

## Annotations on selected *Loepa* species and their preimaginal instars

### 1. The larval morphology of *Loepa miranda* ATKINSON in MOORE, 1865 (Lepidoptera: Saturniidae, Saturniinae)

Wolfgang A. NÄSSIG<sup>1</sup> and Gerhard RAGUS

Dr. Wolfgang A. NÄSSIG, Entomologie II, Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany;

email: wnaessig@sng.uni-frankfurt.de

Gerhard RAGUS, Matthias-Claudius-Weg 31, D-27777 Ganderkesee, Germany

**Abstract:** The larval morphology of *Loepa miranda* ATKINSON in MOORE, 1865 (from N. India) is described and illustrated in colour for the first time. The larva differs from the other *Loepa* species of which the larval morphology is known in the first two instars by the polychromatic colouration and pattern (orangy red on thorax and at the rear end, whitish in the middle, all segments with intensive, fine black pattern). In later instars, the lateral patches are the largest of all species known so far. A hypothesis about the evolution of these camouflage patches is provided.

**Key words:** *Loepa miranda*, Saturniidae, Saturniinae, pre-imaginal morphology, larva, lateral patches, camouflage, evolution.

**Anmerkungen zu ausgewählten *Loepa*-Arten und ihren Präimaginalstadien. 1. Die Larvalmorphologie von *Loepa miranda* ATKINSON in MOORE, 1865 (Lepidoptera: Saturniidae, Saturniinae)**

**Zusammenfassung:** Die larvale Morphologie von *Loepa miranda* ATKINSON in MOORE, 1865 (aus Nordindien) wird erstmals beschrieben und farbig abgebildet. Die ersten beiden Stadien sind sehr ungewöhnlich gefärbt und gezeichnet: am Vorder- und Hinterende rot, dazwischen in der Mitte weiß, alle Segmente mit feiner schwarzer Strichzeichnung. Später sieht die Raupe ähnlich wie die übrigen bisher bekannten *Loepa*-Raupe aus. Die weiblichen bis gelbgrünen lateralen Flecken, die das typische Tarnkleid von *Loepa*-Raupe erzeugen, sind bei *L. miranda* größer als bei allen anderen bekannten Arten. Eine Hypothese über die Ableitung dieser hellen Lateralflecke von der weißen Grundfarbe der L<sub>1</sub>- und L<sub>2</sub>-Raupe wird vorgestellt.

#### Preface

In the mid-1980ies, the authors of the “Saturniidae of Sumatra” project (Rudolf E. J. LAMPE, the late Stefan KAGER and the senior author of the present publication) started the preparatory work on the Saturniidae fauna of Sumatra. At that time it was intended to add not only illustrations of the preimaginal instars of the Sumatran species (as far as these were known then), but also of related other, extra-Sumatran species. Within this frame, the senior author planned the publication of two appendices, one devoted solely to the preimaginal instars of the genus *Cricula* WALKER, 1855, the other to those of *Loepa* MOORE, 1859. Between ca. 1985 and 1995, many of the senior author’s correspondents became informed about these two additionally planned appendices, and several colleagues offered their results for inclusion.

However, due to financial limitations for printing it was necessary to delimit the publication and to cancel these two appendices within the Heterocera Sumatrana work. The available information restricted to the Sumatran species of these genera was eventually condensed within one plate for the publication (NÄSSIG et al. 1996: Appendix 1, Plate 8).

However, the senior author still intends to use those several plates and texts fragments prepared for these two unfinished appendices and to publish the information compiled, supplemented by further results of the recent years. The present publication is the first one of a small series intended to deliver the results concerning the genus *Loepa*. The series is started here with a member of the *miranda*-group of the genus *Loepa* (sensu YEN et al. 2000: 153): *Loepa miranda* ATKINSON in MOORE, 1865.

The compilation of the present paper was only made possible by the existence of the photographs of the junior author, who reared the species in 1989.

