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THE IMMATURE STAGES OF *PHARMACOPHAGUS ANTENOR* (DRURY) (PAPILIONIDAE: TROIDINI) FROM MADAGASCAR

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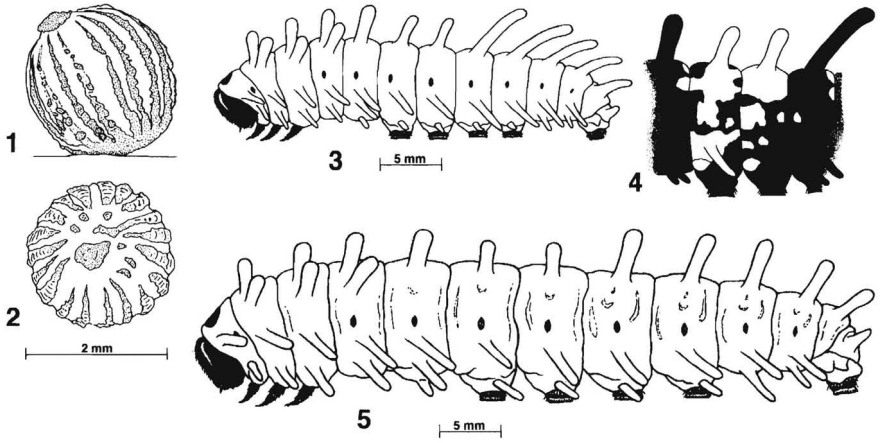
ABSTRACT. The early stages of *Pharmacophagus antenor* from Madagascar are described and illustrated in detail for the first time. They confirm that *Pharmacophagus* differs from Indo–Australian Region *Atrophaneura*, and suggest that the morphological relationships of the genus lie elsewhere within the tribe Troidini.

Additional key words: afrotropical, *Atrophaneura*, larva, ovum, pupa, swallowtail.

Pharmacophagus Haase, 1891, contains the single species *antenor* (Drury 1773). This monotypic Madagascan genus is biogeographically important, as *P. antenor* is the only representative of the swallowtail butterfly tribe Troidini in the entire Afrotropical Region. Taxonomically and systematically, the status of *Pharmacophagus* remains open to speculation. The taxon has been considered to be of generic rank by some authors, but authors such as Hancock (1988) and Miller (1987) have regarded it as warranting only subgeneric rank under *Atrophaneura* Reakirt. Based on the morphological characters of its immature stages, I consider *Pharmacophagus* represents a distinct genus and, using these data, have treated its taxonomic and phyletic status in greater detail elsewhere (Parsons 1996). Like almost all of its troidine relatives in eight other predominantly pantropical genera, *P. antenor* is restricted to larval foodplants of the family Aristolochiaceae. These plants, also mostly pantropical, number about 500 species, the majority of which are large vines or lianas of the genus *Aristolochia* (e.g., Hou 1984).

Preston-Mafham (1991) provided a good color photographic plate of a *P. antenor* adult male and female in copula. He noted that the species is common and widespread over much of Madagascar (e.g., Ampijeroa Forest Reserve), often flying strongly at quite a height. On one occasion, the author "mistook one for a bird as the insect powered strongly along the beach on the hot dry coast at Morondava" (the locality approximately centrally situated on the Madagascan west coast, almost opposite the east coast capital of Antananarivo). Preston-Mafham suggested that "with its widespread distribution and lack of fussiness over habitat, this magnificent butterfly is not under imminent threat from environmental changes by humans."

The immature stages of *P. antenor* were briefly described by Denso (1943), and Igarashi (1984) provided a basic sketch of the pupa. Since Denso's paper, apparently no other accounts of the early stages of *P. an-*



FIGS. 1–5. Early stages of *P. antenor* (line drawings) **1.** Ovum: lateral. **2.** Ovum: dorsal. **3.** Fourth instar larva: lateral. **4.** Fourth instar larva detail of saddle markings: lateral. **5.** Fifth instar larva: lateral.

