, and hung it from a high balcony, in which state he found that, by rubbing the tube, the ball was constantly enabled to attract light bodies in the court below.

His next attempt was to prove whether this power could be conveyed horizontally as well as perpendicularly. With this view, he fixed a cord to a nail which was in one of the beams of the ceiling; and making a loop at that end which hung down, he inserted his packthread, with the ball which was at the end of it through the loop of the cord, and retired with the tube to the other end of the room; but in this state he found that the ball had totally lost the power of attraction. Upon mentioning his disappointed efforts to a friend, it was suggested that the cord, which he had used to support his packthread, might be so coarse as to intercept the electric power; and they accordingly attempted to remedy this evil by employing a silk string, which was much stronger in proportion than a hempen cord. With this apparatus the experiment succeeded far beyond their expectations. Encouraged by this success, and attributing it wholly to the fineness of the silk, they proceeded to support the packthread, to which the ball was attached by very fine brass and iron wire, but, to their utter astonishment, found the effect exactly the same as when they used the hempen cord; the electrical virtue utterly passed away; while, on the other hand, when the packthread was supported by a silken cord, they were able to convey the electric virtue seven hundred and sixty-five feet.

It was evident, therefore, that these effects depended upon some peculiar quality in the silk, which disabled it from conducting away the electrical power, as the hempen cord and the wire had done.

The accidental discovery of Mr Gray led to the knowledge of the non-conducting powers of various other substances; and since the nature of electricity has been more deeply investigated, the true electric properties of most substances have become known, and are now divided into electrics and non-electrics. The following substances are among the principal conductors of the electric fluid; namely, stony substances in general, more especially those of a calcareous nature, such as lime, marble, &c., sulphuric acid, black pyrites, black lead, alum, charcoal, all the metallic ores, the animal fluids, and all other fluids excepting air and oils.

The electric bodies are those substances which, when excited, collect or omit this fluid, such as amber, sulphur, jet, glass, and all precious crystallized stones, all resinous compounds, and all dry substances, such as silk, hair, wool, paper, &c.

Silk was first discovered to be an electric by Mr Gray, in the manner we have already related; but as it was by no means remarkable for emitting sparks, which most commonly engages the attention, its electric virtues were almost entirely overlooked till the year 1759. At that time Mr Symmer presented to the Royal Society some papers, containing a number of very curious experiments made with silk stockings, in substance as follows:—

He had been accustomed to wear two pairs of silk stockings, a black and a white. When these were put off both together, no signs of electricity appeared; but on pulling off the black ones from the white, he heard a snapping or crackling noise, and in the dark perceived sparks of fire between them. To produce this and the following appearances in great perfection, it was only necessary to draw his hand several times backward and forward over his leg with his stockings upon it.

When the stockings were separated, and held at a distance from each other, both of them appeared to be highly excited; the white stocking positively, and the black negatively. While they were kept at a distance from each other, both of them appeared inflated, to such a degree, that they exhibited the entire shape of the leg. When two black or two white stockings were held in one hand, they would repel one another with considerable force, making an angle seemingly of thirty or thirty-five degrees. When a white and black stocking were presented to each other, they were mutually attracted; and, if permitted, would rush together with surprising violence. As they approached, the inflation gradually subsided, and their attraction of foreign objects diminished, but their attraction of one another increased; when they actually met, they became flat, and joined close together like as many folds of silk. When separated again, their electric virtue did not seem to be in the least impaired for having once met; and the same appearances would be exhibited by them for a considerable time. When the experiment was made with two black stockings in one hand, and two white ones in the other, they were thrown into a strange agitation, owing to the attraction between those of different colours, and the repulsion between those of the same colour. This mixture of attractions and repulsions made the stockings catch at each other at greater distances than otherwise they would have done, and afforded a very curious spectacle.

When the stockings were suffered to meet, they stuck together with considerable force. At first Mr Symmer found they required from one to twelve ounces to separate them. Another time they raised seventeen ounces, which was twenty times the weight of the stocking that supported them, and this in a direction parallel to its surface. When one of the stockings was turned inside out, and put within the other, it required twenty ounces to separate them; though at that time ten ounces were sufficient when applied externally. Getting the black stockings new died, and the white ones washed, and whitened in the fumes of sulphur, and then putting them one within the other, with the rough sides together, it required three pounds three ounces to separate them. With stockings of a more substantial make, the cohesion was still greater. When the white stocking was put within the black one, so that the outside of the white was contiguous to the inside of the black, they raised nine pounds, wanting a few ounces; and when the two rough surfaces were contiguous, they raised fifteen pounds one pennyweight and a half. Cutting off the ends of the thread, and the tufts of silk which had been left in the inside of the stockings, was found to be very unfavourable to these experiments.

Mr Symmer also observed, that pieces of white and black silk, when highly electrified, not only cohered with each other, but would also adhere to bodies with broad and even polished surfaces, though these bodies were not electrified. This he discovered accidentally; having, without design, thrown a stocking out of his hand, which stuck to the paper-hangings of the room. He repeated the experiment, and found it would continue hanging near an hour. Having stuck up the black and white stockings in this manner, he came with another pair highly electrified; and applying the white to the black, and the black to the white, he carried them off from the wall, each of them hanging to that which had been brought to it. The same experiments held with the painted boards of the room, and likewise with the looking-glass, to the smooth surface of which both the white and the black silk appeared to adhere more tenaciously than to either of the former.

Similar experiments, but with a greater variety of circumstances, were afterwards made by Mr Cigna of Turin, upon white and black ribands. He took two white silk ribands just dried at the fire, and extended them upon a smooth plane, whether a conducting or electric substance was a matter of indifference. He then drew over them the sharp edge of an ivory ruler, and found that both ribands had acquired electricity enough to adhere to the plane; though, while they continued there, they showed no other sign of it. When taken up separately, they were both negatively electrified, and would repel each other. In their separation, electric sparks were perceived between them; but when again put on the plane, or forced together, no light was perceived without another friction. When, by the operation just now mentioned, they had acquired the negative electricity, if they were placed, not upon the smooth body on which they had been rubbed, but on a rough conducting substance, they would, on their separation, show contrary electricities, which would again disappear on their being joined together. If they had been made to repel each other, and were afterwards forced together, and placed on the rough surface above mentioned, they would in a few minutes be mutually attracted; the lowermost being positively, and the uppermost negatively electrified.

If the two white ribands received their friction upon the rough surface, they always acquired contrary electricities. The upper one was negatively, and the lower one positively electrified, in whatever manner they were taken off. The same change was instantaneously done by any pointed conductor. If two ribands, for instance, were made to repel, and the point of a needle drawn opposite to one of them along its whole length, they would immediately rush together.

The same means which produced a change of electricity in a riband already electrified, would communicate electricity to one which had not as yet received it, viz. laying the unelectrified riband upon a rough surface, and putting the other upon it, or by holding it parallel to an electrified riband, and presenting a pointed conductor to it. He placed a riband that was not quite dry under another that was well dried at the fire, upon a smooth plain; and when he had given them the usual friction with his ruler, he found that, in what manner soever they were removed from the plane, the upper one was negatively, and the lower one positively electrified.—If both ribands were black, all these experiments succeeded in the same manner as with the white. If, instead of the ivory ruler, he made use of any skin, or a piece of smooth glass, the event was the same; but if he made use of a stick of sulphur, the electricities were in all cases the reverse of what they had been before the ribands were rubbed, having always acquired the positive electricity. When he rubbed them with paper, either gilt or not gilt, the results were uncertain. When the ribands were wrapped in paper, gilt or not gilt, and the friction was made upon the paper laid on the plane above mentioned, the ribands acquired both of them the negative electricity. If the ribands were one black and the other white, whichever of them was laid uppermost, and in whatever manner the friction was made, the black generally acquired the negative, and the white the positive electricity.

