

THE LIFE HISTORY OF *PERIPHOPA HIRCIA* (SATURNIIDAE)
WITH A NOTE ON DISTRIBUTION AND LARVAL VARIATION

BRIAN O. C. GARDINER

18 Chesterton Hall Crescent, Cambridge, England

This paper is one of a series dealing with the rearing of Neotropical Saturniidae from eggs imported into England. *Periphoba hircia* Cramer was found to be one of the easier species to rear and was one of the few in which it was possible to carry stock for several generations. Larvae originating from Trinidad were found to differ from Panamanian examples.

P. hircia is not included in the catalogue of the Trinidad Lepidoptera by Kaye and Lamont (1923). It is, however, represented in the collection of the New York Zoological Society by specimens from the Arima valley (Blest, *in litt.*) and has been recorded as readily available from there by Blest (1960a). The eggs sent to me were laid by a female caught in the Arima valley, by Dr. T. S. Collett. Those from Panama were laid by females caught on Barro Colorado Island by Dr. A. D. Blest.

REARING TECHNIQUE

All stages were kept at 20–25° C, with occasional fluctuations of $\pm 5^\circ$ C. The humidity was uncontrolled. The eggs and first instar larvae were kept in small glass-topped metal tins; second and third instar larvae in plastic boxes; larvae from the fourth instar onwards in large wooden and muslin cages, 18 inches square, two feet high. Pupation took place in these cages and so did adult pairing. All stages were subject to natural British daylight conditions, with irregular extra artificial light from time to time in the evenings whilst the stocks were being attended to. Under these conditions there was no diapause and the total period of the life history was about five months.

OBSERVATIONS

Egg.—Very slightly ovoid, measuring 2.5 mm \times 2.3 mm \times 2.5 mm. Color white with a small black micropyle. Laid in regular batches, weakly attached with a clear cement. Pale green when just laid, turning white in a matter of seconds.

In captivity only about 200 eggs or less were obtained. A dissected virgin contained approximately 400 eggs.

A very curious phenomenon was the partial collapse of the eggs a few days before hatching. The top of the egg became depressed inwards to form a shallow depression around the micropyle. At first it was thought that these eggs were going to prove infertile, but subsequently

it was noticed that genuine infertile eggs collapsed not only more quickly, but from the sides. There was no color change prior to hatching, nor was the developing larva visible through the rather thick shell. Hatching occurred three weeks after laying.

Larvae.—The smaller larvae are gregarious and processionary, feeding and resting in groups. By the fourth instar they have started to disperse, feeding singly at night, and remaining in their feeding position during the day. The larvae have six instars, and show a fair amount of scatter in the time taken to pass through the last two. There was no significant difference in the development times of those from Panama or Trinidad. The instar development times, in days, were as follows: 1st—9; 2nd—7; 3rd—7; 4th—9; 5th—7—17; 6th—13—28. Mean total 53.

The first and second instar Panamanian larvae are a fairly uniform reddish-brown, with black spines. Those from Trinidad are chocolate-brown. In the third instar a green lateral line develops; in the fourth the green extends over the dorsal surface and the fifth and sixth instars are virtually similar.

Full-grown larvae (Panama) (Fig. 1) 7–10 cm long (females larger than males). Dorsal surface a pale, rather whitish, blue-green, a little less whitish laterally. Spiracles orange. Ventrally the whole surface a uniform pale green. On abdominal segments a pronounced lateral ridge which gradually becomes light purplish toward the head end. Prolegs translucent green, claspers on inner side brown; fringed with white hairs. Anal segment and claspers outlined in pink. Chalazae short, with dense spines, especially on dorsal surface. Segments 1–3 with four chalazae on each side; on segments 4–5, lateral chalazae modified; from segment 6 onwards rather smaller spines, no sublateral. Along the lateral line the chalazae short, with four short spines and two long white ones directed along the lateral line. On segment 11 a densely spined central dorsal chalaza. Penultimate segment with a small central dorsal chalaza and on either side two long (1.5–2.0 cm) whitish chalazae with short spines. Spines and chalazae green, similar to body.

