
W. J. HOLLAND
THE BUTTERFLY BOOK

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A Popular Guide to a Knowledge of the Butterflies of North America

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THE LIFE-HISTORY AND ANATOMY OF BUTTERFLIES

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> "The study of butterflies—creatures selected as the types of airiness and frivolity—instead of being despised, will some day be valued as one of the most important branches of biological science."—BATES, *Naturalist on the Amazons*.

In studying any subject, it is always well, if possible, to commence at the beginning; and in studying the life of animals, or of a group of animals, we should endeavor to obtain a clear idea at the outset of the manner in which they are developed. It is a familiar saying that "all life is from an egg." This statement is scientifically true in wide fields which come under the eye of the naturalist, and butterflies are no exception to the rule.

THE EGGS OF BUTTERFLIES

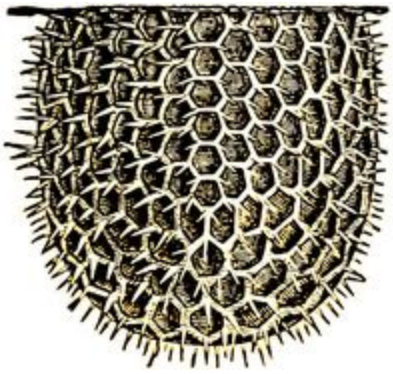

Fig. 1.—Egg of *Basilarchia disippus*, magnified 30 diameters (Riley).

Fig. 2.—Egg of *Basilarchia disippus*, natural size, at the end of under surface of leaf (Riley).

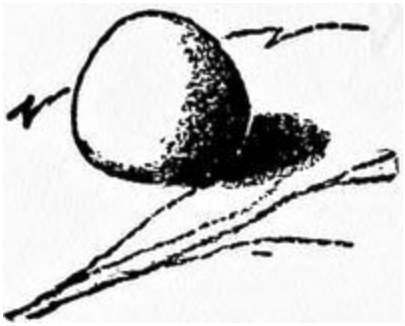

Fig. 3.—Egg of *Papilio turnus*, greatly magnified.

The eggs of butterflies consist of a membranous shell containing a fluid mass composed of the germ of the future caterpillar and the liquid food which is necessary for its maintenance and development until it escapes from the shell. The forms of these eggs are various. Some are spherical, others hemispherical, conical, and cylindrical. Some are barrel-shaped; others have the shape of a cheese, and still others have the form of a turban. Many of them are angled, some depressed at the ends. Their surface is variously ornamented. Sometimes they are ribbed, the ribs running from the center outwardly and downwardly along the sides like the meridian lines upon a globe. Between these ribs there is frequently found a fine network of raised

lines variously arranged. Sometimes the surface is covered with minute depressions, sometimes with a series of minute elevations variously disposed. As there is great variety in the form of the eggs, so also there is great variety in their color. Brown, blue, green, red, and yellow eggs occur. Greenish or greenish-white are common tints. The eggs are often ornamented with dots and lines of darker color. Species which are related to one another show their affinity even in the form of their eggs. At the upper end of the eggs of insects there are one or more curious structures, known as micropyles (little doors), through which the spermatozoa of the male find ingress and they are fertilized. These can only be seen under a good microscope.

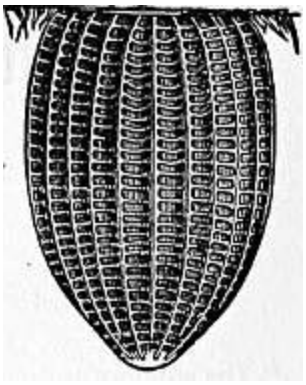

Fig. 4.—Egg of *Anosia plexippus*, magnified 30 diameters (Riley).

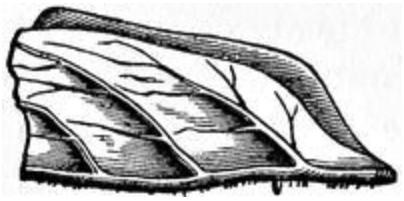

Fig. 5.—Egg of *Anosia plexippus*, natural size, on under side of leaf (Riley).

Fig. 7.—Turban-shaped egg of *Lycæna pseudargiolus*, greatly magnified.

Fig. 8. —Egg of *Melitæa*

***phaëton*, greatly magnified.**

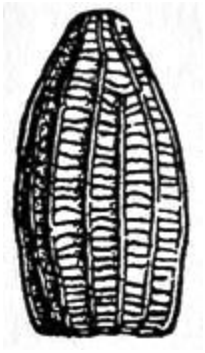

Fig. 6.—Egg of *Anthocharis genutia*, magnified 20 diameters.

