

Revision of the genus *Coeliccia* (Zygoptera: Platycnemididae) in Borneo. Part I: The *borneensis*-group of species

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A revision of the *borneensis*-group of *Coeliccia* species from the SE Asian island of Borneo is presented. The group is characterised based on the form of the penis, the form of the posterior lobe of the female pronotum and the mesostigmal plates of the female. Six species are recognised as occurring in Borneo, of which one is described as new: *C. kenyah* spec. nov. *Coeliccia campioni*, often considered a junior synonym of *C. borneensis*, is shown to be a valid species and new records are provided. *C. coomansi* is shown to be a junior synonym of *C. flavostriata*. Redescriptions based on fresh material are provided for the female of *C. borneensis* and the male of *C. campioni*. The male of *C. borneensis* and the female of *C. campioni* are described for the first time. Variation in *C. arcuata* and *C. flavostriata* is discussed. Keys to both sexes and illustrations of important characters for all named species are given.

Introduction

The platycnemidid calicnemiine genus *Coeliccia* Kirby, 1890, is well represented on the island of Borneo; Lieftinck (1954) lists ten named species, including at least one synonym. In addition, a number of unnamed species is present in collections. Laidlaw (1932) divided the genus into three groups based on characters of wing venation; all of the known Bornean species were placed in the *membranipes*-group, characterised by IR_3 arising distal to the subnodus and R_4 arising from the subnodus. Laidlaw was aware of the defects of his system, noting "Unfortunately there is a tendency to a considerable amount of individual variation in the point of origin of these sectors, and it is well, where possible, to determine their most usual position in any given species." Indeed, in certain specimens of some of the Bornean species, the characters of all three of Laidlaw's groups can be found in the same individual. These venational characters are therefore unsound. However the Bornean species do fall into two groups based especially on the structure of the penis and the female prothorax, and other structural characters, and these structures also provide useful characters for species separation. The majority of species known from Borneo (named and unnamed) fall into a group typified by *C. membranipes* (Rambur, 1842), known from Engano, Java and Sumatra (e.g. Lieftinck 1934, 1935, 1948, 1954); for this reason this species group is referred to here as the *membranipes*-group. The *membranipes*-group also includes representatives from mainland tropical Asia. A revision of the *membranipes*-group in Borneo is in preparation by the author.

Five named species from Borneo stand apart from the *membranipes*-group in colouration, form of the male appendages, penis and structure of the female prothorax, as

well as in other features; these are *C. arcuata* Lieftinck, 1940, *C. borneensis* (Selys, 1886), *C. campioni* Laidlaw, 1918, *C. coomansi* Lieftinck, 1940 and *C. flavostriata* Laidlaw, 1918. These species are considered here to fall into a separate species group, the *borneensis*-group, which finds its nearest relatives in the Philippines and Java (K.-D.B. Dijkstra & D. Gassmann, pers. comm.). *C. coomansi* has been suspected to be a junior synonym of *C. flavostriata*, indeed Orr (2003) does not even list *coomansi* in the Bornean fauna; this synonymy is confirmed here. Figs 1-4 show *borneensis*-group species in life.

Considerable confusion has surrounded *C. borneensis* and *C. campioni*. Selys (1886) described *borneensis* from a single female in the MacLachlan collection, from the Sandakan Bay area in E. Sabah. Laidlaw (1918) described *campioni* from a male collected at or in the vicinity of Lio Matu, a settlement in the Upper Baram area of Sarawak. Subsequently, and apparently without ever seeing the holotype of *borneensis*, Laidlaw treated all members of this species group that came under his notice, and which originated from east of the Lupur River in Sarawak, as *campioni*. Kimmins (1936) later identified material taken at Mt Dulit on the western bank of the Tinjar River as *campioni*; the species has also been reported from Brunei (e.g. Orr 2001). Male specimens previously treated as *campioni*, show considerable variation in some characters, whereas females which have been taken in the same locations as males mostly agree broadly with the holotype of *borneensis*, although there is also some variation. This has led to the as-



Figs 1-4. *C. borneensis*-group species in life: 1. *C. borneensis* male, Gunung Mulu National Park, Sarawak; 2. *C. campioni* male, Mt. Dulit, Sarawak; 3. *C. flavostriata* male, Gunung Gading National Park, Sarawak; 4. *C. flavostriata* female, Kubah National Park, Sarawak. Photograph 1 by R.A. Dow, 2-4 by G.T. Reels.

sumption that *campioni* is probably a junior synonym of *borneensis* (e.g. Orr 2003). The situation is complicated by the facts (1) that the holotype of *borneensis* is in very poor condition, making it difficult to examine, and (2) that no females appear to have been taken in tandem with males, so that doubt must remain over their correct association. However, a number of important characters are very constant and show that *campioni* and *borneensis* are in fact separate species; although the association of males with the female *borneensis* holotype is supposition, based largely on similarities in one character; confirmation of its identity requires the capture of tandem pairs. I show here that all previously published records of *campioni*, apart from those referring to the holotype male and one record where the specimen in question could not be located, actually refer to *borneensis*.

Specimens collected in Kapit and Sri Aman divisions of Sarawak are associated with *borneensis* here because of a lack of convincing differences in the male terminal appendages. However this 'western' form differs in some significant details, in particular in the structure of the prothorax of the single female available for study. The status of the western form cannot be satisfactorily resolved without further material; it may be a distinct species.

In 2006 G.T. Reels and the author collected specimens of an unnamed member of the *borneensis*-group at sites in the Tinjar basin area of Miri division, northeast Sarawak. Additional material was collected at further sites in the Tinjar area in 2007-2008, and one individual was collected in 2008 in the Tubau area in the east of Bintulu division. This is described here as *C. kenyah* spec. nov. In the collections of the RMNH there is a single male from the Ulu Barito area of central Kalimantan, collected by C. Jiggins in 1992 and tentatively identified by J. van Tol as a probable new species, allied to *arcuata*; this is clearly an unnamed species. I give a description of this specimen here as *C. sp. A*, but as its condition is poor I refrain from naming it, although it is included in the key. In the collection of the BMNH there is a single female from ca 1200 m on Mt Dulit that differs from all other known species in the structure of its prothorax; although this is likely to be a new species, it was decided better not to name it until more material becomes available. Keys are presented to both sexes of all named species of the *borneensis*-group.

Material and methods

Material from the following institutions was examined:

BMNH – The Natural History Museum, London, UK

RMNH – Netherlands Centre for Biodiversity Naturalis, Leiden, Netherlands

UKM – Universiti Kebangsaan Malaysia

Substantial material collected in Sarawak from 2005-2008 by G.T. Reels (GTR) and the author (RAD), together with various helpers, and currently in the author's collection (hereafter referred to as coll. Dow), and material from Brunei in the collection of A.G. Orr (coll. Orr), was also examined. By far the greatest part of the material examined was either from the RMNH or from coll. Dow.

All material from Sarawak collected by RAD, GTR and associates from 2005-2008 and initially at least in coll. Dow has a reference code; this is only stated for type material and in instances where particular specimens are mentioned, e.g. where a description is given.

All specimens were examined using stereomicroscopes. Measurements were made with the aid of a measuring eyepiece calibrated to a known scale. The illustrations were made with or with the aid of a Leica MZ16A equipped with a Leica DFC500 camera, motor focusing and LAS auto-imaging software at the RMNH, similar equipment at the BMNH, or with a Scanning Electron Microscope (SEM) at the RMNH.

Terminology used for wing venation and structures between the wing bases follows that in Watson & O'Farrell (1991), other terminology follows Westfall & May (1996). Abdominal segments are referred to as S1-S10, fore- and hindwing are abbreviated as Fw and Hw respectively; some additional terminology is explained in the next section.

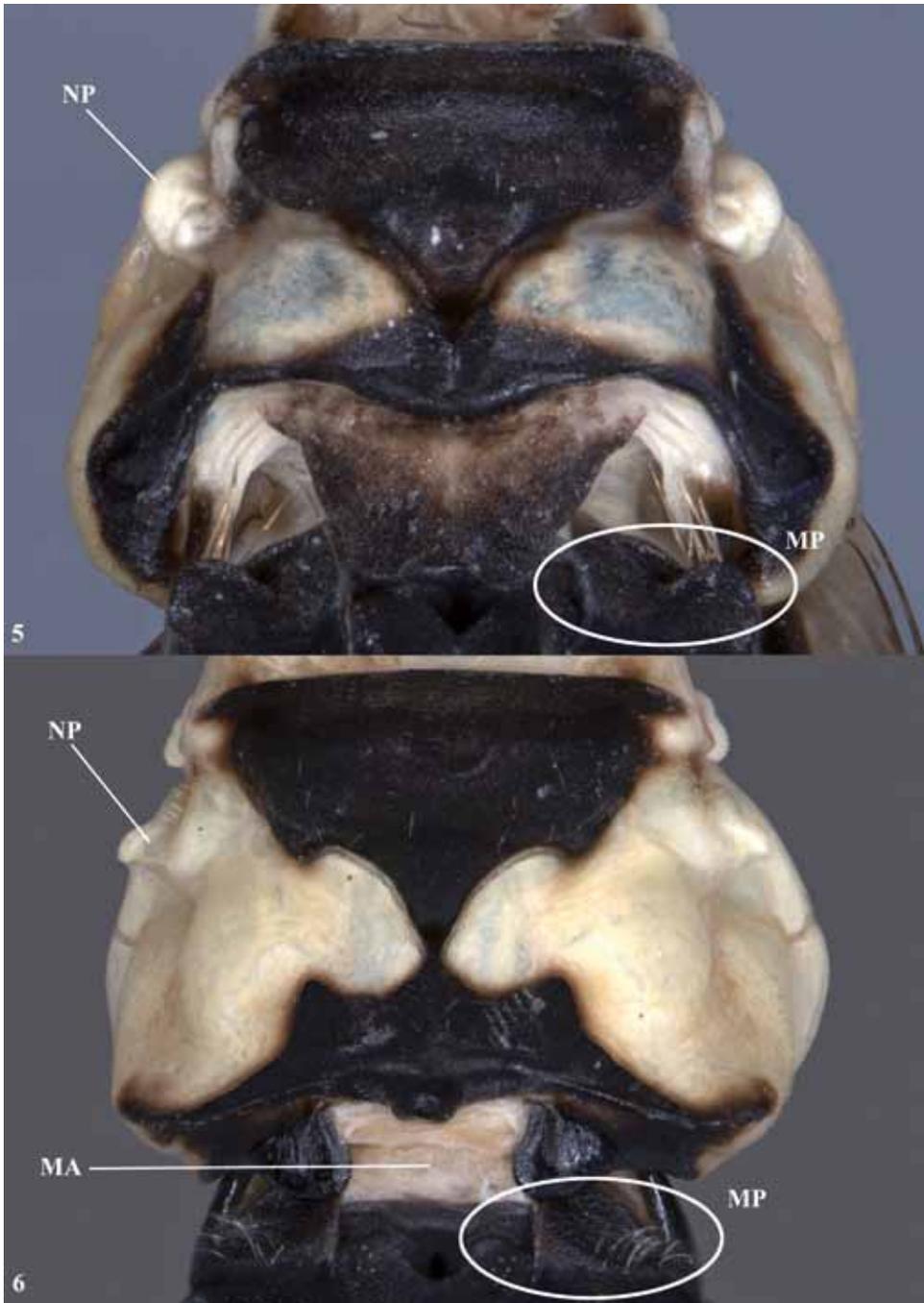
The *borneensis*-group

A distinctive group of species presently placed in the genus *Coelliccia* and broadly agreeing with the characters of that genus (primarily wing venation) as defined by Laidlaw (1932: 7-8). Members of the *borneensis*-group can be distinguished from those of the *membranipes*-group (the only other *Coelliccia* known to occur with *borneensis*-group species) and all other species of *Coelliccia* by the following major characters:

1. The penis (figs 39-44) is of very simple form, the apical segment lacking flagella and with lateral subapical excisions and rudimentary terminal lobes. In contrast the apical segment of *membranipes*-group species bears long flagella and a characteristic hood-like structure.
2. The female pronotum (figs 5-24) has a large posterior lobe, extending backwards to partly cover the mesostigmal region of the synthorax, but sometimes raised upwards. In contrast females of the *membranipes*-group and other species of *Coelliccia* from mainland Asia examined by the author have the posterior lobe much reduced, leaving an exposed membranous area centrally between the posterior lobe and the mesostigmal region of the synthorax (fig. 6 shows a typical *membranipes*-group species, *C. nigrohamata* Laidlaw, 1918 with significant characters marked).
3. The mesostigmal plates of the female (marked in figs 5, 7-8, 10-12) are strongly extended upwards along their rear margin, and typically bear a fringe of hairs on at least a part of the raised portion, which may be at right angles to the rest of the mesepisternum. In contrast the mesostigmal plates of *membranipes*-group species are of simple form and lie flat (fig. 6).

The structure of the posterior lobe of the female pronotum in the *borneensis*-group is atypical in *Coelliccia*; the form of the mesostigmal plates and the penis may be shared only with species from the Philippines and *C. lieftincki* Laidlaw, 1932 from Java (K.-D.B. Dijkstra & D. Gassmann, pers. comm.). Female characters have been underused in the taxonomy of the group, and are likely to prove extremely useful in understanding relationships within it. The recent study of phylogenetic relationships in the Calicnemiinae by Gassmann (2005) only includes a single species of *Coelliccia*, *C. membranipes*, and sheds no light on the relationship of the *borneensis*-group to the rest of the genus; this is a subject in need of further study.

The *borneensis*-group also differs from the *membranipes*-group in a number of other details: the female prothorax typically has more extensive dark colouration, especially around the notopleural suture, where there is always a black mark extending from the rear of the prothorax forwards on either side of the suture, this is henceforth referred to



Figs 5-6. Dorsal view of female prothorax of *C. arcuata*, and typical *membranipes*-group species *C. nigrohamata* for comparison, NP – notopleural projection; MP – mesostigmal plate; MA – membranous area. 5. *C. arcuata* paratype, Kariorang, E. Kalimantan; 6. *C. nigrohamata*, Kubah National Park, Sarawak.

as the 'notopleural stripe'; pale markings on the synthorax of the male are usually, but not always, yellow, whereas in the *membranipes*-group males they are always blue above; the wing venation in the *borneensis*-group is more open than in the *membranipes*-group, with lower Px counts in similar sized individuals; in males pale markings on the terminal abdominal segments are largely, usually entirely, confined to the dorsum, whereas in the *membranipes*-group such markings typically extend laterally; the terminal appendages of the males of *borneensis*-group species exhibit greater structural diversity than do those of the *membranipes*-group.

Certain other characters are useful for distinguishing species. The female prothorax bears up to three types of projecting structures on the propleuron and on the anterior and median pronotal lobes:

1. There are lateral processes anteriorly at around the level of the join of the anterior and median pronotal lobes, positioned just below the notopleural suture in most species, and often extending above the suture. These are referred to as 'notopleural projections' (indicated in figs 5-10 and 19-24) and may be conspicuous in dorsal view. The notopleural projections are present on all species of the group for which the female is known, but in two species these structures are much reduced and positioned largely or entirely above the suture. Similar structures are present on some species of the *membranipes*-group (e.g. fig. 6).
2. Some species bear projections on the median pronotal lobe, placed anteriorly and rather laterally, above the notopleural projections (figs 7-10, 20-21). These are referred to as 'median lobe projections' and are indicated in the figures. The median lobe projections are sometimes also present on males (figs 26-27), but are typically reduced in size compared with the female.
3. Rearward directed processes originating entirely from the rear of the anterior pronotal lobe are present in two species (marked on figs 11-12, 24) and are referred to as 'anterior lobe processes'.