He also observed, that when the texture of the upper piece of silk was loose, yielding, and retiform, like that of a stocking, so that it could move and be rubbed against the lower one, and the rubber was of such a nature as could communicate but little electricity to glass, the electricity which the upper piece of silk acquired did not depend upon the rubber, but upon the body on which it was laid. In this case, the black was always negative and the white positive. But when the silk was hard, rigid, and of a close texture, and the rubber of such a nature as would have imparted a great degree of electricity to glass, the electricity of the upper piece depended on the rubber. Thus, a white silk stocking, rubbed with gilt paper upon glass, became negatively, and the glass positively electrified. But if a piece of silk of a firmer texture was laid upon a plate of glass, it was *always* electrified positively, and the glass negatively, if it was rubbed with sulphur, and for the most part if it was rubbed with gilt paper.

If an electrified riband was brought near an insulated plate of lead, it was attracted, but very feebly. On bringing the finger near the lead, a spark was observed between them, the riband was vigorously attracted, and both together showed no signs of electricity. On the separation of the riband, they were again electrified, and a spark was perceived between the plate and the finger.

When a number of ribands of the same colour were laid upon a smooth conducting substance, and the ruler was drawn over them, he found, that when they were taken up singly, each of them gave sparks at the place where it was separated from the other, as did also the last one with the conductor; and all of them were negatively electrified. If they were all taken from the plate together, they cohered in one mass, which was negatively electrified on both sides. If they were laid upon the rough conductor, and then separated singly, beginning with the lowermost, sparks appeared as before, but all the ribands were electrified positively, except the uppermost.—If they received the friction upon the rough conductor, and were all taken up at once, all the intermediate ribands acquired the electricity, either of the highest or lowest, according as the separation was begun with the highest or the lowest. If two ribands were separated from the bundle at the same time, they clung together, and in that state showed no sign of electricity, as one of them alone would have done. When they were separated, the outermost one had acquired an electricity opposite to that of the bundle, but much weaker.

A number of ribands were placed upon a plate of metal, to which electricity was communicated by means of a glass globe, and a pointed conductor held to the other side of the ribands. The consequence was, that all of them became possessed of the electricity opposite to that of the plate, or of the same, according as they were taken off; except the most remote, which always kept an electricity opposite to that of the plate.

The following experiments were performed by Mr Nicholson, on an improved method of excitation, as well as the action of points, and the direction of the fluid in positive and negative electricity.

1. A glass cylinder was mounted, and a cushion applied with a silk flap, proceeding from the edge of the cushion over its surface, and thence half round the cylinder. The cylinder was then excited by applying an amalgamed leather in the usual manner. The electricity was received by a conductor, and passed off in sparks to Lane's electrometer. By the frequency of these sparks, or by the number of turns required to cause spontaneous explosion of a jar, the strength of the excitation was ascertained.

2. The cushion was withdrawn about one inch from the cylinder, and the excitation performed by the silk only. A stream of fire was seen between the cushion and the silk; and much fewer sparks passed between the balls of the electrometer.

3. A roll of dry silk was interposed, to prevent the stream from passing between the cushion and the silk. Very few sparks then appeared at the electrometer.

4. A metallic rod, not insulated, was then interposed instead of the roll of silk, so as not to touch

any part of the apparatus. A dense stream of electricity appeared between the rod and the silk, and the conductor gave very many sparks.

5. The knob of a jar being substituted in the place of the metallic rod, it became charged negatively.

6. The silk alone, with a piece of tinfoil applied behind it, afforded much electricity, though less than when the cushion was applied with a light pressure. The hand being applied to the silk as a cushion, produced a degree of excitation seldom equalled by any other cushion.

7. The edge of the hand answered as well as the palm.

8. When the excitation by a cushion was weak, a line of light appeared at the anterior part of the cushion, and the silk was strongly disposed to receive electricity from any uninsulated conductor. These appearances did not obtain when the excitation was by any means made very strong.

9. A thick silk, or two or more folds of silk, excited worse than a single very thin flap. The silk used was that which the milliners call Persian.

10. When the silk was separated from the cylinder, sparks passed between them ; the silk was found to be in a weak negative, and the cylinder in a positive state.

The foregoing experiments show that the office of the silk is not merely to prevent the return of electricity from the cylinder to the cushion, but that it is the chief agent in the excitation, while the cushion serves only to supply the electricity, and perhaps increase the pressure at the entering part. There likewise seems to be little reason to doubt, but that the disposition of the electricity to escape from the surface of the cylinder, is not prevented by the interposition of the silk, but by a compensation after the manner of a charge ; the silk being then as strongly negative as the cylinder is positive; and lastly, that the line of light between the silk and cushion in weak excitations, does not consist of returning electricity, but of electricity which passes to the cylinder, in consequence of its not having been sufficiently supplied during its contact with the rubbing surface.

MISCELLANEOUS FACTS.

SOME MOTHS REJECTED BY BIRDS.

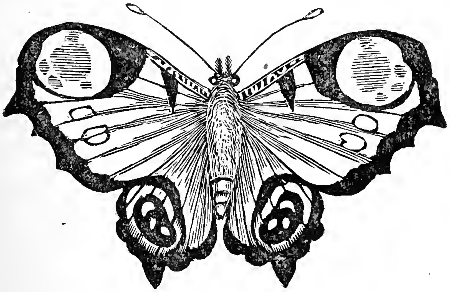
MR BLYTH mentions, in the *Field Naturalist's Magazine,** a singular circumstance, which is quite new to us, namely, that the Magpie Moth (*Abraxas Grossulariata*) is rejected as food by various insectiverous birds, but is unable to account for the cause of this. "I have a nightingale," says he, "which will readily take food from the hand, and which, like all other insectiverous birds, is most voraciously fond of lepidopterous insects in general; but the Magpie Moth he constantly refuses, though I have seen him swallow in succession three or four of the Large Yellow Under-Wings, (*Triphæna.*) I once even kept my insect-eating birds without food beyond their usual time, when I threw into their cage a variety of common moths, amongst which were three or four of the *Abraxas Grossulariata;* but the latter were even then rejected, though the other various species were devoured greedily. One, however, was swallowed by a

* Vol. i. p. 549.

Whin-Chat (*Saxicola Rubetra*), but he did not take a second; and I noticed a Tree-Pipit (*Anthus Arboreus*) take one of them in his mouth, which, on tasting, he refused. The caterpillar, also, is rejected by all these various birds. May not this be a principal cause of the Magpie-Moth being one of the most abundant species we have?"

The same gentleman has made another interesting discovery respecting the eyes of the Dark Arches Moth. He says:—" A few weeks ago, on seeing a remarkably fine specimen of the Dark Arches Moth (*Xylophasia polyodon*), I caught it, and placed it in a small box, which I happened to have in my pocket. On my return home in the evening, when it was almost dark, I gently lifted up the lid, and was not a little amazed to perceive that the moth's eyes had the power of converging the few rays of light, shining in the dark like two little stars, with considerable brilliancy. Ten minutes afterwards, however, when I again looked at the moth, I was surprised to find that its eyes were not visible at all, showing that this faculty is dependent on the will of the animal. I have since examined a considerable number of moths, in various genera, but only in one instance have I again had the satisfaction of beholding this beautiful phenomenon. This was in a common Golden Tail, (*Porthesia chrysorrhœa;*) but the appearance was not so bright as in the *Xylophasia*. It shows.

however, that moths, like many other nocturnal animals, are endowed with this curious power, to enable them to see their way clearly at a time when the vision of diurnal creatures is of little or no avail." *



Variety of the Peacock Butterfly.

In the first edition of this work we gave the above figure of the Peacock Butterfly, and described its ordinary form, omitting to point out the peculiarities of its conformation.

This specimen was captured near Oxford in 1828, and is a curiously shaped variety. The superior wings are about a fourth larger than the inferior ones, in proportion to those of the ordinary specimens ; the whole insect being much more triangular in its general form, and the indentations on the margins of both upper and under wings considerably

* *Field Naturalist's Magazine*, vol. i. p. 550.

more acute, than those which are to be found in the same species generally. The difference here pointed out, will be rendered more obvious, by comparing it with the figure which we have substituted for it, Plate II., page 120.

