PSYCHE.

ON THE NUMBER OF MOLTS OF BUTTERFLIES, WITH SOME HISTORY OF THE MOTH *CALLOSAMIA PROMETHEA*.

BY WILLIAM H: EDWARDS, COALBURGH, W. VA.

When I first began to study the history of the lepidoptera, it was difficult to learn from any quarter how many molts lepidopterous larvae underwent. No one to whom I could apply could tell with any assurance of certainty what was the number of molts among the butterflies, and authors either disagreed or were silent on the subject. Burmeister (Lond. ed., 1836, page 431) says: "The caterpillars of the butterflies molt, according to Kirby and Spence, *frequently; but thrice*, according to Cuvier. The caterpillars of the *noctuae*, *on the contrary*, *molt four times*," etc.

Boisduval (Spec. Gen., v. 1, p. 46) says: "These molts are more or less numerous according to the family; the *rhopalocera* passing *ordinarily three and four;* the greater part of the *heterocera* four, except some clothed species, which pass from seven to eight."

Kirby and Spence (Introd. to Ent., Lond. ed., 1856, p. 36) speak of "butterfly caterpillars throwing off three or more successive skins."

Westwood (Brit. Butt., v. 1, p. 6) says: 'They cast their skins several times."

Harris (Ins. injur. veg., ed. 1862, p. 259) says: "Caterpillars usually change their skins about four times," referring to caterpillars generally.

So it will appear that, twenty years ago, no definite information was to be had on the subject. It was the custom when larvae were described, if any mention of stages earlier than the last, or mature, was made, to say, "young larva," "half grown," etc., with no reference to the number of molts.

During these years, and indeed since 1870, I have bred from the egg many species of butterflies, as Papilios 6, viz., *ajax*, *philenor*, *asterias*, *troilus*, *turnus*, *cresphontes;* Pieris 3, *protodice*, *oleracea*, *rapae;* Colias 2, *eurytheme*, *philodice;* Terias 1, *nicippe;* Danais 1, *archippus;* Argynnis 7, *diana*, *idalia*, *cybele*, *aphrodite*, *egleis*, *myrina*, *bellona;* Euptoieta 1, *claudia;* Melitaea 1, *phaeton;* Phyciodes 3, *harrisii*, *nycteis*, *tharos;* Grapta 3, *interrogationis*, *comma*, *progne;* Vanessa 1, *antiopa;* Pyrameis 2, *atalanta*, *huntera;* Limenitis 2, *arthemis*, *disippus;* Apatura 2, *celtis*, *clyton;* Neonympha 4, *eurytris*, *sosybius*, *gemma*, *canthus;* Debis 1, *portlandia;* Satyrus 1, *alope;* Libythea 1, *bachmanni;*

