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The strange case of *Colophotia miranda* Olivier, 1886
(Coleoptera: Lampyridae: Luciolinae)

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The strange case of *Colophotia miranda* Olivier, 1886 (Coleoptera: Lampyridae: Luciolinae)

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Abstract. A single male specimen identified as *Colophotia miranda* Olivier (Coleoptera: Lampyridae: Luciolinae) by Blair and housed in the Natural History Museum, London, is redescribed, and its identification and affinities explored.

Key words. Firefly, abdominal appendages.

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Introduction

Ernest Olivier, who first described *Colophotia miranda* in 1886, was then curator of insects at the Muséum nationale d'Histoire naturelle, Paris (MNHN). Effectively for lampyridologists he was the first in a narrow line of firefly taxonomists. Thanks to Olivier we have our first subfamily classifications, keys, catalogues and species descriptions; work that has undergone much revision and expansion in the last 100 years.

One of Olivier's strengths, for those of us who followed him, lies in the meticulous way he organized his collections. When LB last examined it in 2015 it was still arranged in an order of taxa that reflected the chronological sequence of his publications. And the sequence of the specimens within those taxa reflected his publications too. It was thus possible to examine his collection and find the specimens he referred to in various publications. As such it is a veritable treasure trove of information for those of us who follow him. Usually.

Why is this an issue now? Today we list all our specimens examined, designate types and so on, which permits accurate relocation of type and other material. It is Olivier's collection that enables us to partly overcome the deficiencies of taxonomic descriptions of over 100 years ago where present day requirements were not expected nor met.

But Olivier made mistakes. He was quite cavalier in identifying isolated females to genus and species. We know now that this is a very difficult proposition and currently have a male based taxonomy for the Luciolinae in particular (Ballantyne et al. 2019). And sometimes his references to the same (named) species in different publications seem to deal with different species (and may well do).

And so, we come to 1886, when he had been publishing on fireflies for about 13 years. He described both male and female of *Colophotia miranda* recorded from Bohol on the island of Mindanao in the Philippines, collected by Oberthür and probably in Oberthür's collection (now within the MNHN). There was no collection date given. Of the five *Colophotia* species Olivier described, three were newly described from both males and females. He distinguished *C. miranda* from the others by its large size (15 mm long). The male abdomen was described with 'un seul appendice recourbé, filiforme et très long, d'un roux brun' [a single curved appendage, threadlike and very long, reddish brown]. This is an unusual feature for any male Luciolinae, as all other males with 'appendages' from the terminal abdomen have them paired (Ballantyne et al. 2019). The female was described as wider. His 1902 catalogue simply listed the species in the Philippines. LB did not find male specimens of this species in either the Olivier or the Oberthür collections in the Muséum nationale d'Histoire naturelle, Paris in 2015.

Subsequently Olivier (1913) himself created some of the confusion we now face in trying to identify *C. miranda* (both male and female) when he presented a dichotomous key to genera (and species) for Lampyridae

from Borneo, an island in the Malay Archipelago, shared by the Malaysian states of Sabah and Sarawak, Indonesian Kalimantan and the nation of Brunei. Olivier's (1913) key used male characteristics that clearly differ from the original 1886 description. *Colophotia miranda* is keyed using antennae filiform, hind angles of the thorax without impressions, antennae longer than the head, tip of elytra not folded and finally "Last ventral segment of male with two long elevated appendices curved upwards" (These are interpreted here as the paired projections of the median posterior projection of ventrite 7; the paired lateral posterior projections are oblique and do not project upwards). Paired appendages of the median posterior projection of ventrite 7 are common within Luciolinae males and considered one of the defining features of *Colophotia* (Ballantyne et al. 2019). The two species Olivier included in *Colophotia* (*C. miranda* and *C. brevis* Olivier 1903) from Borneo in the 1913 key were distinguished mainly by their dorsal colouration. There are no male specimens of *C. miranda* having been collected from Borneo in his much-lauded collection at MNHN.