In the *Field Naturalist's Magazine*, vol. i. p. 229, there is a curious specimen of a butterfly figured, whose wings are like those of opposite sexes.

MIGRATIONS OF PAPILIONACEOUS INSECTS.

In addition to what we have said on this subject at page 100, volume I., we subjoin the following remarks:—That "the extent to which insects migrate," says Mr Blyth, "or rather wander, seems never to have sufficiently engaged the attention of entomologists. Most persons must have remarked, on perusing an account of the localities of our rarer strong-winged insects (such as the *Sphingidæ,* many of the butterflies, &c.,) how very many of them have been principally taken on the eastern and southern coasts of the kingdom. My friend, to whom I am indebted for the above information on birds, mentions having seen several small moths flying out at sea, when about ten miles distant from the Suffolk coast; one only of which was captured, which I find to be the *Lampetia defoliaria.* Mr Stephens, also, records an instance of the Death's-head Hawk-moth (*Acherontia atropos*) being captured four miles at sea; and I have myself observed numberless instances of diurnal moths and butterflies, flying at a considerable distance from land. I have repeatedly seen the Humming-bird Hawk-moth (*Macroglossa stellatarum*) fly straight out to sea; also, on two or three occasions, the Clouded Yellow Butterfly (*Colias Edusa,*) the Small Copper Butterfly (*Lycæna Phlæas,*) and once, the Wall Butterfly (*Hipparchia megæra.*) I have picked up, also, in the Isle of Jersey, amongst the rejectamenta of the sea, a drowned specimen of the large Rhinoceros Beetle (*Sinodendron cylindricum,*) and I could here enumerate various other instances of insects being captured in the Channel; but the species in which, of all others, I have most frequently observed this wandering propensity, is the beautiful Painted Lady Butterfly (*Cynthia Cardui.*)

" There is not, perhaps, any lepidopterous insect whatever, the natural history of which would comprise so many curious particulars as that of the interesting and elegant butterfly, *Cynthia Cardui.* All the insects, it will be observed, whose names are above mentioned, are known to possess a wide geographical range; but the Painted Lady Butterfly may be even said to be an inhabitant of the world at large. Mr Rennie informs me that he has seen specimens from America, from the Caucasus, and from China; I have seen them from North America: the species is said also to occur in Otaheite and Australia, and it is undoubtedly found in Africa. Reports, however, of this kind must be received with some degree of caution, as, without actual and careful comparison, distinct species may have been confounded together. Many birds (particularly of the order *Grallatores*) were once thus said to inhabit all parts of the globe; until it was shown, by careful and minute comparison, that different creatures had been confused together: I allude to the species of *Scolopax, Charadrius, Thalasidroma*, &c., which, though closely resembling each other, are now proved, by various and constant characters, to be distinct. There can, however, be no doubt but that the Painted Lady Butterfly has an amazingly wide range of geographical distribution, and I think it may be fully accounted for by the strange wandering propensities of the insect.

"Of this I have just witnessed a very remarkable example. I had often observed this species to fly straight out to sea, and I have noticed it at a considerable distance from land; but, until within this last fortnight, I never knew them travel in immense flocks. On the 8th of this month, (October 1833,) this beautiful butterfly abounded in all the gardens about this place; upwards of twenty were counted on one clump of dahlias; and, at the same time, they were noticed in equal abundance in a garden about half a mile distant from that in which those dahlias grew. None had been previously observed in the neighbourhood, and all that were seen on that day were very much rubbed and injured, so that they had evidently been long excluded from the chrysalis, and had perhaps travelled a considerable distance. I was unable to ascertain the direction from which they came, neither could I discover the route which they pursued; for a single day the species appeared every where in abundance, and the day after not one was any where to be seen. On the morning of the 10th, however, I observed a single one flying swiftly to the eastward; and since that time several others have been seen; but, as these last were all perfect and uninjured insects, I do not consider that they formed part of the immense flight which passed this place on the 8th. It will be remembered, also, that this same butterfly is the species which passed in such incalculable multitudes through Switzerland some years ago; an occurrence, the description of which must be familiar to every student of entomology.*

"Does not this ascertained fact, of insects thus travelling in enormous flocks from one district to another, explain, in some measure, the sudden appearance of a particular species in vast numbers, in a neighbourhood where it is usually considered rare? It certainly does seem, in many instances, to account for this phenomonon; but still, it will not equally apply in all. It would be wandering,

* This circumstance is described at page 102, vol. i., and at page 98, of the same volume in the first edition.

however, from the present subject, to treat on the wonderful irregularity of insect appearance; some curious facts concerning this I will reserve for a future opportunity; but it is nevertheless worthy of being observed here, that the Painted Lady Butterfly, which is remarkable, in most places, for the extreme irregularity of its occurrence, is equally remarkable in others, (as in some parts of the west of England, and in Jersey,) for appearing with great regularity.

"A very singular circumstance is also related of the *Cynthia Cardui*, by Mr Knapp, in his amusing and excellent 'Journal of a Naturalist.' After some other remarks on the species, he observes that 'some years ago a quantity of earth was raised in cutting a canal in this county (Gloucestershire;) and in the ensuing summer, on the herbage that sprang up from the new soil on the bank, this butterfly was found in abundance, where it had not been observed for many years before.' Might we not reasonably expect, if the soil about Hampstead were to be turned up, on any occasion, to some depth and extent, that the extraordinary and distinctly marked butterfly, *Cynthia Hampstediensis*, would reappear, although so many years have now elapsed since it was last seen?" *

* *Field Naturalist's Magazine*, p. 469.

ORGANS OF HEARING.

There is no part of the physiology of insects more interesting, and yet still in such doubt, as whether or not they enjoy the sense of hearing in the same manner as other animals.

Professor Rennie has published, in the *Field Naturalist's Magazine*, several papers containing some very interesting discussions on this subject, which we shall endeavour to condense, adding such matter as occurs to us as throwing light on this intricate suject. In the first place, he has translated Straus-Dürckheim's excellent paper, from his work on articulated animals.

It is now generally believed that the antennæ are the organs of hearing; and this idea is strongly supported by Dürckheim. In condemning the notion of their being the organs of touch, he says, "Many insects, besides, have their antennæ so short, that they would be obliged to stand erect on the crown of their heads in order to come at the bodies which they might thus wish to explore, and for this their feet are much better adapted.

"Since almost all articulated animals possessing a solid skin have antennæ, which are furnished with nerves of an extraordinary thickness in proportion to their own size, there cannot remain a doubt that they are organs of some sense, and that too a very acute one.

" I have said, that insects are proved by observation to be furnished with an organ of hearing. It is, indeed, scarcely probable that creatures such as the tree-hopper (*Cicada*), and the locust (*Locusta*), to which nature has given the faculty of producing a peculiar sound, by means of an appropriate organ, should, at the same time, be deprived of the means of hearing such sounds, inasmuch as these can have reference only to their own kindred. It is still farther proved, that these insects share the faculty of hearing, along with all other living beings, by their ceasing to sing the instant they fear they have been discovered." *

" I once was observing," says Kirby, " the motions of a weevil (*Apion*) under a pocket microscope : on seeing me, it receded. Upon my making a slight but distinct noise, its antennæ started : I repeated the noise several times, and invariably with the same effect. A beetle (*Harpalus,*) which I was holding in my hand, answered the sound in the same manner repeatedly. I will now mention another effect that I observed, still more remarkable. A little moth was reposing upon my window ;

* See *Field Naturalist's Magazine*, i. pp. 59, 60.