The eggs are laid upon the food-plant upon which the caterpillar, after it is hatched, is destined to live, and the female reveals wonderful instinct in selecting plants which are appropriate to the development of the larva. As a rule, the larvæ are restricted in the range of their food-plants to certain genera, or families of plants.

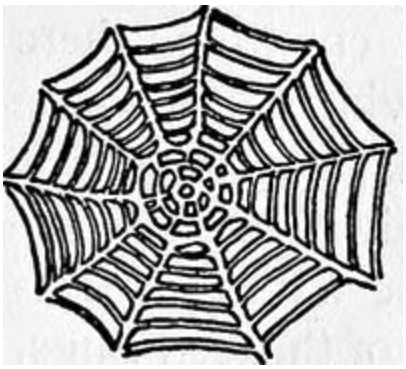

Fig. 9.—Upper end of egg of *Pieris oleracea*, greatly magnified, showing the micropyle.

Fig. 10.—Egg of *Grapta comma*, laid in string-like clusters on the under side of leaf. (Magnified.)

The eggs are deposited sometimes singly, sometimes in small clusters, sometimes in a mass. Fertile eggs, a few days after they have been deposited, frequently undergo a

change of color, and it is often possible with a magnifying-glass to see through the thin shell the form of the minute caterpillar which is being developed within the egg. Unfruitful eggs generally shrivel and dry up after the lapse of a short time.

The period of time requisite for the development of the embryo in the egg varies. Many butterflies are single-brooded; others produce two or three generations during the summer in temperate climates, and even more generations in subtropical or tropical climates. In such cases an interval of only a few days, or weeks at the most, separates the time when the egg was deposited and the time when the larva is hatched. When the period of hatching, or emergence, has arrived, the little caterpillar cuts its way forth from the egg through an opening made either at the side or on the top. Many species have eggs which appear to be provided with a lid, a portion of the shell being separated from the remainder by a thin section, which, when the caterpillar has reached the full limit allowed by the egg, breaks under the pressure of the enlarging embryo within, one portion of the egg flying off, the remainder adhering to the leaf or twig upon which it has been deposited.

Fig. 11.—Eggs of *Vanessa antiopa*, laid in a mass on a twig.

CATERPILLARS

Structure, Form, Color, etc.—The second stage in which the insects we are studying exist is known as the larval stage. The insect is known as a larva, or a caterpillar. In general caterpillars have long, worm-like bodies. Frequently they are thickest about the middle, tapering before and behind, flattened on the under side. While the cylindrical shape is most common, there are some families in which the larvæ are short, oval, or slug-shaped, sometimes curiously modified by ridges and prominences. The body of the larvæ of lepidoptera consists normally of thirteen rings, or segments, the first constituting the head.

Fig. 12.—Caterpillar of *Papilio philenor* (Riley).

Fig. 13.—Head of caterpillar of *Papilio asterias*, front view, enlarged.

Fig. 14.—Head of caterpillar of *Anosia plexippus*, lower side, magnified 10 diameters: *lb*, labrum, or upper lip; *md*, mandibles; *mx*, maxilla, with two palpi; *lm*, labium, or lower

lip, with one pair of palpi; *s*, spinneret; *a*, antenna; *o*, ocelli. (After Burgess.)

The head is always conspicuous, composed of horny or chitinous material, but varying exceedingly in form and size. It is very rarely small and retracted. It is generally large, hemispherical, conical, or bilobed. In some families it is ornamented by horn-like projections. On the lower side are the mouth-parts, consisting of the upper lip, the mandibles, the antennæ, or feelers, the under lip, the maxillæ, and two sets of palpi, known as the maxillary and the labial palpi. In many genera the labium, or under lip, is provided with a short, horny projection known as the spinneret, through which the silk secreted by the caterpillar is passed. On either side, just above the mandibles, are located the eyes, or ocelli, which in the caterpillar are simple, round, shining prominences, generally only to be clearly distinguished by the aid of a magnifying-glass. These ocelli are frequently arranged in series on each side. The palpi are organs of touch connected with the maxillæ and the labium, or under lip, and are used in the process of feeding, and also when the caterpillar is crawling about from place to place. The larva appears to guide itself in great part by means of the palpi.

PLATE II

Fig. 15.—Head of caterpillar of *Anosia plexippus*, side view, showing ocelli.