Olivier (1883a, b) had previously described a large pale coloured species from Borneo as *Luciola lata*, having a median carina on ventrite 7 ("Dernier segment de l'abdomen ...profondément échancré en croissant et chargé sur son milieu d'une forte carène longitudinale obtuse"; last segment of the abdomen ...greatly indented and carrying in the middle a strong longitudinal obtuse carina). A median carina between light organ halves in ventrite 7 in males is also considered a defining characteristic of *Colophotia* (Ballantyne et al. 2019). Subsequently Olivier (1890) synonymized *Luciola lata* with *Luciola pallescens* Gorham, and therefore did not include *L. lata* in his treatment of the Lampyridae of Borneo (Olivier 1913). The matter of the median carina was ignored. The correct identification however of *Luciola lata* assumes considerable significance to our discussion.

Ballantyne et al. (2019: 158, fig. 484–494) addressed a single male collected by H. Mendel from the Malaysian Sabah Danum Valley in June 1999 as a possible representative of *Luciola lata*, and in doing so rejected Olivier's (1890) suggested synonymy of *L. lata* with *L. pallescens* mentioned above. This heavy bodied male with pale dorsal colouration also has a very convex surface to the pronotum, but no median carina on ventrite 7. In various places in both the Olivier and the Pic collections in MNHN, there are several females labelled as *C. miranda* which are probably not that species at all (see Ballantyne et al. 2019:152, 158 where they listed females from Sarawak (Malaysia) and Brunei in both MNHN and NHMUK). The overall similarity of colour, size, location and especially the convex nature of the pronotum led Ballantyne et al. (2019: 158) to consider that these females were much more likely to be females of *Luciola lata*. There is little doubt that Olivier's 1913 mention of a *C. miranda* male from Borneo contributed to his identifications of these females as *Colophotia*.

Ballantyne et al. (2019: 150, fig. 474–476) addressed in some detail a single male from the Philippines identified as *Colophotia miranda* by K. Blair in the Natural History Museum London (NHMUK) but did not dissect it, and thought it did not conform to either of Olivier's descriptions of *Luciola lata* or *Colophotia miranda*. (Kenneth G. Blair who died in 1952 worked in the beetle section of the museum (M. Barclay pers. com.)). It is this specimen that we readdress here.

It is possible that species like *C. miranda* being large and heavy bodied are easy to collect. Think large species like *Luciola candezei* Olivier 1902, *L. clara* Olivier 1907, *L. curticolis* Pic 1927 and *L. ochracea* Gorham 1895 (Ballantyne et al. 2019: 103). If they also fly singly and not in any sort of aggregation then this could explain the scarcity of specimens in collections. But they, like several other large species, may suffer another fate, and simply fall off their pins! Either way, the ease of collection of large heavy fireflies, or their loss once pinned, means that it is very possible that such species are now only represented by the few museum specimens that remain.

We attempt to answer the following:

1. Is this Blair specimen *Colophotia miranda* and can we substantiate the generic assignment?
2. What can we learn about the appendage, has it been broken, were there two, what function could it have?

The title of this paper derives from the Ogden Nash poem "The Strange Case of the Entomologist's Heart", where the entomologist in question found that his love interest, when excited, lit up (like a firefly) in a most unexpected place.

This paper, and its lighthearted approach, is dedicated to the late Jim Lloyd, fireflyer extraordinaire, much admired colleague and dear friend to LB, who would have appreciated the chase.

Materials and Methods

This paper is based on a single specimen in NHMUK identified by K. Blair, which LB dissected. Whether a single specimen is dissected is often governed by its quality, method of preservation (this one was pinned), institutional regulations and finally, if all other permissions are given, the temerity or courage of the taxonomist. This is the only male specimen labelled as *Colophotia miranda* LB has found in over 50 years of firefly research which conforms to the original description.

Characteristics and abbreviations for institutions follow Ballantyne et al. (2019). For convenience some abbreviations for characters are repeated below. Length is given as median maximum length of the pronotum plus length of the elytron to accommodate the droop of the prothorax. Ventricle 7 of the abdomen in its original state was covered in what appeared to be a fine layer of fungus which needed to be removed. The isolated abdomen was immersed in cold 20% KOH with pictures taken every hour, and hourly examination to prevent over softening and reveal as much as possible of the muscle attachments. The aedeagus and aedeagal sheath were removed when the abdomen was sufficiently pliable. After 24 hours immersion it was considered that further treatment in KOH would not reveal any further features, and the abdomen was removed from the KOH, washed in tap water (Canberra ACT) and allowed to dry before remounting on a card under the original specimen. Examination was under an Olympus SZX12 stereo microscope and pictures taken by a Cellsens SC100 camera mounted on the microscope. Pictures were taken at various times during the dissection procedure, as well as of the dried specimen, to show the muscle attachments. Genitalia were stored in glycerol in a genitalia vial mounted under the specimen.

