WILD SILKMOTHS’89.’90

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INTERNATIONAL SOCIETY FOR WILD SILKMOTHS
PREFACE

The International Society for Wild Silkmoths was organized in 1988, by participants in the Workshop of Wild Silkmoths which was part of the 18th International Congress of Entomology held in Vancouver, Canada. Many important papers were presented in this workshop, and these were published as a volume entitled “Wild Silkmoths '88” the following year. These proceedings were widely distributed to groups and scientists engaged in related research and to educational institutions worldwide.

The 1st International Conference of Wild Silkmoths was held in Shenyang, China, in August of 1990, having been delayed one year by changes in the international situation. During the intervening two years a large number of written findings worth of rapid publication had accumulated and it is selections from these which are included “Wild Silkmoths '89 - '90”. This does not, therefore, purport to be a proceedings of the meeting, although publication of a full proceedings of the 1st International Conference of Wild Silkmoths is planned.

This volume contains reports from many field involved in wild silkmoth research: taxonomy, morphology and cytology, physiology and biochemistry, molecular genetics, pathology, silkworm cultivating and artificial diet, and food plants favored by these. All of the papers selected deal with topics important to this area.

Under the leadership of the International Society for Wild Silkmoths, two valuable centers have been established in China: the International Wild Silkmoth Research Center and the International Wild Silkmoth Training Center. Two similar centers are also being planned in India. The number of members of the Wild Silkmoth Society in Japan has increased with activities notably expanding in areas of both research and technological development. Against this background, the importance of international sharing of information related to wild silkmoth research and technology is increasing annually, and those of us in the field are excited by the prospect of new findings and the benefits they offer for others throughout the world interested in this topic.

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New morphological aspects of *Antheraea* Hübner and attempts towards a reclassification of the genus
(Lepidoptera, Saturniidae)

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Introduction

The genus *Antheraea* Hübner, [1819], is - by number of species - the largest saturniid genus in the Oriental Region. Most species are living in South Asia (from India to the Western Moluccas) and the eastern part of Palaearctic Asia; a group of three closely related species lives in the Nearctic Region from South Canada to Central America. Those species of the Australian Region classified as *Antheraea* by some authors are in fact members of an apparently monophyletic group of genera of the Papuan and Australian regions as described by (8); there are no true *Antheraea* known to live east of Seram (Moluccas) on the Southern Hemisphere.

The genus is in need of revision; more than 100 taxa have been described, but not all of these have been placed correctly within *Antheraea*. A revision would probably reveal that there are only between 25 and 50 species. Authors like (2) or (9) listed only the taxa known to them (omitting the American species, but, in case of (9), including some of the unrelated species of the Papuan region), without analyzing their relationships in detail. A more recent attempt at a reclassification of the species was made by (6), who observed some interesting new characters in preimaginal morphology, but he still erroneously included several Papuan and Australian species.

The genus is best defined by the very peculiar construction of the male genitalia: entire armature completely withdrawn under the 8th tergite, which is usually strongly sclerotized (Fig. 1) and often connected by a sclerotized "hyperuncus" (here tentatively so called) with the tegumen; under this "hood", sometimes also laterally, there are in most species many large pouches in the intersegmentals, filled with (pheromone?) scales/hairs; aedeagus slender, often long, asym-
metrical; valves bipartite, with the ventral lobes usually soft, hairy, like a brush; dorsal lobes recurved over the uncus, often with long, strong bristles crossing under the hood of the 8th tergite; there is on both sides a third finger-like processus at the dorsal base of the valves (either a 3rd lobe of the valve or of unclear origin; (1) refer to this part of the genitalia as the "labide"; (7) interpretes it as an alteration of the transtilla), which in many species might be similarly developed to the dorsal lobe of the valve; uncus deeply bilobed or fused, very low under the dorsal lobes, directed ventrally. The sister-group of the genus is unknown.

The male genitalia of all species dissected share a great similarity, which suggests a reliable, complex synapomorphy of the genus. The Australasian species included into Antheraea by some authors do not possess such genitalia and should on genus level strictly be separated. The three-dimensional complexity and strong sclerotization of the genitalia structures make it very difficult to figure the male genitalia by photography.

A study of the genitalia structures and rearings of more than a dozen species with studies of the preimaginal morphology, is the background for a new hypothesis on the basic subdivisions of the genus and a first attempt towards a reclassification of the genus based on cladistic methods.