CHRYSOPHANUS 1, *americana;* LYCAENA 2, *pseudargiolus, comyntas;* PAMPHILA 4, *hobomok, huron, verna, cernes;* EUDAMUS 3, *bathyllus, lycidas, tityrus;* PHOLISORA 1, *catullus:* 53 species, all but one or two to imago, and these through the larval stages to chrysalis. Several others I have received in either first or second larval stages from correspondents, and have carried the larvae to imago, as PAPILIO 1, *palamedes;* CALLIDRYAS 1, *eubule;* HELICONIA 1, *charitonia;* AGRAULIS 1, *vanillae;* ERESIA 1, *texana;* LIMENITIS 1, *eros;* APATURA 2, *alicia, flora:* making 8 species. Besides this, Messrs. Couper, Baron, Mead, and other correspondents have bred other species, of which I have had reports, as *Papilio brevicauda* and *machaon* (the latter determined at my special request by Dr. Aug. Weismann and Mr. Wm. Buckler) *Pieris beckeri* and *sisymbri, Anthocharis stella, Danais berenice, Melitaea rubicunda* and *chalcedon, Grapta satyrus, Pamphila ethlius,* 10 species, thus making 71 species whose complete larval history has been observed. It is difficult to follow the stages of the Hesperians, as the larvae conceal themselves in cases of leaves, but so far as I have been able to do so, the molts in each case have been four. In *Eudamus lycidas* and *Pholisora catullus* I made sure of this the past season. About *Callidryas eubule* I am in doubt, that is, whether there are three or four molts. The early stages so much resemble each other in this species and pass so rapidly, that I could not be sure at which stage I received the larvae from Georgia. Mr. Baron reported three molts to both *Pieris beckeri* and *P. sisymbri*, and gave dates of their occurrence. There certainly were three only to *Neonympha gemma*, verified by me in several broods. But in all other cases there have been four, except when the larvae hibernated, and then an additional molt occurred. There seems to be a necessity with the hibernators of getting rid of the rigid skin in which the larva has passed the winter; that is, if the hibernation has taken place during the middle stages, as it does in *Apatura* and *Limenitis*. In these cases very little food is taken between the molt which precedes hibernation and the one which follows it, and the larva while in lethargy is actually smaller than before the next previous molt. The skin shrinks, and has to be cast off before the awakened larva can grow. These species (observed), whose larvae molt five times in the winter brood, require but four molts during the summer. In the case of *Limenitis disippus* the stages up to the third molt are identical in the winter and summer broods, but the stage following the third in summer is equivalent to the two stages after the third in winter, and the stage after the fourth of the one comes to be identical with the stage after the fifth of the other. Many larvae go into lethargy immediately after exclusion from the egg, as the large Argynnids, and probably all the Satyrids of the *alope* group.* The former pass five molts, but probably only four in summer.

* I have now hibernating young larvae of *Satyrus silvestris*, eggs of which species were received from Mr. Baron and hatched here at Coalburgh. They look like and behave exactly as *alope*.

At any rate the small Argynnids, as *myrina* and *bellona*, pass but four in summer. *Satyrus alope* passes but four, although the only brood of the year is that of winter. In both these genera, the larvae eat nothing before lethargy, except their own egg shell, but feed for several days after awaking and before a molt comes on.

The genera above mentioned, on which observations have been made, embrace a large proportion of those which belong to the North American butterfly fauna, and we may infer that butterflies of the other genera, at least those which inhabit temperate regions, will as a rule be found to behave likewise, and that the regular number of molts is four, except in cases of hibernation, three being a very rare exception.

In the Entomologists' Monthly Magazine for July 1880, Mr. Wm. Buckler, who has had very great experience in breeding lepidopterous larvae, contributes a paper entitled: "Is the number of moults of lepidopterous larvae constant in the same species?" and begins thus: "I have been impressed lately with the uncertainty that seems to exist as to the number of times lepidopterous larvae moult in course of their growth, and have been considering whence this uncertainty springs. . . . Or is it quite certain, as many think, that the number of moults varies in the same species? . . . I know that the number of moults certainly varies in different species. I have myself made sure that six is the number for some and nine for others, as in the case *Nola centonalis*. . . . Any one who has made notes on which he can depend about the growth of any species he has reared, would I think do good service by publishing them," etc.

What I have said before will in some respects answer Mr. Buckler's query, so far as concerns North American butterflies at least. I have no doubt the several species are constant in the number of their molts, the exceptional cases being as I have stated.

But whether the same can be said of all species of *heterocera* I am not competent to say. Certain observations made on *Callosamia promethea* would seem to indicate that there may be variability.

I happened last spring to have a cocoon of this silk-worm moth, which I had brought in from a tulip tree, and as a female came from it, it occurred to me to see how many molts its larvae might have. I have long given up breeding or collecting *heterocera* (though for several years I bred *sphinges* and *bombycidae* largely), the North American Diurnals giving me more work than I can properly attend to; but I had some curiosity to satisfy in this particular case. I tied the subject to a tree, and during the night it was impregnated, and next day, 19 April, it laid many eggs. The hatching began 1 May. The first molt took place 7 May; second molt, 11 May; third molt, 15 May. On 22 May, or 7 days after third molt, the first larva was shut up in its cocoon. I was much surprised at this, as I had expected four molts, and I searched the books to see what had been said about this species. (*To be continued on p. 171.*)