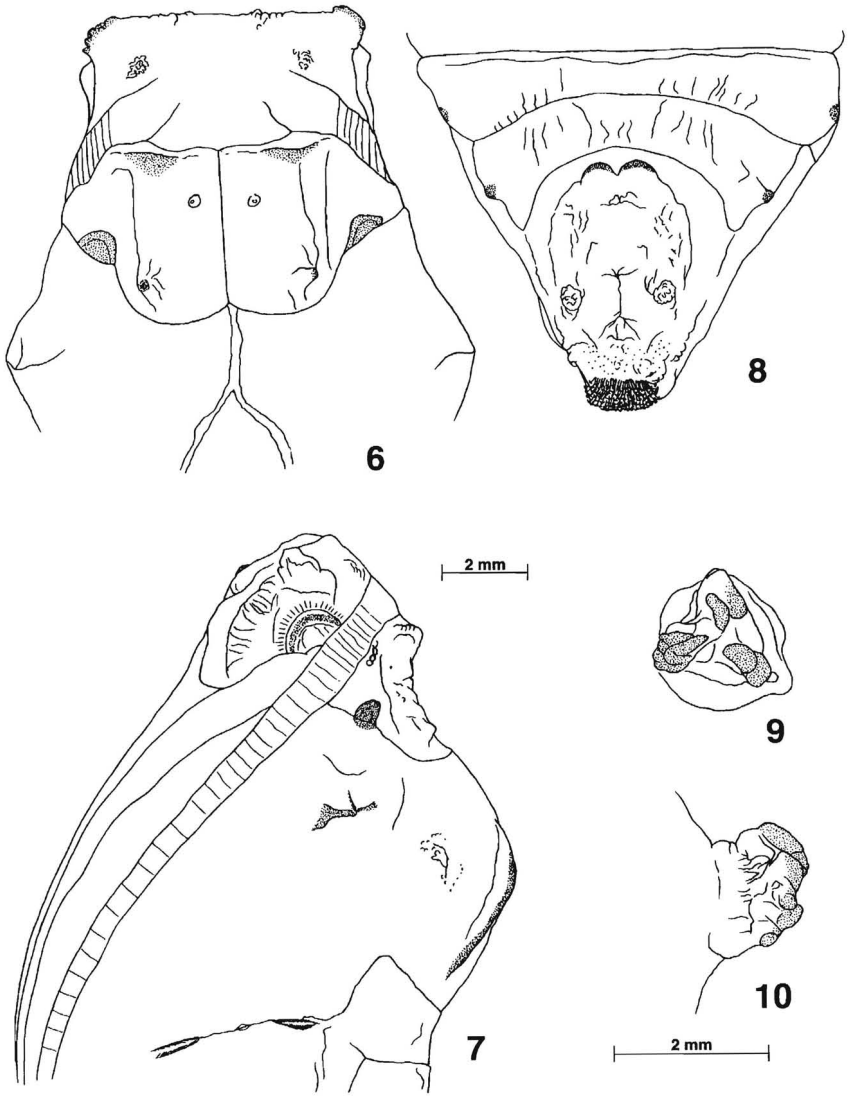
tenor have been published, hence the account and illustrations provided below. The material from which the descriptions are made was kindly provided to me by A. Peyrieras who, in 1979 while at the Department Recherché Scientifique et Technical in Antananarivo, Madagascar, sent me alcohol-preserved *P. antenor* immature stages. This included both wild-collected and captively-reared specimens, all material having been taken in the immediate area of Antananarivo.

IMMATURE STAGES

Egg. (Figs. 1 and 2). Circa 2.0 mm in diameter, spherical, but slightly basally flattened, chorion white, covered with thin layer of pinkish, wax-like glue which affixes ovum to substrate, glue forming ca. 19 thick granulose ribs, and a thick apical "cap." Based on the specimens on preserved leaves received, eggs are laid on the underside of a leaf of the foodplant, as is typical of many troidines.

Larva. The "saddle mark" typical of Troidini is present on abdominal segments (AS) 3 and 4, and is uniquely macular in *P. antenor* (Fig. 4). Although somewhat variable, it is similar through instars 2–4, comprising wholly white subdorsal tubercles on AS 3 and 4, their bases broadly white and middorsally just touching, or nearly so, white lateral tubercles on AS 3, white blotches of various sizes laterally on AS 3 and 4. Other smaller, more rounded white spots are usually present elsewhere on the body, notably forming rows of 4 across the back of the larva, these most prominent in the fourth instar on the posterior margins of the mesothoracic segment and AS 2 and 5 (Fig. 13). Otherwise the larva is as follows:

