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Discovery of a third species of *Lamproptera* Gray, 1832 (Lepidoptera: Papilionidae)

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Abstract

A newly discovered, third species of the genus *Lamproptera* (Lepidoptera: Papilionidae) is described, 183 years after the second currently recognised species was first named. *Lamproptera paracurius* Hu, Zhang & Cotton **sp. n.**, from N.E. Yunnan, China, is based on marked differences in external morphology and male genital structure. The species is confirmed as a member of the genus, and detailed comparisons are made with other taxa included in the genus. Keys to *Lamproptera* species based on external characters and male genitalia are included.

Key words: Leptocircini, new species, Dongchuan, Yunnan, China

Introduction

The dragontails, genus *Lamproptera* Gray, 1832 (Lepidoptera: Papilionidae: Leptocircini), are the smallest papilionid butterflies found in tropical Asia (Tsukada & Nishiyama 1980b). Adults possess conspicuously prolonged tails on the hindwings, which assist their aerobatic, dragonfly-like flight—the origin of “dragontail”. Male *Lamproptera* aggregate in groups and drink from wet sandy places near the edge of water, where they tend to sit slightly apart from other groups of puddling swallowtails (Cotton & Racheli [2007]). Females can be seen visiting flowers in open places near forest edges, but are less commonly encountered than males.

Lamproptera is confined to the Oriental Region (Talbot 1939). For many years *L. curius* (Fabricius, 1787) and *L. meges* (Zinken, 1831) were the only recognized species, with various subspecies described and documented over time (Felder & Felder 1862, 1865; Butler [1870]; Moore 1902; Fruhstorfer 1898, 1909; Tytler 1912, 1939; Hata 1951; Tsukada & Nishiyama 1980a, 1980b). *L. curius* occurs from Northeast India across Indochina to South China, Malaysia and the Greater Sundas (Sumatra, Java, Borneo, Palawan, and some smaller offshore islands) (Tsukada & Nishiyama 1980b). The second known species, *L. meges*, described 183 years ago, occurs from Southwest China across Indochina to South China, Hainan, Malaysia, the Philippines, and much of the western Malay Archipelago (Sumatra, Java, Borneo, Palawan, and Sulawesi) (Tsukada & Nishiyama 1980b). Both species occur in South and Southwest China with partial sympatry (Wu 2001). Genus *Lamproptera* was estimated by Simonsen *et al.* (2011) to have diverged from ancestral tribe Leptocircini at least 44 million years ago. Since there has been considerable confusion over the tribal name, with many publications using alternate names (mainly Graphiini or Lampropterini) we take the opportunity to confirm the conclusion of Smith & Vane-Wright (2001: 506–508) that Leptocircini is the ICZN Code compliant name for the tribe.

In summer 2013 the first and second authors made several expeditions to Northeast Yunnan to investigate the butterfly fauna. During their trips, 58 unusual-looking *Lamproptera* were collected just east of Dongchuan, a mountain township lying approximately 140 km northeast of Kunming, in the Jinsha River Valley. The Jinsha

River flows northwards to the Yangtze River rather than south towards Indochina. Many of these specimens were found to represent a species new to science, described below. First, however, we take the opportunity to confirm that this new species is correctly located within the genus *Lamproptera*.

***Lamproptera* Gray, 1832**

Lamproptera Gray, 1832: pl 102, fig. 4 [no text]. Type species by monotypy: *Papilio curius* Fabricius, 1787.

Leptocircus Swainson, 1833: pl. 106. Type species by monotypy: *Papilio curius* Fabricius, 1787. [Invalid: junior objective synonym of *Lamproptera*.]

Lamprosurus Boisduval, 1836: 380. Type species by monotypy: *Papilio curius* Fabricius, 1787. [Invalid: introduced in synonymy, and junior objective synonym of *Lamproptera*.]

All dragontails have a very unusual adult phenotype for a swallowtail butterfly, with the hindwings some 20% longer than the short forewings, and the hindwing tails very long, equal to or even longer than the main hindwing itself. As a result, the hindwing, measured from wing base to the end of the intact tail (tip of extended vein M_3), is at least twice the length of the forewing as measured from the base to the end of vein R_2 , and often considerably longer. No other swallowtail has such an extreme difference in total fore- and hind-wing length (not even swordtails, *Graphium* subgenus *Pathysa*), and this characteristic alone is sufficient to mark *Lamproptera* out as a natural group, to which all three species discussed below clearly belong.

As a member of the Papilionidae, *Lamproptera* has, as expected, a larval osmeterium (confirmed by Howarth 1976, and Igarashi 1979, for *L. curius*; Igarashi & Fukuda 2000, for *L. meges*), and vein 2A of the forewing runs free toward the posterior margin (Tsukada & Nishiyama 1980b; as “3A” in Bascombe *et al.* 1999, fig. 6.12; characters 1 and 3 respectively, in Miller 1987). As members of the subfamily Papilioninae, among other characters, the dragontails have a basal spur to the cubito-vannal vein in the forewing, together with a single anal vein 1A+2A in the hindwing (characters 19 and 7 respectively, in Miller 1987; Bascombe *et al.* 1999, fig. 6.12). These features, other than the presence of an osmeterium in the unknown larva of the new species, are confirmed for all three species discussed below.

As members of the Leptocircini, morphological characters of *Lamproptera* include: hindwing r-m cross-vein sinuate (difficult to appreciate in *Lamproptera* due to the extreme reduction of the hindwing discal cell: Miller 1987, character 46); aedeagus bell-shaped at base (Miller 1987, character 47); and articulated dorsolateral sclerite of male genital valve (Miller 1987, character 48). These features are confirmed here for all three species included below. Other autapomorphies of the Leptocircini noted by Miller (1987) mostly concern the early stages and the female sex, which are not available for the new species.

According to Miller (1987, clade 8D), within the Leptocircini, *Lamproptera* forms a group with *Iphiclides* and *Graphium* s. l. marked by two synapomorphies: pointed aedeagus (Miller 1987, character 63) and dorsolaterally narrowed tegumen (Miller 1987, character 64). These features are confirmed for all three species here included in *Lamproptera*.

Lamproptera can be grouped with *Graphium* to the exclusion of *Iphiclides* by possession of apparently unique larval and pupal characters, and sharply narrowed tentorial crests—a feature of the internal anatomy not studied here (Miller 1987, characters 69, 70, 72). Miller (1987, character 71) also noted that (*Graphium* + *Lamproptera*) can be supported by the middle discocellular vein (mdc) in the forewing being shorter than the upper discocellular (udc)—although this feature does recur in *Battus* (Papilioninae: Troidini). As also pointed out by Miller (1987), although the forewing udc in *Lamproptera* is longer than the mdc, the orientation of the discocellular veins in this genus is unique. This configuration of the forewing discocellular veins is confirmed for all three *Lamproptera* species included here.

For genus *Lamproptera* Miller (1987, clade 8G) notes several autapomorphies, including: pseuduncus absent (Miller 1987, character 67), very small hindwing discal cell (Miller 1987, character 73), upper angle of forewing discal cell acute (Miller 1987, character 74), and forewing veins R_3 and R_4 “long stalked”, with R_3 arising from R_{3+4} shortly beyond the end of the discal cell (Miller 1987, character 75). These characters are confirmed for all three species now included in the genus.

Material and methods

Taxon sampling. The following taxa were examined and sampled from the authors' private collections, other private collections and specimen depositories of academic institutions, with permission. All the extensive material examined, including type material, together with the names of depositories, is documented in Appendix 1. Subspecific designations for *Lamproptera* species are currently under review; for the purposes of the present study the authors have followed Tsukada & Nishiyama (1980b).

Lamproptera curius curius (Fabricius, 1787). Type locality: 'Siam'.

Lamproptera curius magistralis (Fruhstorfer, 1909). Type locality: 'China, Yunnan, Mongtse und Manhao'.

