MOTHS.

ENCYCLOPÆDIA BRITANNICA, NINTH EDITION.

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tion they take several days to deposit their eggs, during which the life of the male is of no further consequence to the perpetuation of the species. Whatever may be the true interpretation of this phenomenon, it is certain that many butterflies and moths of both sexes are so coloured as to be to a greater or less extent protected thereby. Many moths, which rest by day clinging to the trunks of trees, so exactly resemble in the colour of their upper wings the bark on which they rest as only to be distinguished on close examination; while many small species which habitually rest on leaves are often mistaken for the droppings of birds. The upper surfaces of the wings of butterflies are in almost all cases the more gaily coloured, and when at rest, these are raised perpendicularly over the back, so as only to expose the under surfaces, which are often dull coloured, and in some cases have been shown to be directly imitative of surrounding objects. The best example of this is to be found in the Malayan butterfly, *Kallima paralekta*, and its Indian ally, *Kallima inachis*, both brilliant and conspicuous insects on the wing, but which no sooner alight than they become invisible. The under surfaces of their wings, though varying greatly, yet form in every case a perfect representation of a leaf in some stage or other of decay, the butterfly at the same time disposing of the rest of its body so as to bear out the deception. How this is effected is best told by Mr Wallace, who was the first to observe it, in his valuable work on the Malay Archipelago.

"The habit of the species is always to rest on a twig and among dead or dried leaves, and in this position, with the wings closely pressed together, their outline is exactly that of a moderately sized leaf slightly curved or shrivelled. The tail of the hind wings forms a perfect stalk and touches the stick, while the insect is supported by the middle pair of legs, which are not noticed among the twigs and fibres that surround it. The head and antennæ are drawn back between the wings so as to be quite concealed, and there is a little notch hollowed out at the very base of the wings, which allows the head to be retracted sufficiently."

Moths, when at rest, have the hind wings folded close to the body, while the fore wings cover all, and it is the latter that usually show an assimilation in colour to surrounding nature. Many butterflies and moths, there seems good reason to believe, are coloured in imitation of other and often widely different species possessing some special means of protection, as sting or nauseous juices, the mimetic forms, it is supposed, sharing with their models in immunity from the attacks of insectivorous animals. The phenomena of mimickry were first observed by Bates among the *Heliconidæ*, a family of South American butterflies, remarkable for their great numbers, the gaudiness of their colouring in both sexes and on both surfaces of their wings, and for their comparative slowness of flight. It was found that, owing to the nauseous nature of their juices, those brilliant butterflies were left unmolested by insect-eaters. It was also observed that several species of a genus closely allied to our Cabbage Butterflies, totally different both in the colour and form of the wings from the *Heliconidæ*, so closely resembled particular species of the latter as not to be distinguishable from them on the wing. Exactly similar phenomena have been observed in the tropical regions of Asia and Africa, where the similarly protected *Danaïdæ* and *Acræidæ* find imitators among the otherwise unprotected Papilios and Diademas. There are two families of day-flying moths, *Sesiidæ* and *Ægeriidæ*, with clear transparent wings, the scales being confined mainly to the margins and nervures, which in their wings and in the form and colour of their bodies might be readily mistaken for bees or wasps, a similarity recognized in such specific names as *bombiciformis*, *apiformis*, *vespiformis*, &c., applied to different species of these moths. Other species of the same "clear wing" group have opaque wings closely resembling those of certain species of *Coleoptera* found in the same neighbourhood, and these have their wings when at rest closed over their bodies like the elytra of beetles.

Butterflies and moths undergo complete metamorphosis, that is, after emerging from the egg, and before attaining the full development of the imago, they pass through the larva and pupa stages—the latter being one of total inactivity in so far as the outward manifestations of life are concerned. The eggs vary greatly in shape, and are deposited in a great variety of situations—on the under sides of leaves, on the outside of the cocoon, as in the Vapourer Moth (*Orgyia antiqua*), the female of which is wingless, glued together in rings round the smaller branches of fruit trees, as in *Clisiocampa neustria*, or in the interior of hives, the larvæ afterwards feeding on the wax, as in the Honey-comb Moth (*Galleria cerella*). They thus show a remarkable instinct in depositing their eggs in situations where the larvæ may afterwards obtain their appropriate food, although they themselves can have no knowledge of that food. The caterpillar emerges from the egg usually in a week or ten days. Unlike the perfect insect it is provided with a masticatory mouth. It has three pairs of legs on the anterior segments of its body, corresponding to the six legs of the future imago, besides which it is provided with a variable number of conical feet or *prolegs* placed posteriorly, and which are merely processes of the external covering of the caterpillar. Goossens, a Continental naturalist, has recently observed that the number of prolegs in some species differs at different ages, and gives a case in which a caterpillar with originally six prolegs acquired two additional pairs after the third moult. The body cavity is almost entirely occupied with the digestive system, and with that concerned in the production of the silky material used in forming the cocoon. Silk is secreted as a viscous fluid in tubes, which after many convolutions widen into a large reservoir filled with the yellow liquid, narrowing again into a tube extending to the mouth, where it communicates with the outside by means of a conical and jointed papilla known as the *spinneret*. Through this organ the viscous fluid is forced in two exceedingly delicate streams, which coalesce, and on exposure to the atmosphere harden into a single continuous thread. The silky material is not completely formed till the caterpillar reaches maturity. Caterpillars are either smooth skinned or more or less covered with hairs; in the former case they are a favourite food of insectivorous animals, while in the latter they are almost universally rejected,—recent investigations on this subject going to prove that the hairs on certain species of caterpillars have a power of stinging, somewhat analogous to that possessed by the hairs on the surface of a nettle.

No sooner does the caterpillar emerge from the egg than it begins to eat voraciously, and in a few days has grown so large that a change of skin becomes necessary. The old skin is cast off, and with it the entire internal lining of the alimentary canal, and in the majority of butterflies and moths five such changes take place before the caterpillar has attained its full growth, while the Tiger Moth (*Arctia caja*) is said to cast its skin at least ten times. Those moultings do not usually affect the appearance of the caterpillar, except in enlarging it; but in the case of *Samia cecropia*, a species of *Bombycidæ*, the larvæ are said to pass from black to various shades of green and azure blue in the course of their moultings. The larvæ of the family *Psychidæ*—the larger members of which are found in America and Australia—have the curious habit of constructing cases which they carry about with them, and within which they afterwards undergo transformation. Each larva has but a single case, and when this gets too narrow it splits longitudinally and is enlarged by interpos-