First instar: unavailable. *Second instar* (Fig. 11): ca. 13 mm long, saddle markings as above, typically troidine in shape and configuration of fleshy tubercles (8 rows on thoracic segments and AS 1–2; 6 rows on AS 3–10), subdorsal tubercles longest, body dark pinkish-brown, slightly paler on anal segments, prothoracic plate glossy black; head glossy black, sparsely hirsute. *Third instar* (Figs. 12, 16, 17): ca. 25 mm long, similar to second instar,



FIGS. 6–10. Pupa of *P. antenor* (line drawings). **6.** Detail of prothorax and head: dorsal. **7.** Detail of thorax and head: lateral. **8.** Detail of anal segments and cremaster of male: ventral. (In the female, abdominal segment 9 is ventromedially divided by a vertical line). **9.** Detail of dorsolateral abdominal tubercle (segment 5): dorsal. **10.** Ditto: lateral.

but ground color darker, more purple, and subdorsal tubercles on saddle segments AS 3 and 4 distinctly shorter than the rest. *Fourth instar* (Figs. 3, 4, 13): ca. 40 mm long, similar to third instar, but ground color dark brown, almost black, subdorsal tubercles on AS 5–9 somewhat longer and apically slimmer than rest, but decreasing in length posteriorly.

Fifth instar (Figs. 5, 14, 15): ca. 58 mm long, similar to fourth instar, but apparently uniform dark brown (based on the single alcohol-preserved specimen of this instar), all subdorsal tubercles distinctly apically rounded and mildly club-like.

The distinctly shorter subdorsal abdominal tubercles on segments 3+4, and club-like subdorsal tubercles in the final instar larva of *Pharmacophagus*, are specializations (or autapomorphies) among the tribe Troidini. Although Cuban *Battus devilliers* (Godart 1823) also possesses club-like subdorsal tubercles (color plate 31a in Tyler et al. 1994), this is a specialization at the species (rather than genus) level, as all other known *Battus* larvae possess tubercles with the plesiomorphic tapered condition.

Pupa. (Figs. 6–10, 18–20). Circa 43 mm long and 17 mm wide (male ca. 40 mm long, 16 mm wide), distinctly S-shaped in lateral profile, fairly stout and ovate in dorsal profile, wing cases large, very prominently and smoothly convex ventrally, frontal margin truncate, almost straight with only very small, truncate dorsolateral projections above eyes, prothorax concave in lateral profile, mesothorax with a pair of small lateral tubercles, abdomen with 3 pairs of bluntly truncate, irregularly deltoid and nodular dorsolateral tubercles on segments 4–6, decreasing markedly in size, 2 further low and rounded, vestigial pairs of dorsolateral tubercles on AS 7 and 8, AS 4 with a low, rounded lateral flange-like projection, ground color pale yellowish-brown, ventrally (wings, legs) with irregular blotches of dark brown melanin, metathorax and AS 1–4 dorsally with a "saddle-marking" of posteriorly diverging dark brown lines, between these a uniformly unmarked area of pale yellowish-brown, region outside lines and bounded by dorsal margin of wings with a fine tracery of irregular dark brown lines, continuing laterally and ventrally onto abdomen. A typical metathoracic girdle and thick mat of strong black silk supports the pupa. Duration 14 days (Denso 1943).

The form of the *P. antenor* pupa is unique for the tribe Troidini. In particular, the bluntly truncate, irregularly deltoid and nodular form of the dorsolateral abdominal tubercles (Figs. 9, 10) is unique to *antenor*. In all other Troidini (e.g., Figs. 21, 22) the tubercles are tapered, even when they are slightly truncate or spatulate.

FOODPLANT NOTES

Pharmacophagus antenor is monophagous on *Aristolochia acuminata* (Aristolochiaceae) (Denso 1943, A. Peyrieras pers. comm. 1979). Study of the literature, and herbarium material (e.g., pers. obs. at the Royal Botanic Gardens, Kew, Richmond, United Kingdom) suggests that this is the only *Aristolochia* species in Madagascar. The vine occurs in areas of marginal vegetation and has glabrous, heart-shaped leaves typical of its genus. Its flower is also typical, with a tubular, unilabiate perianth. On the moist west coast of Madagascar, *A. acuminata* does not lose its leaves and *P. antenor* flies there all year round (Denso 1943). However, in the seasonally dry south of the island, leaves of *A. acuminata* are shed between May and June with new leaf growth by the end of October; and Denso recorded that in the south, *P. antenor* undergoes an aestivative