#### Introduction

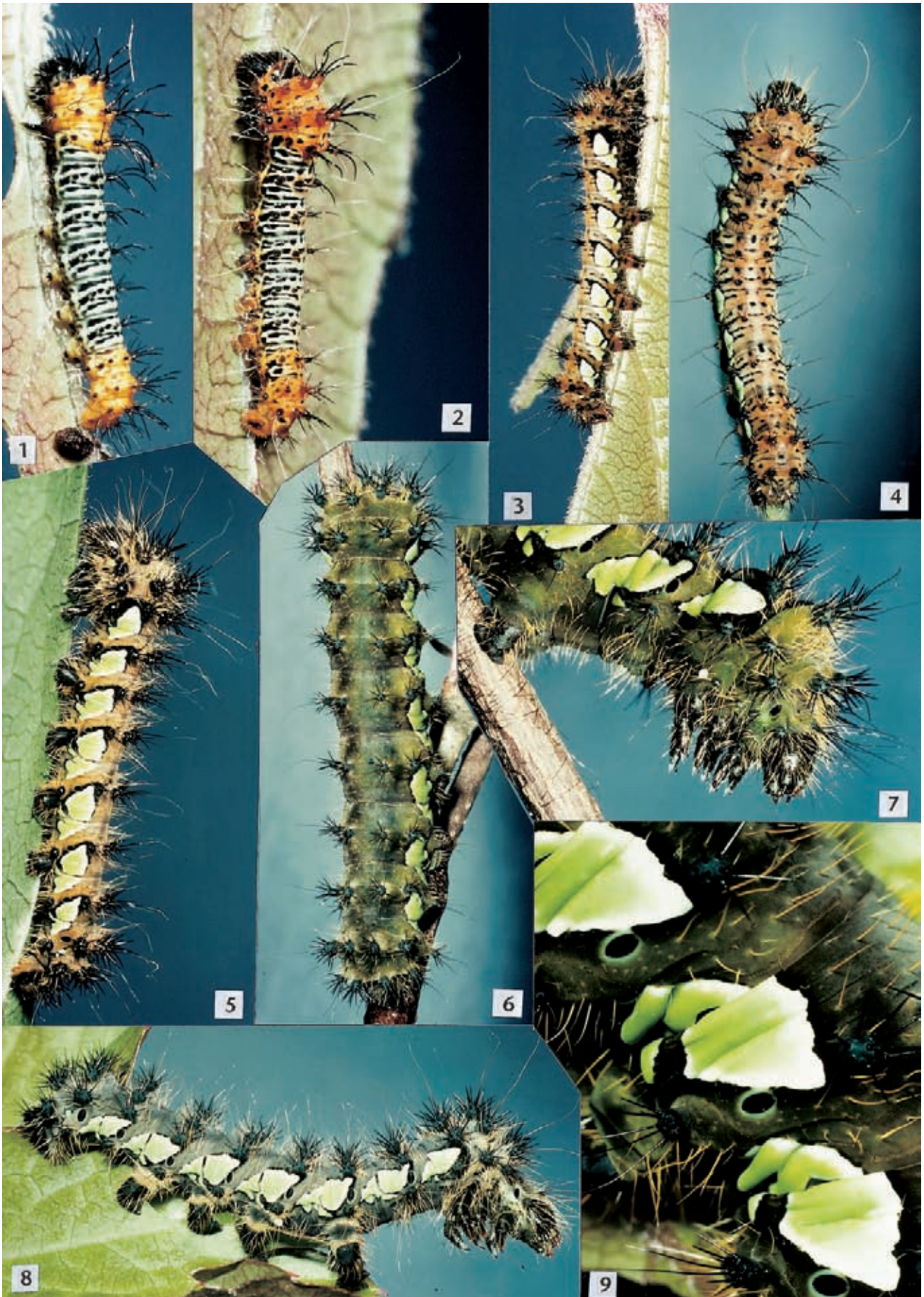
In a recent publication about *Loepa* (YEN et al. 2000: 159), it was already stated that G. RAGUS has information regarding the preimaginal instars of *Loepa miranda*. The present publication intends to make the facts available to the public.

The data provided here is part of the compilation of general knowledge about the genus *Loepa*, which will eventually lead to further, more general publications on systematics (including a revision), distribution, etc. For general observations on *Loepa* preimaginals, see also NÄSSIG & TREADAWAY (1988: 170–172) and NÄSSIG et al. (1996: 136–139) and the references therein.

#### Results

The junior author reared *L. miranda* in March/April 1989 from eggs received from northern India. The eggs were received in early November 1988, and the larvae went through 5 instars (i.e., 4 larval moults) during the rearing. Cocoons were obtained ca. in early April 1989. At least two specimens (a pair, Figs. 10–14) hatched, but did not copulate; these two specimens are today in the junior author’s collection, but regrettably without label data.

<sup>1</sup> 55th contribution to the knowledge of the Saturniidae.



Colour plate 1: Larval instars of *Loepa miranda* from N. Thailand. Fig. 1: L<sub>1</sub>. Fig. 2: L<sub>2</sub>. Figs. 3, 4: L<sub>3</sub>. Fig. 3: lateral view, Fig. 4 dorsal view. Fig. 5: L<sub>4</sub>. Figs. 6–9: L<sub>4</sub>. Fig. 6: dorsal view; Fig. 7: lateral view of head and front part of the body; Fig. 8: lateral view; Fig. 9: details of the body. — All photographs taken in 1989 by Gerhard RAGUS.