Lamproptera curius walkeri (Moore, 1902). Type locality: 'Hong Kong'.

Lamproptera meges akirai Tsukada & Nishiyama, 1980. Type locality: 'Bantimurung, S. Celebes'.

Lamproptera meges decius (C. Felder & R. Felder, 1862). Type locality: 'Luzon'.

Lamproptera meges virescens (Butler, [1870]). Type locality: 'Java and Moulmein'.

Lamproptera sp. n. Type locality: Dongchuan, N.E. Yunnan, China.

Morphological comparisons. Specimens of *Lamproptera* were spread for examination; those of *L. curius* were spread with the scent scales on their hindwings exposed.

Spread specimens were photographed using a Fujifilm S9600 digital camera (Fujifilm, Japan) with a Kenko Close Up +2 lens (Kenko Co., Ltd., Japan). A deep blue background was applied in an attempt to maximize the difference between the specimen, especially the whitish marking, cilia, and the hyaline forewing patch, and the background. Photos were adjusted using Adobe Photoshop CS (Adobe, USA), and the reference photos of *L. curius* and *L. meges* were processed to display the upperside and underside on the left and right half of the same image. Diagnostic characters of the new taxon were also denoted using Adobe Photoshop CS. For comparison between taxa, the length of antenna and the length of forewing were measured to 0.5 mm precision, and the breadth of forewing marginal band in space M_2 and the breadth of hindwing discal band in the middle portion were measured to 0.1 mm precision under a Nikon SMZ1500 stereoscope (Nikon, Japan).

The forelegs bear significant discriminatory characters in genus *Lamproptera*, therefore a foreleg of each specimen was taken to observe the structure of tarsal claws and to count the number of spines on the ventral side of the first tarsus under the stereoscope. Before observation, the forelegs were washed with absolute ethanol on a vortex to remove detached scales and hair, as well as environmental particles like dirt and pollen. After observation, the legs were fixed on a glue card and pinned with the specimens.

To observe the male genitalia, the abdomen was taken from the specimen and placed into a 1.5 mL Eppendorf tube, and 1 mL water was added to the abdomen to rehydrate the tissue at 50 °C for 30 min, then 1 mL 10% sodium hydroxide solution was used to digest soft tissue at 70 °C for 1 h. The treated abdomen was neutralized with 2% acetic acid and then dissected in a water-filled Petri dish under the stereoscope to remove residual tissues, scales, and hair. The genitalia were then transferred to 80% glycerol for 12 h to render them transparent. Photographs were taken with a Nikon DMX1200 digital camera (Nikon, Japan) mounted on the same stereoscope and automatically stacked using Helicon Focus 3.2 (Helicon Software, USA). After observation and photography, all parts of the genitalia were fixed on the same glue card bearing the foreleg and pinned with the specimen. The terminology of male genitalia mainly follows that proposed by Miller (1987).

Results

Morphological examination of the specimens collected at Dongchuan and comparison with known taxa led the authors to conclude that many represented a species new to science; particularly as it was found to be sympatric and synchronic with *L. curius*.

Description of new species

Lamproptera paracurius Hu, Zhang & Cotton sp. n.

Brief diagnosis. *L. paracurius* is similar in overall appearance to the type species of *Lamproptera*, *L. curius*, but can readily be separated by the following diagnostic characters (Figures 4–6): (a) forewing marginal band broad, on average 2.45 mm in width; (b) additional white stripe between black margin and hyaline patch on forewing; (c) hyaline patch with a smoky tinge, less transparent than in *L. curius* (or *L. meges*); (d) forewing discal band mostly white with only a fine hyaline stripe (at least half the width of this band is transparent in *L. curius*); (e) absence of hindwing anal fold and scent scales (as in *L. meges*; in *L. curius* the anal fold contains creamy white scent scales: character 49 of Miller, 1987); (f) in most specimens, black band on hindwing underside isolated from anal margin; (g) lateral, pleural areas of abdomen creamy-white with a single, fine, black line (ochraceous-white and marked by two rows of black spots in *L. curius* and *L. meges*). Several characters of the male genitalia also separate the new species from *L. curius* (Figures 2, 6): (h) valve 3.0–3.4 mm in length, ventral margin smooth (concave and angled in *L. curius*); (i) hook-like process of the clasper reduced and blunt (in *L. curius* relatively large and sharp); (j) uncus very broad and triangular in lateral view (small and narrow in *L. curius*); (k) arms and posterior part of juxta shorter than in *L. curius*.

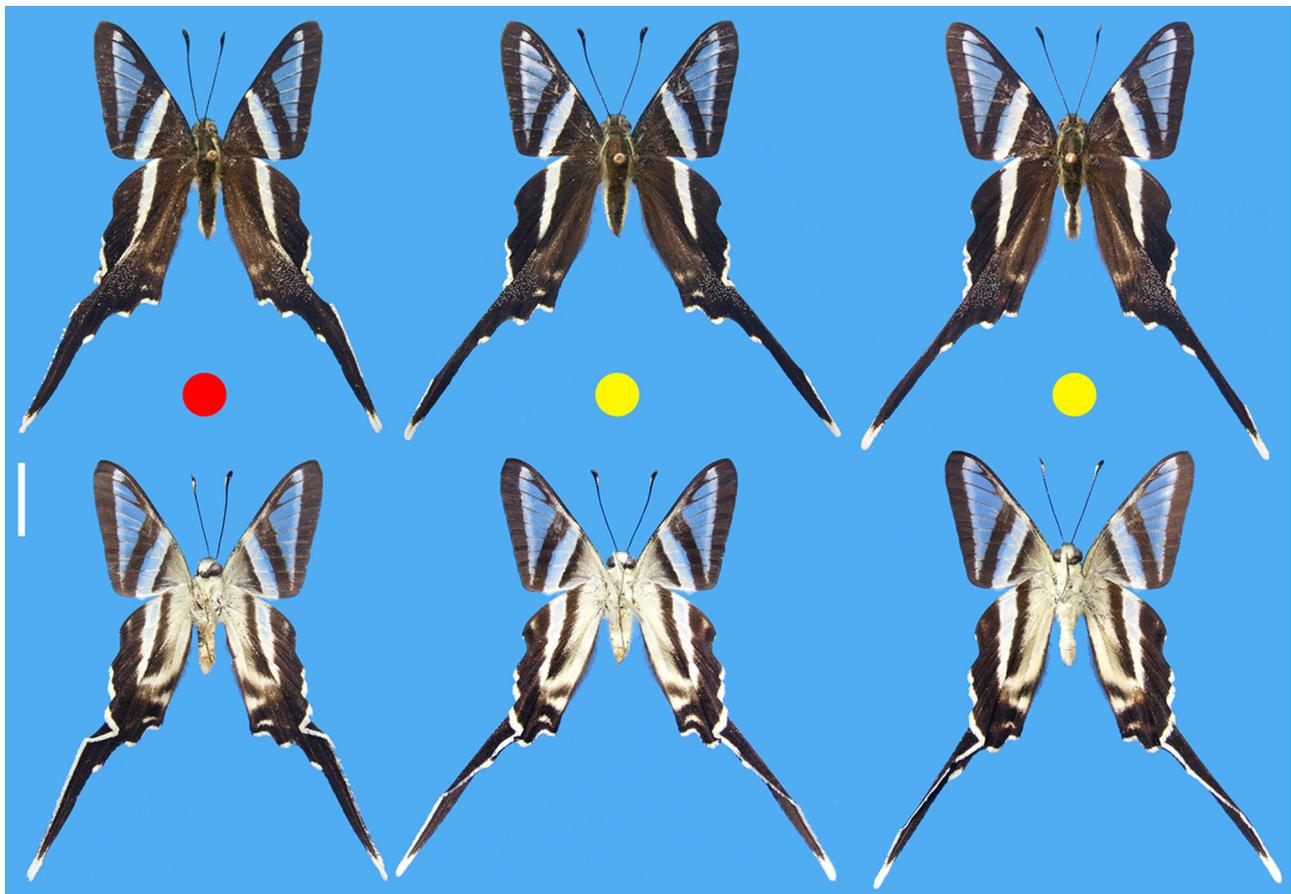


FIGURE 1. Holotype (with red dot) and two paratypes (with yellow dots) of *Lamproptera paracurius*, upperside above and underside below, scale bar = 10 mm.