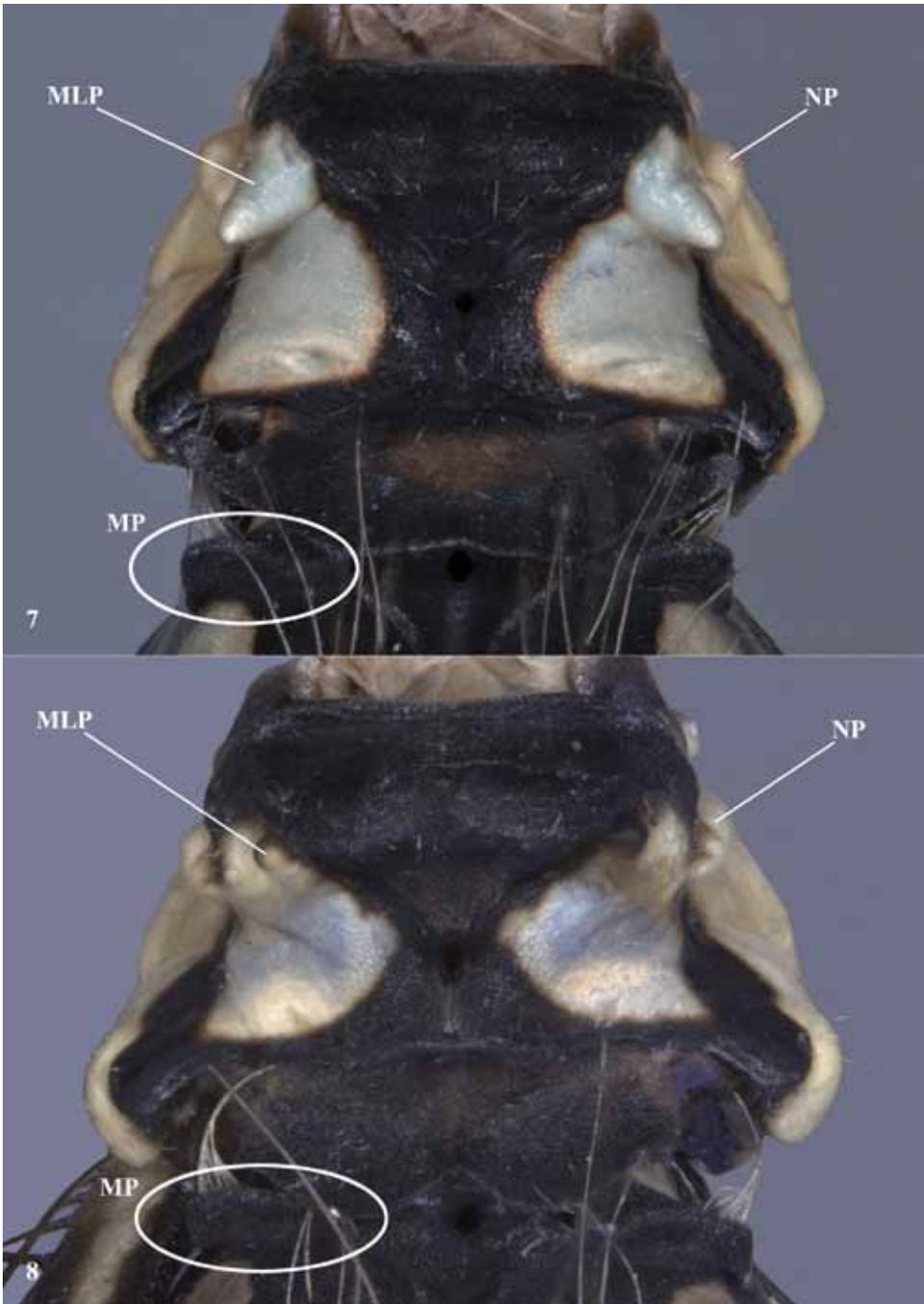
In addition, in some species the median pronotal lobe is conspicuously short centrally, longer laterally just above the notopleural suture (figs 5, 12). The posterior pronotal lobe often has lateral projections in one or both sexes (i.e. figs 14-15, 17-18, 26-27), sometimes down-turned so that they are not visible in dorsal view (e.g. fig. 9).

The penis is extremely similar in the different species within the group, although possibly the exact shape of the subapical excision might have some diagnostic value.

The cerci of the male, away from the apex, are approximately triangular in cross section, with upper and outer-lateral surfaces (often not clearly differentiated), and an inner-ventral surface that is concave over much of its length; this surface bears a single tooth. The position, orientation and size of the tooth are useful characters for distinguishing species.

The colouration of structures between the wing bases of males appears to have some diagnostic value, at least for *borneensis* and *campioni*. Although these structures are difficult to observe, they are likely to be apparent to a female damselfly being approached by a male and may be used for species recognition.

All species of the *borneensis*-group inhabit forest streams, with *borneensis* and *arcuata* seemingly occupying a wider range of habitats than the other species; the former is found from occasionally flooded lowland forest to small rocky streams at 800 m and above on Mt. Dulit, the latter has been recorded from lowland forest in flat terrain to ca



Figs 7-8. *C. borneensis* female prothorax, dorsal view, NP – notopleural projection; MLP – pronotal median lobe projection; MP – mesostigmal plate: 7. typical form, Mt. Dulit, Sarawak; 8. western form, Sungai Sbong, Sarawak.



Figs 9-10. Female prothorax, dorsal view, NP – notopleural projection; MLP – pronotal median lobe projection; MP – mesostigmal plate: 9. *C. borneensis* holotype, Sandakan Bay area, Sabah; 10. *C. campioni*, Mt. Dulit, Sarawak.

700 m in steep terrain at Poring Hot Springs in Sabah. The other species appear to be restricted to small streams in hilly and mountainous terrain. Apart from *arcuata* and *borneensis*, the species appear to have restricted distributions. On Mt Dulit in Sarawak three, possibly four, species occur, and three species have been found along a short stretch of a single stream. Additional species are likely to be found at high altitude or in the still largely unexplored central parts of Borneo.

Key to the named species of the *borneensis*-group

Males (includes *C. sp. A*)

1. Basal half of labrum extensively pale 2
 - Labrum entirely black 3
2. Cerci in lateral view not or only slightly down-turned towards end, with tips often hidden by the paraprocts (fig. 54). Paraprocts measured along the lower margin in a straight line from base to tip ca 3 times as long as S10 *C. flavostriata*
 - Cerci down-turned at end, paraprocts strongly up-turned towards tip, giving appendages a pincer-like appearance in lateral view (fig. 55). Paraprocts just over 2 times as long as S10 *C. kenyah* spec. nov.
3. Cerci with large interior spine-like tooth (figs 57, 62). Paraprocts in ventral view relatively wide and flattened along most of their length (figs 63, 68) 4
 - Cerci with smaller interior tooth that is often difficult to see (figs 58, 59). Paraprocts tapering rapidly from base, at least in terminal half, to form a long rounded incurved process (figs 64, 65) 5
4. Cerci with basally directed tooth at about a third of length from base. Paraprocts down-turned from about midpoint in lateral view (fig. 51) *C. arcuata*
 - Cerci with tooth very long, basally and downwards directed, inserted just beyond the midpoint. Paraprocts not down-turned in lateral view, abruptly narrowed at the level of the tips of the cerci, with a conspicuous dorsal hump immediately before the contraction (fig. 56) *C. species A*
5. Cerci in dorsal view broad with tooth directed inwards from base, then angled basally and abruptly downwards (fig. 59); in lateral view broad at tip. Paraprocts in ventral view with apical fifth attenuated and turned inward abruptly (fig. 65). Metascutum and dorsal surfaces of axillaries largely yellow, with no blue *C. campioni*
 - Cerci with tooth small (sometimes entirely hidden by orientation of appendages) and basally directed (fig. 58), straight but sometimes bifurcated at the tip. Paraprocts in ventral view with distal half attenuated and turned gradually to form a quarter circle (fig. 64). Metascutum and axillaries always with at least some blue, often almost entirely blue *C. borneensis*

Females

1. Pronotum with anterior lobe processes (figs 11, 12). Notopleural projections small, difficult to see (figs 22-24) 2
 - Pronotum without anterior lobe processes. Notopleural projections large (figs 7, 8, 10, 20, 21) 3

2. Posterior pronotal lobe large, raised up with lateral margins expanded and folded rearwards in the upper part (figs 11, 16, 22, 23), where often reduced to form a pair of sharp-pointed spurs (figs 16, 22). Anterior lobe processes small, rearwards-pointing and ridge-like (fig. 11) *C. flavostriata*
- Posterior pronotal lobe not raised up, wide, with long sharp-pointed lateral projections (figs 12, 17). Anterior lobe processes long and flattened, lying over almost the entire length of median lobe centrally (fig. 13) *C. kenyah* spec. nov.
3. Posterior pronotal lobe narrow, flat, tapering rearward, without lateral projections (fig. 13) *C. arcuata*
- Posterior pronotal lobe broad, with lateral projections 4
4. Posterior pronotal lobe with lateral projections pointing outwards or slightly rearwards (fig. 15), down-turned and distinctively shaped in lateral view as shown in fig. 18. Median lobe projections in form of low ridges (fig. 10) *C. campioni*.
- Posterior pronotal lobe with lateral projections simple, pointed forwards and outwards, narrow towards tip (fig. 14), sometimes folded downwards. Median lobe projections not ridge-like 5
5. Pronotal median lobe projections in form of conical dorso-lateral horns (fig. 7)
..... *C. borneensis* typical form.
- Pronotal median lobe projections in form of small hemispheres (fig. 8)
..... *C. borneensis* western form.

Coeliccia arcuata Lieftinck, 1940
(figs 5, 13, 19, 25, 31, 39, 45, 51, 57, 63, 70)

Coeliccia arcuata Lieftinck, 1940: 353-355, figs 7-8 (original description both sexes, East Kalimantan).—
Lieftinck, 1954: 46 (distribution); Lieftinck, 1971: 34 (note on holotype and first described female);
van Tol, 1992: 38; Orr, 2003: 39, 77; Cleary et al, 2004: 445 (East Kalimantan).

Type material.— (all RMNH): Holotype ♂, Indonesia, E. Kalimantan, Kutai, Sangkoelirang, Batu Besi, v-vi.1937, M.E. Walsh, JvT no. 2947, in brown paper triangle: "♂ ♀//*Coeliccia*//sp. n.", "*arcuata*//Lft", "~~cf. flavostriata~~", "1.", "E. Borneo, Sangkoelirang//Batu Besi//V-VI.1937 M.E. Walsh"; these all handwritten, also a red label, typed in black ink with black border "TYPES" (the 'S' handwritten); Paratypes: 1 ♀, in same paper triangle as holotype, same data; 2 ♀, same area and collector, Kariorang, iv.1937 and vi.1937, in paper triangle: "2 ♀", "*Coeliccia*//cf. ~~*flavostriata*~~ // *arcuata*//Lieft.", "sp. n.", "♀ proth." (this circled), "E. Borneo//Sangkoelirang", "PARATYPES", "Kariorang", "IV.1937", "id., VI.1937" and "M.E. Walsh"; 1 ♂, same area and collector, vi.1937, Babi Djoeton.

Other material.— Sabah (in RMNH except as noted): 1 ♂, N Sabah, Mt Kinabalu, Poring Hot Springs, small stream near trail to Langanan waterfall, 600-700 m, 29.iv.2005, in coll. Dow; 1 ♂ (JvT no. 8085), 16.iii.1987, E. Sabah, 60 km W. of Lahad Datu, Danum Valley, near Sungai Segama, brooklet crossing west trail, 170m, J. van Tol; 8 ♂ (JvT nos. 8078-8083, 8086-8087), 19.iii.1987, same area, brooklet above artificial pond near field centre, 1 misidentified as *C. campioni*, J. van Tol; 1 ♂ (JvT no. 8088), 24.iii.1987, same area, Sungai Palum Tambon, 160-180 m, J. van Tol; 2 ♂ (1 in pieces), 23-28.iv.1994, same site, 150-160 m, M. Hämäläinen; 1 ♂, 9-18.xi.1958, E. Sabah, Tawau, Kalabkan river, T.C. Maa. Indonesia, Kalimantan (all RMNH): 2 ♂, 12.xi.1996, S. Kalimantan, Banjarbaru, Aranio distr., 5 km SE of Belangian village, Riam Kanan Lake, Gunung Pisang primary forest, Sungai Kuinam, M. Bedjanich.

Remarks.— *C. arcuata* is easily distinguished from all other known species except *C. species A* by the form of the male paraprocts in ventral view (fig. 63) and the posterior



Figs 11-12. Female prothorax, dorsal view. ALP – pronotal anterior lobe process; MP – mesostigmal plate: 11. *C. flavostriata*, Kubah National Park, Sarawak; 12. *C. kenyah*, Loagan Bunut National Park, Sarawak.

pronotal lobe in the female (figs 5, 13, 19). It is most readily distinguished from *C. sp. A* by the position and size of the tooth on the cerci, and by the paraprocts seen in profile (figs 51, 56).

Lieftinck (1940: 353) lists two males and three females in the type series, but only the holotype and three female paratypes are marked as such in RMNH. However an additional male with data coinciding with that of the type series, collected at "Babi Djoeton", a location listed by Lieftinck for the type series, is present and must be the additional male paratype; it is listed as such above.

Lieftinck's (1940) description of both sexes of *arcuata* requires few additions, however it does not give the colour of the antehumeral stripes of male *arcuata*; in the holotype and some other males they are yellow, but others have blue antehumeral stripes; males with different coloured antehumeral stripes can occur within single populations. The antehumeral stripes of the female paratypes are blue. It is likely the colour of the antehumeral stripes is correlated with the maturity of the individual. There are blue markings on the dorsum of the axillaries in the male, and on the metascutum.

The prothorax of female *arcuata* (figs 5, 19) has large notopleural projections, but no anterior lobe processes or median lobe projections. The raised part of each mesostigmal plate is separated from the posterior pronotal lobe by nearly its own width.

In the type series the dorsal surface of S2 has no pale markings, but in all other material studied a blue, oval to rectangular marking is present on the basal two-thirds. The extent of the blue markings on S9-10 also varies, in some specimens the entire dorsum is blue, in others (including the holotype and male paratype) these markings are reduced to a large dorsal mark on S9 and a much smaller mid dorsal spot on S10.

The measurements of material studied fall within the following ranges: ♂: abdomen without appendages 33-38.75 mm, Hw 19.5-24 mm; ♀: abdomen without cerci or ovipositor 30-33 mm, Hw 21-22 mm.

Distribution and habitat.— Northern and eastern Sabah from Poring Hot Springs southwards, southern and eastern Kalimantan (fig. 70). Small streams and springs in lowland mixed dipterocarp forest.