Morphology of male genitalia and larvae

Male genitalia. The structure of the "third processus" at the valve basis and of the dorsal lobe of the valve offers good characters to reclassify the genus. Three different constructions are to be found:

1. The "third processus" or "labide" or transtilla is much longer than the dorsal lobe of the valves, distally armed with many strong bristles; it strongly resembles in shape the dorsal lobe of the valves within the following groups and obviously fulfills the same function, possibly stimulating the female or transferring male pheromone scales or something like this. Species: All American species and A. compta Rothschild (Fig. 2) from NE India.

2. The "third processus" is also large, but not armed with bristles; its distal part can be fold in medioventrally, which is a unique synapomorphy of the group (in all other groups the "labide" is more or less monolithic) (Fig. 3). Species: A. assamensis Helfer and others (e.g. formosana Sonan).

3. The "third processus" is small, the dorsal lobe of the valve is longer than it (Fig. 4). All other species.
Larvae. The caterpillars of the commonly reared species of the Holarctic region or India are usually very similar to each other and exhibit a large number of apomorphies, which obscure the relationships to other groups. The dorsal scoli on abdominal segment 8 of the larvae are mostly fused in mature larvae, but often separated in earlier instars. There is a lateral stripe in mature caterpillars of most species above the spiracles, not integrated into the supraspiracular row of scoli. This supraspiracular stripe is lacking in the American species (the larva of *A. compta* is unknown); all other larvae reared showed this supraspiracular stripe at least in the last instar. In all other Saturniinae larvae known a lateral stripe - when present - is basal, below the spiracles, including the subspiracular row of scoli. This supraspiracular stripe of *Antheraea* ends in the anal proleg complex. The anal end of the body usually tapers to a triangular point; in other saturniine caterpillars the caudal end is usually much broader, nearly rectangular. The scoli and the bristles of several species of *Antheraea* were studied by (6). The cocoon is large, ovoid, often hard; there is no preformed exit, the imagines soften the texture with body fluid from their mouths and cut an opening with the strong spines at the wing bases.

Attempts towards a reclassification of the genus

The most basic dichotomy within *Antheraea* seems to be that of "supraspiracular lateral stripe in mature larvae present" versus "not present". The most parsimonious explanation would be to interpret the presence of that character as a synapomorphy, the lacking of it being plesiomorphic, as compared with potential outgroups.

The situation in genitalia morphology is more complicated, because the outgroup comparison does not clearly show the plesiomorphic condition. As the "third processus" is either lacking or only weakly developed in most saturniine genera, the conditions in the 3rd group listed above may be interpreted as a more plesiomorphic state, with the situation in the *polyphemus/compta*-group and in the *assamensis*-group possibly being two different apomorphic developments. Combining these interpretations, the following hypothesis of a basic reclassification of the genus *Antheraea* arises (genus names and authors after (3)):

1st subgenus: *Antheraea* (Telea Hübner, [1819]), stat. nov.

Type species: *polyphemus* Cramer, 1775. Apomorphic character states: The development of the "third processus" as the most prominent part of the male genitalia. Plesiomorphic character states: The lack of the supraspiracular lateral...
stripe in mature larvae. Species: the American taxa: A. (T.) polyphemus; A. (T.) godmani Druce; A. (T.) montezuma Salle (sensu (7)); in addition the Himalayan A. (T.) compa Rothschild, which is very interesting from zoogeographical point of view and requires further explanation.

2nd subgenus: Antheraea (Antheraeopsis Wood-Mason, 1866), stat. nov.
Type species: assama Westwood, 1848 (= assamensis Helfer, 1837). Apomorphic character states: a) The development of the "third processus", especially the fact that it can be fold in medioventrally; this unique situation can well be a development independently from the conditions in subgenus Telea. b) The presence of a supraspiracular lateral stripe in penultimate and ultimate (L4 & L5) instars of the larva. Plesiomorphic character states: The fact that this supraspiracular stripe is replaced in young instars (L2 & L3) by two (weakly developed) lateral stripes, which may explain the evolutionary origin of the single supraspiracular stripe. Species: The group of taxa around assamensis Helfer: formosana Sonan, youngi Watson, castanea Jordan etc.

3rd subgenus: Antheraea (Antheraea Hübner, [1819])
Type species: mylitta Drury, 1773 (?= paphia Linnaeus, 1758). Apomorphic character states: The presence of a supraspiracular lateral stripe in larvae, often beginning as early as in L2 or L3. Plesiomorphic character states: The fact that the "third processus" is only small. Species: all other.