Description. Male (Figure 1). Head, thorax, and abdomen black dorsally and creamy-white ventrally and laterally, a fine black line running along pleural area of abdomen except for valve. Legs black dorsally and white ventrally, with 6–10 tarsal spines on the ventral side of the first tarsus, tarsal claws paired with a large tooth on each of the inner margins. Antenna 11.5–13.5 mm (mean = 12.54 ± 0.41 mm, $n = 42$), club obviously enlarged and curved dorsally, uniformly black except for a whitish spot at base of the club on ventral side. Length of forewing 18.0–22.0 mm (mean = 20.60 ± 0.80 mm, $n = 42$). Forewing veins R_3 and R_4 long stalked, with vein R_5 arising from

R_{3+4} just beyond the end of the discal cell. Forewing upperside: costa black; a black humeral patch at basal third peppered with greyish white scales, a parallel black band running from middle of costa towards the anal angle; between the black humeral patch and band is a white band with its outer margin lined by a fine hyaline stripe, the white band abruptly narrows when crossing the upper discocellular vein; a large hyaline triangular patch in the outer half of forewing with clear black veins running through, and a narrow, white submarginal stripe just between the hyaline patch and the marginal band, making the spot in space R_3 whitish; a broad black marginal band with breadth of 1.6–2.8 mm in space M_2 (mean = 2.45 ± 0.19 mm, $n = 42$). Forewing underside: at least basal three-quarters of humeral patch tinged with greyish-white, costa peppered with greyish white from the base to the subapical spot, the remaining characters similar to upperside but slightly paler. Hindwing upperside: ground colour black, anal portion dark brown with white cilia in the lower half of termen, a broad white discal band running from the middle of costa to vein M_3 (this feature is often hidden in the folded hindwing), with a breadth of 1.7–2.5 mm at its middle (mean = 2.06 ± 0.18 mm, $n = 42$); the area below the end of the discal band peppered with white scales; a faint “L”-shaped greyish-white marking in the anal zone, and a white spot formed by dense white scales below; tail uniformly black with a white tip and cilia; no anal fold or scent scales. Hindwing underside: black termen, tail, cilia, and discal band as upperside but paler; a broad greyish-white basal patch from costa ending at conjunction with apex of the discal band, forming an isolated pale black band in between, which is slightly turned towards but not reaching the anal margin; a short, triangular transverse band just distal to the large basal patch and a sharply-defined white crescent marking more distally near the anal angle accompanied by a faint, small, whitish spot (which may disappear in some specimens); a faint whitish spot near the end of space $Sc+R_1$.

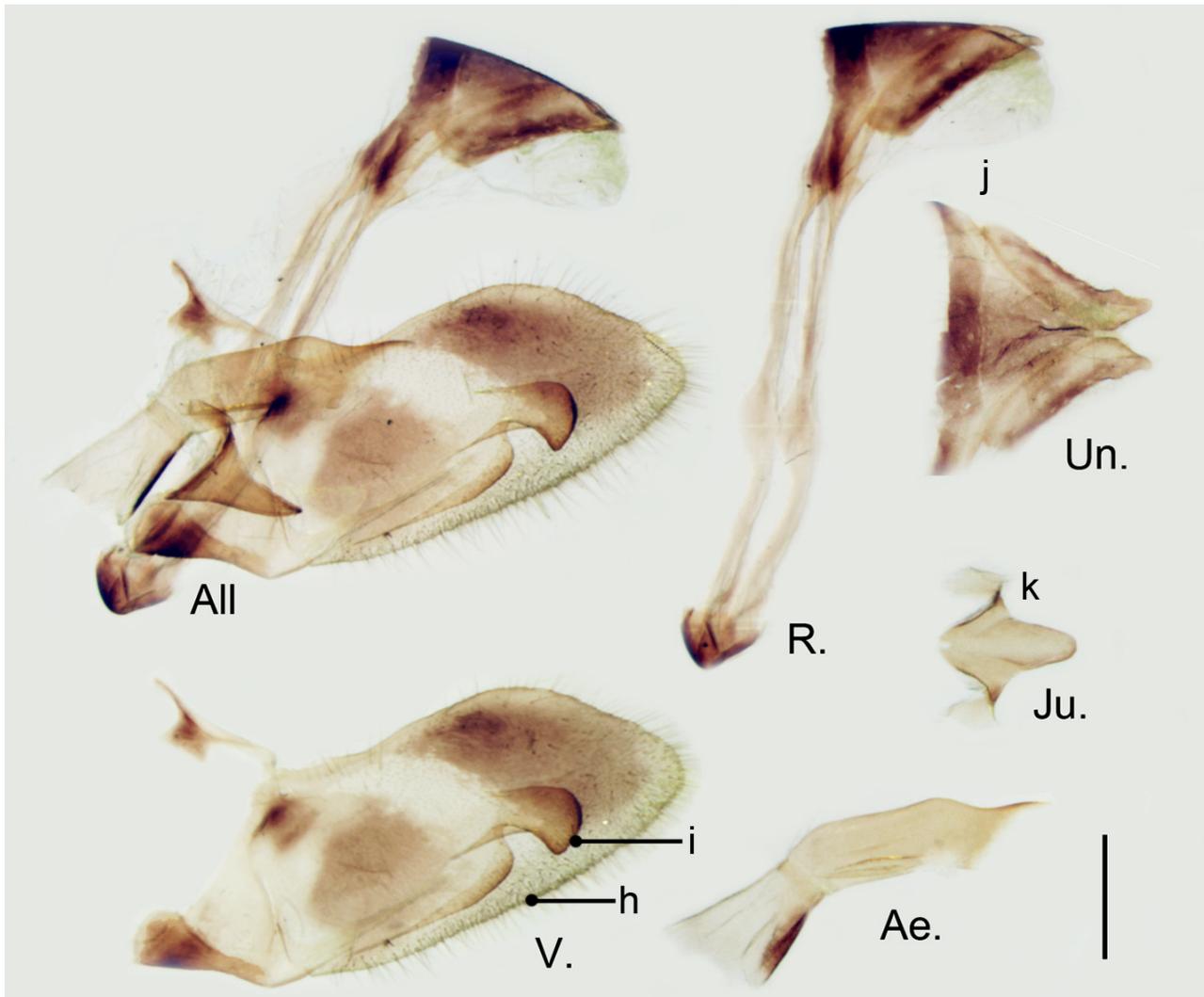


FIGURE 2. Male genitalia of *L. paracurius*; All: entire genitalia with left valve removed, R.: ring, Un.: uncus, V.: right valve, Ae.: aedeagus, and Ju.: ventral view of juxta; scale bar = 1 mm; with the letters corresponding to those in Diagnosis.

Male genitalia: A total of 10 male genitalia were dissected and characters were found to be consistent. Heavily sclerotized. Ring slender, saccus small, uncus rather broad with bifid end. Valve elongated, 3.0–3.4 mm in length, 1.1–1.3 mm in width, margin covered by hairs, the median section of dorsal margin convex, the ventral margin smoothly curved into a round and blunt tip. Clasper well defined, with a broad and blunt hook at the apex. Lateral arms of juxta short, posterior part elongated, with a small emargination in middle of anterior base. Aedeagus curved ventrally, 2.3–2.8 mm in length, the basal half bell-shaped and pointed at the dorsal tip (Figure 2).

Female: Unknown, likely to be similar to male in overall appearance.

Type material: Holotype: ♂, Dongchuan (26.1031 °N, 103.2045 °E), N.E. Yunnan, China, alt. 1,460 m asl., 2013–VIII–3, X. Zhang leg.