The body of the caterpillar is covered by a thin skin, which often lies in wrinkled folds, admitting of great freedom of motion. The body is composed, as we have seen, of rings, or segments, the first three of which, back of the head, correspond to the thorax of the perfect insect, and the last nine to the abdomen of the butterfly. On each ring, with the exception of the second, the third, and the last, there is found on either side a small oval opening known as a spiracle, through which the creature breathes. As a rule, the spiracles of the first and eleventh rings are larger in size than the others.

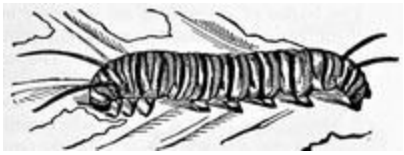

Fig 16.—Caterpillar of *Anosia plexippus*, milkweed butterfly (Riley).

Every caterpillar has on each of the first three segments a pair of legs, which are organs composed of three somewhat horny parts covered and bound together with skin, and armed at their extremities by a sharp claw (Fig. 17). These three pairs of feet in the caterpillar are always known as the fore legs, and correspond to the six which are found in the butterfly or the moth. In addition, in most cases, we find four pairs of prolegs on the under side of the segments from the sixth to the ninth, and another pair on the last segment, which latter pair are called the anal prolegs. These organs, which are necessary to the life of the caterpillar, do not reappear in the perfect insect, but are lost when the transformation from the caterpillar to the chrysalis takes place. There are various modifications of this scheme of foot-like appendages, only the larger and more highly developed forms of lepidoptera having as many pairs of prolegs as have been enumerated.

Fig. 18.—

Fig. 17.—Fore leg of caterpillar of *Vanessa antiopa*, enlarged.

Anterior segments of caterpillar of milkweed butterfly, showing thoracic or true legs (Riley).

Fig. 19.—Proleg of caterpillar of *Vanessa antiopa*, enlarged.

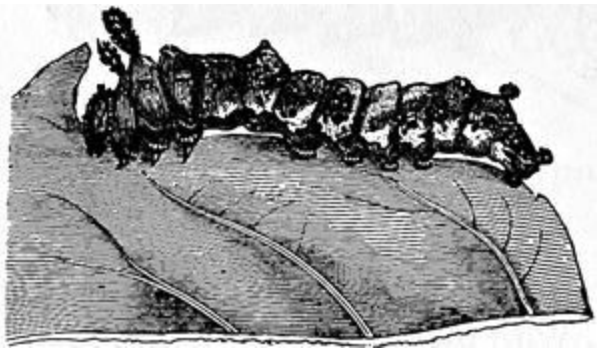

Fig. 20.—Caterpillar of *Basilarchia disippus*, the viceroy, natural size (Riley).

The bodies of caterpillars are variously ornamented: many of them are quite smooth; many are provided with horny projections, spines, and eminences. The coloration of caterpillars is as remarkable in the variety which it displays as is the ornamentation by means of the prominences of which we have just spoken. As caterpillars, for the most part, feed upon growing vegetation, multitudes of them are green in color, being thus adapted to their surroundings and securing a measure of protection. Many are brown, and exactly mimic the color of the twigs and branches upon which they rest when not engaged in feeding. Not a few are very gaily colored, but in almost every case this gay coloring is found to bear some relation to the color of the objects upon which they rest.

Caterpillars vary in their social habits. Some species are gregarious, and are found in colonies. These frequently build for themselves defenses, weaving webs of silk among the

branches, in which they are in part protected from their enemies and also from the inclemencies of the weather. Most caterpillars are, however, solitary, and no community life is maintained by the vast majority of species. Many species have the habit of drawing together the edges of a leaf, in which way they form a covering for themselves. The caterpillars of some butterflies are wood-boring, and construct tunnels in the pith, or in the soft layers of growing plants. In these cases, being protected and concealed from view, the caterpillars are generally white in their coloration, resembling in this respect the larvæ of wood-boring beetles. A most curious phenomenon has within comparatively recent years been discovered in connection with the larval stage of certain small butterflies belonging to the family *Lycœnidœ*. The caterpillars are carnivorous, or rather aphidivorous; they live upon aphids, or plant-lice, and scale-insects, and cover themselves with the white exudations or mealy secretions of the latter. This trait is characteristic of only one of our North American species, the Harvester (*Feniseca tarquinius*).

Fig. 21.—Early stages of the goatweed butterfly: *a*, caterpillar; *b*, chrysalis; *c*, leaf drawn together

at edges to form a nest. (Natural size.) (Riley.)