Coeliccia borneensis (Selys, 1886)

(figs 1, 7, 8, 14, 20, 26, 32, 33, 40, 46, 52, 58, 64, 71)

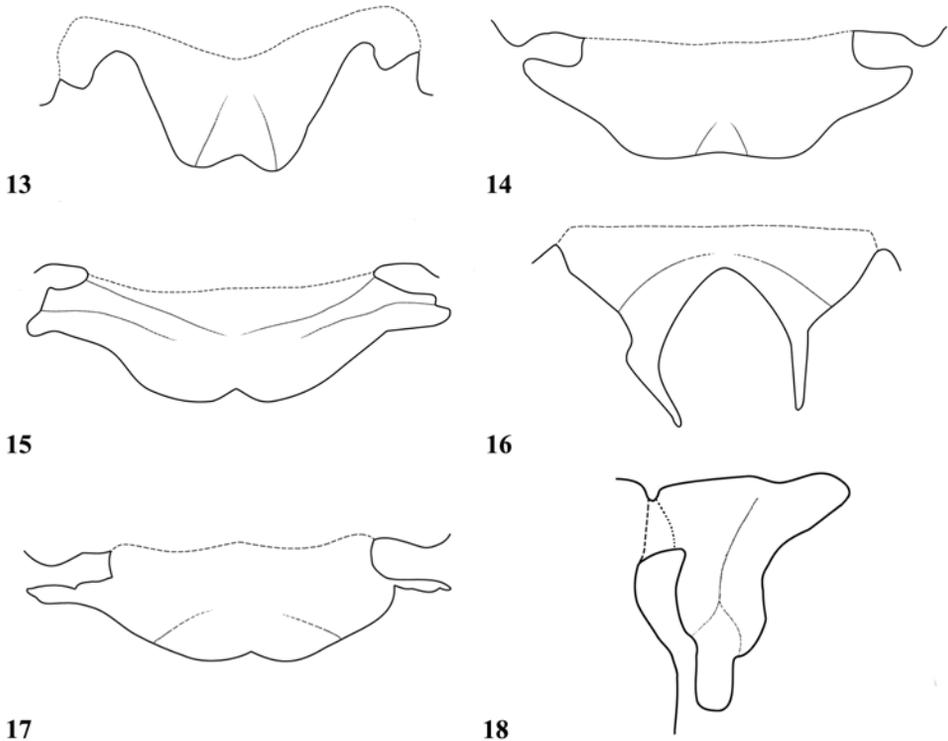
Trichocnemis borneensis Selys, 1886: 116-117 (original description, female, N Borneo).

Coeliccia borneensis (Selys, 1886).— Laidlaw, 1918: 231 (note); Laidlaw, 1920: 334 (note); Laidlaw, 1932: 41-42 (some description, possibly erroneous); Lieftinck, 1954: 46; Kimmins, 1970: 179 (note on type); Orr, 2003: 39. Dow & Reels, 2008: 3, part (Gunung Mulu National Park, Sarawak).

Coeliccia campioni Laidlaw, 1918.— Laidlaw, 1931: 247 (Bettotan, E Sabah); Laidlaw, 1932: 36-37, fig. 2, part (description of female, illustration of female prothorax, Long Semiyang, Sarawak); Kimmins, 1936: 88 (foot of Mt. Dulit, Sarawak); Lieftinck, 1954: 46, part; Orr, 2001: 186 (Kuala Belalong Field Studies Centre, Brunei); Orr, 2003: 39, 77, fig. 104, Plate 7b.

Type material.— Holotype ♀ (BMNH), Malaysian Borneo, Sabah, Elopura (Sandakan bay area), iii.1884. Six labels on pin: circular with red margin, typed "Holo//type"; pink paper, typed "Type"; handwritten "North//Borneo"; handwritten "Elopura//Mch//84"; blue, typed "McLachlan Coll./B.M. 1938-674"; handwritten "*Trichocnemis/borneensis*, S." Head detached, in cellophane envelope on pin.

Other material.— Sarawak (in coll. Dow except as noted): 2 ♂, Sri Aman division, Batang Ai National Park, steep tributary to Sungai Bebiang Besar, 4.xii.2007, RAD; 1 ♂, same national park, tributary to



Figs 13-18. Female posterior pronotal lobe detail: 13. *C. arcuata* dorsal, Sungai Kuinam, S. Kalimantan; 14. *C. borneensis* dorsal, Mt. Dulit, Sarawak; 15. *C. campioni* dorsal, Mt. Dulit, Sarawak; 16. *C. flavostriata* dorsal, Kubah National Park, Sarawak; 17. *C. kenyah* dorsal, Loagan Bunut National Park, Sarawak; 18. *C. campioni* lateral.

Sungai Nanga Beredik, 8.xii.2007, RAD; 2 ♂ (UKM), Kapit division, Lanjak Entimau Wildlife Sanctuary, Sungai Jik, 18.vi.2008, C.Y. Choong; 1 ♂ (UKM), same area, Sungai Kemau, 20.vi.2008, C.Y. Choong; 1 ♂, 1 ♀, Kapit division, Kapit town area, tributaries to Sungai Spong (tributary of the Baleh River) ca one hour upstream from Kapit, 11.ii.2008, RAD; 3 ♂, Kapit division, Kapit town area, Sebabei Recreational Park, large tributary to Sungai Sebabi, 7.ii.2008, RAD; 1 ♂ (RMNH 229002), same data, in ethanol; 1 ♂, same area, trailside by Sungai Sebabi, 7.ii.2008, RAD; 1 ♂, same area, tributary to Sungai Kapit upstream of last longhouse (currently called Rumah Bundong¹), 9.ii.2008, RAD; 1 ♂, 11.ix.1932, 1 ♂, 15.ix.1932, 1 ♀, 5.x.1932, 1 ♂, 10.x.1932 (BMNH), Miri division, Mt. Dulit area, foot of Mt. Dulit, junction of rivers Tinjar and Lejok, B.M. Hobby and A.W. Moore; 1 ♂, same area, stream at 750-800 m, 27.viii.2008, RAD; 1 ♂, same area, stream at 780-840 m, 28.viii.2008, GTR; 1 ♀, same data, RAD; 1 ♀, same area, stream at 820-850 m, 29.viii.2008, RAD; 1 ♀, same data, GTR; 1 ♀, same area and date, stream at 820-920 m, L. Southwell; 1 ♂, same area, trailside at ca 300 m, 1.ix.2008, RAD; 1 ♀ (BMNH), Miri division, upper Baram area, Long Semiyang, 24.x.1920, collector unknown, in newspaper triangle in envelope (with "1" added in pencil on lower right hand corner): in pencil "24-10-20"; in pencil "campioni//♀"; in red ink "14"; 1 ♂, 1 ♀, Miri division, Gunung Mulu National Park, swampy areas in lowland forest on Penan

¹ Rumah Bundong, as an Iban longhouse, takes its name from the headman; when the headman changes, so does the name of the longhouse.

route between Deer Cave and Long Iman, 17.iv.2005, RAD; 1 ♀, stream in alluvial forest near Sungai Melinau, 9.ii.2006, RAD; 1 ♀, same National Park, park headquarters, at research centre, 15.ii.2006; 1 ♂, foot of Gunung Mulu, trailside on Summit Trail near junction with Sarawak Chamber trail, 7.i.2008, RAD; 2 ♂, Limbang division, same National Park, trailside in lowland forest by Headhunters Trail, 14.ii.2006, RAD; 2 ♂, same location and date, J. Simun. Sabah: A series from Bettotan, W of Sandakan, E Sabah, labelled as *C. campioni*, except as noted in BMNH (papered collection), collector not given but probably H.M. Pendlebury (see Laidlaw (1931, p. 234)): 1 ♂, 1 ♀, pinned, 11.vii.1927; 2 ♀, 24.vii.1927; 1 ♂, 27.vii.1927; 1 ♂, 29.vii.1927; 1 ♀, 11.vii.1927; 1 ♀, 22.viii.1927; 1 ♂ (RMNH), 27.vii.1927; 1 ♀ (RMNH), 29.viii.1927; 1 ♂, 1 ♀ (RMNH), 29.x.1957, E. Sabah, Sepilok, J.L. Gressitt; 1 ♂ (RMNH, JvT no. 8085), iii.1987, E. Sabah, Danum Valley, near Sungai Segama, brooklet crossing west trail, caught in malaise trap, C. van Achterberg; 1 ♂ (RMNH), 26.iv.1994, same area, stream and waterfall 500 m N. of Borneo Rainforest Lodge, 200 m, misidentified as *C. arcuata*, M. Hämäläinen. Brunei (in coll. Orr): 1 ♂, Kuala Belalong Field Studies Centre, 7.viii.1995, A.G. Orr; 1 ♂, same location and collector, without date.

No full and reliable description of the male of *borneensis* has previously been available (see comments under *campioni* on Laidlaw's 1932 description of the male supposedly of that species); a description is given below. As the holotype of *borneensis* is in an extremely poor condition, and the original description is fairly brief, a description of a fresh female specimen is also given.

Description.— Male [SAR07_8_PCD282, Mt. Dulit, 780-840 m, 29.viii.2008].

Head.— Labium pale except for dark brown tipped hooks on palps. Labrum shining black. Anteclypeus blue, postclypeus shining black, with a pair of small blue markings at each posterior corner. Mandible bases largely blue. Genae blue. Antennae black, except for a pale ring at top of scape and extreme base of pedicel. Vertex and frons largely matt black, with pentagonal pale blue markings running from the outer margin of the lateral ocelli to behind the antenna base. Ocelli whitish. Small, approximately oval, transverse postocular spots. Occiput black.

Thorax.— Prothorax (fig. 26) with pronotal anterior and posterior lobes black, each half of median lobe largely occupied by a pair of large yellow markings, narrowly separated dorsally by a thin black band, this widening anteriorly and posteriorly. Median pronotal lobe projections present as a pair of conical horns, directed backwards and outwards, situated antero-laterally on the median lobe, just below the lateral corners of the anterior lobe, the yellow marking extended to cover the horns and the area to the front and below them. Posterior lobe wide, with short, narrow lateral projections rounded at tips, and directed slightly forward. Propleuron largely yellow, except for the notopleural stripe, which terminates just below the tip of the median lobe projections, and extends along the rear margin. Synthorax with mesepisternum black with a pair of long yellow antehumeral stripes (fig. 32). Antealar triangles black. Mesepimeron largely black, with a yellow mark in the rear upper corner. Metepisternum largely yellow, with a long black wedge running along the metapleural suture, terminating shortly before the spiracle, and extending very narrowly beside the antealar carina and along the interpleural suture. Metepimeron largely yellow. Venter of synthorax yellow. Mesinfraepisternum black except for the lower rear corner, which is yellow. Metinfraepisternum yellow. Wing articulations with small blue markings on the dorsal surfaces of the axillaries. Metascutum with a pair of approx. circular blue marks, metapostnotum pale yellowish. Legs: Coxae and trochanters pale yellow. Femora pale on flexor surfaces except near the joint, dark on extensor surfaces, anterior femora also with a dark streak along the lower 3/4 of the flexor surface, leaving only a narrow and obscure pale area



Fig. 19. *C. arcuata* female paratype, Kariorang, E. Kalimantan, prothorax, lateral view, NP – notopleural projection.

on the outer surface. Tibiae black on flexor surfaces, pale on extensor surfaces except around joints, where dark, and on anterior tibia, where brown. Tarsi dark brown. Wings: Fw with 16 Px, Hw with 15 Px (left), 14 Px (right). Pt black, with a very narrow and faint paler margin apparent around all sides except the rear one; covering one underlying cell, almost rectangular.

Abdomen.— S1 yellow except for a narrow dark brown apical band, extended along the dorsal midline, and expanding on the basal third of the dorsum to form a mark shaped like a wine glass. S2 pale brown above, becoming paler laterally, brownish yellow on its lowest quarter. S3 darker brown above, becoming paler below, with a narrow yellow basal band, interrupted dorsally. Segments from S4-7 black above, paler below, the delineation between dark and light areas becoming more abrupt and sharper on successive segments. S8 blue behind the posterior carina, otherwise black. S9-10 entirely blue above (fig. 46), black laterally. Terminal appendages black, cercus with backward-pointing denticles on dorsum, tip down-turned, flattened and hollowed on inner surface, orientated so that it nearly faces the end of S10 (fig. 52). A small tooth on the inner-ventral surface (fig. 58), arising slightly over halfway, positioned centrally on a shallow ridge, directed basally and downwards; on the right hand cercus the tip of this tooth is bifid. Paraprocts projecting very slightly beyond cerci, of distinctive shape in lateral view (fig. 52), in ventral view (fig. 64) slender and evenly curved inwards towards tip, right paraproct with extreme tip turned sharply backwards.

Penis.— Typical for *borneensis* group, see fig. 40.

Measurements.— Abdomen without appendages 33 mm, cerci ca 0.75 mm, Hw 21.5 mm.

Female.— [SAR07_8_PCD277, Mt. Dulit, 820-850 m, 29.viii.2008] as male except as noted.

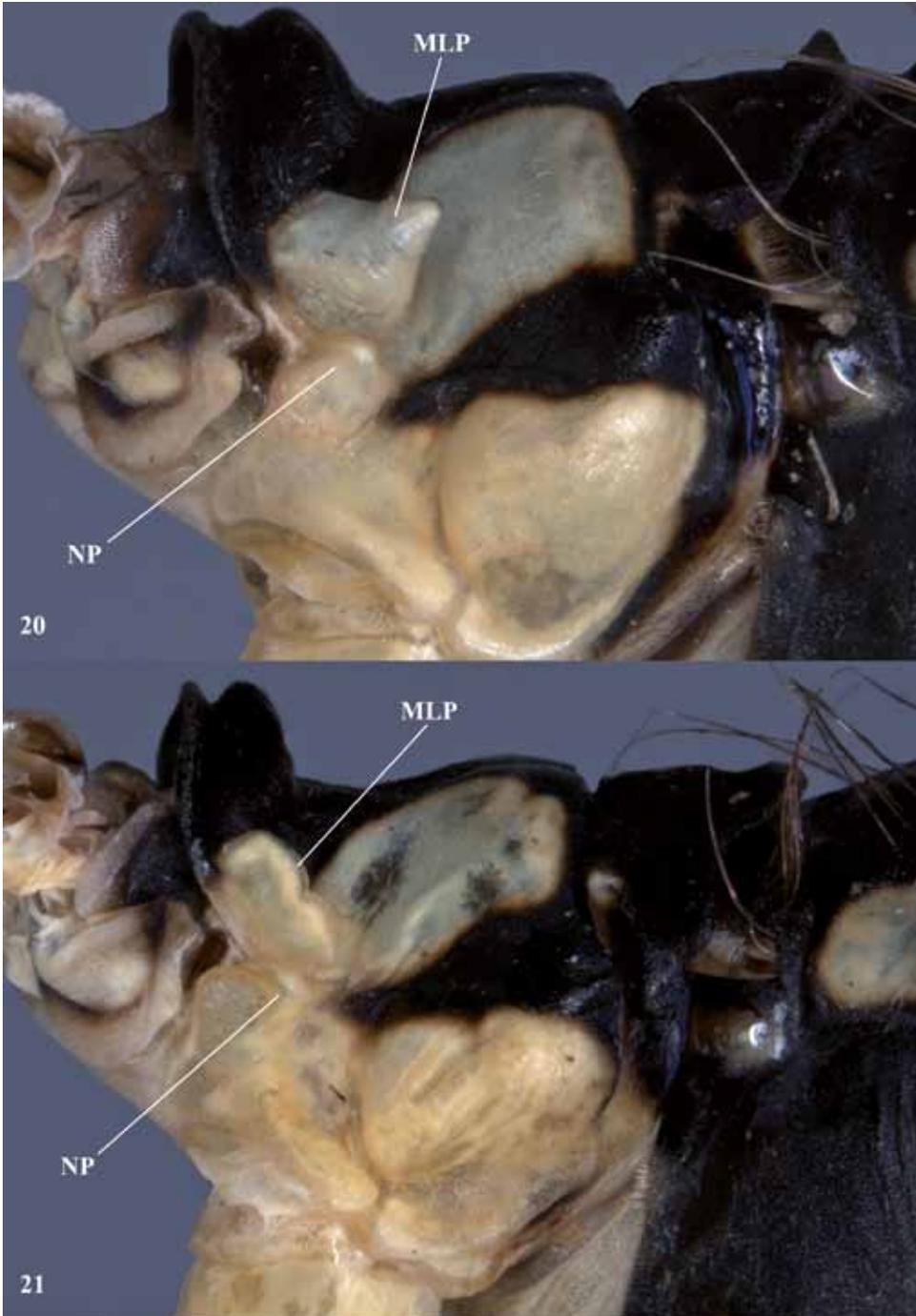
Head.— Markings on top of head broader at base than in male, contracting behind the antenna and continuing as a narrow parallel-sided band to eye margin. Ocelli yellowish.