Abbreviations for taxonomic characters

ASD	distance between antennal sockets
ASW	antennal socket greatest diameter
FS	antennal flagellar segments
GHW	greatest head width (across eyes, measured parallel to ASD)
L	length
LO	light organ
MPP	median posterior projection ventrite 7 male only
PLP	posterolateral projections ventrite 7 male only
SIW	smallest interocular width (measured horizontally, may be on the same level as ASD, ASW, above it if the eyes are closer there)
T7, 8, etc.	abdominal tergites
V6, 7, etc.	abdominal ventrites, referred to by actual, not visible number

Results

Colophotia miranda Olivier in Baer, 1886

Colophotia miranda Olivier in Baer 1886: 186; Olivier 1902: 76; 1913: 59. McDermott 1966: 116. Ballantyne and Lambkin 2013: 64. Ballantyne et al. 2019: fig. 474–483.

Type. Not located in MNHN during LB's visit in 2013.

Specimen examined. PHILIPPINES as Philippine islands, no collection date nor collector. Male determined *Colophotia miranda* Olivier by KG Blair (NHMUK).

Summary of diagnostic features. Dorsal colour pale brown; 15.8 mm long; light organs in ventrite 7 bipartite and widely separated; median posterior area of ventrite 7 terminated by a single elongate slender apically acute 'appendage' which is considered to conform to Olivier's (1886) description.

Male. 15.8 mm long; 6.8 mm wide measured at region of pin through right elytron.

Colour (Fig. 1A, B): Dorsal surface very pale brown; pronotum semitransparent with fat body showing irregularly through cuticle; head between eyes light brown, semitransparent, with fat body visible; left antenna with pale brown scape and remaining segments darker brown; right antenna colour ventral surface scape pale