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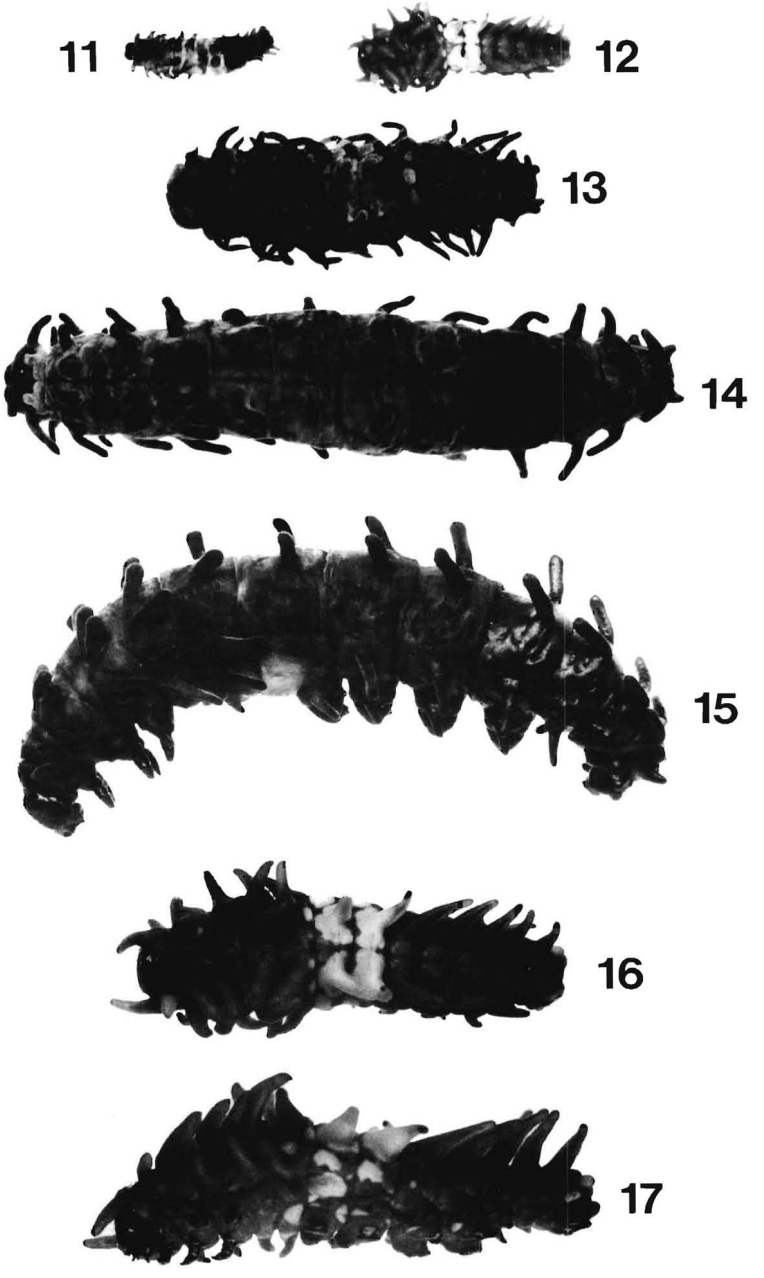
FIGS. 11–17. Larva of *P. antenor* (photographs 11–15 represented at same scale; 16 and 17 at different scale. Larval heads to left). **11.** Second instar: dorsal. **12.** Third instar: dorsal. **13.** Fourth instar: dorsal. **14.** Fifth instar: dorsal. **15.** Fifth instar: lateral. **16.** Third instar: dorsal (note saddle detail). **17.** Third instar: lateral (note saddle detail).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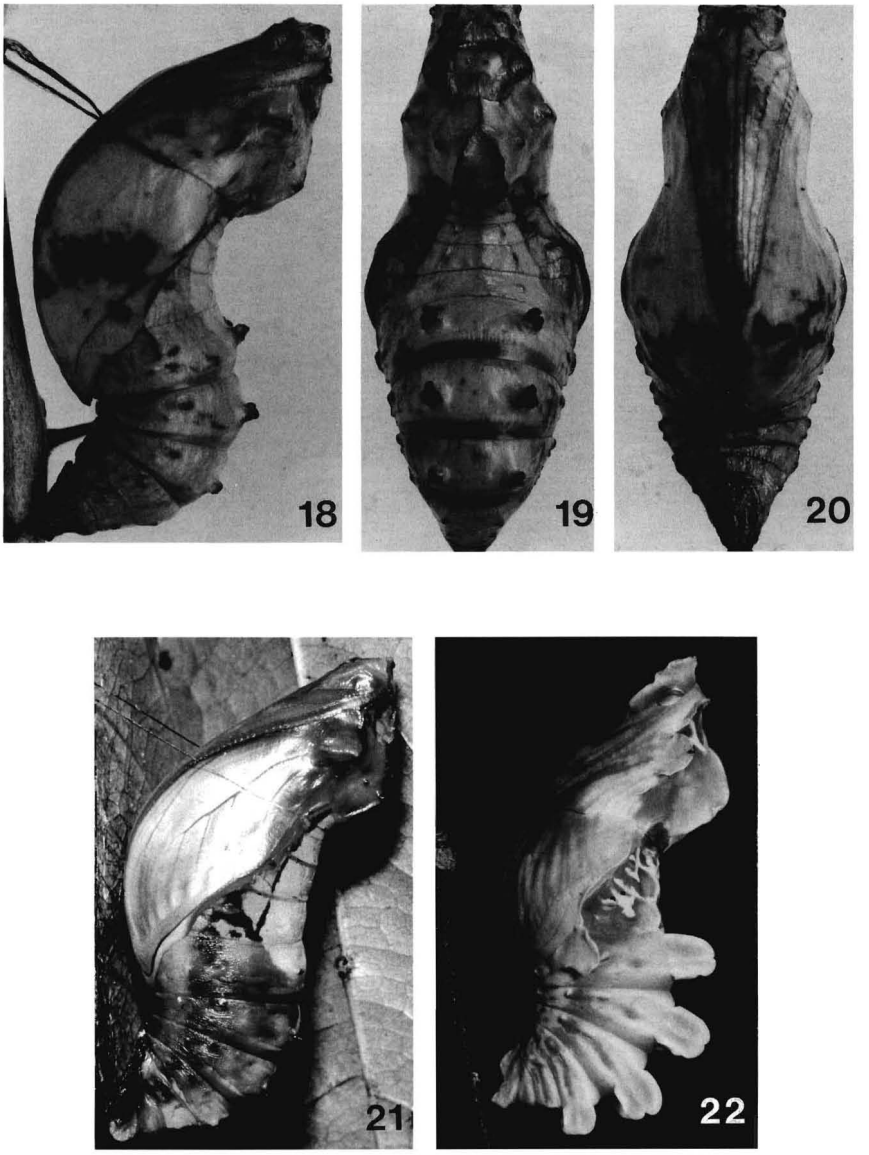