Thorax.— Prothorax (figs 7, 14, 20) with pale markings on median pronotal lobe pale bluish green, widely separated dorsally. Median lobe projections in form of conical horns as in male, but longer and broader at base. Large notopleural projection immediately below the horns and raised above the level of the pronotal margin, in dorsal view this approximately semi-circular. Notopleural stripe terminating behind the projection, broad posteriorly. Posterior lobe in dorsal view as shown in fig. 14. Synthorax with mesostigmal plates (fig. 7) raised up at almost a right angle to rest of mesepisternum, with a clump of long hairs at highest part, directed upwards and forwards. Antehumeral stripes narrower anteriorly than in male, pale greenish. Pale marking on metepisternum yellow near legs but becoming bluish beyond the spiracle. Wing articulations with the dorsum of the axillaries black without blue markings. Legs (all detached), similar to male, but yellow tint on outer extensor surface of anterior femur better defined, anterior tibia almost entirely black. Wings: Fw with 15 Px, Hw with 14 Px. Pt dark brown, with a narrow pale margin on proximal and distal sides, fainter and less well defined on costal side and at rear.

Abdomen.— Overall darker than in the male. S1 with the yellow markings widely separated by brown on the dorsum. S2 dark brown above, becoming paler laterally. S3 similar to male, but darker. S4-8 only pale laterally near the margin of the tergite. S4-6 dark brown above, becoming black by rear of S7. S8 dorsum black, with a pale bluish green subapical band slightly produced anteriorly as a small triangle. S9-10 entirely black. Cerci black, shorter than S10. Ovipositor largely black.

Measurements.— Abdomen without cerci or ovipositor 33.5 mm, ovipositor ca 1.75 mm, Hw 23.5 mm.

Variation.— Eastern populations (Brunei, Miri and Limbang divisions in Sarawak, and Sabah) – The blue lateral marks on the postclypeus vary in size in both sexes; in some individuals they are tiny. Males from Miri division in Sarawak all have the pale dorsal head markings incomplete, not reaching the margin of the eye, whereas in males from east Sabah these markings reach the margin of the eye. Males from Brunei and northeast Sarawak all have pronotal median lobe projections in the form of conical horns, although these vary in size; in those from east Sabah these structures are not always conical, but reduced to small lumps of indistinct shape in some individuals. The lateral projections of the posterior pronotal lobe are variable in length in males, and overlap with those of *campioni* in this regard. The antehumeral stripes in two individuals from the foot of Mt. Dulit are shorter than described above. There is some variation in the extent and colour of pale marks on the axillaries, with extensive blue on one or both pairs in many individuals, but with merely small obscurely pale blue areas on others, but they are never yellow. The length of the tooth on the cercus varies slightly, and the tip of the tooth is sometimes bifid, sometimes not. The holotype differs from the female described above in a few details. The pronotal median lobe projections (only



Figs 20-21. Female prothorax, lateral view, NP – notopleural projection; MLP – pronotal median lobe projection: 20. *C. borneensis*, Mt. Dulit, Sarawak; 21. *C. campioni*, Mt. Dulit, Sarawak.



Figs 22-23. *C. flavostriata* female prothorax, lateral view, NP – notopleural projection: 22. *C. flavostriata*, Kubah National Park, Sarawak; 23. allotype of *C. coomansi* (slightly dorsal view), Gunung Poteng, Kalimantan.

right hand side fully visible, that on the left largely obscured by glue) are somewhat truncated in appearance, and depressed centrally (fig. 9); this may be the result of damage to the specimen, but if not it is the most significant difference from all other material available, the other features of the prothorax agree well. The pale S8 dorsal marking lacks the anterior triangular projection. Pale marks, sometimes nearly contiguous, are present between the lateral and median ocelli in most female specimens available. In a few females there is a pair of dorsal lateral pale spots on S9, united in one individual to form a transverse band. The width of the S8 transverse band is quite variable, as is the extent of pale colouration on the mandible bases.

Western populations (Kapit and Sri Aman divisions, Sarawak) – One male taken by the trailside by the Sungai Sebabi in Sebabi Recreational Park, Kapit division, agrees broadly with eastern males in colouration, markings, and in having pronotal median lobe projections in the form of small conical horns. Other males from Kapit and Sri Aman differ in that they have shorter to much shorter antehumeral stripes than typical (fig. 33), no pale markings on the postclypeus and have either no median lobe projections, or small projections that appear hemispherical in dorsal view, and have the outer surface of the anterior femora more extensively dark. Moreover, in Kapit division the same males have all pale markings blue, but those from Sri Aman (Batang Ai National Park) have yellow thoracic markings; all of these males have the dorsal head markings blue. The single western female available (Sungai Spong, Kapit division) is only associated with the males by supposition, but is coloured similarly, without pale markings on the postclypeus, and with pronotal median lobe projections small and hemispherical (fig. 8). The median pronotal lobe of the female is conspicuously shorter than in eastern females, although not as short as in *arcuata* or *flavostriata*. With the exception of the yellow male from Sebabi Recreational Park noted above, the average size of western individuals is lower than eastern ones. The subapical excisions of the apical penis lobe in the one western male examined by SEM are more open than seen in eastern populations.

Measurements.— Eastern populations.— ♂: abdomen without appendages 32-37 mm (ca 34 mm on average), Hw 18.5-22.5 mm. ♀: abdomen without cerci or ovipositor 30.5-34 mm, Hw 21-23.5 mm.

Western populations (yellow male from Sebabi recreational park excluded).— ♂: abdomen without appendages 30-33.25 mm (ca 32 mm on average), Hw 17.5-19.5 mm; ♀: abdomen without cerci or ovipositor 30.5 mm, Hw 20 mm.

Remarks.— Laidlaw's (1932) account of *borneensis* is confusing: he states that it is "unknown to me", but gives a brief description of the female holotype, including a description of the posterior pronotal lobe that appears to bear no resemblance to that of the holotype, but rather to some species from the *membranipes*-group.

The female from Long Semiyán appears to be the female illustrated by Laidlaw (1932) under *campioni*, although Laidlaw gives the date of collection as 25.x.1920 rather than 24.x.1920. Long Semiyán is probably Long Semiang, a location on the upper Baram, not far from Lio Matu. The dates given by Laidlaw (1931) for the collection of individuals from Bettotan do not exactly tally with the dates with the specimens: Laidlaw gives 24.vii.1927 to 24.viii.1927, but the dates with the specimens are in the range 11.vii.1927 to 29.viii.1927.

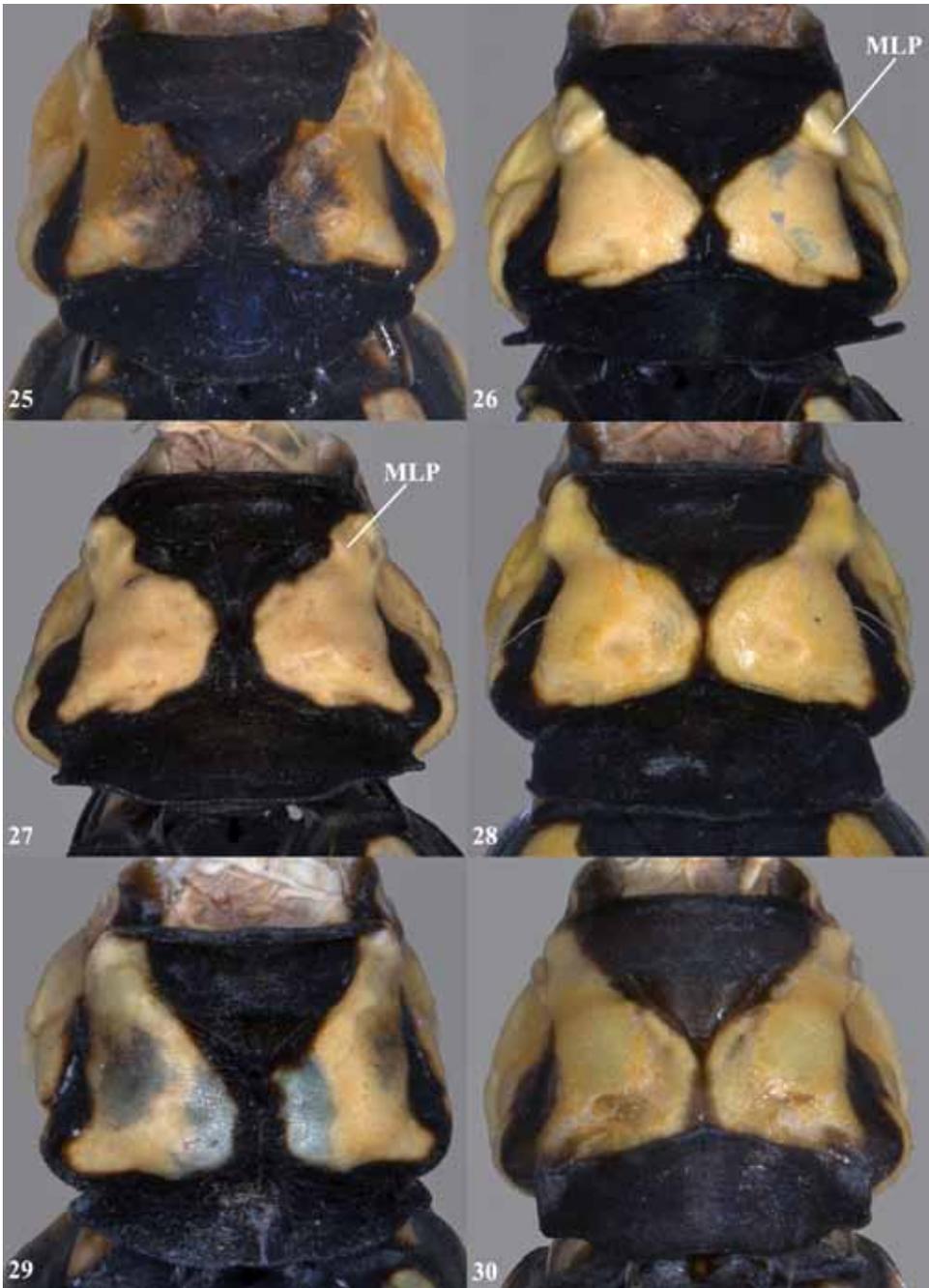
There is considerable variation in *borneensis* across its known range, and within



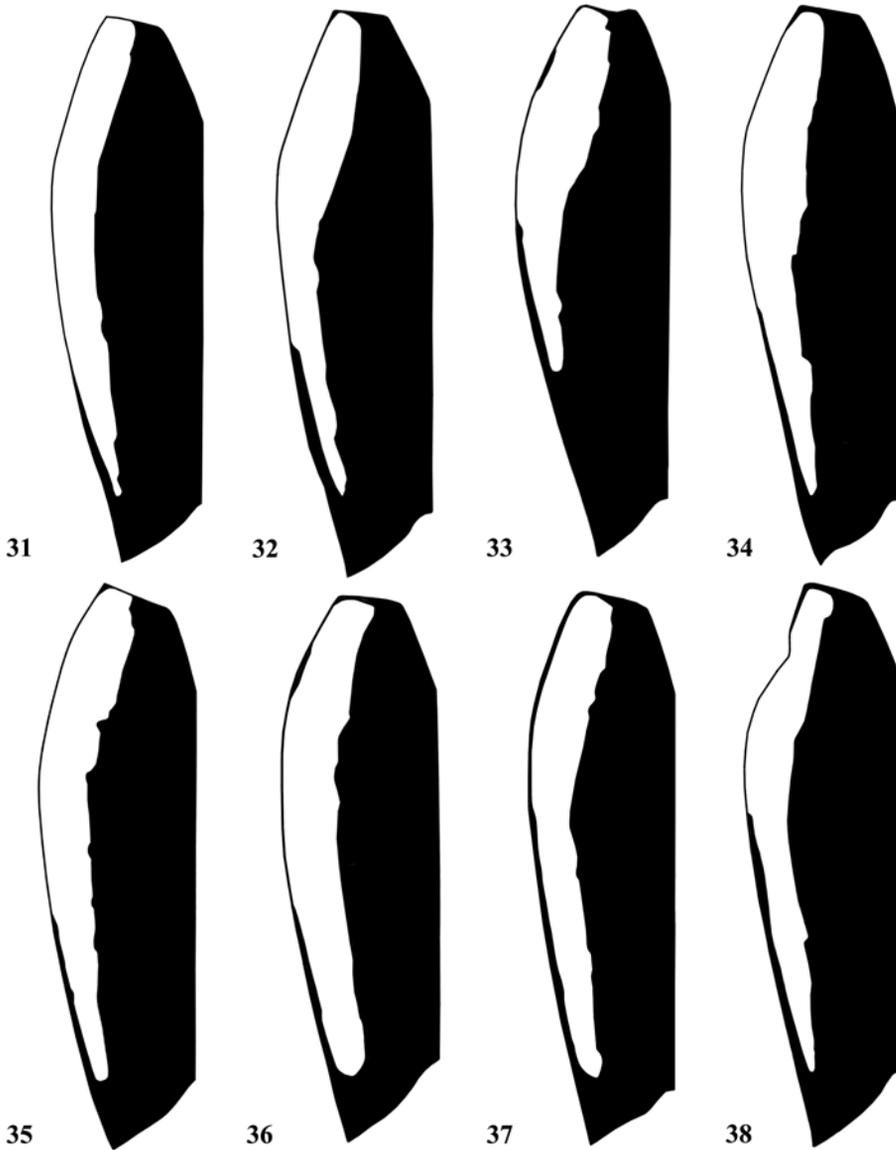
Fig. 24. *C. kenyah* female prothorax, lateral view (image of right side, flipped), Loagan Bunut National Park, Sarawak, ALP – pronotal anterior lobe process; NP – notopleural projection.

some populations. In particular most specimens from Kapit and Sri Aman divisions in Sarawak, treated as *borneensis* here, differ rather consistently in a number of characters; the single female available differs significantly in the structure of the prothorax. However this female is only associated with the males by supposition, and might be an aberrant individual or represent the western extreme of a cline. Most differences apparent in the males fall within or close to the observed range of variation in eastern populations; in particular no convincing differences have been detected in the terminal appendages. The colour differences in individuals from Kapit division may be related to maturity; cases of colour change from blue to yellow with maturity are known, for instance, in the tropical Asian Protoneuridae (*e.g.* Lieftinck 1937: 77), however cases where some apparently mature individuals from certain populations keep the immature blue colouration are also known (Orr 2001: 191, Dow 2008: 47). With the material currently available the status of the western populations cannot be satisfactorily resolved; in these circumstances, although the western populations may be a distinct species, they are best treated as *borneensis* until longer series and material from intermediate locations become available.

The most significant difference in the holotype of *borneensis* from other female specimens is in the details of the structure of the pronotal median lobe projections. Given the condition of the holotype, whilst it is possible that it is actually a different species from all other material considered here, damage is the most likely explanation for the differences.



Figs 25-30. Male prothorax, dorsal view, MLP – pronotal median lobe projection: 25. *C. arcuata* Sungai Kuinam, S. Kalimantan; 26. *C. borneensis*, Mt. Dulit, Sarawak; 27. *C. campioni*, Mt. Dulit, Sarawak; 28. *C. flavostriata*, Kubah National Park, Sarawak; 29. *C. kenyah*, Mt. Dulit, Sarawak; 30. *C. species A*, Murung river, Kalimantan.