brown, pedicel and apical two segments dark brown, dorsal surface as for left; ventral surface of thorax and legs pale brown; abdomen in original state before immersion in any fluids with dorsum pale brown semitransparent and fat bodies visible beneath cuticle in all but terminal tergite; ventral surface with V2–4 pale brown semitransparent, V5 slightly paler, V6 with LO plaques adhering to lateral areas of ventrite appearing mid brown and intervening area semitransparent with irregular distribution of fat body beneath; anterior area of V7 in dry specimen with lateral brown LO plaques and an apparent posterior margin separating this from the posterior area which is encircled by paler brown PLP incurving, and was covered in light brown material of unknown origin; after soaking in KOH all of the ventral surface of the MPP and PLP, and a narrow area anterior to the emarginations appears to be clumped fat body beneath. Pronotum (Fig. 1A, B): 3.0 mm long, 4.7 mm wide; anterior margin broadly rounded scarcely projecting beyond the rounded obtuse anterolateral corners; lateral margins diverging in anterior half and pronotum widest across middle; lateral margins converge posteriorly with slightly angulate posterior corners not behind anterior corners but to the sides; posterior corners slightly obtuse; median posterior margin shallowly emarginated and projecting a little beyond the posterior corners; most of dorsal surface smooth with flattened and widely explanate lateral margins; median area of disc a little elevated and shallow depressions just behind anterior margin behind head, and across and in front of posterior margin, not extending to laterally explanate region; pronotal width slightly less than humeral width. Elytra (Fig. 1A): 12.8 mm long; no elevated interstitial lines; lateral margins slightly convex sided; with wide epipleuron extending laterally just behind anterior margin of hypomerion and diminishing in width towards elytral apex. Head (Fig. 1A): GHW 2.3 mm; SIW 0.9 mm; ASD subequal to ASW; vertex barely depressed between eyes. Antennae (Fig. 1A): 11 segmented, three times as long as GHW, with elongate scape, small pedicel and all flagellar segments longer than wide; FS 1–7 four times as long as wide; FS 8 $\frac{3}{4}$ as long as FS 7, and FS 9 $\frac{3}{4}$ as long as FS 8. Mouthparts (Fig. 1A): well developed and male can probably feed; apical labial palpomere in the form of an elongate slender triangle (L 4–5 × W) with inner margin entire. Legs (Fig. 1A): no tibiae swollen or curved; hind femora stout slightly wider than femora 1 and 2. Abdomen (Fig. 1D, 2): V6: appears to have no light organs in the median area and they may be emarginated in this segment, or the median area devoid of light organ is a consequence of some aspect of dehydration and the dissection, as there are no obvious muscle attachments in the median area of V6; V7: with broadly and evenly emarginated anterior margin (not obvious in intact specimen); lateral margins converging posteriorly; posterior margin trisinate (Fig. 2A, B) with oblique PLP which are half the length of the MPP and curve inwards partly embracing the MPP in dried specimen (Fig. 1D); deep slightly irregular emarginations separate MPP and PLP; MPP broad and deep with concave dorsal surface; apically truncated with a single elongate very slender apically acute appendage arising from the left side of the apex, and remaining margins densely hairy; dorsal surface V7 with brown facing cuticle covering sides of MPP and around emarginations to the PLP. Muscle attachments (Fig. 2A, B): a large block of longitudinal muscles attach on the median area of V7 between light organ halves and narrow to a median band along the dorsal median surface of the MPP; in the anterior portion these muscles split into two wide bands attaching to the anterior margin on either side of the anterior emargination of V7; small lateral bands reach the sides anterior to the PLP; T8 (Fig. 2 D–F): lateral margins straight converging slightly posteriorly; median posterior margin with a deep and narrow emargination, margined by acute corners, and further shallow lateral emarginations between median area and rounded posterolateral corners; dorsal surface with deep median longitudinal emargination which houses the aedeagus and sheath in repose and distinct acute margins separating this median channel from flat side areas which have no spines; there is no muscle attachment posterior to the flanges in T8; strongly sclerotized and dark flanges with obliquely truncated apices each projecting posteriorly arise at the anterior end of the acute margins of the median trough; anterolateral paired prolongations of T8 rounded and slightly shorter than the median length of the entire posterior portion. Muscle attachments (Fig. 2 E, F): strong bands of longitudinal muscles attach onto the basal portion of the flanges. Aedeagal sheath Fig. 3 A–C): elongate slender about 7 × as long as wide; tergite of sheath in two sections; anterior margin evenly emarginated. Aedeagus (Fig. 3 D–F): elongate slender about 6 × as long as wide; appearing slightly asymmetrical (basal piece is turned to one side); lateral lobes very short scarcely separated.