I made a quiet, not loud, but distinct noise: the antenna nearest to me immediately moved towards me. I repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ; till at length the insect, being alarmed, became more agitated and violent in its motions. In this instance it could not be touch; since the antenna was not applied to a surface, but directed towards the quarter from which the sound came, as if to listen. It is necessary, however, to remark, that there is a want of precision in these experiments, as no precautions are mentioned to have been taken to hide the cause of the noise from the eyes of the insect."*

"It is important to remark, with regard to this inquiry, that no effect is likely to be produced upon insects by sounds unconnected with their habits;† for even the timid hare will scarcely bend its ear to the clang of a peal of bells, or the beat of a drum, while the bark of a lapdog would put it to immediate flight; and though a flock of rooks, as we have frequently remarked, will feed unalarmed during a violent thunder-storm, the report of a fowling-piece, though ever so distant, or even of a boy's pop-gun, will instantly rouse them. The same holds with respect to insects; and accordingly the quick-eared grashoppers, locusts, and crickets, will not pay any

* *Introduction to Entomology*, vol. iv. p. 242.

† *Huber on Bees*, p. 285.

attention to the beating of a watch, the ringing of glasses, or any similar noise, while the object is kept out of their sight,—but the rustle of leaves, or the seemingly noiseless tread of one of their own species, near them, puts them in a moment on the alert.—Having at present about a dozen of different species of this order alive, we have repeated these experiments in every possible form; but the most important, with respect to the antennæ, is that, when a leaf or a bit of paper is rustled under a table, the green grashopper (*Acrida viridissima*) immediately bends one or both of its long antennæ in the direction of the sound, just as a rabbit would do its ears if similarly alarmed. The same effect is produced when a large beetle, in a box, is placed out of sight near it; and when placed behind, it bends the antennæ back over the body, and bustles to get out. It is obvious to us, indeed, that it is partly, if not wholly, in consequence of the great length of their antennæ that these insects hear so acutely; and we think we have remarked that the species in which they are short have a less perfect sense of hearing. In the capricorn beetles (*Lamia, &c.*), which live on the wood and bark of trees, the antennæ are also very long, for the purpose, it may be, of warning the insect of the approach of snakes, lizards, or the voracious woodpecker, whose loud tapping, however, it will not be difficult to recognise. The pretty moths, called by our London collectors the Long-horned Japan (*Adela*, LATREILLE), have their antennæ prodigiously long; and as they appear early in spring, even, as Latreille remarks, before the oak is in leaf, may not these organs be to give them quick intelligence of the approach of birds, who are then most eager in hunting after insects? Be this as it may, these little moths are exceedingly timid, and, though not of very rapid flight, will start off at the slightest rustle." *

"When observing the various actions of insects, we see them suddenly stretch their antennæ forwards in case of noise, danger, or, in general, when any thing is done to attract their attention; and they keep them thus stretched forward as long as their attention continues, a circumstance which proves that the antennæ serve the purpose of apprising them of what passes at a distance, and consequently must either be organs of hearing or organs of smell. M. Rèaumur, (*Mém. des Insectes*, i. 643,) while he rejects the opinion that the antennæ serve to explore objects, thinks it possible they may be the organs either of some unknown sense, or of smell. The latter opinion, however, is supported by no fact either anatomical or physiological; nor is it at all even probable, inasmuch as the antennæ are not soft and lubricated, as observation proves to be necessary for this kind of

* See *Insect Miscellanies*, pp. 108, 109.

sensation: it appears to me more plausible to infer that the antennæ serve for the perception of sounds. This opinion is founded partly on the analogy of what occurs in the larger animals, who prick up their ears under similar circumstances in order to hear better; and partly because, on following the progress of *degradation* in the organ of hearing from the first of the vertebrate animals (*Vertebrata*), we arrive again in the last analysis at the antennæ of articulated animals, by a sort of transition occurring in the lobster and craw-fish (*Astacus*), a genus in which this organ occurs in the simplest form, compared with that of superior animals."

[The author here goes into several details illustrative of this last statement, which we shall omit, as of less weight than what follows.]

"The solidity of the envelope of antennæ renders these organs well adapted to undergo the same vibrations as the air, in the same manner as the strings of an Æolian harp vibrate and emit various sounds, according as they are differently struck by the air. In this view, however, we might infer that nature would have made antennæ in the form of rods, consisting of a single piece, in order that they might be more susceptible of vibrations; but it ought to be considered, that these organs would, by such a conformation, have been much exposed to breaking, while, in consequence of their jointed form, they have the advantage of regulating the degree of vibration at pleasure, as may indeed be observed when insects listen with attention; I mean, that the joints of the antennæ perform the same functions as the chain of small bones in the chamber of the human ear, inasmuch as they form a similar chain, and transmit the vibrations of the air to the auditory pulp." *

On this subject, Bonsdorf says, "There are none who know not that there exist many kinds of insects which can produce sounds variously modulated, and sometimes acute buzzing noises, for exciting which they are furnished with proper instruments, which will be explained more fully (if it please God) on another opportunity.

"We ought not surely then to represent as useless to the insects themselves, the voice at one time fierce, at another the pure messenger of joy, heard whilst we enter the woods and groves, or walk through the meadows, resounding at one time with the shrilling of gnats, and at another with the various nuptial songs of grashoppers and crickets.

"The more attentive observers and describers of the economy of the honey bees, mention differences in their sounds, such as a humming early in the morning when the working bees go out upon their flower-choosing excursions; another, whilst they re-

* See *Field Naturalist's Magazine*, i. pp. 60, 61.

turn to a peaceful rest in the evening; another, while they call forth the whole hive in defence of the state against the attacks of enemies; another, while they clean their hives from filth; and another, whilst the queen-bee leads forth a swarm to seek new settlements. Now, I ask those who deny hearing to insects, what can be the use of sounds so variously modulated, unless the bees can by hearing discriminate those sounds?" *

"Not once, but a hundred times, I have tried by experiment the acuteness of hearing in insects, as often as I have delighted my mind with contemplating the beauties of nature in study during the summer nights, destined otherwise for the purpose of recruiting exhausted strength. In such cases, how much attention is requisite to avoid disturbing the roaming moths, and how rapid is their flight on the least noise being made, even before I could have imagined that the noise could have reached their ears.

"Unless, therefore, every circumstance misleads me, the inference is correct, that there is a constant relation between the power of expressing various sounds and the power of perceiving the same; and this is strengthened the more as it is more clearly seen and proved by sad experience in the case of a man born deaf and dumb, which appears to prove

* *Field Naturalist's Magazine*, i. p. 295.

that hearing is the inseparable companion of the power of uttering sound."*

After dilating at considerable length on this subject, Bonsdorf says, "There remains only one doubt, which the diligence of an after age may remove, namely, what openings the tremulous waves of sound may have reserved for them in the inmost recesses of the antennæ, since these organs are terminated by no open mouth; or whether these pores and openings between the joints be concealed, by which the very tender members connecting the joints alternately may be struck, for which use these holes, invisible to the naked eye, seem clearly to be arranged, and fitted equally for hearing, as the smallest bones of the semicircular canals in the larger animals.

"Nothing more, therefore, is requisite in this case for confirming this opinion, than to show that the antennæ are active and watchful whenever they are exposed to hostile and sudden sounds.

"I have examined, by many and various experiments for several years, insects of different kinds, in which the size of the antennæ was different, and such experiments, provided due care and attention are employed, cannot be performed without the most striking results. In proportion, also, as the summer season was agreeable, and the weather

* *Field Naturalist's Magazine*, i. p. 296.

mild and serene, my success was greater and more delightful. As all my observations agreed in this one circumstance, I omit to enumerate them; for the antennæ being erect as soon as they were put on the alert, they were moved hither and thither by means of loud sounds, for they disregarded such as were very small. These they may be said to have drunk in; and if alarmed by new sounds, they rejoiced when they could effect their escape as soon as possible, and preserve life and safety by the most rapid flight. So I have observed very frequently when the antennæ were folded up in the *Lepturæ, Elateres, Curculiones, Papiliones, Apes;* nay, even the house-fly, as soon as they were moved and excited by irregular sounds or noise, would erect their antennæ, and betake themselves to flight, without any other excitement. The *Sphinges* again, and *Phalænæ,* during the night, fly about the flowers of the marragon and other lily plants, emitting an agreeable smell; during the night, scarcely could a voice be raised then they would turn round very swiftly, and the antennæ appear to be, as it were, convulsed.