Figs 31-38. Mesepisternal markings: 31. *C. arcuata* male, Sungai Kuinam, S. Kalimantan; 32. *C. borneensis* typical form male, Mt. Dulit, Sarawak; 33. *C. borneensis* western form male, Sungai Spong, Sarawak; 34. *C. campioni* male, Mt. Dulit, Sarawak; 35. *C. flavostriata* male, Kubah National Park, Sarawak; 36. *C. kenyah* male, Mt. Dulit, Sarawak; 37. *C. kenyah* female, Loagan Bunut National Park, Sarawak; 38. *C. species A*, Murung river, Kalimantan.

All other known species of the *borneensis*-group are readily distinguished from *borneensis* by the characters given in the keys. Given the clearly close relationship between *arcuata* and species A, and the significant differences in prothoracic structure between female *arcuata* and *borneensis*, it is reasonable to expect that the female of species A, when it becomes known, will also differ considerably in its prothorax from that of *borneensis*. In northeast Sarawak, where *borneensis* and *campioni* can occur together, the shape of the median lobe projections and incomplete dorsal head markings of male *borneensis* appear to offer reliable and relatively easily observable means of distinguishing the two species. Outside the known range of *campioni*, *borneensis* appears to become more variable in a number of characters.

As no tandem pairs of either *borneensis* or *campioni* are as yet available for study, the association of the sexes made here for both species is by supposition based on the structure of the pronotal median lobe projection.

Distribution and habitat.— Brunei, Sarawak and Sabah (fig. 71), with records in Sarawak as far west as Batang Ai National Park in Sri Aman division; records from Sabah are all from the east. The range of habitats occupied by *borneensis* is rather wide, extending from occasionally flooded lowland forest on flat terrain to small streams and trickles in mixed dipterocarp forest. The altitudinal range is also wide, from near sea level to over 900 m.

Coeliccia campioni Laidlaw, 1918
(figs 2, 10, 15, 18, 21, 27, 34, 41, 47, 53, 59, 65, 70)

Coeliccia campioni Laidlaw, 1918: 224-225, figs 3-4 (description holotype male, Lio Matu, Sarawak).—

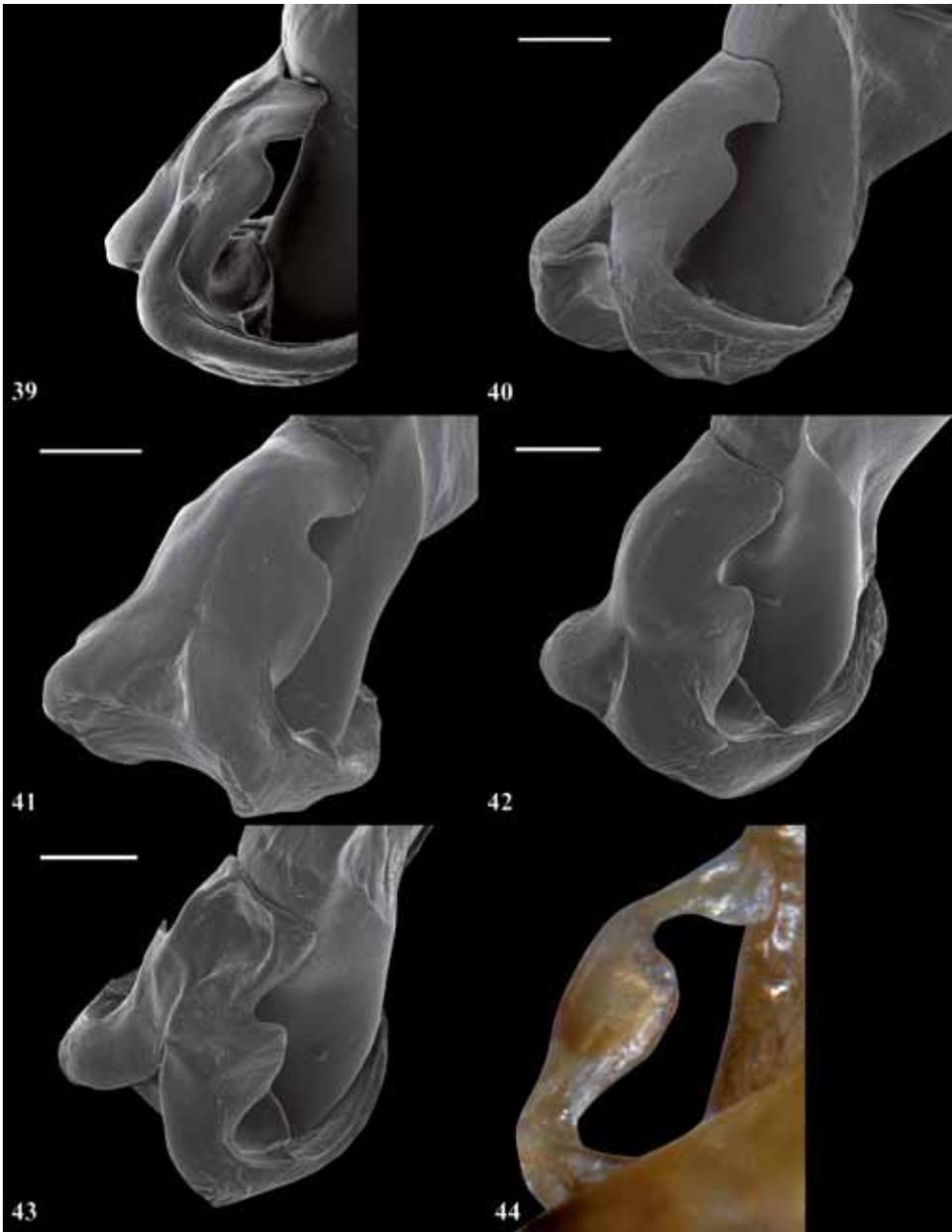
Laidlaw, 1920: 333; Laidlaw, 1932: 36-37, part; Lieftinck, 1954: 46; Kimmins, 1970: 179 (note on holotype); Orr, 2003: 39.

Coeliccia borneensis (Selys, 1886).— Dow & Reels, 2008: 3, part (Gunung Mulu National Park, Sarawak).

Type material.— Holotype ♂ (BMNH), Malaysian Borneo, Sarawak, Miri division, upper Baram area, Lio Matu, 31.x.1914, collector unknown. Three labels on pin: circular card with red margin, typed, "Type//H.T."; rectangular card, handwritten "Borneo//Lio Matu//31.x.1914//191(17-80)"; rectangular card, handwritten "*Coeliccia/campioni*//Type ♂". Wings on RHS and terminal abdominal segments detached, the latter in pieces, in clear cellophane envelope; head and prothorax detached, in cellophane pill case on pin.

Other material.— (all from Sarawak, all in coll. Dow except as noted): 1 ♂, Miri division, Mt. Dulit, stream at 750-800 m, 27.viii.2008, RAD; 1 ♀, same data, GTR; 1 ♂, same area and date, trailside at 500-600 m, GTR; 3 ♂, same area, streams at 780-840 m; 28.viii.2008, RAD; 3 ♂, same data, GTR; 4 ♂, same area, stream at 780-800 m, 29.viii.2008, S. Malit; 3 ♂ (1 in ethanol, RMNH 500010); same area and date, streams at 820-920 m, GTR; 1 ♀, same data, RAD; 1 ♀, same area, stream at 850-880 m, 30.viii.2008, GTR; 4 ♂, same area, streams at 830-920 m, 31.viii.2008, RAD; 1 ♂, same data, M. Kaling; 1 ♂, same area and date, stream at 850-900 m, GTR; 1 ♂, Miri division, Gunung Mulu National Park, lower slopes of Gunung Mulu, 'Camp 2' streams², ca 500 m, 19.ii.2006, J. Simun; 1 ♂, same date and location, RAD; 1 ♂, same location, 6.i.2008, L. Southwell.

² 'Camp 2' is not a camp, but a place on the trail to the summit of Gunung Mulu, purported to be a former campsite. It is located on a ridge, with a stream running just below and parallel to the ridge on one side, and the head of another stream on the other side.



Figs 39-44. Penis, ventral-lateral view, scale bars 100 μ m: 39. *C. arcuata*, Sabah; 40. *C. borneensis*, Gunung Mulu National Park, Sarawak; 41. *C. campioni*, Mt. Dulit, Sarawak; 42. *C. flavostriata*, Kubah National Park, Sarawak; 43. *C. kenyah*, Mt. Dulit, Sarawak; 44. *C. sp. A* (lateral view), Murung river, Kalimantan.

The holotype of *campioni* is in a bad condition and not suitable for detailed redescription. A full description of a fresh male *campioni*, agreeing well with the holotype, although not topotypical, and the first description of the female, are given below.

Description.— Male [SAR07_8_PCD261, Mt Dulit, 700-800 m, 29.viii.2008].

Head.— Labium pale except for black tipped hooks on palps. Labrum shining black. Anteclypeus very pale bluish green, postclypeus entirely shining black. Mandible bases largely pale blue. Genae pale blue. Rest of head black except as noted below. Antennae with pale ring at top of scape and extreme base of pedicel. A pale yellow-green band running from the lateral ocelli behind the antenna base to the eye margin. Median ocellus yellow, lateral ocelli white with black centre. Small, approximately oval, transverse postocular spots. Occiput black.

Thorax.— Prothorax (fig. 27) with pronotal anterior and hind lobes black, median lobe largely occupied by a pair of large yellow markings, separated centrally by a black band, this widening anteriorly and posteriorly, where it continues narrowly around the rear of the lobe and joins the notopleural stripe. Median lobe projections present as short and low rounded ridges arising near the corner of the anterior lobe and directed downwards and rearwards towards the propleuron, the yellow marking extended to cover the ridge and the area to its front and below. Posterior pronotal lobe wide, shaped as shown in fig. 27, with short lateral projections directed straight outwards. Propleuron yellow, except for the notopleural stripe that terminates just below the level of the end of the ridge on the median pronotal lobe, and extends along the rear margin. Synthorax with mesepisternum black with a pair of long yellow antehumeral stripes (fig. 34). Antealar triangles black. Mesepimeron largely black, with a yellow mark in the rear upper corner. Metepisternum largely yellow, with a long black wedge running along the metapleural suture, terminating shortly before the spiracle, at just before half length, and extending beside the antealar carina and along the interpleural suture, narrowly to rear but broadening before the end. Metepimeron largely yellow. Venter of synthorax yellow. Mesinfraepisternum black except for the lower rear corner, which is yellow. Metinfraepisternum yellow. Wing articulations with the dorsum of the axillaries largely bright yellow. Metascutum and metapostnotum also largely bright yellow. Legs: Coxae and trochanters pale yellow. Femora largely pale on flexor surfaces except near the joint, a dark stripe on outer extensor surfaces, anterior femora also with a dark streak along the lower 3/4 of the flexor surface, leaving a yellow band on the outer surface. Tibiae black on flexor surfaces, pale on extensor surfaces except around joints, where dark, and on anterior femora, where it is brown. Tarsi dark brown. Wings: Fw with 16 Px (left), 14 (right), Hw with 13 Px (left), 12 Px (right). Pt black, with a narrow pale margin apparent around all sides except the rear one; covering one underlying cell.

Abdomen.— S1 yellow except for a narrow dark brown and black apical band, extended broadly along the dorsal midline, and expanding on the basal 1/3 of the dorsum. S2 pale brown above, becoming paler laterally. S3 darker brown above, becoming paler below, with a narrow yellow basal annulus, interrupted dorsally. S4-8 dark brown above, becoming black by the posterior part of S6, paler narrowly below along the tergal margin, the delineation between dark and light areas becoming better defined on successive segments. S8 blue behind posterior carina. S9 (fig. 47) blue behind the posterior carina, with an approximately triangular blue marking, based immediately anterior to the posterior carina and terminating just before the segment base, black laterally.

S10 almost entirely blue above, with just a narrow black basal band, interrupted centrally, and a narrow black posterior border. Terminal appendages black, cerci extending ca twice the length of S10, tips down-turned, flattened and slightly hollowed on inner surface; short denticles on dorsum. Lower margin of the inner-ventral surface with moderate sized tooth arising around midpoint (fig. 59), directed inwards at base, then angled basally and abruptly downwards, giving a hooked appearance, tip broad and slightly bifid. Inner-ventral surface of cercus with a deep longitudinal fold originating from base and terminating beyond the tooth. In lateral view paraprocts almost reaching tips of cerci, thick over most of length, upper margin abruptly bent down near the point where the tip turns inwards, giving a truncated appearance (fig. 53); in ventral view (fig. 65) quite slender towards apex, abruptly curved inwards at ca a right angle shortly before the tips, pale interiorly.

Penis.— As shown in fig. 41.

Measurements.— Abdomen without appendages 38 mm, cerci ca 0.75 mm, Hw 23 mm.

Female.— [SAR07_8_PCD288, Mt Dulit, trailside at 750-800m, 27.viii.2008] as male except as noted.

Head.— Ocelli yellowish. A greenish spot between lateral and median ocelli.

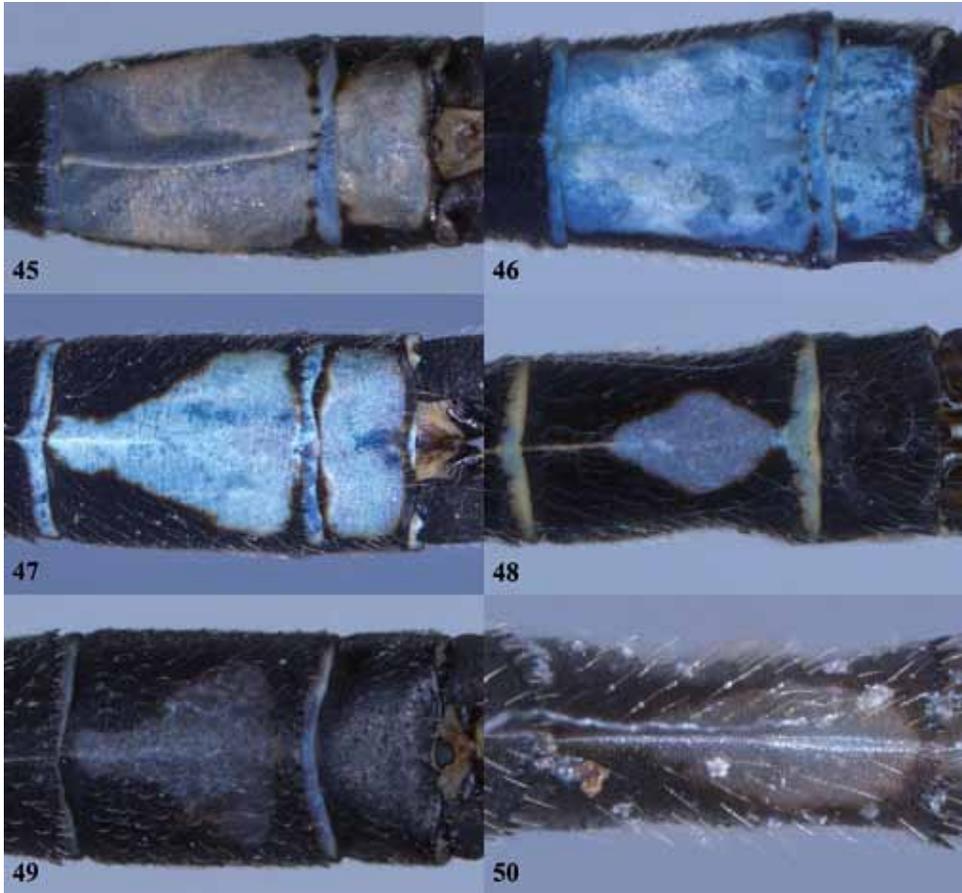
Thorax.— Prothorax (figs 10, 15, 18, 21): pronotum with median lobe projection shaped as male, but larger, large notopleural projection immediately below, projecting upwards and outwards, clearly visible in dorsal view (fig. 10). Pale dorsal markings on median lobe more widely separated than in male, the inner margin of these triangular. Posterior pronotal lobe with lateral projections long and down-turned so largely obscured in dorsal view (fig. 15), in lateral view distinctively shaped as shown in fig. 18. Notopleural stripe only briefly and narrowly extended along rear margin. Synthorax: Mesostigmal plates raised beside the hind pronotal lobe, with a dense fringe of long hairs on top, directed upwards and forwards. Antehumeral stripes pale greenish, slightly less wide at widest point than in male. The black marking above the metapleural suture broader than in the male over much of its length. Axillaries dorsally, metascutum and metapostnotum with dull yellowish markings. Legs as male. Wings: Fw with 16 Px (left), 17 Px (right); Hw with 15 Px. Pt dark grey with irregular paler border, this largely absent on rear side; almost rectangular, covering one underlying cell.