Paratypes: 1♂, the same location, 2013–VI–16, S. J. Hu leg.; 22♂, the same location, 2013–VIII–3, S. J. Hu and X. Zhang leg.; 34♂, the same location, 2013–IX–14–15, S. J. Hu and X. Zhang leg.

The holotype and four paratypes are deposited in the specimen deposition of the Kunming Institute of Zoology (KIZ), Chinese Academy of Sciences (registration numbers: holotype 0070950, paratypes 0070951–0070954). Nine paratypes have been transferred to the private collection of A. M. Cotton in Chiang Mai, Thailand, and the remaining paratypes are kept in the private collections of the first and second authors.

Habitat. A small river valley which runs to the Xiaojiang River (Figure 3), a branch of the Jinsha River system in N.E. Yunnan. *L. paracurius* males were observed and collected at the water's edge, perching on damp sand.



FIGURE 3. Habitat of *Lamproptera paracurius* in Dongchuan, N.E. Yunnan, China.

Host Plant. No potential host plant has yet been observed near the type locality. Presumably *Illigera* species, family Hernandiaceae, like both other *Lamproptera* species; future bionomic studies are required.

Voltinism. Probably multivoltine, adults have so far been recorded from June to September.

Derivatio Nominis. The new species was named according to its superficial similarity to *L. curius*. The prefix “para-” was used in combination with “curius” to express the close resemblance. The species name is to be treated as a noun in apposition.

Key to species of *Lamproptera*

Based on external characters:

- 1 Forewing inner discal band white; a hyaline band at least 1 mm wide between the black and white bands 2
- Forewing inner discal band pale green (or with a blue hue, colour more vivid when alive); no obvious hyaline band between the black and pale green bands *L. meges*
- 2 Forewing black marginal band edged proximally with white *L. paracurius*
- Forewing black marginal band not edged proximally with white *L. curius*

Based on male genitalia:

- 1 Uncus small, narrow, valve elongated, 4.5–4.8 mm in length (length 3.0–3.1 times maximum depth), ventrally concave, apex angular, clasper with a long hook, aedeagus curved, juxta with long processes. *L. curius*
- Uncus relatively broad, clasper not as above 2
- 2 Uncus triangular in lateral view; valve elongated, 3.0–3.4 mm in length (length 2.5–2.9 times maximum depth), ventrally straight, apex sub-angular, clasper with short but well-developed hook, aedeagus curved, juxta with short processes *L. paracurius*
- Uncus beak-like in lateral view; valve relatively rounded, 3.2–4.2 mm in length (length 2.0–2.1 times maximum depth), ventrally slightly or not convex, apex rounded, clasper with hook short or strongly reduced, aedeagus almost straight, juxta wide *L. meges*

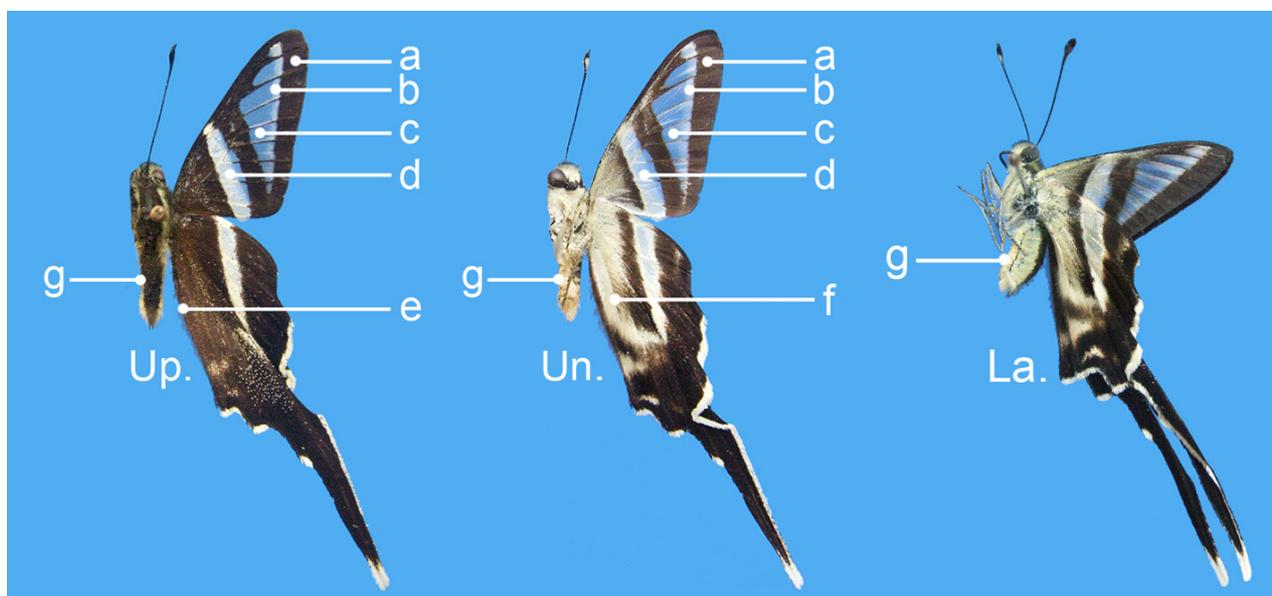


FIGURE 4. Diagnostic characters of *Lamproptera paracurius*, Up.: upperside, Un.: underside, La. lateral view; with the letters corresponding to those in the Diagnosis.

Discussion

The extra white stripe between the hyaline patch and the black marginal band on the forewing in combination with lack of scent scales on the hindwing are the most useful distinguishing characters for *Lamproptera paracurius*. Also, the male genitalia offer other useful characters for identification of the new species, especially the broad uncus and reduced, blunt hook of the clasper. Examination of a long series of specimens showed that all these characters are very constant, especially the forewing submarginal white stripe, which can be seen clearly in all individuals, even in worn specimens. No *L. curius* collected from the type locality showed any of these characters, nor were there any transitional forms. This evidence from sympatry is strongly indicative that *L. paracurius* is a distinct species from the widespread *L. curius*. Our examination of the type series did reveal some individual variation: the basal whitish patch on the hindwing underside is variable in length, completely isolating the black discal band from the anal margin, or shorter, enabling the band to connect with the margin, approaching the condition seen in *L. curius*.