Sting.—Of all the Hemileucinae larvae whose sting the author has experienced, *P. hircia* was by far the most painful. There also appears to be a difference between the long lateral spines and the others. The ordinary spines produced an effect similar to that of a nettle (*Urtica dioica*), but far more persistent, the skin still being tender after five hours. The effect had worn off by the following morning. From the long lateral spine there was a burning sensation similar to that of a honey bee (*Apis mellifera* L.) sting. There was a slight reddening and swelling and the skin was hot and remained swollen and tender for several days. A red mark (similar to a blood blister) was evident after four days and this persisted for about three weeks. It is worth mentioning that the effect from no other Hemileucid larva has lasted more than half-an-hour.

Larval differences: Trinidad vs. Panama.—While there are no struc-

tural differences, the larvae from Trinidad differed in color and to some extent in behavior, from the Panamanian. The earlier instar difference has already been mentioned above. In the final instar the shade of green is different. The dorsal surface on Trinidad individuals is dark green, the chalazae and spines similar, becoming even darker laterally. The lateral ridge is whitish with the spines greenish-white and black-tipped. Ventrally Trinidad larvae are greenish blue, rather darker than the Panamanian examples and with a sprinkling of small blackish dots. The claspers are similar, feet outlined brown. The head is rather shiny green. Dorsally, the intersegmental membrane between segments 3-4; 4-5; 5-6; and 6-7 is crimson. This color is not visible when the larva is normally at rest, but when it is disturbed the larva assumes a curved position like an interrogation mark [?], the head being tucked into the forelegs. The crimson then comes prominently into view. The long chalazae on the penultimate segment are greenish-white with blackish spines. The anal segment is entirely pinkish-brown.

Although it was not possible to carry out detailed and controlled experiments on behavior, the larvae from Trinidad and from Panama were reared side by side and it was possible to make a few general observations on the behavioral differences.

In the earlier instars (the third especially) the Trinidad larvae exhibited a communal reaction on being disturbed as, for instance, jarring the plastic box they were in. This reaction consisted in throwing the head and thoracic segments up into the air two or three times. This reaction could not be initiated in the Panama larvae.

In the middle instars the Trinidad larvae showed a marked tendency to drop off their food and wriggle violently on the floor on being disturbed. This usually happened when they were being given fresh food. Up to about 50 per cent would sometimes do this. With the Panama larvae a few would do this, certainly not more than 10 per cent, and it was considered that both lots were being given about an equal amount of disturbance and the cages contained approximately equal numbers of larvae.

Finally in the final instar there was the assumption of the [?] position (Fig. 1), although to elucidate this, rather rough treatment (firm prodding; picking up with forceps) needed to be applied. This produced the crimson flash in the Trinidad larvae and there was the firm impression—which cannot, however, be supported by definite numerical data—that this reaction was more likely to be assumed by the Trinidad specimens.

It is interesting to speculate upon these differences. Poisonous spines do not constitute an absolute defence. It has been reported (Blest,



Fig. 1. Full-grown larva of *Periphoba hircia* Cramer. This larva shows the “?” position assumed when it is disturbed.

personal communication) that a Coatimundi (*Nasua* sp.) can roll the spines off *Automeris* spp. on stony ground and then eat the larvae. Only field observations in Trinidad and Panama can elucidate the problem associated with the crimson flash in *P. hircia*.

There is no recent revision of *Periphoba* and the Panamanian examples are true *hircia* and not the form *arcaeii* reported by Draudt (1930) as corresponding with some specimens from Panama. The present author could not on gross differences, separate the adults from the two localities, but it is possible they may prove to be different species. On the other hand *Automeris memusae* Walker has different larvae from the southern and northern limits of its range according to studies by the present author. Due to lack of material no attempt could be made at cross-pairing the adults from the two localities.