FIGS. 19–22. Pupa of *P. antenor* compared to those of other Troidini (photographs). **18.** *P. antenor* (ca. 40 mm long): lateral. **19.** *P. antenor*: dorsal. **20.** *P. antenor*: ventral. **21.** *Ornithoptera paradisea* Staud. (ca. 60 mm long) from Papua New Guinea: lateral. **22.** *Atrophaneura polydorus* (L.) (ca. 28 mm long) from Papua New Guinea: lateral.

pupal diapause, the adults eclosing only when new rains arrive. Preston-Mafham (1991) did not mention *A. acuminata* by name but stated that *P. antenor*'s *Aristolochia* foodplants "are well distributed throughout Madagascar in many different habitats, hence the butterfly's wide distribution within the island."

Records of Combretaceae as a troidine foodplant family have been perpetuated in the literature (e.g., Ehrlich & Raven 1964, Common & Waterhouse 1981, Watson & Whalley 1975), but these are erroneous. For example, in spite of Denso's (1943) earlier correct identification of *Aristolochia acuminata* as the larval foodplant, Viette (1955) stated that *P. antenor* utilises *Quisqualis grandidieri* of the Combretaceae. Of relevance, the phenolic acid patterns of *Aristolochia* and *Quisqualis* were compared by Das et al. (1966) and found to be different. As Weintraub (1995) pointed out, many of the early literature records have 'muddied' the pool of data on troidine foodplants. This is because many incorrect foodplants have been recorded based on erroneous determinations. My research (Parsons 1996 and unpubl. data), like that of Weintraub, has shown that troidine foodplant relations are indeed far more restricted (to Aristolochiaceae) than previous data might suggest.

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