"I must not pass over in silence, however, that no evidence more clear could be desired of the sensibility of the antennæ to quick sounds, than what occurred to me last summer in my garden. I observed, in a morning walk, undertaken for the purpose of catching insects on the hazels, that, while standing in the shade, a nut weevil was sitting quietly at a distance upon a leaf, with the antennæ hanging down as if they were asleep; on which account I directed a pocket-telescope to the spot, which was above five feet distant, and therefore convenient for viewing the insect. The point of view being thus determined, I made a loud sound, and I was delighted with the opportunity of seeing the weevil not only roused, but the antennæ which had been hanging down became elongated, and being full of joints, struck by the undulations of sound, they extended themselves, and remained on the alert till alarmed again by a fresh sound. The insects fell down on the ground, as is the habit of those and other weevils. I have never attended to any proof of hearing in spiders, among which the want of antennæ is supplied by acute sight and smell; but all these proofs, weighed together and separately, seem to add strength to the probability of our conjecture, namely, that the antennæ are given to insects for the purpose of perceiving and recognising sounds, in a similar manner as the sails of a ship serve to convert the wind to the use of the sailor; from which analogy and comparison, I suppose that this name has been assigned to these organs of insects."*

Professor Treviranus says, "I believed I had

* *Field Naturalist's Magazine*, i. pages 298-99.

discovered the organ of hearing in the cockroach, (*Blata Orientalis,*) in the form of an opening covered by a membrane, white, interiorly concave, and situated at the base of the antennæ; under it there is a projection from the brain, (the first nerve-knot or ganglion,) which appears to perform the office of an auditory nerve. The membrane was not round, but semicircular, and immediately bordering on the ring in which the antennæ are fixed. Under it I found a white horny substance, similar to that which covers the inner crustaceous envelope of the head. The projections of the brain appeared to give off nerves to the antennæ on each side; but I could not determine whether it spread out over the membrane, which I am inclined to consider the organ of hearing, as I could not otherwise conceive of its functions.

The antennæ of butterflies terminate in a clubbed tip, in which there are not muscles for producing motion, as in the body of these organs, but half a liquid substance filling the cavity. In the Alderman Butterfly, (*Ammiralis Atalanta,*) I found this substance intermixed with membranous matter, resembling in some degree the substance found in the auditory sacs of the frog, the calcareous portions being less than in the latter. I think it exceedingly probable that the clubs of the antennæ are the seat of the sense of hearing." *

* See *Field Naturalist's Magazine*, ii. p. 24.

METHOD OF COLLECTING BUTTERFLIES, SPHINGES, AND MOTHS.

Almost every country on the globe is inhabited by numerous species of lepidopterous insects. These are habited in more splendid attire as we approach the Tropics.

The localities of the lepidoptera are exceedingly varied; some inhabit open fields, others are to be found in the recesses of woods, lanes, and at the bottom of hedges. But by far the best way to make a collection of this order of insects is, to procure them either in the larva or pupa state; and, if in the former condition, they must be fed on their natural vegetable diet till they have attained their full size, and changed into the pupa condition. In this state they must be carefully kept till they transform into the perfect or imago state. By this means they are likely to be more perfect than when taken by the net or other means, as the scales or dust which invests their wings is very easily removed, which renders the insect imperfect, and has a tendency to destroy its beauty.

To procure the pupæ or larvæ of lepidopterous insects, the collector must beat the branches of trees into his folding gauze net, as also hedges, nettles, and other plants, on which these larvæ feed, or to which many of the pupæ are suspended by the tail.

In searching for moths which fly by night, the London collectors have a lantern constructed with a concave back, and provided with a reflector behind. This lantern is fastened round the body of the lepidopterist, about the region of the stomach, by means of a belt. The fly net should be held open in front by the collector, when all those nocturnal flying moths will be entrapped which come within the influence of the light, to which they are naturally attracted. In hot and close summer evenings, if a candle is placed on the table of a summer house, or in other rooms, with the windows open, it will be found that many of the night flying lepidoptera will be thereby attracted.

When taking lepidopterous insects by means of forceps, they should be as widely expanded as possible, and the insect should be approached with great caution. When the entomologist has approached sufficiently near, the instrument should be quickly closed on the animal, including the leaf on which it is settled. When the prey is secured, a gentle pressure with the finger and thumb is applied to the thorax below the wings, which soon kills it.

Mr Haworth, in the "*Lepidoptera Britannica,*" in mentioning the tenacity of life in the *Bombyx Cossus,* or Goat Moth, states, that "the usual way of compressing the *thorax* is not sufficient to kill this insect. They will live several days after the most severe pressure has been given there, to the great uneasiness of any humane entomologist. The methods of suffocation by tobacco or sulphur, are equally inefficacious, unless continued for a greater number of hours than is proper for the preservation of the specimens. Another method now in practice is better, and however fraught with cruelty it may appear to the inexperienced collector, is the greatest piece of *comparative mercy* that can, in this case, be administered. When the larger moths must be killed, destroy them at once by the *insertion of a strong, red-hot needle* into their thickest parts, beginning at the front of *the thorax.* If this be properly *done,* instead of *lingering through several days, they are dead in a moment.* It appears to me, however, that insects being animals of *cold* and *sluggish juices,* are not so susceptible of the sensations we call pain, as those which enjoy a warmer temperature of body, and a swifter circulation of the fluids. To the philosophic mind, it is self-evident that they have not such acute organs of feeling pain, as other animals of a *similar size,* whose juices are endowed with a quicker motion, and possess a constant, regular, and genial warmth, such as young mice, or the naked young of birds. If any of these have the misfortune to lose their heads or limbs from force, speedy death is the certain consequence; but insects under similar circumstances, it is well known, are capable of surviving a considerable time."

Butterflies are soon killed by passing a pin through the thorax; but probably the safest way is to adopt Mr Haworth's plan, of making their instant death certain. The pin passed through the thorax of small moths, generally proves almost instantly fatal to them.

But though nipping the breast will kill many small lepidŏptera, the larger ones will live long after it. "To despatch these effectually," say Kirby and Spence, "you will find the following apparatus very convenient:—Fix in a small tin saucepan, filled with boiling water, a tin tube consisting of two pieces that fit into each other; cover the mouth of the lower one with a piece of gauze or canvass, and place your insects upon it; then fix the upper one over it, and cover also the mouth of this with gauze, &c., and the steam from the boiling water will effectually kill your insects without injuring their plumage. There is another more simple mode of doing this; the apparatus for which may be met with every where. Fix a piece or two of elder or willow, or any soft wood, with the bark on, across the bottom of a mug, and on this stick your impaled insects, invert the mug in a deep basin, into which pour boiling water till it is covered, holding it down with a knife, &c., that the expansion of the included air may not overturn it. In two minutes, or less, all the insects will be found dead, and not at all wetted. If the sticks do not exactly fit, they may be wedged in with a piece of cork. Professor Peck, who used to put minute insects into the hollow of a quill, stopped with a piece of wood made to fit, killed them instantaneously by holding it over the flame of a candle." *

When the insects are killed, the next thing is to prepare them for being placed in the cabinet. The entomologist should have at hand a pincushion supplied with entomological pins, called *short whites.* The pin should be pierced through the middle of the thorax, forcing it sufficiently through, so that enough may be projecting to pierce the cork of the drawer, and hold the insect sufficiently firm. The insect, to look well, should be nearly close to the paper, but at such a distance as the legs do not touch the bottom, as they are thereby liable to be broken.

Some of the continental collectors have the insect forced up to nearly the head of the pin, so that they may examine it with a microscope without removing the glass lid. This, however, is liable to the

* Kirby and Spence, *Introduction to Entomology*, iv. p. 529.