This third subgenus contains the vast majority of taxa described in the genus. Therefore a tentative further subdivision into 4 species-groups is suggested here:
A) The paphia/frithi-group, with very variable imagines in rich red to yellow or brown colours (often in reddish with yellow highlights, compare also (4)). This group is presently only defined by weak or supposedly plesiomorphic characters (e.g. ova with two equatorial rings; this character is shared with A. (Telea)) and may therefore be a paraphyletic assembly. It comprises the majority of taxa described. Several supposed species of this group do not differ in male genitalia, which often makes it very difficult to reliably identify a species. Perhaps a secondary system of sexual pheromones in males is involved in speciation? More research is necessary.
B) The rosieri-group, comprising only one Sundanian species, A. (A.) rosieri Toxopeus. This species was described by (10) in a genus of its own (Loepantheraea); but because of the male genitalia morphology this species should not be excluded from Antheraea, in spite of its unusual wing pattern, as shown
by (5). A. (A.) rosieri has not yet been reared due to the fact that the foodplant is unknown; the L1 larvae do not accept the standard foodplants of other Antheraea species.

C) The helferi-group. This group is a monophyletic unit, well-defined by the morphology of the L1 larva (yellow with dark lateral and dorsal stripes and a dark triangular or rhomboid dorsal patch on metathorax and abdominal segment 1) and a black "eyelid" to the hindwing ocellus (5). The latter character is similar to the usually reddish or yellowish or brown "eyelid" of the following group and may be a synapomorphy of the two groups. The helferi-group comprises the species helferi Moore, yamamai Guérin-Ménéville, pratti Bouvier, diehl Lemaire and some more.

D) The pernyi-group, a small, but well defined group with black L1 larvae. The taxa pernyi Guérin-Ménéville and roylei Moore are of high importance in sericulture; korintjiana Bouvier and a few more taxa belong to this group as well.

Discussion

The reclassification offered here is, with respect to details, a tentative one only; but it seems very likely that the three subgenera will remain stable through further phylogenetic studies. It must be quoted that a rising of these three subgenera to the level of genus would appear unjustified; the basic similarity of the male genitalia, wing pattern and larval morphology of the known species is such convincing that any exclusion of some of these species from Antheraea appears to be a violation of the generic concept.

A taxonomic and phylogenetic revision of all taxa described within Antheraea is urgently necessary. The author intends to undertake such a study in future. Revisionary work is complicated by the fact that the identity of the species is often obscured by surprising similarities in male genitalia of closely related taxa; the concept of morphospecies, which usually is to be used for species where the biospecies concept cannot be applied due to lack of sufficient knowledge, does often not offer reliable boundaries for species within Antheraea. A cooperation between all people interested in Antheraea to increase our knowledge of the different taxa would be very valuable and eventually will lead to a modern revision of the genus. We need information on all aspects of morphology and life-history the species. It will be necessary to rear all species from material collected in the wild in different areas of their distribution. Such studies would clarify systematic problems and likely also lead to improvements for sericulture. It is hoped that this paper will be a first step towards such cooperation.
Fig. 1: The sclerotized "hood" of the 8th abdominal tergite of most species of *Antheraea*, encircling the tegumen-valves complex. Dissection number 546/87 WAN, *Antheraea (Antheraea) gschwandneri* Niepelt(?), Sumatra, small dark morph. a) lateral, b) dorsal view; left side = caudal end. Scale bars 1 mm.

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Figs. 2-4: Drawings of the male genitalia of the three subgenera of *Antheraea*. a) ventral (or caudo-ventral) view, b) lateral view, c) aedeagus. Abbreviations: d = dorsal lobe of valve; v = ventral lobe of valve; t = "third lobe" or transtilla; b = bristles of the "third lobe"; u = uncus; h = "hyperuncus", i.e., the sclerotized connection between the tegumen and the "hood" of the 8th tergite. Fig. 2: dissection no. 563/87 WAN, *Antheraea (Telea) compota*, North India. Fig. 3: dissection no. 561/87 WAN, *Antheraea (Antheraeopsis) assamensis* youngi, Sumatra. Fig. 4: dissection no. 546/87 WAN, *Antheraea (Antheraea) gschwandneri*(?), Sumatra, small dark morph. Scale bars 1 mm. All drawings Jutta Klein, Frankfurt.
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References