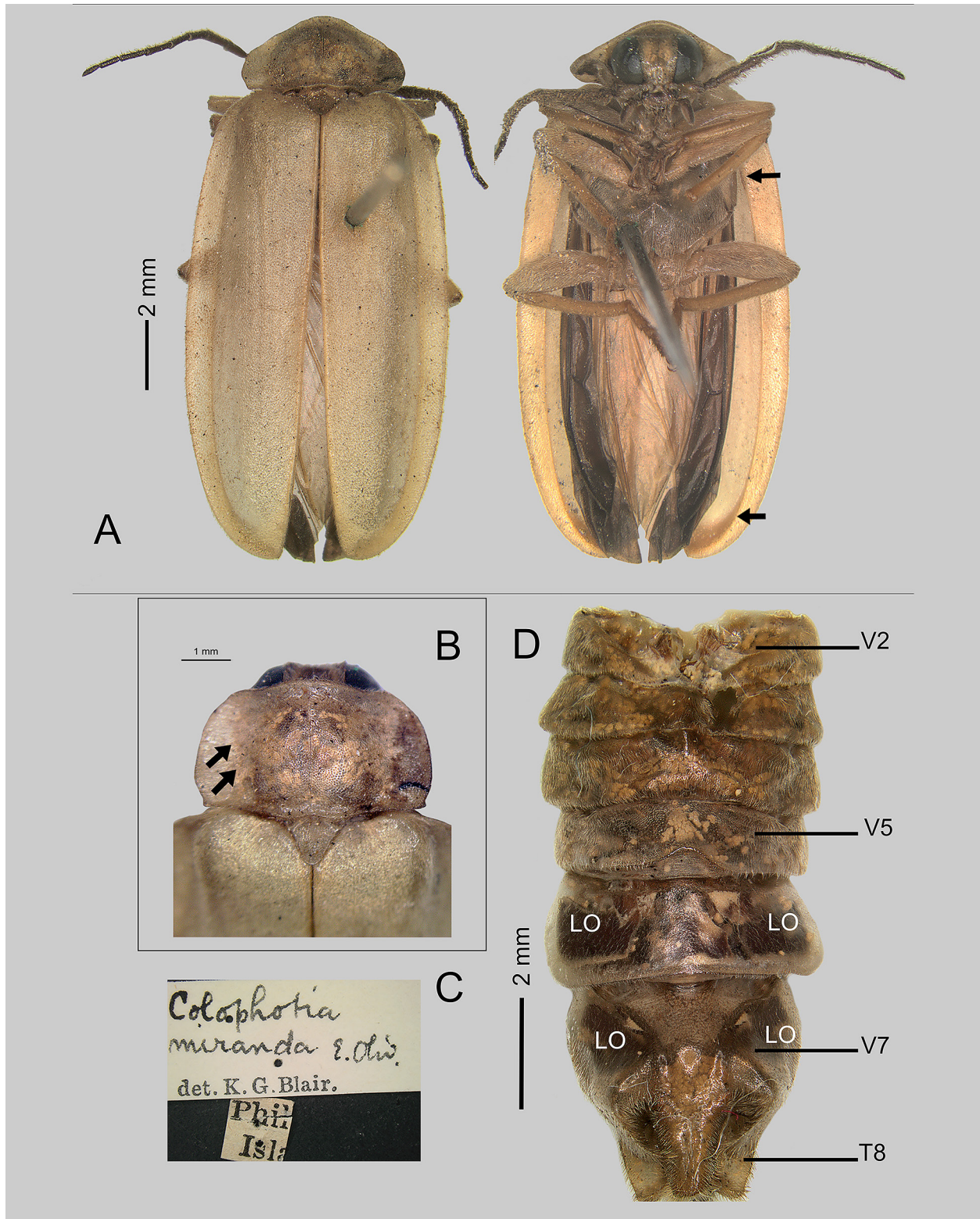


Figure 1. *Colophotia miranda* male. **A)** Habitus dorsal and ventral with epipleuron arrowed; **B)** Detail head and pronotum, with arrows at margins of the median elevated area of disc; **C)** Specimen label; **D)** Dried specimen before dissection, abdominal ventrites showing actual number of ventrite, with T8, LO situated on V6 and V7. Figure legends: LO – light organ; T8 – tergite 8; V2 – ventrite 2; V5 – ventrite 5; V7 – ventrite 7.