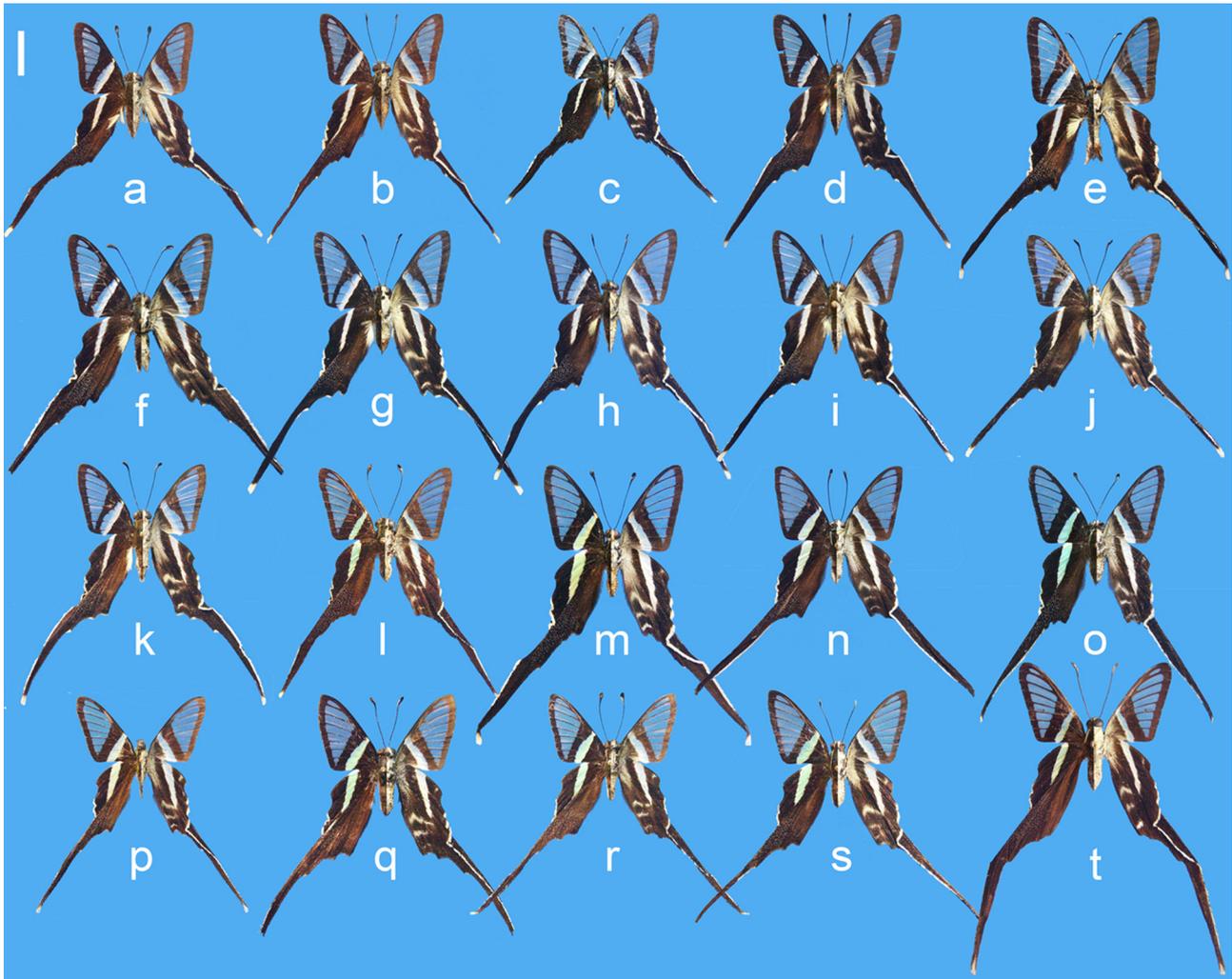


FIGURE 5. *Lamproptera curius* and *L. meges*, upperside of each specimen on the left and underside on the right, scale bar = 10 mm (at top left). a–f: *L. curius curius*: a–b: Cameron Highlands, Malaysia; c: Phetburi, Thailand; d: Xiang Khouang, Laos; e: Xam Neua, Laos; f: Chudu Razi Hills, Myanmar; g–j: *L. curius magistralis*: g: Hekou, S. Yunnan, China; h: Yuanjiang, C. Yunnan, China; i: Dongchuan, N.E. Yunnan, China; j: Jinkouhe, S.W. Sichuan, China; k: *L. curius walkeri*: Libo, S.E. Guizhou, China. l: *L. meges decius*: Marinduque Is., Philippines; m–s: *L. meges virescens*: m: Cameron Highlands, Malaysia; n: Phetburi, Thailand; o: Hinboun District, Laos; p: Jinghong, S. Yunnan, China; q: Gaoligong Shan, W. Yunnan, China; r: Libo, S.E. Guizhou, China; s: Jianfeng Ling, Hainan, China; t: *L. meges akirai*: S. Sulawesi, Indonesia.

Our examination of *L. curius* (Figure 5a–k, 6A) showed that the southern populations of *L. curius curius* (specimens collected from S. Thailand and Sundaland) are usually smaller, but have the black postdiscal and marginal bands of the forewing broader than other populations from Indochina, Myanmar, and W. and S. Yunnan. However, specimens collected from N. Laos are larger but the black bands are still well developed. Compared to Indochinese and Malayan specimens, those collected from S.W. and S. China have a narrower forewing black postdiscal band but a broader forewing discal band, especially the hyaline portion. According to Moore (1902), the broader forewing discal band and expanded hyaline section of this band are the distinguishing characters for *L. curius walkeri*. Judging by this, *L. curius* from part of S.W. China (C., S., and N.E. Yunnan, S.W. Sichuan, S.E. Guizhou, Guangxi) and S. China (Guangdong, Hong Kong, and Hainan) may all belong to ssp. *walkeri*. But illustrations of a Hainan specimen (Gu & Chen 1997), and specimens from Hainan in the Cotton collection, show a broken forewing postdiscal band, making them rather different in general appearance, and different from the illustration of a specimen from Hong Kong (Chou 1994) as well as all but two of those from Hong Kong in the BMNH collection in London. Also, *L. curius magistralis* (Fruhstorfer, 1909), described from the Red-River valley, is extremely similar to ssp. *walkeri*, making the boundary between the two subspecies very unclear. The identity of the Hainan population needs to be studied carefully due to its possible difference from populations in Guangdong.

Examination of the male genitalia of *L. curius walkeri* and *L. curius magistralis* showed no difference from that of *L. curius curius*.

For *L. meges*, which possesses many more subspecies than *L. curius*, recognition of subspecies also needs review. The present study only included a few taxa for comparative analysis, but resulted in some interesting findings. First, the insular specimens from S. Sulawesi and N. Philippines showed morphological differences from the continental material (Figure 5l–t), and also exhibited obvious differences from *L. meges meges*, which is found in Borneo, Sumatra, Bangka and Java (the type locality) according to Tsukada and Nishiyama (1980b). However, *L. meges ennius* (C. Felder & R. Felder, 1865) from C. and E. Sulawesi showed similar characters with our specimens from S. Sulawesi and the type photos of *L. meges akirai* illustrated in Tsukada and Nishiyama (1980a). *Ssp. indistincta* (Tytler, 1912) and the remaining Indochinese subspecies also need further study, but are outside the scope of this paper. The separation between *L. meges annamiticus* (Fruhstorfer, 1909), *L. meges pallidus* (Fruhstorfer, 1909), and *L. meges virescens* is rather weak (Inayoshi 2013), and requires careful analysis since mountains in this region do not seem to be true barriers to restrict population exchange. It is possible that there are other barriers in the Indochinese region less obvious than mountains, such as the dry zone in southeastern Thailand separating *ssp. virescens* from *annamiticus*. Similarly, insular *L. meges* needs further revision, and some populations may represent a distinct species, even though the male genitalia look similar (Figure 6B, C, D; Tsukada and Nishiyama 1980b).