In addition to being protected from enemies by having colors which enable them to elude observation, as has been already stated, some caterpillars are provided with other means of defense. The caterpillars of the swallowtail butterflies are provided with a bifurcate or forked organ, generally yellow in color, which is protruded from an opening in the skin back of the head, and which emits a powerful odor (Fig. 22). This protrusive organ evidently exists only for purposes of defense, and the secretion of the odor is analogous to the secretion of evil odors by some of the vertebrate animals, as the skunk. The majority of caterpillars, when attacked by insect or other enemies, defend themselves by quickly hurling the anterior part of the body from side to side.

Fig. 22.—Head of caterpillar of *Papilio troilus*, with scent-organs, or *osmateria*, protruded.

Moults.—Caterpillars in the process of growth and development from time to time shed their skins. This process is called *moulting*. Moulting takes place, as a rule, at regular intervals, though there are exceptions to this rule. The young larva, having emerged from the egg, grows for a number of days, until the epidermis, or true skin, has become too small. It then ceases feeding, attaches itself firmly to some point, and remains quiet for a time. During this period certain changes are taking place, and then the skin splits along the middle line from the head to the extremity of the last segment, and the caterpillar crawls forth from the skin, which is left behind it, attached to the leaf or branch to which it was fastened. The skin of the head

sometimes remains attached to the head of the caterpillar for a time after it has moulted, and then falls off to the ground. Ordinarily not more than five, and frequently only four, moults take place between hatching from the egg and the change into the chrysalis. In cases where caterpillars hibernate, or pass the winter in inaction, a long interval necessarily elapses between moults. Some arctic species are known in which the development from the egg to the perfect insect covers a period of two or three years, long periods of hibernation under the arctic snows taking place. The manner in which the caterpillar withdraws itself from its exuviæ, or old skin, is highly interesting. Every little spine or rough prominence is withdrawn from its covering, and the skin is left as a perfect cast of the creature which has emerged from it, even the hairs and spines attached to the skin being left behind and replaced by others.

The Food of the Caterpillar.—The vast majority of the caterpillars of butterflies subsist upon vegetable food, the only exceptions being the singular one already noted in which the larvæ feed upon scale-insects. Some of the *Hesperiidæ*, a group in which the relationship between butterflies and moths is shown, have larvæ which burrow in the roots and stems of vegetation.

Duration of the Larval State.—The duration of the larval state varies greatly. In temperate climates the majority of species exist in the caterpillar state for from two to three months, and where hibernation takes place, for ten months. Many caterpillars which hibernate do so immediately after emerging from the egg and before having made the first moult. The great majority, however, hibernate after having passed one or more moults. With the approach of spring they renew their feeding upon the first reappearance of the foliage of their proper food-plant, or are transformed into chrysalids and presently emerge as perfect insects. A few

species live gregariously during the period of hibernation, constructing for themselves a shelter of leaves woven together with strands of silk.

Transformation.—The larval or caterpillar stage having been completed, and full development having been attained, the caterpillar is transformed into a pupa, or chrysalis. Of this, the third stage in the life of the insect, we now shall speak at length.

THE PUPA, OR CHRYSALIS

The caterpillars of many butterflies attach themselves by a button of silk to the under surface of a branch or stone, or other projecting surface, and are transformed into chrysalids, which are naked, and which hang perpendicularly from the surface to which they are attached. Other caterpillars attach themselves to surfaces by means of a button of silk which holds the anal extremity of the chrysalis, and have, in addition, a girdle of silk which passes around the middle of the chrysalis, holding it in place very much as a papoose is held on the back of an Indian squaw by a strap passed over her shoulders.

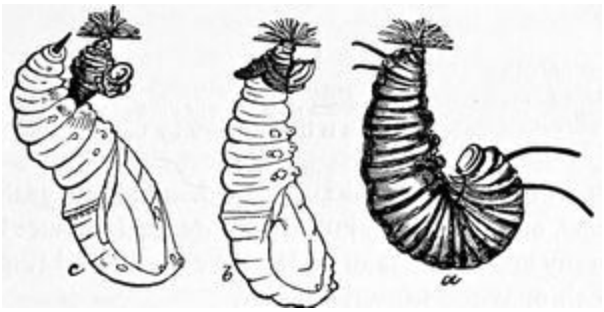

Fig. 23.—Caterpillar of *Anosia plexippus*, undergoing change into chrysalis: *a*, caterpillar just before rending of the skin; *b*, chrysalis just before the cremaster, or hook, at its end is withdrawn; *c*, chrysalis holding itself in place by the folds of the shed skin caught between the edges of the abdominal segments, while with the cremaster, armed with microscopic hooks, it searches for the button of silk from which it is to hang (Riley). (Compare Fig. 24, showing final form of the chrysalis.)