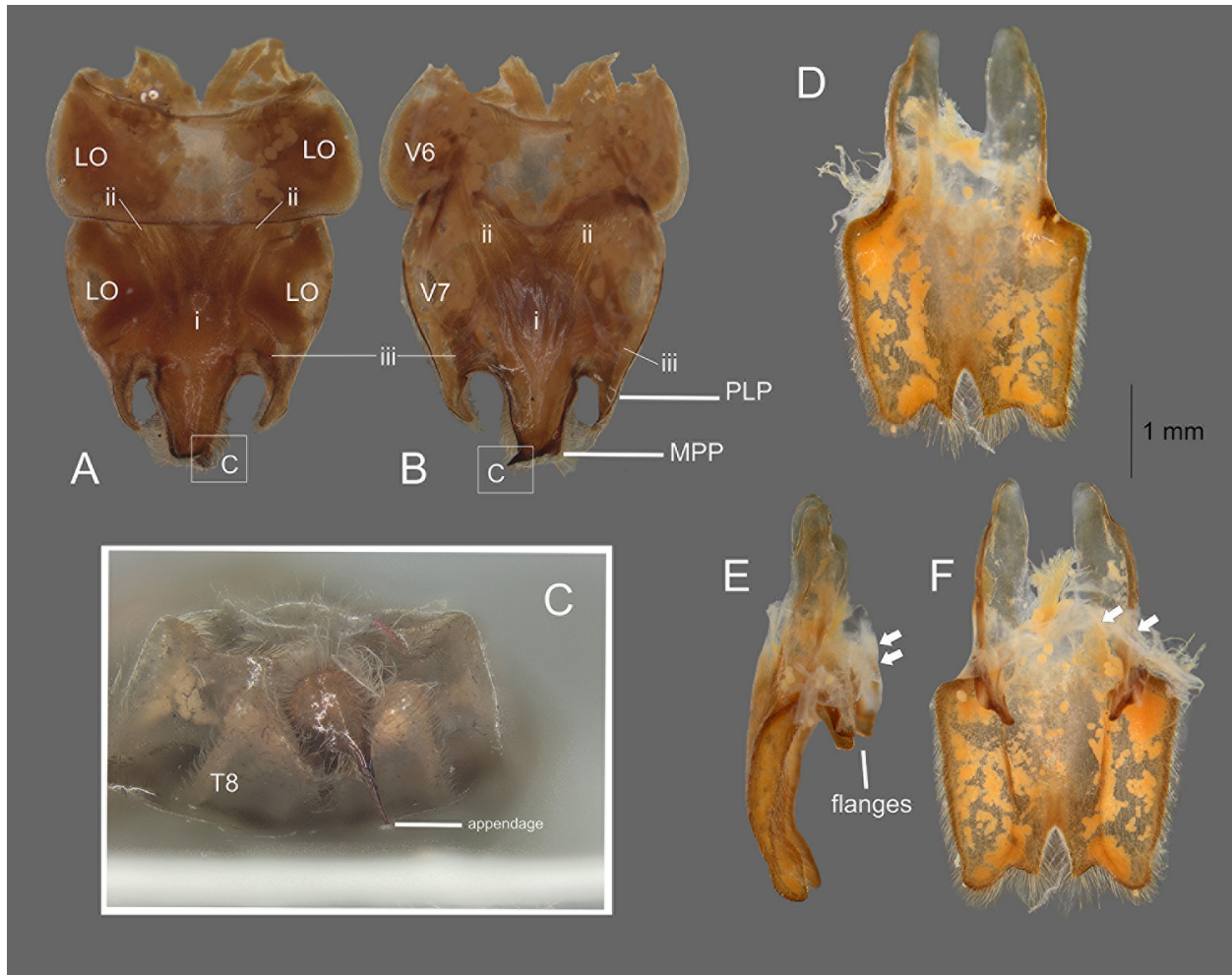


Figure 2. Abdomen of *Colophotia miranda* male. **A)** V6 and V7, dorsal; **B)** V6 and V7 ventral with single apical appendage (C), muscle attachments (i, ii, iii) indicated; **C)** posterior view ventrites uppermost, single apical appendage indicated; **D–F)** Tergite 8. D – dorsal, E – right lateral (flanges indicated, muscles blocks arrowed), F – ventral (muscles blocks arrowed). Figure legends: LO – light organ; MPP – median posterior projection; PLP – posterolateral projection; T8 – tergite 8; V6 – ventrite 6; V7 – ventrite 7; i, ii, iii – muscle attachments.

Discussion

Identified as *Colophotia miranda* and addressed here we have: 1. males and females described from Mindanao in the Philippines in the MNHN but not found, males described as having a single ‘appendage’ arising from the abdominal apex; only one male in NHMUK has been located and has the single ‘appendage’. 2. Unlocated males from Borneo having two ‘appendages’ arising from the abdominal apex. 3. Several females from Borneo in MNHN.

Additionally, described from Borneo as having a median carina on V7 (a diagnostic feature of, and only seen in *Colophotia*) is *Luciola lata* which was subsequently synonymized with *Luciola pallescens*, with the mystery of the median carina, presence or absence, not addressed. And finally, as discussed in Ballantyne et al. (2019), there was an attempt to identify a male specimen in the NHMUK collected by H. Mendel from the Malaysian Sabah Danum Valley in June 1999 from Borneo as *Luciola lata*, (without median carina), and a rejection of the synonymy with *Luciola pallescens*, but with features suggesting its close affinity to the ‘*miranda*’ females in MNHN addressed above.

A strange case indeed.