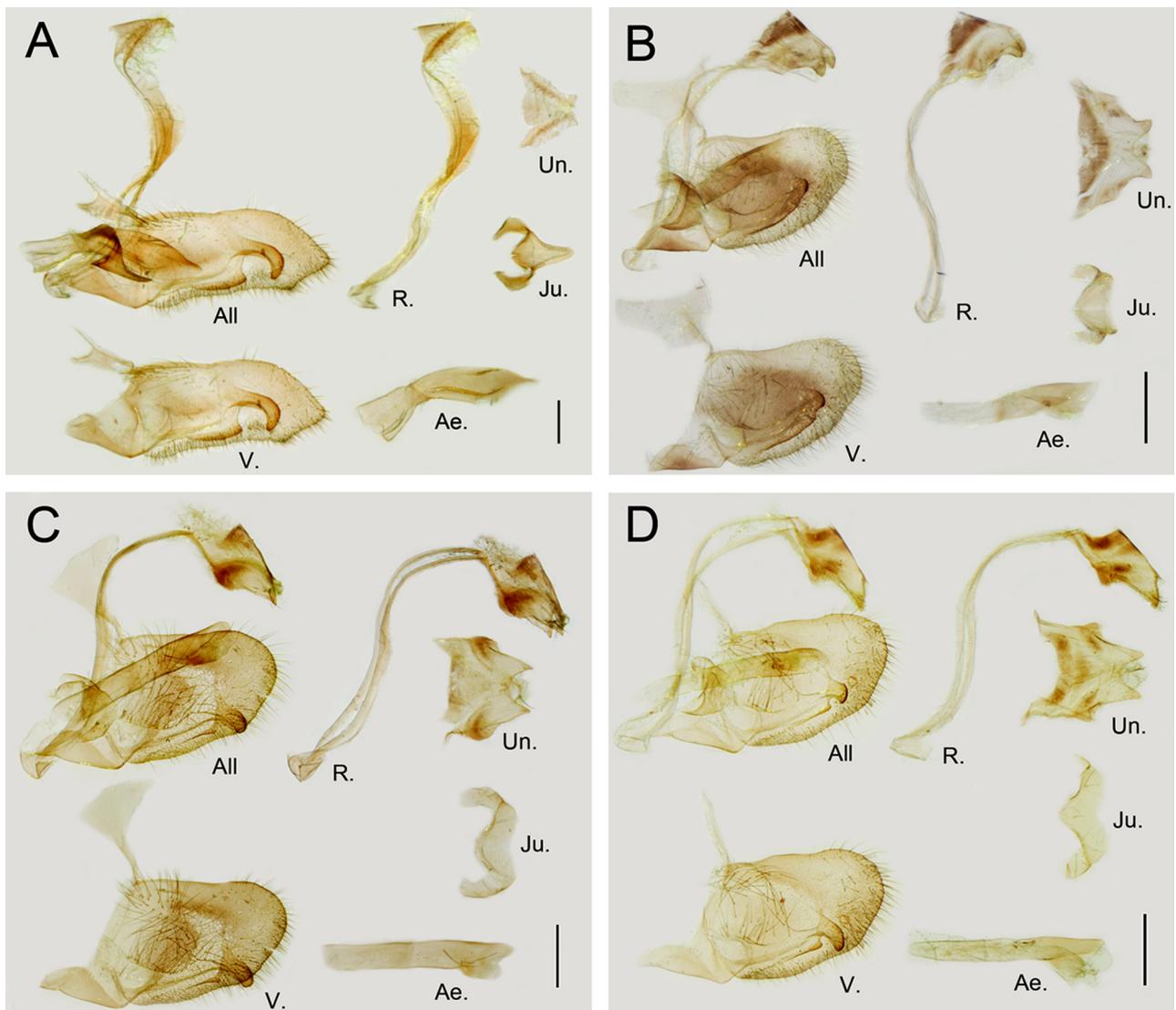


FIGURE 6. Male genitalia of A: *L. curius curius* (Xiang Khouang, Laos), B: *L. meges virescens* (S. Yunnan, China), C: *L. meges akirai* (S. Sulawesi, Indonesia), and D: *L. meges decius* (Marinduque Island, Philippines), scale bar = 1 mm, abbreviations correspond to those in Figure 2.

When examining specimens for the present study, the authors realized that this genus is a rather more complex group of tropical butterflies than previously thought, hence we also did an initial DNA analysis on the materials in hand, sequencing 658 bp of the COI gene (the DNA barcode fragment). The preliminary result of our DNA analysis placed *L. paracurius* between *L. curius* and *L. meges*, and sibling with the former species. Also, the DNA phylogeny showed clear lineage separation within the clade of *L. curius*, indicating subspecific divergence; most probably between *L. curius curius* and *L. curius walkeri* (Hu *et al.* unpublished data). However, due to lack of fresh specimens from Hong Kong, the type locality of *L. curius walkeri*, the true identify of the other subspecies in our analysis cannot be conclusively demonstrated at present. For *L. meges*, the genetic separation of insular material (i.e., *L. meges decius* and *L. m. akirai*) was greater than among the remaining continental populations, indicating a probable divergence at specific level. Therefore, further phylogenetic research on *Lamproptera* is required to answer questions concerning biogeography and subspecies separation. This will require more extensive specimen collection, bibliographic research, and a combined morphological and molecular dataset to include additional gene sequences.

Discovery of a third species of the genus in N.E. Yunnan raises questions about how and when *L. paracurius* diverged from ancestral *Lamproptera*. Since the distribution of *Lamproptera* species often follows river systems, we can speculate that populations of the ancestor of *L. paracurius* and *L. curius* became isolated due to geographical barriers caused by changes to the distinct pattern of paleo-river systems in S.W. China and Indochina. The paleo- Irrawaddy, Nujiang, Lancang, and Jinsha rivers originally all flowed into the paleo-Red River and then entered the Gulf of Tonkin. However, the lower portions of the modern Irrawaddy, Salween, Mekong and Yangtze rivers belonged to independent river systems (Clark *et al.* 2004). Given such isolation, the dragontails could have diverged and speciated, acquiring novel morphological characters over time. However, the rise of the Himalayas and the Tibetan Plateau significantly changed the drainage of the river systems. After capture of the Yangtze, the paleo- Irrawaddy, Nujiang, Lancang, and Jinsha rivers became isolated from the Red River system and were then connected with the lower portion of the Irrawaddy, Salween, Mekong, and Yangtze rivers respectively, forming the modern drainage pattern (Clark *et al.* 2004). During the course of this change, *L. curius* would have been able to repopulate the northern areas inhabited by *L. paracurius*. It may be possible to use molecular clock analysis, such as that used in Simonsen *et al.* (2011), to estimate the minimum age of divergence between the ancestral lineages, and compare the result with known geographical changes. It is surprising that *L. paracurius* is so far only known from a single locality in Yunnan. More study is needed to examine the true range of the new species, as it is likely that *L. paracurius* also occurs in other suitable habitat in the border region between Yunnan and Sichuan.

This new species description was due to be part of a revision of genus *Lamproptera*, but we decided to publish the description separately when specimens of the new species were offered for sale on the internet. A revision of the genus, including a detailed DNA analysis, will follow in a subsequent paper.

Note on the sole known type of *Lamproptera curius* (Fabricius, 1787)

During studies on the *Lamproptera* found in the region of the new species, photos of the type specimen of *Lamproptera curius* were obtained from the Natural History Museum (BMNH), London, for examination. In order to clarify the problem of the identity of this specimen it is also necessary to consider its status and origin.

Status. Fabricius (1787) described *Papilio curius* from a specimen or specimens in the Banks Collection, now housed in the BMNH. While it is clear from Doubleday (1843) that by the time he wrote his paper separating *Lamproptera meges* and *L. curius* there was only a single specimen of *Lamproptera* in the Banks Collection, it cannot be assumed that there was only a single specimen in the collection when Fabricius described the species. Following ICZN Code Recommendation 73F the specimen should thus be treated as a syntype, rather than holotype. However the statement by Butler [1870: 259] that ‘The type specimen of *P. curius* is in the Banksian Collection’ is a lectotype designation under Article 74.5 of the ICZN Code. Moore (1902: 135) made an even clearer statement ‘The Fabrician type specimen, in the Banksian Cabinet at the British Museum, is recorded from Siam’. Consequently the single specimen currently present in the Banks Collection at the BMNH must be regarded as the lectotype of *Papilio curius* Fabricius, 1787, and the type locality is ‘Siam’ [= Thailand].

Identity. On receipt of the photos from the BMNH the third author immediately realised that the type does not actually belong to the species currently known as *Lamproptera curius*, but by morphology and wing pattern is clearly a female of *Lamproptera meges annamiticus* Fruhstorfer, 1909.

The lectotype of *L. curius* is a female, which sex in *L. meges* generally has paler green bands than the male, but this specimen is very faded so that most of the discal band is bleached almost white. Only at the costa of the forewing is it still detectable that the band was not originally white. The pale hindwing band is very broad, unlike *curius*, and importantly there is only a very narrow space between the 'white' forewing discal band and the black band just distal to it. Some specimens of *meges* do have such a narrow space between the bands but it is always much less than 1 mm wide, and the veins in the space, as in the lectotype, are white not black as in specimens of *Lamproptera curius*.