Foodplants.—The larvae proved to be fairly polyphagous on temperate region deciduous trees, and on one evergreen tree. The newly-hatched larvae were given a wide choice. The majority of the larger larvae, however, were mainly fed on beech (*Fagus sylvatica*) or evergreen oak (*Quercus ilex*) due to their availability. The F₁ generation was reared

almost entirely on evergreen oak and in the final instar finished their development on hawthorn (*Crataegus oxyacantha*). The specimens of this generation were rather small compared to those of the first. The following leaves were readily eaten: various plums and cherries (*Prunus* spp.); black locust (*Robinia pseudoacacia*); beech (*Fagus sylvatica*); oaks (*Quercus* spp.); apple (*Malus* sp.); hawthorn (*Crataegus oxyacantha*); hornbeam (*Carpinus betulus*). Black poplar (*Populus nigra*) and privet (*Ligustrum ovalifolium*) were refused.

Pupation.—When the larvae are full grown the green color is gradually replaced by a pink shade, during a period of about 48 hours. This commences as a broad dorsal stripe and gradually diffuses over the rest of the body. The spines also fade and become yellowish. After wandering about for a day the larvae settled down to make a cocoon. They were supplied, in the rearing cage, with a few inches of moist peat on top of which was a thick layer of sphagnum moss. The majority of the cocoons were formed under the moss, the whole of the outside of the cocoon being firmly covered with the peat. The larvae pupated fairly uniformly over the floor area of the cage. This was in marked contrast to the choice of so many species which prefer the corners and angles and also to the very fussy larvae of *Dirphia curitiba* Draudt, which could not be induced to pupate in the cages and for which special provision had to be made (Gardiner, 1963).

The cocoon of *P. hircia* is a double structure. There is a thin, rather clear, papery inner chamber. The outer chamber is loosely spun and on its outer surface is firmly adherent to its surroundings, in this case particles of peat and moss. The inner chamber is suspended within the outer by a number of stalks, there being about one-eighth of an inch gap between the two.

The majority of the pupae were used for physiological experiments. The duration of the few retained was 2½–3 months.

Adults.—The freshly emerged adult gives off a pervading and persistent odor of rotten onions. Most of this odor appears to originate from the copious meconium. It is subtly different from, although similar to, and certainly more persistent than, the odor reported from *Eacles penelope* Cramer (Gardiner, 1967). Probably it serves the same purpose of protection during the vulnerable period while the wings are expanding and drying, although in the author's opinion it is not a foul odor as reported by Blest (1960b) for moths of the genus *Periphoba*. This, however, is a matter of opinion, and to predators with a well developed sense of smell it may indeed be a foul and even nauseating odor.

The adult moths were placed in a cage 18 inches square by 24 inches high. Several pairings were obtained, although not all the eggs laid were

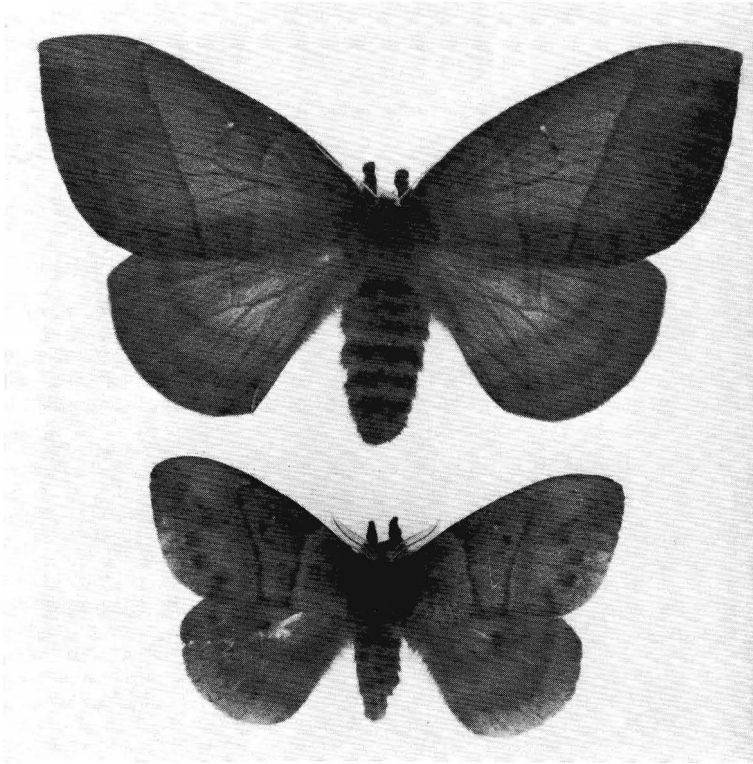


Fig. 2. Adult *Periphoba hircia* Cramer. Female above, male below.