The foodplant used successfully throughout the rearing was an ornamental species of the genus *Parthenocissus* (Vitaceae), probably *P. tricuspidata*. Twigs were cut, put into water and in a warm room pushed to develop their foliage in spring.

The larvae are morphologically such outstanding compared with other species of the genus, where this is known, that it is necessary to describe them here in more detail (based on the photographs of G. RAGUS; the senior author has not seen the larvae alive by himself).

**Abbreviations used in the text:**

A1–A10 abdominal segments 1–10.

T1–T3 thoracic segments 1–3, always counted from the head.

**Description**

The first two instars are very much different from the early instars of other *Loepa* larvae known thus far. In other species, the  $L_1$  and  $L_2$  caterpillars are black or reddish or in a combination of these two colours, but always more or less monochromous (or just bichromatic), without a detailed pattern.

In all instars the dorsal scoli on A8 and A9 are fully separate (not even approached), as is usual for the genus.

**$L_1$  larva** (Fig. 1): Head, prothoracic shield, spiracles, thoracic legs, scoli and most bristles black; tiny black shields laterally on the prolegs. Thorax segments and cephal half (approx.) of A1 as well as A7–A10 orange with some weak dark pattern. Caudal half of A1 and A2–A6 white with black pattern (see illustration). No secondary bristles outside the scoli visible.

**$L_2$  larva** (Fig. 2): Very similar to  $L_1$ . The differences are as follows: Colours somewhat deeper. The caudal half of A7 is now also white with black pattern, while its cephal half is still orangy red. A lateral, keel-shaped “footstripe” in weak orangy colour along the substigmal scoli. Central bristles of the larger scoli very much elongate, soft and white. Scoli on thorax and at the rear end enlarged, differently coloured: reddish in the red area, black in the white area. A little blackish shield laterally on the anal prolegs. Spiracles blackish. Head capsule width (measured horizontally in an exuvial head capsule kept by the junior author) 1,3 mm.

In the moult from  $L_2$  to  $L_3$ , pattern and colouration change drastically:

**$L_3$  larva** (Figs. 3, 4): Ground colour now a dirty greyish orange, somewhat brighter in the middle of the body; still a fine blackish pattern on the segments. Prominent, large yellowish green, encircled with bright white, lateral patches on A1–A7, subdivided by dark lines; to the front and dorsal side bordered with a contrasting black line. Two little whitish dots also in the border area of A8/9. The area of these lateral patches, which are typical for all *Loepa* caterpillars known, is larger than in all other species of which I have seen the larvae before. Head, true legs, spiracles, scoli and all shorter bristles, shields on the

prolegs, and anal shield black. Head capsule width (see above) 2,2 mm. At some places (especially on the thorax) a few short, whitish secondary hairs outside the scoli. The “footstripe” appears to have disappeared again.

The bright lateral patches are always (in the instars  $L_3$ – $L_5$ ) overlapping between two segments, beginning cephally above the spiracle and running down to the next following segment, where they end triangularly below the spiracle.

**$L_4$  larva** (Fig. 5): The larva is now approaching the typical morphology of mature *Loepa* larvae. Ground colour still a dirty greyish orange, but now nearly without the little black pattern and uniform along the whole body. Other colouration like in  $L_3$ . Many whitish secondary hairs outside the scoli along most part of the body.

The yellowish green lateral patches show probably the largest extension relative to the total surface of the body in third and fourth instar. Head capsule width (see above) 3,1 mm.

**$L_5$  larva** (Figs. 6–9): Ground colour now changed to a dark greenish brown, somewhat showing different local tones. Most scoli large, dark bluish black, covered with many spines, which appear to be quite effective mechanical defensive bristles (see below). All legs more or less blackish. Spiracles black with a bright greenish ring around them, placed within the cephalo-ventral contrasting black borderline of the yellowish green, encircled with white, lateral patches. All along the body a cover of short, soft secondary hairs in whitish or yellow colour, but largely inconspicuous. No conspicuous basal cells of these secondary hairs as in some other species of the genus.

**Individual variability:** On some of the larvae there appear to be little whitish dots also on the thoracic segments in the instars  $L_3$ – $L_5$ .

**Cocoon and pupa** (not illustrated): Cocoon more or less of the usual “spindle-like” shape of the genus, with a thin, incomplete, net-like inner cocoon with fine meshes. Medium to dark brown, but with some black and green strands of silk especially in the outer envelope along the twig and in the “pylons” to fix the cocoon to the surrounding during construction. 5.5–5.8 cm long, maximum diameter 2 cm, spun along a twig. Pupa blackish brown, with the unpigmented “window” between the eyes and antennal bases typical for probably all Saturniini pupae in cocoons; empty pupal exuvia (after hatching of the moth) max. diameter 1.3 cm, 3.2 cm long. Cremaster anchored in the silk. Evidently no central cephal or prothoracic tergal crest. – No surprises as compared to other species of the genus.