The lectotype of *L. curius* can clearly be identified as belonging to the population found from southeastern Thailand near the border with Cambodia eastwards to southern Vietnam, described as *annamiticus* Fruhstorfer, 1909, due to the obvious character at the tip of the forewing; namely a thickening of the dark scales along the vein R_4 (Munroe 1961) below the apical space of the hyaline area of the forewing. This thickening causes the uppermost hyaline space to be considerably reduced in size, and is not present in subspecies *virescens* found throughout the rest of Thailand.

In reality the name *curius* should have been applied to the species that is known as *Lamproptera meges* (Zinken, 1831), but Doubleday (1843) incorrectly assigned the species name to the white striped species, which all authors have subsequently followed. This error was partly due to the state of the lectotype itself, and a misinterpretation by Doubleday of the characters separating the species, probably because he had seen too few specimens of the relatively few taxa in the genus known at that time. None of the now recognised subspecies of the two known species had been described by then; *decius* (Felder & Felder, 1862) being the first, followed by *enni*us (Felder & Felder, 1865) and *virescens* (Butler, [1870]). Many of the remaining subspecies were described by Fruhstorfer in 1898 and 1909.

Origin. Joseph Banks received butterfly specimens from Southeast Asia from two sources. The less likely collectors of the lectotype were David Nelson and William Bailey, who were paid by Banks to travel on Captain Cook's third voyage between 1776 and 1780 (Corbet 1941). They collected butterflies on Pulau Condore [= Con Son Island, off the south coast of Vietnam] some of which are housed in the Banks collection. However Monastyrskii (pers. comm.) has informed me that no specimens of *Lamproptera* were recorded on Con Son Island by any of the people subsequently known to have collected there, namely Metaye, Moulton, Bedford-Russell, Nguyen Chi Thanh and Monastyrskii himself. Thus it is unlikely that the type of *L. curius* came from there, never mind the fact that Con Son Island was not actually part of Siam [= Thailand].

The second potential source of the type specimen of *Lamproptera curius* was the Danish botanist John Gerard Koenig who lived in southern India until his death in 1785. During 1778 and 1779 Koenig visited Siam twice, the first visit in the latter part of 1778 and early 1779, when he visited Bangkok, Chantibuhn [= Chanthaburi] and Pulau Salang [= Phuket] and later in 1779 he spent considerable time collecting butterflies in the region of Phuket. Corbet (1941) discussed these voyages, and deduced that Koenig must have collected the type of *L. curius* on what is now known as Phuket island. It is almost certain for the reasons stated above that Koenig was indeed the collector of the type specimen, but the assumption of Corbet (1941) that it came from Phuket is not borne out by the phenotype of the actual specimen. The whole of western Thailand, including Phuket, and the Malay Peninsula is within the range of *L. meges virescens*. That subspecies does not have a thickening of the dark scales on vein R_4 near the tip of the forewing, and consequently the apical hyaline space of the forewing is much larger than in ssp. *annamiticus*. Koenig's diaries were translated into English (Koenig 1894) and it is clear from those diaries that he visited Chanthaburi from 25–28 January 1779. Although he didn't specifically mention collecting butterflies he did convey his enthusiasm for the nature of the region: 'The mountains of Chantibuhn still excited the wish in me to be able to pay them a longer visit'. Thus it is quite probable that the type of *L. curius* was actually collected by Koenig in Chanthaburi in late January 1779, rather than later in the year in Phuket as stated by Corbet (1941).

Conclusions. The lectotype of *Lamproptera curius* (Fabricius, 1787) housed in the Banks Collection, BMNH, is here shown to be a female of *Lamproptera meges annamiticus* (Fruhstorfer, 1909) which was probably collected by Koenig in Chanthaburi, Thailand in late January 1779.

In order to conserve prevailing usage of the names *curius* and *meges* an application will be made to the ICZN Commission under Code Article 75.6; meanwhile prevailing usage of the names is to be maintained.

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APPENDIX 1. Material examined.

Names of depositories are given in alphabetical order, with institutions listed after private collections, and are abbreviated as follows: AMC, collection of Adam M. Cotton (Chiang Mai, Thailand); HH, collection of Hao Huang (Tsingtao, China); SJH, collection of Shao-ji Hu (Kunming, China); JL, collection of Jian Luo (Beijing, China); JQZ, collection of Jian-qing Zhu (Shanghai, China); XZ, collection of Xin Zhang (Kunming, China); BMNH, collections of the Natural History Museum, (London, United Kingdom); SFU, collection of Southwest Forest University (Kunming, China); YNU, collection of Yunnan University (Kunming, China). Taxa and countries are arranged alphabetically.

Lamproptera curius curius (Fabricius, 1787). Type Locality ‘Siam’:

CHINA: 1♂, Dulongjiang, N.W. Yunnan 2012-IX-17, J. Lu leg., [AMC]; 1 ♀, Fugong, N.W. Yunnan, 2006-VII-17, [AMC]; 3♂♂ Gaoligong Shan, W. Yunnan, 2008-VI, [AMC]; 7♂, Jinghong, S. Yunnan, 1999-VI-20, J. C. He leg., [YNU]. INDIA: 1♂, Pynursla, Meghalaya, 1943-X-6, R. E. Parsons leg., [AMC]. INDONESIA: 1♂, Anai Valley, Padang Panjang, W. Sumatra, 1979-VIII-14, A. M. Cotton leg., [AMC]; 1♂, ditto, 1979-VIII-11, W. Liang leg., [AMC]; 1♂, ditto, 1979-VIII-14, L. Liang leg., [AMC]; 1♂, ditto, 1979-VIII-7, L. Liang leg., [AMC]. LAOS: 2♂, Phou Phan, Xam Neua, 2009-III-2–3, local catcher leg., [SJH]; 1♂, ditto, 2010-IV-2, local catcher leg., [SJH]; 1♀, Phou Pha Man, Hinboun District, 2005-VIII-7, A. M. Cotton leg., [AMC]; 1♂, Tad Xai Waterfall, Thabok, 2006-IV-18, A. M. Cotton leg., [AMC]; 1♂, ditto, 2005-VI-23, A. M. Cotton leg., [AMC]; 1♂, ditto, 2005-VIII-9, A. M. Cotton leg., [AMC]; 1♂, 2km from Nam Phao border post, Lak Sao, 2006-IV-21, A. M. Cotton leg., [AMC]; 1♂, ditto, 2006-II-14, A. M. Cotton leg., [AMC]; 1♂, ditto, 2006-I-17, A. M. Cotton leg., [AMC]; 1♀, ditto, 2005-VI-21, A. M. Cotton leg., [AMC]; 2♂, 4 km N.E. of Muang Moc (18.9453 °N, 104.0455 °E), Xiang Khouang, 2013-VI-24, S. J. Hu leg., [SJH]. MALAYSIA: 2♂, Cameron Highlands, 2012-VIII, local catcher leg., [SJH]; 1♂, ditto 1979-VII-23, A. M. Cotton leg., [AMC]; 1♂, Tapah Hills, Perak, 2007-III-14, local catcher leg., [AMC]; 6♂, Chenderiang Forest, Perak, 2010-I, local catcher leg., [AMC]. MYANMAR: 1♂, Kushin, N. Kachin State, 1998-VIII-5, [AMC]; 1♂, ditto, 1998-VIII-16, [AMC]; 1♂, Chudu Razi Hills, Kachin State, 2011-V-27, local catcher leg., [SJH]; 1♂, ditto, 2011-VIII-18, local catcher leg., [SJH]. PHILIPPINES: 1♂, N. Palawan 2004-VI, [AMC]; 1♂, Palawan 1978-I-2, [AMC]. THAILAND: 1♀ **LECTOTYPE**, 63/48 [round blue label], curius, Fab./♀ Siam [handwritten in red ink], *curius*, Fab. ♀ “Siam”/Mant. Ins. ii p. g n.71 (1787) [handwritten in black ink], two round red ‘Type’ labels, BMNH (E) # 668043 [BMNH], [see note about this specimen]; 3♂, Wang Takrai, Nakhon Nayok, 1982-VI-15, A. M. Cotton leg., [AMC]; 1♂, Lin Chang, Nong Ya Plong, Phetburi, 2012-V-24, A. Rakkasikorn leg., [SJH]; 1♂, ditto, 2007-VIII-18, A. Rakkasikorn leg., [AMC].