Abdomen.— Generally darker than in male, similar to that of the *borneensis* female. S8 dorsally with a pale blue marking, almost identical to that of *borneensis*. Cerci black, shorter than S10, tips sharply pointed. Ovipositor dark brown to black.

Measurements: abdomen without cerci or ovipositor 35 mm, ovipositor ca 1.75 mm, Hw 23 mm.

Variation.— There are some minor differences between the holotype and the male described above: the prothorax is very similar, but the pronotal median lobe projection is even less obvious, and the pale markings on the same lobe are more narrowly separated, the lateral projections of the posterior lobe are slightly longer, but of the same width. S1 dorsally anterior to the posterior carina is almost entirely pale; the S8 dorsal blue marking is less triangular, more bottle-shaped.

There is little other variation between the male described above, the holotype and the other males examined. The dorsal head markings are faded in some specimens, presumably as a result of age. In a few individuals the pronotal ridge is shorter. The



Figs 45-50. Dorsal markings of male terminal abdominal segments: 45. *C. arcuata*, Sungai Kuinam, S. Kalimantan; 46. *C. borneensis*, Mt. Dulit, Sarawak; 47. *C. campioni*, Mt. Dulit, Sarawak; 48. *C. flavostriata*, Kubah National Park, Sarawak; 49. *C. kenyah*, Mt. Dulit, Sarawak; 50. *C. species A*, Murung river, Kalimantan.

blue dorsal marking on abdominal S9 is narrower on some specimens, and occasionally the S10 mark is somewhat reduced in size. The length of the male abdomen is rather variable. There are no significant differences between the female described and the other two female specimens available.

Measurements.— ♂: abdomen without appendages 34.75-40.25 mm, Hw 21-24.25 mm; ♀: abdomen without cerci or ovipositor 34.75-36 mm, Hw 22.5-24 mm.

Remarks (also see under *C. borneensis*).— The association of females with *campioni* males is by supposition, based on their co-occurrence at sites on Mt. Dulit and the presence of similar ridge-like median pronotal lobe projections on both sexes. Laidlaw's 1932 description of *campioni* male, slightly more detailed than his original description, may be composite; a male from Long Semiyang is listed as well as the holotype, this specimen could not be located in the BMNH collections, but the locality is the same as the female *borneensis* described as that of *campioni* in the same paper and the male may

well have been *borneensis*. In the same publication Laidlaw provides a number of illustrations of what is said to be male *campioni* (Plate I, fig. 6; Plate II, figs 5-6; Plate III, fig. 5), these could all be of either *borneensis* or *campioni*; and it is not stated which specimen was used for these illustrations.

Male *campioni* are easily separated from males of all known species by several characters (see keys): in particular they are separated from the most similar species, *borneensis*, by the form of the terminal appendages and pronotal structures (see also under *borneensis*). Female *campioni* are separated from those of all other known species by the structures of the median pronotal lobe and the form of the posterior pronotal lobe.

Distribution and habitat.— All records of *C. campioni* are from Miri division in NE Sarawak (fig. 70). It appears to be a species of small rocky streams in mixed dipterocarp forest in steep terrain. The holotype is from Lio Matu, a settlement on the upper Baram, a mountainous area; the altitude at which the holotype was collected is unknown. Specimens in coll. Dow were collected from approximately 500-920 m.

Coeliccia flavostriata Laidlaw, 1918

(figs 3, 4, 11, 16, 22, 23, 28, 35, 42, 48, 54, 60, 66, 69)

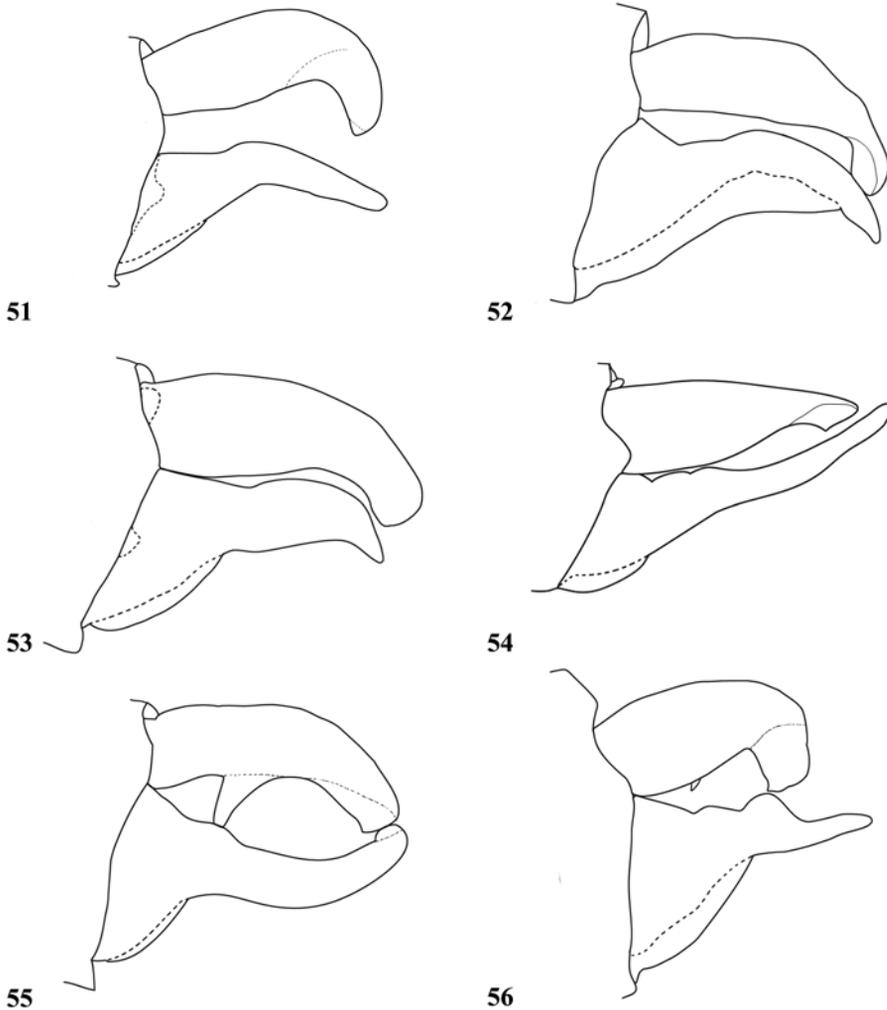
Coeliccia flavostriata Laidlaw, 1918: 223, fig. 1.— Laidlaw, 1920: 333; Laidlaw, 1932: 34 (additional description); Lieftinck, 1954: 47 (distribution); Kimmins, 1970: 179 (note on holotype); Orr, 2003: 77.

Coeliccia coomansi Lieftinck, 1940: 355-356, figs 9-10.— Lieftinck, 1954: 46; Lieftinck, 1971: 81 (note on holotype and first described female of *coomansi*); van Tol, 1992: 71; Matsuki & Kitagawa, 1993: 4 (Mt. Serapi); Kitagawa, 1997: 6-7, fig. 7 (Hindu Temple, Kuching, Sarawak). **Syn. nov.**

Type material.— Holotype ♂ (BMNH), Malaysian Borneo, Sarawak, Samarahan division, Mt Merinjak, 26.v.1914, J.C. Moulton. Terminal abdominal segments detached, in pill case on pin. Four labels on pin: round printed label, white with red margin, "Type//HT"; rectangular folded piece of old newspaper, handwritten "n. sp//♂", "type", "*Coeliccia flavostriata*", these all in pen, "Mt. Merinjak//28/5/14" in pencil; small off white rectangle, handwritten "Mt. Merinjak//Borneo//28.v.1914//1917-18". *C. coomansi* (all RMNH, all leg. L. Coomans de Ruiter): 1 ♂, holotype of *C. coomansi*, 31.i.1932, W. Kalimantan, Singkawang, Gunung Poteng; 1 ♀, allotype of *C. coomansi*, same data, 400 m; 1 ♂, same data (but not included in the type series of *C. coomansi*); 1 ♂, paratype of *C. coomansi*, 1.vi.1934, same location.

Other material.— (all in coll. Dow except as noted): Sarawak: all Kuching division except as noted: 1 ♂, Gunung Gading National Park, small hillside stream, 29.i.2008, RAD; 1 ♂, same data, GTR; 2 ♂, Annah Rais, tributary to Sungai Annah Rais, 19.iii.2005, RAD; 2 ♂, same area, second order tributary to Sungai Annah Rais, 26.i.2006, RAD; 1 ♂, west of Kubah National Park, Mt Singai, small stream above church, 2.x.2008, RAD; 4 ♂, 1 ♀ (in tandem with one of the males), Kubah National Park, stream-like drain at edge of forest by road up Gunung Serapi, 13.iv.2005, RAD; 2 ♂, same location, 21.i.2006, RAD; 1 ♀, same location, 23.ii.2008, RAD; 1 ♂, same national park, boulder strewn stream on Gunung Serapi, 14.iv.2005, RAD; 1 ♂, 1 ♀ (in tandem), same national park, stream at ca 350 m on Gunung Serapi, 21.i.2006, RAD; 1 ♀, same national park, stream on Main Trail, 13.iv.2006, RAD; 1 ♂, same national park, small stream on Waterfall Trail, 13.iv.2006, RAD; 1 ♂, same trail, tributary stream above waterfall, 14.iv.2006, RAD; 2 ♂, same trail, at waterfall, 13.ii.2008, GTR; 2 ♀, same location, 21.viii.2008, RAD; 1 ♂ (RMNH 500004), same data, GTR, in ethanol; 1 ♂, same national park, stream on Belian Trail, 15.ix.2008, RAD; 1 ♂, Gunung Santubong National Park, stream above waterfall on trail to summit, 28.v.2005, RAD; 2 ♂ (RMNH), 4-9.vii.1959, Samarahan division, S. of Serian, Tapuh, T.C. Maa.

Remarks.— Laidlaw (1918) described *flavostriata* from three males collected on mountains in west Sarawak; only the holotype is present in the BMNH, one paratype was "to be returned to the Sarawak Museum". Lieftinck (1940) described *coomansi* from



Figs 51-56. Male terminal appendages, lateral view: 51. *C. arcuata* Sungai Kuinam, S. Kalimantan; 52. *C. borneensis*, Gunung Mulu National Park, Sarawak; 53. *C. campioni*, Mt. Dulit, Sarawak; 54. *C. flavostriata* modified from Lieftinck (1940), Gunung Poeteng, Kalimantan; 55. *C. kenyah*, Mt. Dulit, Sarawak; 56. *C. species A*, Murung river, Kalimantan.

a small series including a female, from Gunung Poteng, a mountain in north-west Kalimantan, not far from the border with Sarawak. Lieftinck's description of both sexes of *coomansi*, although brief, serves well as a description of *flavostriata* in combination with the notes below.

It is difficult to understand why Lieftinck chose to describe *coomansi* as new. The papers containing the available type material all have "*C. sp. cf. flavostriata*" written on them, albeit crossed out. In the description of the male he noted that certain features of the wing venation are identical to *flavostriata*, but he offered no differential diagnosis of

the two. I have examined the type series of *coomansi* and find no significant differences in the males from the holotype of *flavostrciata* or other males from Sarawak; the single female of *coomansi* falls within the range of variation found in female *flavostrciata* either taken in tandem or in association with males in Sarawak; it is clear that *coomansi* is a junior synonym of *flavostrciata*.

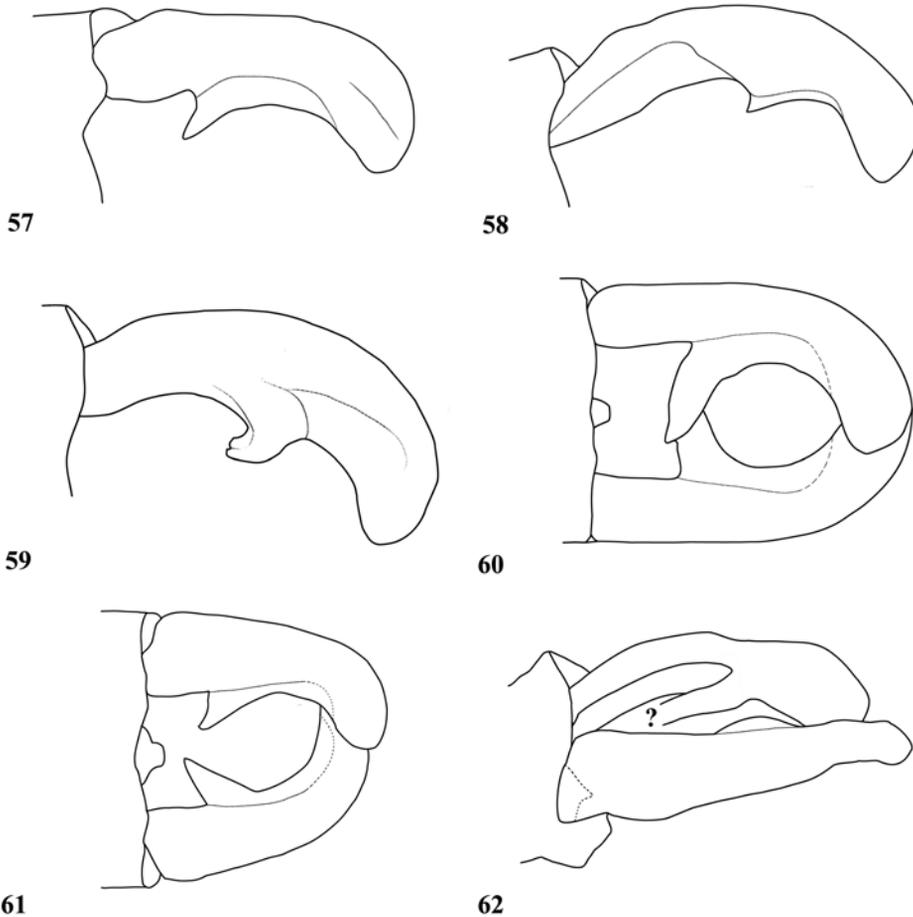
The pronotum of female *flavostrciata* (figs 11, 16, 22, 23) lacks median lobe projections, and the notopleural projections are rudimentary. Anterior lobe processes are present, a character which only *kenyah* shares, although these structures are small in *flavostrciata*.