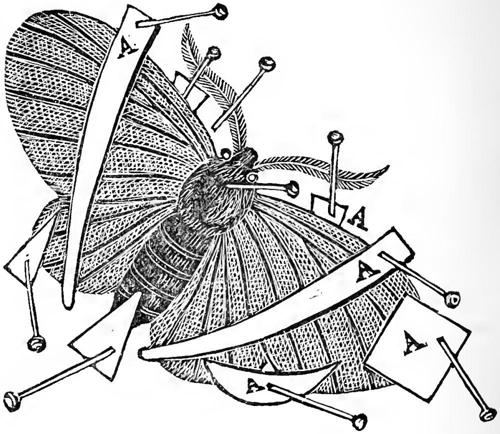
objection, that the pin is very liable to be bent in pushing it into the cork, and the insect does not look nearly so well as when near the paper.

The best method of arranging lepidopterous, or indeed other insects, is to arrange them in columns, with the generic name at the head of each column, and the specific name affixed to each species, or in a line with the insect to its right. The lines ought to be ruled with a black lead pencil, by which an alteration can easily be made without destroying the whole of the paper. Males and females should be placed together if they can be had; and if pos-tible two specimens of each, for the purpose of exhibiting both the upper and under side. If the insect is subject to variety, these should also be procured, as these are very useful in elucidating species. Besides the generic and specific names, the country should also be marked, as well as the particular locality of the specimens preserved.

OF SETTING LEPIDOPTERA.

The wings of lepidopterous insects should be adjusted with great nicety and uniformity, otherwise they never look well.

The larger insects of this order are set by braces chiefly. A single one should in the first place be introduced under the wing, near the thorax, as shown in the following figure,



and a longer brace extending over the wings, as at AA. These should not bear upon the wings, but be ready to rest gently on them, when required. The wings are now elevated to their proper position by the setting needle, and other braces are used as necessity dictates, in the manner represented in the above figure. The feet and antennæ are extended and kept in their places by means of pins ; in which operation small braces are also occasionally used.

The French entomologists set butterflies, moths, and sphinges, on a piece of soft wood, in which they have excavated a groove for the reception of the body, as deep as the insertion of the wings. They are otherwise preserved as above directed.

In the larger butterflies, moths, and sphinges, the abdomen should be perforated, its contents extracted, and then stuffed with fine cotton, after having been washed internally with the solution of corrosive sublimate. Indeed, the cotton should also be rubbed with the arsenical soap before being introduced, as these insects are particularly liable to the attack of smaller insects, such as the mite.

Several of the moth tribe are extremely liable to change their colour some time after they have been placed in a cabinet. This change is frequently occasioned by an oily matter which is common to many of them. This first makes its appearance in small spots on the body, but soon spreads itself over the abdomen, thorax, and wings; and ends in a total obliteration of all the beautiful markings. A method which has been sometimes successfully adopted, is to sprinkle all the wings with powdered chalk, and holding a heated iron over it; the chalk absorbs the grease, and may then be blown off by means of a pair of small bellows. Another way of applying the chalk, and perhaps the better of the two, is to throw some powdered chalk on the face of a heated iron, and then put it into a piece of linen cloth, and apply it to the body of the insect;

the heat of the iron will soften the grease, and the chalk will absorb it.

Another method is to hold a heated iron over the insects for a few minutes, and then to wash the spotted or greasy places with ox gall and water, applied with a camel-hair pencil, and afterwards wash it with pure water, and dry it by an application of bloating paper, and when perfectly dry imbue it with the solution of corrosive sublimate. But grease seldom appears where the contents of the abdomen have been removed.

It is most difficult, if not nearly impracticable, to set many of the smaller moths without destroying the characters of their wings; and the trunks of many of them are so small that they are not even the breadth of a pin. The only method therefore of preserving these is by gumming them on a card, and keeping their wings expanded by means of the gum. This must be applied with a camel-hair pencil. If the collector has two specimens, one should be set with expanded wings, and the other in the state while at rest. These small insects should be placed on dark coloured or black cards, if they are themselves pale; and if dark, they should be fixed on white cards.

ON PRESERVING EGGS OF LEPIDOPTERA.

The eggs of this order of insects are subject to great variety, not only in the form, but also in the markings which ornament their surface. They are very easily preserved. Swammerdam's method was to perforate them with a fine needle, and then press out their contents, afterwards inflate them with a glass blowpipe, and fill them with a mixture of oil of spike and resin.

OF LARVÆ OR CATERPILLARS.

Immersion in spirits of wine is the most immediate and effectual way of destroying caterpillars; and they may be long kept in it without injuring their colours.

For insects which undergo their metamorphoses under the ground, a larger breeding cage than recommended at page 220, will be found more effectual. It ought to be from three to four feet square, and from two to three feet deep, with a tin covering externally; through the sides and bottoms of which small holes should be pierced. This box should be filled with earth, having a quantity of vegetables placed in it, such as are fed on by the caterpillars intended to be bred, and then sink it into a bed of soil, allowing the surface to be exposed to the changes of the atmosphere. This box should have a covering of brass or iron wire-cloth to prevent the escape of the caterpillars. When they have fed their accustomed time, and attained maturity, they will dig themselves a recess under the surface of the soil, and there undergo their change into a chrysalis. In this condition they will continue, till transformed by the genial influence of the sun.

"Some years," says Mr Samouelle,* "produce a greater quantity of caterpillars than others; and keeping each kind by themselves would require an immense number of cages, and much time in changing the food, and paying a proper attention to them. It is a common practice to have a breeding cage of larger dimensions, by which means a great number of caterpillars may be fed in one cage, in which a variety of food may be put, but must be taken away and replaced with fresh plants, every second or third day, for this tends greatly to the obtaining of fine specimens of the perfect insect."

OF PUPÆ.

The skin of the pupæ generally retain their original shape and colour, as before the insect burst from its confinement. No preparation is therefore necessary, and it should only be fixed on a card, as above directed for the caterpillar.

* *Samouelle's Entomologist's Useful Compendium*, p. 310.

THE INSECT CABINET.

The drawers of the cabinet should be about fifteen inches in length, eighteen in breadth, and two inches deep. There should be a layer of cork of about the sixth of an inch in thickness glued on the bottoms, and a piece of paper pasted on the top. The cork ought to be of the best quality, and free from cracks and knots. Each drawer should have a lid of glass, which must rest upon a rabbet. This excludes the air, and prevents dust.

" The simplest method of corking drawers is, to purchase the cork of a corkcutter, ready prepared; but it will be much cheaper for the entomologist to prepare it himself. In this case it should be cut into stripes, of about three inches wide, with a corkcutter's knife, to smooth the surface, and to divide it. The stripes should be fixed in a vice, and cut to the thickness required with a fine saw; but grease must not be used in the operation, as it will not only prevent the cork from adhering to the bottom of the drawer, but will also grease the paper which should be pasted on its surface. The black face of the cork should be rasped down to a smooth surface. After having reduced the slips to about three quarters of an inch in thickness, the darkest or worst side of each slip should be glued down to a sheet of brown, or cartridge paper; this should be laid on a deal board, about three feet in length, and of the width required for a drawer or box; a few fine nails, or brads, must be driven through each piece of cork, to keep it firm and in its place, until the glue be dried: by this means, sheets of cork may be formed the size of the drawer. All the irregularities are filed or rasped down quite to a level surface, and then polished smooth with pumice-stone. The sheet thus formed and furnished, is glued into the drawers. To prevent its warping, some weights must be equally distributed over the cork, that it may adhere firmly to the bottom of the drawer. When quite dry, the weights are removed, and the cork covered with fine white paper, but not very thick. The paper is allowed to be quite damp with the paste before it is placed on the cork; and, when dry, it will become perfectly tight." *

* *Brown's Taxidermist's Manual*, p. 89.

REMARKS ON THE PRESERVATION OF LEPIDOPTEROUS INSECTS.