Lamproptera curius magistralis (Fruhstorfer, 1909). Type Locality ‘China, Yunnan, Mongtse und Manhao’:

CHINA: 1♂ **SYNTYPE**, Yunnan/Manhao/Chasseurs Japonais/1894, Fruhstorfer Coll./B.M. 1937-285, curius/magistralis/Fruhst. [handwriting of H. Fruhstorfer] [BMNH]; 1♀ **SYNTYPE**, Yunnan/Mengtze/Chasseurs Japonais/1894, red Fruhstorfer ‘Type’ label, curius/magistralis/Fruhst. [handwriting of H. Fruhstorfer], BMNH (E) # 149655 [BMNH]; 1♂, Yunnan/Mengtze/Chasseurs Japonais/1894, Ex Oberthür Coll./Brit.Mus.1927-3, BMNH (E) # 149654 [BMNH]; 2♂, Hekou, S. Yunnan, 1992-X-4, H. Huang leg., [HH]; 11♂, Geha, Hekou, 2013-X-4-5, 350 m, S. J. Hu leg., [SJH]; 5♂, Yuanjiang, 750 m, C. Yunnan, 2009-IX-1-3, S. J. Hu and X. Zhang leg., [SJH]; 2♂, Dongchuan, 1,460 m, N.E. Yunnan, 2013-VIII-3, S. J. Hu leg., [SJH]; 1♂, ditto, 2013-VIII-3, X. Zhang leg., [XZ]; 5♂, Jinping, 690–1,000 m, S. Yunnan, 2013-VIII-12, Q. Zeng leg., [SFU]; 1♂, Jinkouhe (Chia-Kou-Ho), Sichuan, 2013-VIII-15, S. Y. Lang leg., [SJH]; 6♂, 1♀, Dongchuan, 1,460 m, N.E. Yunnan, 2013-IX-14-15, S. J. Hu leg., [SJH]; 3♂, ditto, 2013-IX-14-15, X. Zhang leg., [XZ].

Lamproptera curius walkeri (Moore, 1902). Type Locality ‘Hong Kong’:

CHINA: 3♀ **SYNTYPES**, Hong Kong/1892-III/J. J. Walker [leg.] [2♀ with round yellow ‘Co-type’ labels, no accession numbers, 1♀ with round red ‘Type’ label, BMNH (E) # 149657], [BMNH]; 1♂, Hong Kong/1891-X, Fruhstorfer Coll./B.M. 1937-285, [BMNH]; group photo of 8♂ and 6♀, Hong Kong, in draw [BMNH]; 1♂, Hainan, 2007-V, local catcher leg., [AMC]; 1♂, Wuzhi Shan, Hainan, 2006-V-3, J. Lu leg., [AMC]; 1♂, ditto, 2008-V-9, J. Lu leg., [AMC]; 1♂, Jianfeng Ling, Hainan, 2012-III-15 J. Lu leg., [AMC]; 1♂, Shengtang Shan, Jinxiu, Guangxi, 700 m, 2011-VIII-14 (reared), J. Q. Zhu leg., [JQZ]; 9♂, Libo, S.E. Guizhou, 2013-VII-21-27, S. Y. Lang leg., [SJH]. VIETNAM: 1♂, Tamdao, 1993-V-13, P. Sukkit leg., [AMC].

Lamproptera meges akirai Tsukada & Nishiyama 1980. Type Locality ‘Bantimurung, S. Celebes’:

INDONESIA: 1♂, S. Sulawesi, 2008-XII, local catcher leg., [XZ]; 2♂, ditto, 2012-II, local catcher leg., [SJH].

Lamproptera meges decius (C. Felder & R. Felder 1862). Type Locality ‘Luzon’:

PHILIPPINES: 5♂, Marinduque Island, 2012-VIII, local catcher leg., [SJH].

Lamproptera meges virescens (Butler, [1870]). Type Locality ‘Java and Moulmein’:

CHINA: 5♂, Jinghong, S. Yunnan, 1995-VII-16, E. T. Ye leg., [SJH]; 4♂, ditto, 2000-V-3, J. C. He leg., [YNU]; 1♂, Jianfeng Ling, Hainan, 1997-IV-8, local catcher leg., [JL]; 1♂, ditto, 2011-V-8, local catcher leg., [JL]; 1♂, Wu Zhi Shan, Hainan, 2008-V-9, J. Lu leg., [AMC]; 3♂, Gaoligong Shan, W. Yunnan, 2,500 m, 2008-VI, local catcher leg., [SJH]; 5♂, Malipo, S.E. Yunnan, 2009-V, Y. Yang leg., [AMC]; 1♂, Shifu Village, Nankai, Baishan, Hainan, 400 m, 2011-V-3, J. Q. Zhu leg., [JQZ]; 11♂, Libo, S.E. Guizhou, 2013-VII-21-27, S. Y. Lang leg., [SJH]; 1♂, Jinping, 700 m, S. Yunnan, 2013-VIII-12, Q. Zeng leg., [SFU]; 4♂, Geha, Hekou, 2013-X-4-5, 350 m, S.J. Hu leg., [SJH]. LAOS: 1♂, Tad Xai Waterfall, Thabok District, 280 m, 2005-VI-23, A. M. Cotton leg., [SJH]; 2♂, ditto, 2005-VIII-9, A. M. Cotton leg., [AMC]; 1♂, Koun Kham Valley, Hinboun District, 170 m, 2006-II-17, A. M. Cotton leg., [SJH]; 1♂, ditto, 2011-III-4, K. Phongpiyarnit leg., [SJH]; 1♂, Koun Ngun Valley, Hinboun District, 2007-IV-1, A. M. Cotton leg., [SJH]; 1♂, ditto, 2007-IV-6, A. M. Cotton leg., [SJH]; 1♂, ditto, 2007-VII-28, A. M. Cotton leg., [SJH]. MALAYSIA: 3♂, Cameron Highlands, 2012-VIII, local catcher leg., [SJH]; 1♂, Tapah Hills, Perak, 2007-I-11, local catcher leg., [AMC]; 1♂, ditto, 2007-III-3, local catcher leg., [AMC]; 1♂, ditto, 2007-III-14, local catcher leg., [AMC]; 1♂, ditto, 2006-IX-11, local catcher leg., [AMC]; 1♂, Cameron Highlands, Perak, 1979-VIII-24, A. M. Cotton leg., [AMC]; 1♀, ditto, 1979-VII-28, A. M. Cotton leg., [AMC]. MYANMAR: 1♂ **SYNTYPE** Moulmein./Pur.from/Arch^d. Clark./43-43., BMNH (E) # 149277 [BMNH]. THAILAND: 1♂, Lin Chang, Nong Ya Plong, Phetburi, 2011-XI-25, A. Rakkasikorn leg., [SJH]; 1♂, ditto, 2012-V-24, A. Rakkasikorn leg., [SJH]; 2♂, ditto, 2007-VII-5, A. Rakkasikorn leg., [AMC]; 4♂, Chiang Mai, 2012-X, local catcher leg., [SJH].

Lamproptera sp. n.:

CHINA: 1♂, Dongchuan (26.1031 °N, 103.2045 °E), 1,460 m asl., N.E. Yunnan, 2013-VI-16, S. J. Hu leg.; 23♂, ditto, 2013-VIII-3, S. J. Hu and X. Zhang leg.; 34♂, ditto, 2013-IX-14-15, S. J. Hu and X. Zhang leg.