**Larval defensive abilities:** The junior author did not research specifically about this character, but as the spiny bristles on the scoli look like in other species it appears that the defensive abilities might be close to other species of the genus, where this is known: mainly mechan-



**Plate 2:** *Loepa miranda* from N. Thailand from the rearing reported here. **Figs. 10, 11:** Male, same specimen (not to the same scale). **Figs. 13, 14:** Female, same specimen (not to the same scale). **Figs. 10 & 12** upperside, **Figs. 11 & 13** underside. Both specimens are approximately of the same size; wingspan in both ca. 10 cm. — All photographs taken by Gerhard RAGUS.

ical (stiff, spiny bristles), only very little (if at all) chemical defense by secretion within these bristles (in other species, there is no fluid secretion contained within the bristles).

### Discussion

The  $L_1/L_2$  larva with its fine and contrasting blackish pattern and the differing ground colour (orangy red and white) is quite unusual for a Saturniinae larva. It resembles to some degree the pattern shown by early instar larvae of Brahmaeidae, e.g., *Brahmaea* (*Brahmophthalma*) *hearseyi* (WHITE, 1862) as illustrated, for example, by NÄSSIG & PAUKSTADT (1990: 133, figs. 5–7). The black pattern (mainly thin upright stripes) resembles to some degree the larval pattern of  $L_1$  larvae of *Antheraea* (*Antheraeopsis*) larvae or of some larvae of the *frithi*-group of *Antheraea* (*Antheraea*) — see illustrations, for

example, in NÄSSIG et al. (1996, Appendix 1) —, but this is clearly different in detail (length, number, and location within each segment of the blackish stripes), and it is, therefore, most probably not at all a shared or synapomorphic character.

The larval morphology of the  $L_1/L_2$  of *L. miranda* as described here makes it somewhat less likely that the early instar larvae described and illustrated by YEN et al. (2000: 159, fig. 5) really belong to its probable sister-species *L. mirandula* YEN et al., 2000 from Taiwan. Therefore, a confirmation of this observation by a successful rearing through the full life cycle of *L. mirandula* would be very helpful.

The bright lateral patches of all middle to late instar *Loepa* caterpillars known thus far represent most likely a very effective camouflage pattern (see NÄSSIG & TREAD-

AWAY 1988: 170–172, NÄSSIG et al. 1996: 138–139). The evolutionary origin of this extravagant pattern is still unknown, but the observed morphology of the early instars of *L. miranda* might possibly offer a plausible explanation:

These big yellowish green, encircled with white, lateral patches in the instars  $L_3$ – $L_5$  show remnants of the black lines of the former instars. This could explain the evolution of these lateral bright patches of the genus *Loepa* as being derivations of the white ground colour of earlier instars. This would, therefore, identify the white ground colour of the mid-body of early instars ( $L_1 + L_2$ ) of *L. miranda* as being the plesiomorphic condition within the genus. Consequently, the mono- or bichromatic reddish and/or black early instar larvae of other species would appear to represent the more apomorphic condition.

In this context, it would be extremely interesting to learn about the larval morphology (especially of early instars) of the two species of the *oberthuri*-group of the genus (*L. oberthuri* (LEECH, 1890) and *L. anthera* JORDAN, 1911), which are supposed to be the most plesiomorphic species of the genus according to their ♂ genitalia morphology.

## References

- MOORE, F. (1865): XX. Descriptions of new species of Bombyces from North Eastern India. — Transactions of the Entomological Society of London, 3rd series, 2 (5): 423–425, pl. xxii.
- NÄSSIG, W. A., LAMPE, R. E. J., & KAGER, S. (1996): The Saturniidae of Sumatra (Lepidoptera). [Including: Appendix I: The preimaginal instars of some Sumatran and South East Asian species of Saturniidae, including general notes on the genus *Antheraea* (Lepidoptera).] — Heterocera Sumatrana, Göttingen, 10: 3–170.
- , & PAUKSTADT, U. (1990): The Brahmaeidae of Sumatra. — Heterocera Sumatrana, Göttingen, 6: 117–136.
- , & TREADAWAY, C. G. (1988): Bemerkungen über die *Loepa*-Arten der Philippinen (Lepidoptera, Saturniidae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 9 (3): 159–176.
- YEN, S.-H., NÄSSIG, W. A., NAUMANN, S., & BRECHLIN, R. (2000): A new species of the *miranda*-group of the genus *Loepa* from Taiwan (Lepidoptera: Saturniidae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 21 (3): 153–162.