Apart from variation in size (ranges given below), the most significant variation in male *flavostrciata* is in the presence or absence of pale markings on the postclypeus and terminal abdominal segments. The holotype has no pale marks on the postclypeus, but many other males examined have such marks at the posterior corners, ranging from small to tiny; although they are not mentioned by Lieftinck, these marks are present on the holotype and one of the paratypes of *coomansi*, but not on a male from the same location not included in the type series. Laidlaw mentions that the "youngest of the three males has a whitish, diamond-shaped spot on the dorsum of segment 10", this male was not available for study, but many males have a pale blue mark on the dorsum of S9, one male from Annah Rais has a tiny blue mark centrally on the dorsum of S10, as well as much larger S9 mark than is typical. The S9 mark is typically diamond-shaped (fig. 48), but sometimes triangular or teardrop-shaped. In a few individuals it is completely absent, most of these also have rather faded antehumeral markings; it appears that the S9 mark may be a feature of immature males, vanishing with advancing age. Most males examined have a fine pale line centrally along the dorsum of S6-9, terminating on S9 at the apex of the dorsal marking when it is present. The pale marking on the basal half of the labrum is somewhat reduced and faded in two males examined.

Females exhibit some variation in the form of the hind margin and upper parts of the lateral margins of the pronotal posterior lobe, with the allotype of *coomansi* (fig. 23) representing one extreme of development (also seen in some females from Sarawak), and the female illustrated in figs 11, 16 and 22 the other extreme, with the upper lateral parts of the lobe reduced and produced backwards as sharp spurs. There is also some variation in the development of the anterior lobe processes. Females also vary in the presence or absence of small blue marks on the posterior corners of the postclypeus. There is typically a subapical dorsal bluish green transverse band on S8, but in some specimens this is reduced to a pair of small marks dorso-laterally and in others the band is narrowly and irregularly interrupted dorsally; it appears likely that this marking fades with age as in the male. In two females there are pair of tiny blue subapical dorsal spots on S9.

Measurements.— ♂: abdomen without appendages 31-37 mm, Hw 19-22.5 mm; ♀: abdomen without cerci or ovipositor 30.5-34.5 mm, Hw 20.5-23.5 mm.

Both sexes of *flavostrciata* are readily separated from all other known species by the characters given in the keys. In particular males differ from the other known species in the form of terminal appendages, females differ in the form of the anterior and posterior pronotal lobes. Distribution and habitat.— Sarawak west of the Lupar river (Kuching and Samarahan divisions) and Gunung Poteng in NW Kalimantan (fig. 69). It is encountered with some regularity in a variety of high gradient forest habitats at Kubah National Park near Kuching, including at sections of drain with a trickle of water beside



Figs 57-62. Male cerci, dorsal and dorso-lateral views: 57. *C. arcuata*, Sungai Kuinam, S. Kalimantan; 58. *C. borneensis*, Mt. Dulit, Sarawak; 59. *C. campioni*, Mt. Dulit, Sarawak; 60. *C. flavostriata*, Kubah National Park, Sarawak; 61. *C. kenyah*, Mt. Dulit, Sarawak; 62. *C. species A*, Murung river, Kalimantan, the tip of the inner tooth is not visible on the specimen and is not shown.

the tarmac road on Gunung Serapi, and at other locations in west Sarawak, including some in highly disturbed forest (e.g. at Annah Rais near the Kalimantan border). However its range does appear to be rather limited, and it is vulnerable to deforestation of its hillside habitats. It occurs from near sea level up to at least 600 m.

Coeliccia kenyah spec. nov.

(figs 12, 17, 24, 29, 36, 37, 43, 49, 55, 58, 64, 69)

Type material.— Holotype ♂ (SAR06_PCD30), Malaysian Borneo, Sarawak: Miri, division, foot of Mt. Dulit, steep tributary to Sungei Long Aton, 31.iii.2006, RAD.— Paratypes (13 ♂, 2 ♀, all from Sarawak):

1 ♂ (SAR07_8_PCD319), Bintulu division, Tubau area, high gradient trickle in disturbed forest, 19.x.2008, RAD; 1 ♂ (SAR06_PCD31), same data as holotype; 1 ♂ (SAR06_PCD50), lower slopes of Mt. Dulit, ca. 300m, small steep stream, 1.iv.2006, GTR; 1 ♀ (SAR07_8_PCD270), same area, stream at 750-800 m, 27.viii.2008, RAD; 3 ♂ (SAR06_PCD35-37), 1 ♀ (SAR06_PCD38), Loagan Bunut National Park, small high gradient stream, 3.iv.2006, RAD; 1 ♂ (SAR07_8_PCD25), between km 40 and 50 on Samling Timber Company Feeder road, small high gradient tributary to Sungai Suan, 11.xii.2007, RAD; 4 ♂ (SAR07_8_PCD18-21) same data, GTR; 2 ♂ (SAR07_8_PCD56-57), North Tinjar area, small high gradient hillside stream, 21.xii.2007, RAD. All in disturbed mixed dipterocarp forest. Holotype and one female paratype to be deposited in RMNH, remaining paratypes to be deposited in BMNH, and in coll. Dow.

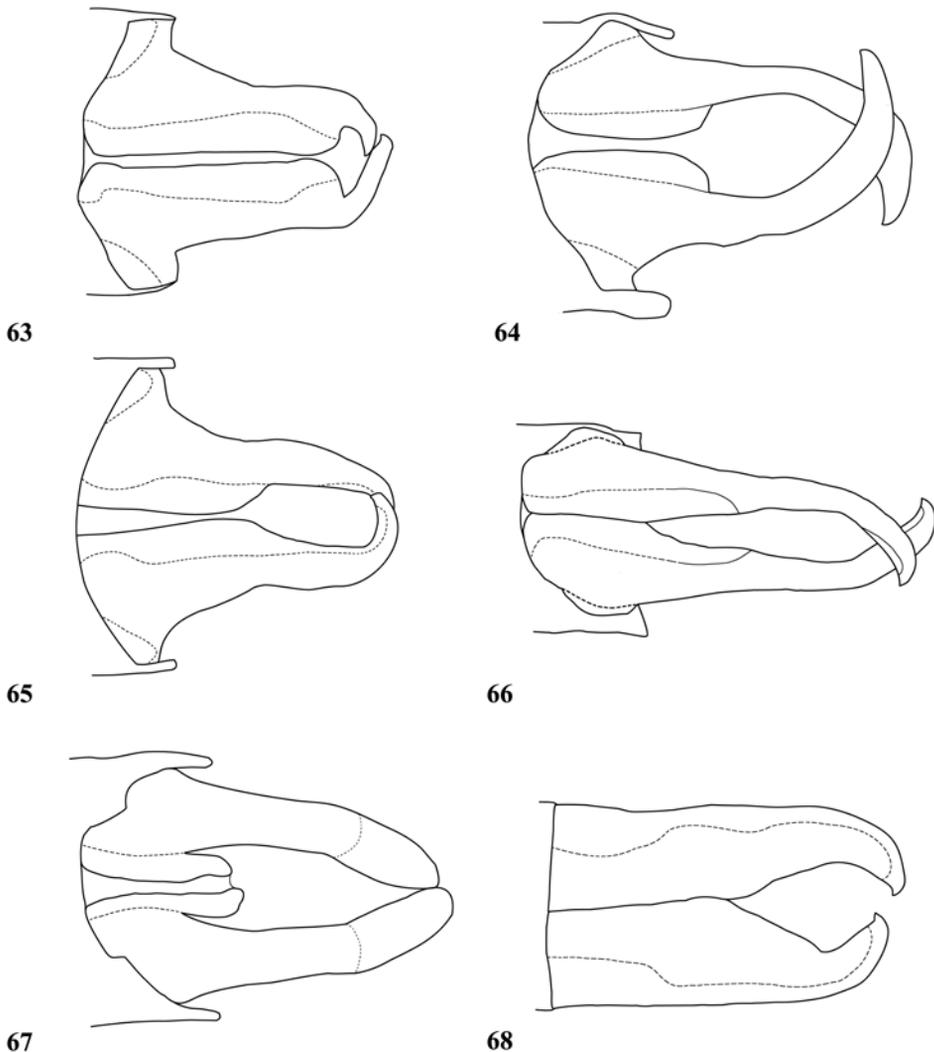
Etymology.— *Kenyah*, a noun in apposition; named for the Kenyah people, who inhabit the Tinjar valley in the shadow of Mt. Dulit, where the first specimens of this species were collected.

Description.— Holotype male.

Head.— Labium pale yellow, except for black hooks of the labial palps. Mandible bases with upper 3/4 pale blue, remainder black, genae entirely pale blue. Labrum blue on basal 1/2 (sides) to 2/3 (middle), black to front, with this extending centrally into blue area in a short “V”-shape. Anteclypeus pale blue, postclypeus shining black. Frons and vertex entirely matt black except for a pale greenish mark extending from the lateral ocellus behind the antenna base, widening until just before the level of the antenna, then tapering, just reaching the margin of the eye. Rear of head and occiput entirely black with small transversely elongated yellowish postocular spots, widely separated from each other and the margin of the eye. Antennae matt black except for narrow pale ring at extreme top of scape and base of pedicel, and a brown area at top of pedicel.

Thorax.— Prothorax (fig. 29): Anterior lobe of pronotum mostly black, with small area of yellow laterally, median lobe largely occupied by a pair of pale yellow markings, separated dorsally by a broad black triangular mark produced at its posterior apex into a short, broad mid-dorsal bar. Notopleural stripe narrow and irregular. Posterior lobe entirely black, wide, fan-shaped. Propleuron entirely pale yellow except for the notopleural stripe. Synthorax dorsally with mesepisternum matt black with long, dull and faint yellow antehumeral stripes (fig. 36). Antealar triangles black. Mesepimeron mostly black, with a small triangular yellow marking in the upper posterior corner. Metepisternum yellow except for a narrow black area along the interpleural suture in the rear 1/3 and a wider black band along the posterior 2/5 of the metapleural suture and extending narrowly alongside the antealar carina. Metepimeron largely yellow. Venter of synthorax entirely pale yellow. Metinfraepisternum pale yellow. Mesinfraepisternum black except for the lower posterior corner which is yellow. Fw axillaries dorsally with faded blue marks anteriorly, Hw axillaries with bright blue anterior marks, pair of blue marks on the metascutum, metapostnotum pale. Legs: coxae and trochanters pale yellow. Femora pale yellow with dark markings as follows: on distal part of all legs and extending along most of the flexor surface on the anterior pair, and along the outer margin of the extensor surface for almost the entire length on all legs. Tibiae black near femora, this extending along the flexor surface on all legs, otherwise coloured dirty cream, dark distally. Tarsi dark brown. Wings: 13 Px in Fw, 12 in Hw. Pt brown, with incomplete whitish border, covering one underlying cell and almost parallel-sided.

Abdomen.— S1 yellow laterally except for a brown apical band, extended dorsally as a narrow line, expanding on the anterior 2/3 to cover almost the entire dorsal surface.



Figs 63-68. Male paraprocts, ventral view: 63. *C. arcuata*, Sungai Kuinam, S. Kalimantan; 64. *C. borneensis*, Gunung Mulu National Park, Sarawak; 65. *C. campioni*, Mt. Dulit, Sarawak; 66. *C. flavostriata*, Kubah National Park, Sarawak; 67. *C. kenyah*, Mt. Dulit, Sarawak; 68. *C. species A*, Murung river, Kalimantan.

S2 pale brown, lighter below. S3-6 brown, lighter at lower part of sides and with brown becoming progressively darker on each segment. S3 with an almost complete narrow pale basal band, interrupted medially, on S4-6 this marking reduced to lateral pale bands, not extending onto dorsal surface. S7-8 black dorsally and on upper part of sides, pale below. S9 black laterally and dorsally, with much of the dorsal surface taken up by a faint pale blue marking, roughly triangular with apex almost at basal margin (fig. 49). S10 entirely black. Epiproct prominent, rectangular. Cerci extending slightly

less than twice the length of S10 (fig. 55), matt black, covered in pale hairs, with short broad blunt-ended denticles on upper and outer surfaces. Cercus with large basally and downward directed spine on the inner surface arising shortly before mid point (figs 55, 61). Paraprocts dark shiny brown, in lateral view slightly longer than the cerci, in last third directed upwards at ca 45 degrees and inwards, overlapping tips of cerci; beyond their base in ventral view of almost even width (fig. 67).

Penis.— as shown in figure 43.

Measurements.— abdomen with appendages 33.25 mm, cerci 0.75 mm, Hw 20.25 mm.

Female.— [SAR06-PCD38, Loagan Bunut National Park] As male except as noted below.

Head.— Labrum entirely black. Mandible bases largely pale blue-green. Postocular spots small. Complete, irregular, pale band from ocelli to eye margin, and pale greenish marks between lateral ocelli and median ocellus

Thorax.— Prothorax (figs 12, 17, 24): pronotum with anterior lobe processes in the form of two remarkable elongate, flattened, backward directed structures (fig. 12), lying flat against the surface of the median lobe of the pronotum, and reaching almost to the rear margin of that lobe. These processes converge basally, but turn outward for their distal third. Notopleural projections tiny. Posterior lobe shield-like, with long narrow lateral projections (fig. 17). Colouring similar to male, but notopleural stripe broader, and extended upwards and downwards at its anterior end; yellow colouration on anterior lobe of pronotum extending along the outer edges of the backward-directed processes. Synthorax dorsally with mesepisternum dull black. Antehumeral stripes (fig. 37) pale blue-green. Rest of synthorax very similar to male except that pale colouration on metepisternum becomes bluish towards the wing bases, black markings here slightly more extensive than in male, with that along the metapleural suture extending for nearly 3/4 of the length of the suture. Legs as in male. Wings with 14 Px in Fw, 12 (left) or 13 (right) Px in Hw. Pt brownish grey with a narrow white margin, covering one underlying cell (except on right Fw where the underlying cell is unusually long, extending well beyond Pt).

Abdomen.— S1-7 marked as male, except brown colouration is generally darker on all segments. S8 mostly black. S9-10 entirely dark brown-black. Cerci just shorter than S10, sharply pointed. Ovipositor largely very dark brown.

Measurements.— Abdomen without cerci or ovipositor 31.75 mm, ovipositor 2 mm, Hw 21.25 mm.