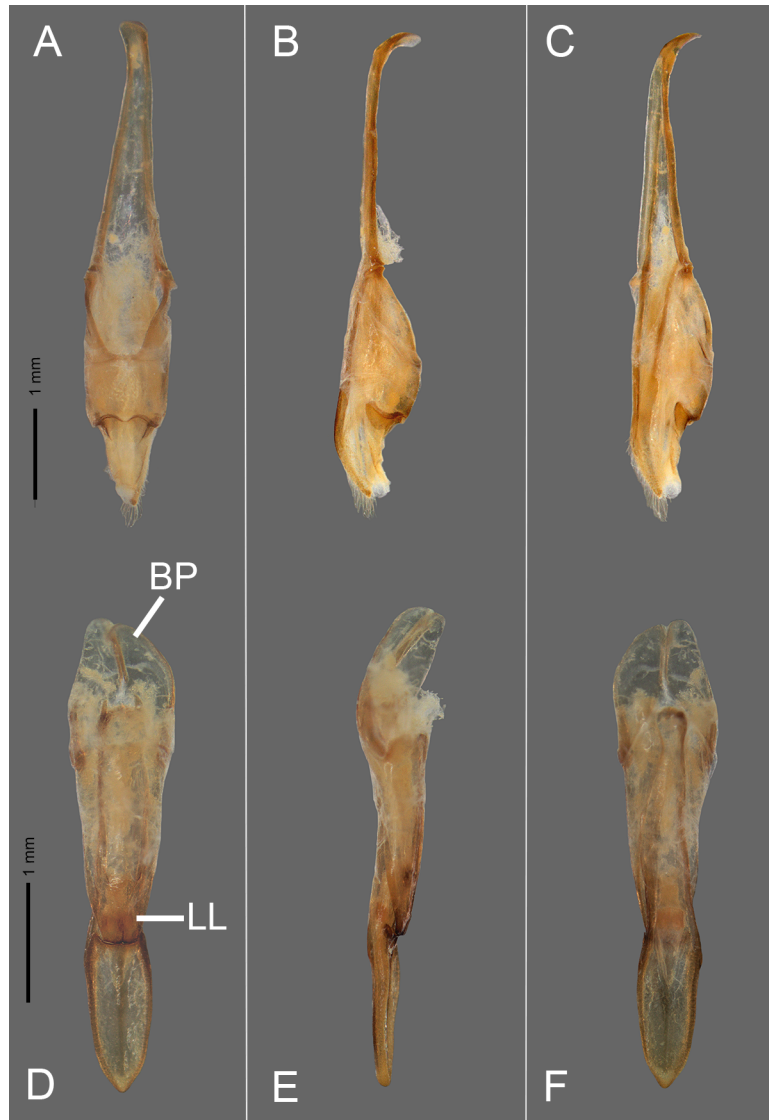


Figure 3. Genitalia of *Colophotia miranda* male. **A–C**) Aedeagal sheath (without aedeagus), **D–F**) Aedeagus. **A, D** – dorsal, **B, E** – left lateral, **C** – ventrolateral, **F** – ventral view. Figure legends: **BP** – basal piece; **LL** – lateral lobe.

Olivier's two descriptions of *C. miranda* (Olivier 1886, 1913), one from the Philippines and the other Borneo, may have indicated two different species, if not genera. Olivier's (1913) description of the male Borneo specimen conforms to our present ideas of the genus *Colophotia* as redescribed in Ballantyne et al. (2019) in having dual hooks arising from the median projection of V7. We are unable to locate these specimens, or to confirm species identity of Olivier's (1913) specimens.

There is sufficient commonality in the detailed comparison here of the Blair specimen in NHMUK (having a single appendage from the abdomen inclining dorsally) with Olivier's (1886) description (having a single appendage of the abdomen curving dorsally), and in the results of the dissections, for us to consider that this single male from the Philippines is *Colophotia miranda*.

Comparison of features of the genus *Colophotia* in Ballantyne et al. (2019) with the Blair specimen suggest that most generic features also conform. Of those that do not, we cannot account for the antennae where the final

three flagellomeres are not shortened, as they are in other *Colophotia*. If there is a median carina on V7 then on this specimen it becomes too much of a subjective interpretation as it would be very wide and flat. Genera in the large clade to which *Colophotia* belongs (Ballantyne et al. 2019: 174, fig. S1) usually have pronota parallel sided and none have laterally explanate pronotal margins as this specimen does. No other species in the Luciolinae thus far has been recorded with such wide epipleura.