Of all the varied tribes of insects, the lepidoptera are probably the most perishable. They are particularly subject to mouldiness, and are very liable to the attacks of mites, and other minute insects, which eat into and consume their bodies. Cabinets should therefore be kept in very dry situations; and care should be taken that the insect is perfectly dry when first placed in the cabinet. But when they do get mouldy, it may be washed off with a camel's hair pencil, dipped in camphorated spirits of wine. After which the insect must be placed in a dry or warm situation till thoroughly dried, before being returned into the cabinet.

Each drawer should always have a piece of camphor kept in it, for the purpose of preventing the mites from entering, although this does not always prove successful. The presence of mites is easily known by small parcels of dust, which will usually be found deposited where they are. They must be immediately picked out, and their lodgement carefully cleaned with a camel hair pencil, which has been previously dipped in a solution of corrosive sublimate, and then dried.

On this subject Mr Waterton makes the following remarks:—"I only know of two methods," says he, "to guard preserved insects from the depredations of living ones. The first is, by poisoning the atmosphere—the second is, by poisoning the prepared specimens themselves, so effectually, that they are no longer food for the depredators. But there are some objections to both these modes; a poisoned atmosphere will evaporate in time if not attended to, or if neglected to be renewed; and there is great difficulty in poisoning some specimens on account of their delicacy and minuteness. If you keep spirits of turpentine in the boxes which contain your preserved specimens, I am of opinion that those specimens will be safe as long as the odour of the turpentine remains in the box, for it is said to be the most pernicious of all scents to insects. But it requires attention to keep up an atmosphere of spirit of turpentine; if it be allowed to evaporate entirely, then there is a clear and undisputed path open to the inroads of the enemy; he will take advantage of your absence or neglect, and when you return to view your treasure you will find it in ruins. Spirits of turpentine poured into a common glass inkstand, in which there is a piece of sponge, and placed in a corner of your box, will create a poisoned atmosphere, and kill every insect there. The poisoning of your specimens by means of corrosive sublimate in alcohol, is a most effectual method. As soon as the operation is properly performed, the depredating insect perceives that the prepared specimen is no longer food for it, and will for ever cease to attack it; but then every part must have received the poison, otherwise those parts where the poison has not reached will still be exposed to the enemy, and he will pass unhurt over the poisoned parts till he arrives at that part of your specimen which is still wholesome food for him. Now, the difficulty lies in applying the solution to very minute specimens without injuring their appearance; and all that can be said is, to recommend unwearied exertion, which is sure to be attended with great skill, and great skill will insure surprising success. I myself have attended to the preservation of insects with the assiduity which Horace recommends to poets:—'Nocturna versate manu, versate diurna.' The result has been astonishing success, and a perfect conviction that there is no absolute and lasting safety for prepared specimens in zoology from the depredations of insects, except by poisoning every part of them with a solution of corrosive sublimate in alcohol.

"The tight boxes, and aromatic atmospheres, will certainly do a great deal, but they are liable to fail, for this obvious reason, viz. that they do not render for ever absolutely baneful and abhorrent to the depredator, that which in itself is nutritious and grateful to him. In an evil hour, through neglect in keeping up a poisoned atmosphere, the specimens collected by industry, and prepared by art, and which ought to live, as it were, for the admiration of future ages, may fall a prey to an intruding and almost invisible enemy; so that unless the solution of corrosive sublimate in alcohol is applied, you are never perfectly safe from surprise. I have tried a decoction of aloes, wormwood, and walnut leaves, thinking they would be of service, on account of their bitterness: the trial completely failed. Wherefore I venture to recommend not to put much trust in simples.

'Contra vim mortis, non est medicamen in hortis.'

'Against the deadly moth, can I,
From herbs, no remedy supply.'"

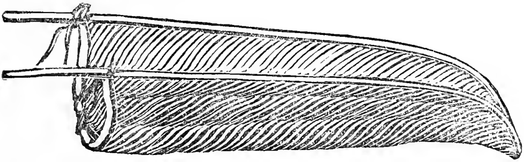
METHOD OF TRANSPORTING INSECTS.

The plan described by Levaillant in his Travels in Africa, for the preservation of his entomological collections, is the following:—Boxes or chests carefully made of light wood, of a convenient portable size, are provided with partitions and moveable shelves, each consisting of a simple board; these are fitted, at the distance of two inches one from another, in grooves in the sides of the box, in which they are made to slide with accuracy and facility, and are therefore removable at pleasure

These boards or shelves have necessarily the exact dimensions of the ends of the chest, and are placed in a vertical position; a small vacancy is preserved between their lower extremity and the floor, and any object detached by accident falls to the bottom without causing farther injury. Each board or shelf, lined with cork or soft wood, supplies, in some measure, the place of a cabinet drawer. When taken out of the box and placed on a table, it rests securely and affords a plain surface, upon which insects may be fixed, or examined with perfect ease and security. It is returned into the box in an instant, which, if carefully made, when closed, secures most effectually the contents. One large box may conveniently contain fourteen boards, answering the purpose of as many drawers; and, being eighteen inches square, they are of a manageable size. Dr Horsfield found these boxes most admirably adapted to his entomological pursuits while in Java, and preferred those made of light wood. He says, that when he commenced packing for transportation, "boxes according to Levaillant's plan, were therefore provided of more substantial material than those employed in travelling, in proportion to the increase of the collection. The wood of the *Bombax pentandrum* was employed for lining the boards and securing the pins; and I ascribed to an acquaintance with the peculiar property of this wood, which renders it an effectual substitute for cork, the preservation of the collection during its transportation. After having carefully packed the subjects, every necessary precaution that suggested itself was used in securing the boxes against accidents during the voyage. They were individually painted and covered with oil cloth. Each box was then placed in an outer case, made of the same substantial materials, and secured in the same manner," by which means the whole of his extensive and valuable collection of lepidopterous insects were safely brought to England.

Caterpillars may also be preserved by first squeezing out their entrails, and insert into the puncture a glass tube which has been drawn to a very fine point. This pipe must be blown into while the skin of the caterpillar is held over a charcoal fire, and kept constantly turned round, until it becomes hardened. It is then rubbed over with oil of spike, dried, and then placed into the cabinet. They should be gummed to a piece of card, so that they may not be touched in lifting them, as they are very liable to be squeezed, and thus broken.

INSTRUMENTS USED IN COLLECTING, SETTING, AND PRESERVING BUTTERFLIES, SPHINGES, AND MOTHS.



THE ENTOMOLOGICAL OR FLY NET.

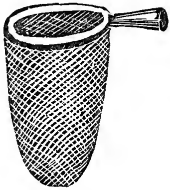
THIS net, which is figured above, is similar in construction to the bat fowling-net, and is either made of close green gauze or open muslin. It is sometimes white, which is not so useful as green, although the former is best adapted for minute moths, being more easily seen on it. The rods ought to be made of beech or hickory; holly and hazel will also answer the purpose. They should be from five to six feet in length, made quite round and smooth, and gradually tapering to a point. The cross-piece should be made of cane, and fitted into a ferrule of an angulated form. The rod should be divided into three or four pieces, so that it may be carried conveniently in the pocket; a ferrule should be riveted on each joint at the upper part;

and each joint should be provided with a notch or check, so as to prevent the upper part from warping. Great care ought to be taken in fitting the joints to the brass tubes, so that they may fit exactly, and thus prevent them from falling to pieces.

THE FOLDING NET.

This net must be bound round with a broad welting, doubled, for receiving the side rods. At the top there must be a piece of shamois leather, for the purpose of acting as a hinge, which must be sewed round the welting, divided and attached in the middle, so as to prevent the cross-piece from slipping; at the lower side there should be about four inches of gauze turned up, so as to form a bag; there ought to be strings attached, so as to pass through a staple for drawing the net tight on each side.

When this instrument is used, the handles or rods are to be taken one in each hand, and with this lepidopterous insects may be taken during their flight; and this is performed by opening and shutting the net, and securing the insects between the folds. It may also be used for collecting caterpillars. When used for this purpose, the lepidopterist must expand it under the trees, bushes, or plants, which they inhabit, and beat the branches with a stick, and the caterpillars will naturally fall on the net.