Variation.— The holotype appears to be a mature individual, with bright colours faded. A number of individuals have the light markings on the dorsum of the head, the mesepisternum and abdominal S9 much brighter. Some individuals have tiny marks laterally on the postclypeus. There is some variation in the width of the light markings on the dorsum of the head, and on the labrum, where the basal blue colouring is typically reduced compared to the holotype. The extent of the black area on the metepisternum varies slightly. The mark on the dorsum of S9 varies in shape from that seen in the holotype to triangular; in the male from the Tubau area it is much narrower than typical. In three of five males, all with light markings bright and presumably relatively immature, there are blue markings on the dorsum of S10; in one of these males there is an irregular subapical transverse stripe, with a narrow central projection pointing towards and almost reaching the base of the segment, in another the central projection is absent

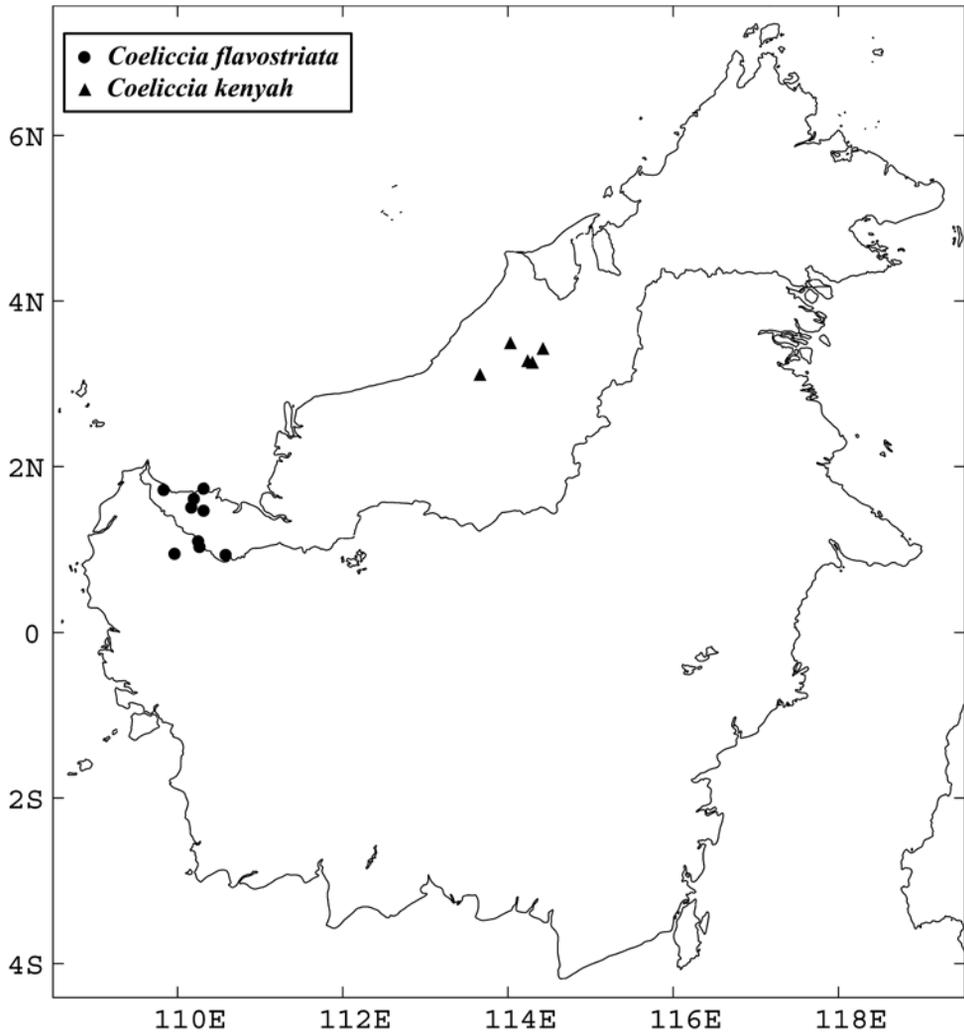


Fig. 69. Distribution of *C. flavostriata* and *C. kenyah*.

and in the third only the central projection is present. In males from the Tubau and N Tinjar areas there is a small, very narrow, central subapical blue streak on S8; these males also have their light colours bright. The second female specimen has its light colours generally brighter, and the S9 lateral-dorsal markings are joined in the middle to form a complete subapical band. The angular projections of the pronotal posterior lobe are slightly shorter than in the female described.

Measurements.— ♂: abdomen without appendages 29-33.5 mm, Hw 17.5-20.5 mm; ♀: abdomen without cerci or ovipositor 31.75-34 mm, Hw 21.25-23 mm.

Remarks.— The female specimen from Loagan Bunut National Park was in tandem with one of the males when seen, but tandem broke within the net before the specimen

could be removed. An additional, unobserved, male of the same species was captured with the same swing. Although the female cannot be strictly associated with either male, there is little doubt she is conspecific with both.

The presence of additional blue markings on the dorsum of either S8 or S10 in at least some populations appears likely to be a characteristic of immature males, disappearing with advancing age.

Distribution and habitat.— The Tinjar basin in Miri division and the Tubau area of Bintulu division, Sarawak (fig. 69). *C. kenyah* is a species of trickles and small streams in steep terrain in mixed dipterocarp forest. All material available was collected in the altitude range ca 50-800 m, with most records from ca 50-300 m.

Coelliccia species A
(figs 30, 38, 44, 50, 56, 62, 68, 70)

Material.— ♂ (RMNH), Indonesia, central Kalimantan, Ulu Barito, Murung river, 6.viii.1992, C. Jiggins. In white paper triangle in outer envelope with card. Teneral, slightly crushed. Envelope with "*Coelliccia* new species near *arcuata*" in J. van Tol's hand; card with two hand-written annotations by JvT: "♂" and "*Coelliccia* aff. *arcuata*//?new species", and the following typed: "INDONESIA Central Borneo//Project Barito Ulu. Murung Camp along//Murung river, c. 8 km upstream from junction//with Barito river. 0°06'S 114°19'E.//July/August 1992. C. Jiggins"; paper triangle with hand-written annotations (presumably by C. Jiggins) "*Coelliccia* sp F", the 'F' in a box, "♂//only" and "80//6/8".

Description.— Male.

Head.— Labium pale except for black end hooks of labial palp. Labrum and postclypeus shining black, anteclypeus, mandible bases and genae pale yellow. Rest of head black, with exceptions as noted below. A yellow mark extending diagonally from lateral ocellus behind the antennae toward the eye, expanding before level of antenna, then contracting again, terminating shortly after antenna. Scape with pale ring at top, similar at base of pedicel, which is dark brown at top. Small, transversely orientated yellow postocular spots.

Thorax.— Prothorax (fig. 30) with anterior pronotal lobe black except for yellow corners, continuous with large yellow markings occupying most of median pronotal lobe, separated by narrow, dark brown, mid-dorsal streak. Posterior pronotal lobe black, broad and deep, almost rectangular. Notopleural stripe with irregular outline, narrowly extended along rear margin of propleuron for a short distance, sides otherwise yellow. Synthorax with mesepisternum black with long yellow antehumeral stripes (fig. 38). Antealar triangles black. Mesepimeron mostly black, with a small triangular yellow marking in the upper posterior corner. Metepisternum yellow except for a very narrow dark area along the interpleural suture at rear 1/3 and a wider black band above the posterior part of the metapleural suture, terminating well before the spiracle, extending alongside lower 2/3 of the antealar carina. Metepimeron largely yellow. Venter of synthorax pale yellow. Mesinfraepisternum entirely black except for the lower posterior corner, which is yellow. Metinfraepisternum pale yellow. Axillaries dorsally with obscurely yellow brown markings, metascutum largely yellow, metapostnotum brownish. Legs: coxae and trochanters pale yellow. Femora pale yellow with brown markings as follows: on distal part of all legs and extending along most of the flexor surface on the anterior pair, and along the outer margin of the

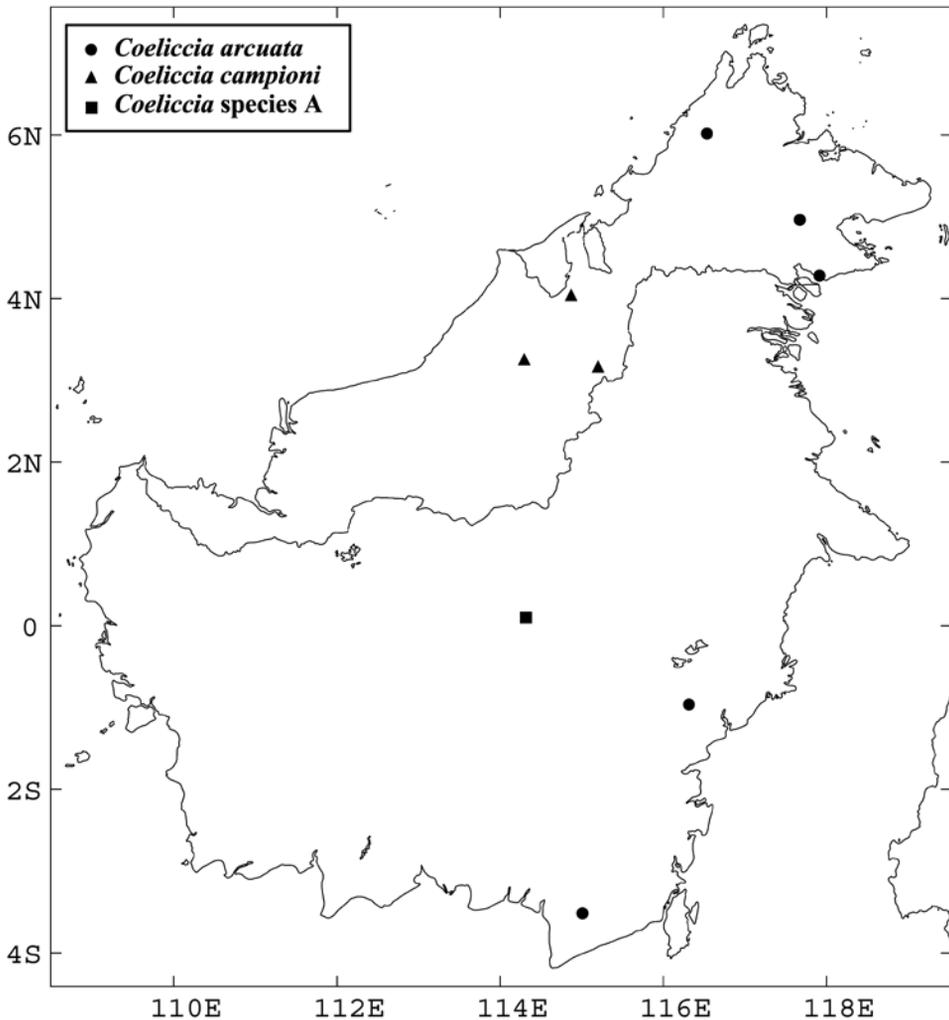


Fig. 70. Distribution of *C. arcuata*, *C. campioni* and *C. species A*.

extensor surface for almost the entire length on all legs. Tibiae brown near femora, this extending along the flexor surface on all legs, otherwise coloured dirty cream, dark distally. Tarsi dark brown with extensive pale areas. Wings: Fw with 13 Px (left), 12 (right), 12 Px in Hw. Pt grey with white margin, almost rectangular, covering one underlying cell.

Abdomen.—S1 yellow laterally except for a brown apical band, dorsally with an obscure brown area. S2 pale brown, slightly lighter below. S3-7 brown above, lighter at lower part of sides and with dorsal brown becoming progressively darker on each segment. S3 with an almost complete narrow pale anterior band, interrupted medially, on S4-7 this band is present, but becomes progressively fainter. S8 very dark

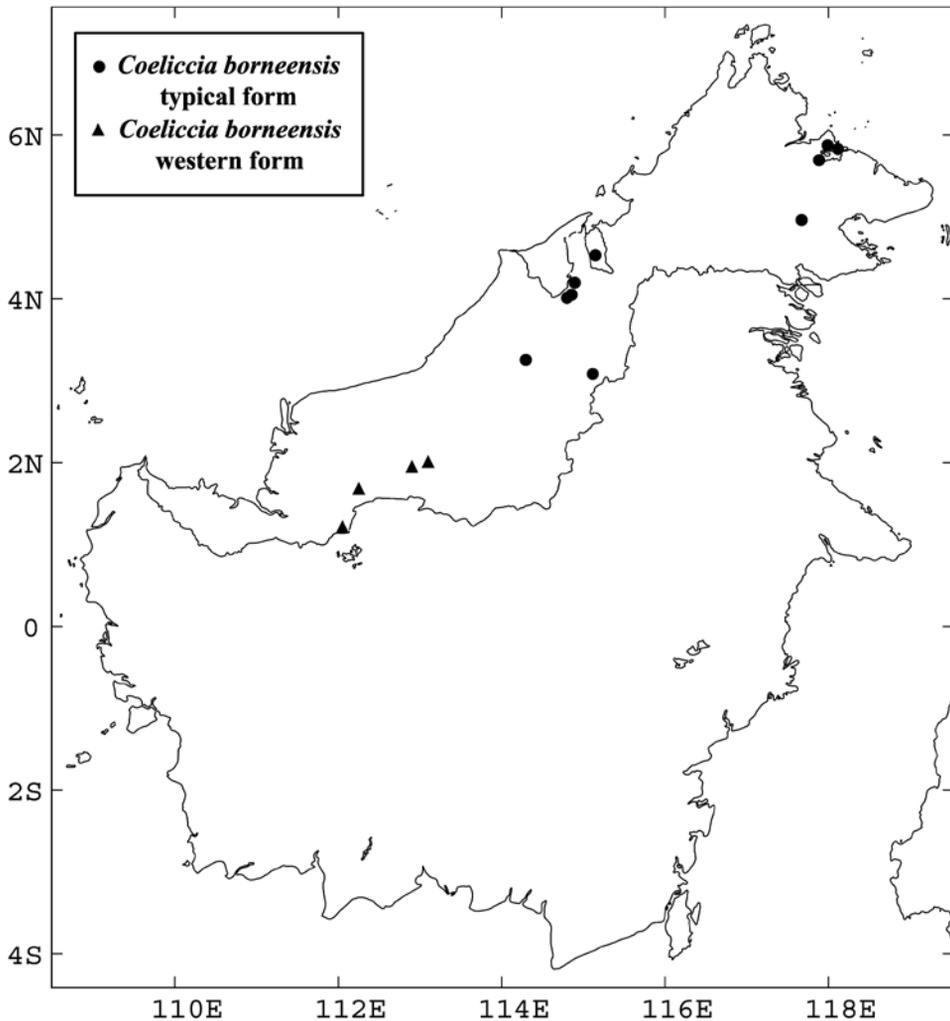


Fig. 71. Distribution of *C. borneensis*.

brown dorsally and on upper part of sides, pale below, pale bluish behind posterior carina dorsally. S9 dorsally with a large, pale blue, teardrop-shaped marking, in the posterior 3/4 (fig. 50), dark brown laterally and bluish behind posterior carina. S10 dark brown except ventro-laterally, where pale. Cerci brown, paler towards tips, paraprocts dark brown on outer and upper surfaces, pale interiorly and ventrally. Cerci about twice as long as S10, with tips strongly down-turned (fig. 56), orientation of tips possibly unnatural as the result of crushing, a long tooth on inner side, directed basally and downwards, inserted at ca 4/7 of cercus length, that on the right partially visible in fig. 62 (where it appears on the left because the image has been flipped for consistency with the other figures); the tip of the tooth on the left cercus is visible in lateral view where it

protrudes below the lower margin of the cerci (fig. 56). Paraprocts in lateral view projecting beyond cerci, upper margin with a prominent hump shortly before the tip, then abruptly narrowed, and flattened, tapering to and in-curved at tip; in ventral view (fig. 68) wide over basal ca 2/3, then quite abruptly narrowing and tapering to tips, which are pointed inwards towards each other.

Penis.— As shown in fig. 44.

Measurements.— Abdomen without appendages 33.75 mm, superior appendages ca 0.75 mm, Hw 21 mm.

Female.— Unknown.

Remarks.— Jan van Tol had already examined this specimen, and identified it as likely to be a new species, which is clearly the case. As the specimen would make a poor holotype I refrain from naming the species at this time. The male is clearly separated from all other known species of the *borneensis*-group by the characters given in the keys; given the differences in the male terminal appendages from even the allied *arcuata* it is likely that the female will differ considerably in prothoracic structure from the other species.

Distribution and habitat.— Known only from the type locality in central Kalimantan (fig. 70). Details of the habitat are unknown.

Coeliccia species B

Material.— 1 ♀ (BMNH): Malaysian Borneo, Sarawak, Miri division, Mt Dulit, 20.x.1932, B.M. Hobby & A.W. Moore, head detached, in gelatine capsule, abdomen and wings on right hand side detached, abdomen previously broken and glued. In addition to the original labels, a folded white, handwritten, paper rectangle is present on the pin, added by K.-D.B. Dijkstra: “not *campioni*!//nov. spec.?”

Remarks.— Kimmins (1936) appears to have omitted this specimen from his list of Odonata collected on Mt. Dulit. It differs from the females of all known species in details of the structure of the prothorax and is likely to represent an unnamed species, but in the absence of the male and with only one old specimen in poor condition I prefer not to describe it at this time. Note that this specimen is not included in the key to females.

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