However, many features do conform to previous generic descriptions of *Colophotia* (see Ballantyne et al. 2019). These include the well-developed lateral oblique projections on V7, the bipartite light organs, the elongate aedeagal sheath and aedeagus, and the very short lateral lobes of the aedeagus all consistent with *Colophotia*. Colour, size, and location support the assignment to *Colophotia miranda*. The oblique lateral projections from V7 cannot be confused with anything Olivier might have described as dorsally curving hook/s as they do not extend beyond the tergites, and only curve inwards towards the MPP.

Ballantyne et al. (2019) initially thought that the single Blair specimen examined here, and which was not then dissected, did not conform to either of Olivier's descriptions. The posterior area of ventrite 7 was then covered in what appears to be fungus (Ballantyne et al. 2019: 152, fig. 475). Only immersion in KOH clearly revealed the single narrowed, and apically acute appendage arising from the MPP of V7. It is surprising that this appendage was still intact. This finding clearly supports the determination of this specimen as *Colophotia miranda*. It is assumed that Olivier originally examined a fresher specimen in which the appendage would have been clearly visible.

Ballantyne (1987: 178) attempted interpretations of function for the many male terminal abdomen modifications seen in the Luciolinae. She felt that many of the different morphologies encountered "may not necessarily be of copulatory significance in themselves, but appear to relate either directly or indirectly, to internal areas of muscle attachment". It was postulated that the loss of ventrite 8 in the Luciolinae, as a surface area for muscle attachment, resulted in additional areas for muscle attachment being required in segments anterior to segment 8, and would for example account for the development of a bipartite light organ in ventrite 7. Many of the terminal abdomen modifications were seen as mechanical modifications for reinforcement in areas where most muscle pull was encountered for example the extreme form of terminal abdomen development seen in some *Colophotia* like *C. bakeri* Pic 1924 (Ballantyne et al. 2019: 71, fig. 215–217). In *C. bakeri* additional to a bipartite light organ in ventrite 7 there is a wide heavily sclerotized median projection from ventrite 7 which is apically emarginated with each side of the emargination ending in slender dorsally curving hooks. All other *Colophotia* examined by Ballantyne et al. (2019: 66) have a ventrite 7 median projection ending in paired dorsally curving hooks, and obliquely inclined lateral projections from the sides of ventrite 7. In some of these species the median projection is short and not well sclerotized (e.g., *C. brevis* Ballantyne et al. 2019: 73, fig. 222, 223) and it is not presently possible to explain why such an apparently 'extreme' modification occurs in *C. bakeri*.

However it may help to attempt to explain part of what we see in this specimen we identify as *C. miranda*. This specimen differs from other *Colophotia* as the median posterior projection is not apically bifurcate, but solid and truncated (Fig. 2A, B). Muscle attachments are visible especially in the median area of the dorsal surface of ventrite 7 between light organ halves, and such a development of this area would certainly help reinforce against muscle pull. It does not explain why there would be such a long and single projection from ventrite 7. Short laterally inclined muscles also can move the PLP of V7 slightly but the purpose is not clear.

Conclusions

The specimen identified by K. Blair in NHMUK is considered to be *Colophotia miranda* as described by Olivier (1886).

The assignment of this species to the genus *Colophotia* is substantiated but the genus *Colophotia* as re-described by Ballantyne et al. (2019) will need to be further expanded to accommodate *C. miranda*.

We are unable to answer whether there were two appendages and one has broken. We feel that any break of such a slender appendage would be along its length and not at the base.

We cannot ascribe any function to such a slender structure.

Males and females described as *Colophotia miranda* from the Philippines by Olivier (1886) cannot be relocated.

Males described as having a single elongate slender ‘appendicule’ from the terminal abdomen by Olivier (1886) were not found in MNHN.

Males from Borneo described as *Colophotia miranda* by Olivier (1913) have not been relocated.

Females from Borneo in MNHN and NHMUK, some labelled *Colophotia miranda*, are considered to be females of *Luciola lata* Olivier.

The type of *Luciola lata* has not been located and the species still stands under *species incertae sedis* as recommended by Ballantyne et al. (2019).

The male specimen from Danum Valley Sabah and described by Ballantyne et al. (2019) is considered to represent *Luciola lata*, and the synonymy of *Luciola lata* with *Luciola pallescens* is rejected.

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