THE HOOP NET.

This hoop net consists of a strong brass wire hoop, from nine inches to a foot in diameter, with a socket for receiving the end of a walking stick or rod, which the lepidopterist should always carry along with him. Some are made with a screw, for greater security. To this ring is attached a bag of net, gauze, or muslin, about a foot in depth. "The French collectors," say Messrs Kirby and Spence,* "use a net of this kind, in which the hoop is formed of two semicircular pieces of iron or brass wire, hooked together at one end, and at the other made to lap over the corresponding piece, and pierced to receive the screw at the end of your stick. When not employed they double the hoop, and conceal it under the rest; they fix to it a muslin bag of two feet long. This net is made to serve various purposes. With it they catch *Lepidoptera* and other flying insects; and an adroit collector, by giving it a certain twist, completely closes the mouth,

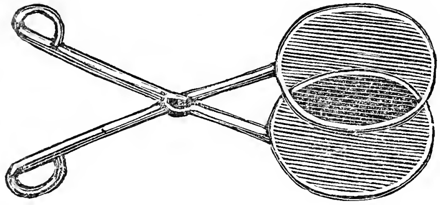
* *Introduction to Entomology*, iv. p. 516.

so as to prevent the escape of his captives. Fixed to a very long pole, (Mr Haworth says it should be twenty or thirty feet long,) it is the best net for the Purple Emperor Butterfly," described at page 156, volume first of this work.*

MACLEAN'S ELASTIC NET.

This net is constructed of two stout pieces of cane, split and connected by a joint at each end, also by a rod which lies between them, "in which a pully is fixed; through this a cord fastened to the canes passes; a long cane with a ferrule receives the lower end of the rod, and forms a handle; and to the canes is fastened a net of green gauze." The handle is taken in the right hand, and the string in the left; when the latter is pulled, the canes bend till they form a hoop, and the net appended to them is open; when insects are within it the cord is relaxed, and the canes become straight. Close the mouth of the net, and secure the insects. These are kept close by the left hand, and the prey is disabled with the right.

* Page 152, vol. i., First Edition.



ENTOMOLOGICAL FORCEPS.

The forceps is a very useful instrument for collecting day-flying lepidopterous insects.

Some of these are formed with octagonal leaves, and others circular or oval; they ought to be five or six inches in diameter, and covered with muslin or green gauze, or very fine catgut, the meshes of which ought to allow the head of a lace pin to pass through it. The joint of the handle should be placed nearer the rings for the finger and thumb, than to the leaves of the instrument, or it will not open well. The handles may be made of iron, but the hoop should always be of brass, to prevent its rusting, or, if made of iron, it ought to be painted. The objection to the leaves of forceps being round is, that when the insect wished to be seized is perched upon a wall, or other vertical situations, they cannot be applied with such certainty of securing the object.

The entomological forceps made use of in Germany are not only longer in the handles, but also larger in the leaves. The leaves are generally from ten to twelve inches in diameter.

POCKET COLLECTING BOX.

The lepidopterist ought to provide himself with one or two light chip boxes, or thin deal ones. These should be lined with cork on the bottom. When an insect is taken, and killed, a pin should be passed through its thorax, and with this it ought to be attached to the bottom of the box. These boxes should have camphor placed in them, within a small gauze bag, which has the effect of rendering the animal soon stupid, and ultimately of killing it.

Messrs Kirby and Spence recommend that the boxes should be numbered in a small memorandum-book, carried for the purpose, in which should be inserted any remarks, as to food, station, and habits of any insect which may be taken, inserting against them the number of the box or phial that contains it.

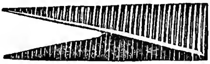
The same gentlemen say they have found, when at a loss, a piece of elder, with the pith taken out to a sufficient depth at both ends, and each mouth stopped with a wooden plug, a useful insect box. This we should think particularly useful in the case of taking small moths, which are difficult to be secured in the open air, from their smallness, and also the danger of destroying the farina of their wings.

COLLECTING PHIAL.

For the smaller species of butterflies and moths, a small wide-mouthed phial will be found extremely useful to the collector. In the cork should be inserted a flattened tin tube, into which a piece of wood should be neatly fitted. By putting the insects through this tube, there is no likelihood of those which are already within the phial escaping.

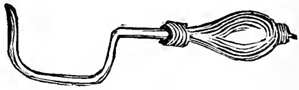
POCKET LARVÆ BOX.

This is simply a small chip-box, with an aperture at top and bottom, and covered with fine open muslin, for the admission of air. Care ought to be taken to insert into the box a portion of the leaves on which the caterpillar feeds, as larvæ feed almost unremittingly, consuming many times their own weight of leaves every day.



BRASS PLIARS.

This instrument is indispensable in picking up small insects, as by using them the entomologist is less likely to remove the scaly powder from the wings.

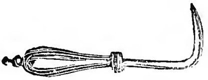


A DIGGER.

This instrument is made of steel or iron, somewhat about six inches in length, and fixed into a wooden handle. It is used for collecting the pupæ of lepidopterous insects, which lie concealed at the roots of trees and bottoms of hedges. It is also used for stripping off the bark from trees, where the larvæ of many rare insects are to be found; it ought to be arrow-pointed.

SETTING NEEDLE.

This instrument is fixed to the stalk of a common hair pencil, and is used for extending the parts of insects, such as their limbs, antennæ, wings, &c. On the opposite end of the stick there ought to be a hair pencil, for the purpose of removing any dust which may fall upon them.



This is another kind of Setting Needle, the use of which will be obvious.

PINS.

The pins used for insects are the small lace kind, and made very fine for the express purpose; they ought to be well tinned, to prevent the juices of the insect from acting on them, and thus producing verdigris, which destroys the insects.

SETTING BOARDS.

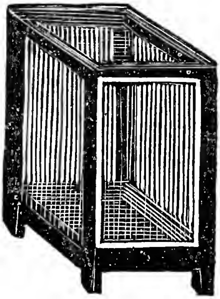
These consist simply of convenient sized thin deal boards, and covered with a thin layer of cork; which ought to be perfectly level on the surface, and covered with white paper.

BRACES.

These are small slips of card, which are made use of for confining the wings of butterflies, sphinges, and moths, while in the act of drying.

STORE BOXES.

These should not exceed a foot square in size; both top and bottom being about two inches and a half in depth; and made on the same plan as backgammon boards. The inside should be lined with cork, covered with paper.



THE BREEDING CAGE.

This is used for rearing the caterpillars or larvæ of lepidopterous insects as they are hatched. It ought to be made of hard wood, having its sides and front covered with gauze or fine muslin. In the inside is affixed a box or tube for the reception of a small phial for inserting plants, on which the caterpillars are accustomed to feed, which it is intended to rear. Breeding cages may be made of any dimensions; but the most convenient size is about a foot in height, eight inches in breadth, and from four to five in depth. One species of caterpillar only ought to be introduced at a time, as many of these devour each other.

A quantity of earth, mixed with a little sand, of about two inches in depth, should be placed at the bottom of each box. The mould should be of a fine vegetable kind, if possible, which does not so easily dry and consolidate as clayey soil. The cages should be placed in some cool place, away from the influence of the sun, as many species pass to the pupa condition, remain in that state, and transform into the perfect insect under the surface of the earth. Consequently, if the earth is dry and hard, they will be unable to burst from their confinement.

" Those who endeavour to rear the Death's Head Hawk Moth, often fail after the insect has passed into a chrysalis state. I have been informed," says Mr L. W. Clarke, " by a person who has several times bred them, that his method is to moisten the chrysalis every morning with warm water, and then place it in the breeding cage, near the fire, by which means the fluids of the body are preserved, and the case is not too strong for the perfect insect to penetrate. He also says, that if they be placed in a bark stove with plants, and covered with the earth, they will not perish, as is the case with those generally exposed to the temperature of our climate." *

* *Field Naturalist's Magazine*, vol. i. p. 48.

END OF VOLUME THIRD.

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