fertile. The moths were observed in copulà about midnight and remained so until dusk the following evening. This lengthy period in copulà is unusual among the Hemileucinae, most of those with which I am acquainted separate within an hour, or at least by dawn. Fig. 2 shows the adult moth.

An unusual habit of the unmated females was their habit of curling the abdomen and laying infertile eggs between their legs in a jumbled clump. The females would 'call' for two or three nights before doing this. Mated females lived for about six days, males only four, and they rapidly battered their wings in the cages. Adults kept at from -5° to 10° C could be kept alive for three weeks.

ACKNOWLEDGEMENTS

The expenses of Drs. Blest and Collett in the field, together with other expenses in connection with this work, were borne by Grant No. GM.

07109 from the United States National Institutes of Health. Thanks are especially due to Dr. Blest for information and for helpful criticism of the original manuscript; also for taking the photograph of the larva. The photograph of the adult moths is by Simon Frey of the A.R.C. Virus Research Unit, Cambridge.

LITERATURE CITED

- BLEST, A. D., 1960a. The resting position of *Cerodirphia speciosa* (Cramer), (Lepidoptera, Saturniidae): The ritualization of a conflict posture. *Zoologica*, 45: 81-90.
- 1960b. A study of the biology of Saturniid moths in the Canal Zone Biological Area. Smithsonian Report for 1959: 447-464.
- DRAUDT, M., 1930. *in*: Seitz, A. (Ed.), *The Macrolepidoptera of the world*. Vol. 6. Stuttgart.
- GARDINER, B. O. C., 1963. Breeding the south American silk-moth *Dirphia curitiba* Draudt. *Bull. amat. Ent. Soc.*, 22: 123-124.
1967. Notes on *Eacles penelope* (Saturniidae). *J. Res. Lepid.* (in press).
- KAYE, W. J., & N. LAMONT, 1923. A Catalogue of the Trinidad Lepidoptera Heterocera (Moths). *Memoirs of the Dept. Agric. Trinidad & Tobago*, No. 3.

A UNIDIRECTIONAL MASS MOVEMENT BY *Satyrrium saepium* (LYCAENIDAE)

On 12 July, 1967, near the site of the ghost town of Nortonville in Contra Costa County, California, a large number of *Satyrrium saepium* (Bdv.) were observed in a rather continuous downslope flight. The flight was noted only along the steeply inclined bottom of a small dry ravine where it passed northwesterly through grazed oak woodland. A broken canopy of live oak and arborescent toyon (*Heteromeles*) partly shaded the dry oat-forb understory. The insects were observed from about 12:30 to 1:00 PM. P.D.T., as they passed in an erratic stream perhaps no more than three or four feet wide and about three feet above the ground. Although no count was taken, it is estimated that the rate of passage varied from about five to fifteen individuals, averaging ten or twelve, per minute.

Generally the butterflies continued rapidly downward but occasionally an individual became diverted long enough to flutter briefly around the downstream base of a small rocky outcrop in the drainage bed. Only three or four individuals were seen to fly up the ravine. Probable larval food plant was common some hundred yards upstream in an extensive community of chamise—ceanothus chaparral. No water was available in the ravine or for some distance below its mouth. Some moisture was present in an adjacent ravine, where, however, only a few individuals of *S. saepium* were seen behaving in a manner not remarkable. Other examples of the species were encountered at more normal density elsewhere in the vicinity.

C. DON MACNEILL, DIV. NAT. SCI., OAKLAND MUSEUM, OAKLAND, CALIFORNIA.