NEW DRAGONFLIES *(ODONATA)* FROM BORNEO, WITH NOTES ON THEIR HABITS AND LARVAE

by

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The following descriptions of new Odonata are the result of a brief collecting expedition to the lowlands of southern Borneo, made by the author from July 20 till August 1, 1953. Though these notes are necessarily somewhat disconnected and deal with scattered members of the order, it has been thought worth while publishing them without delay, along with a few remarks on habits and larvae, in order to have the new specific names and references incorporated in my forthcoming "Handlist of Malaysian Odonata", which I hope can soon be published.

The tour started at Sampit, on the Sungai Mentaja or Sampit river, some 30 kilometres from the sea-coast, from which place three excursions were made into the forest swamps west and east of the village. From Sampit our party travelled two days upstream by motor launch to Pemantang, which is some 120 kilometres further inland on the same river and still in heavily wooded, almost flat country. This place became our headquarters whence collecting trips were made in various directions, chiefly into old secondary forest and swampy areas nearby, but also along the banks of the muddy S. Mentaja and its tributary river Sapiri, collecting on the latter occasion being carried out en route, standing athwart in a native s a m p a n. Although clear running streams, with gravel banks or stones in the bed, were completely lacking in this area, several jungly retreats and small, slow flowing muddy brooks offered suitable breeding-places to a number of highly interesting and previously unknown species.

In the early morning of August 1, return to Sampit was made again by motor launch, and as the water had risen more than four feet since our arrival at Pemantang, Sampit was reached the same day a few hours after sunset. The next and last day — the first cloudless morning during the whole trip! — the forest marshes west of the village were visited once more in search of some of the rarer species, and on this occasion several forms could be added to the list.

The collection made on this trip consists of 87 species, 5 of which proved to be new to science while 5 others apparently had not previously been recorded from the island. Although the results obtained (after 9 days of field work) are considered highly satisfactory, the collection is hardly representative of the entire fauna of the region visited. Owing to lack of prolonged sunshine during most of the time, no Corduliidae were noticed on the wing save *Epophthalmia*, the Gomphidae and Aeshnidae being also poorly represented.

Yet, I was fortunate enough to secure the larvae of four species of *Macromia* by exploring carefully, by means of a sieve basket, the bottom fauna of a tiny forest brook near Pemantang. This inconspicuous stream also yielded the larvae of several other rare species of dragonfly, including those of *Gomphidia, Macrogomphus, Microgomphus* and *Tetracanthagyna*, and of the zygopters *Libellago hyalina, Elattoneura* and *Rhinagrion borneense*.

The following list of the species secured may give an impression of the composition of the local fauna, and also of the wealth of species occurring. Those marked with an asterisk are additions to the fauna of Borneo.

Fam. Chlorocyphidae: *Libellago aurantiaca* (SEL.); *L. dorsocyana* LIEFT.; *L. hyalina* (SEL.), with larva; **L. l. lineata* (BURM.); *L. semiopaca* (SEL.); *Pachycypha aurea* LIEFT.; *Sundacypha petiolata* (SEL.).

Fam. Epallagidae: *Euphaea impar* SEL., and *Dysphaea lugens* SEL.

Fam. Agriidae: *Vestalis amoena* SEL.

Fam. Megapodagriidae: *Podolestes atomarius* LIEFT.; *P. furcifer* LIEFT.; *Rhinagrion borneense* (SEL.), with larva.

Fam. Protoneuridae: *Elattoneura aurantiaca* (SEL.); *E. analis* (SEL.), with larva; **E. erythromma*, sp. n.; *Prodasineura interrupta* (SEL.); *P. tenebricosa* LIEFT.

Fam. Platycnemididae: *Copera v. vittata* (SEL.), and *Coeliccia resecta* LIEFT.

Fam. Coenagriidae: *Onychargia atrocyana* SEL.; *Ceriagrion cerinorubellum* (BR.); *Archibasis melanocyana* (SEL.); *A. incisura* LIEFT.; *A. tenella* LIEFT.; *A. viola* LIEFT.; *Pseudagrion coomansi* LIEFT., with larva; **Pseudagrion* sp. n. indet. (♀ only); *Amphicnemis erminea* LIEFT., with larva; **A. dactylostyla*, sp. n.; **A. pandanicola*, sp. n.; **Mortonagrion forficulatum*, sp. n.; *Agriocnemis femina* (BR.).

Fam. Gomphidae: *Ictinogomphus acutus* (LAIDL.); *I. decoratus melaenops* (SEL.); *Gomphidia maclachlani* SEL., with larva; *Microgomphus ch. chelifer* SEL., larva, supposition; *Macrogomphus parallelogramma albardae* SEL., with larva; *M. decemlineatus* SEL.; *Burmagomphus* spec. indet. (♀ only).

Fam. Aeshnidae: *Tetracanthagyna plagiata* (WATERH.), exuvia; *Heliaeschna idae* (BR.).

Fam. Corduliidae: *Epophthalmia v. vittigera* (RB.); **Macromia arachnomima*, sp. n. (bred from larva); *M. cincta* RB. (bred from larva); *M. cydippe* LAIDL. (bred from larva); *M. mnemosyne* LIEFT., or sp. n. (supposition, ♀ bred from larva).

Fam. Libellulidae: *Orchithemis pruinans* (SEL.); *O. pulcherrima* BR.; *O. xanthosoma* LAIDL.; *Lyriothemis cleis* BR.; *L. biappendiculata* (SEL.); *Pornothemis serrata* KRÜG.; **P. starrei* LIEFT.; *Cratilla l. lineata* (BR.); *C. metallica* (BR.); *Orthetrum chrysis* (SEL.); *O. glaucum* (BR.); *O. s. sabina* (DR.); *O. t. testaceum* (BURM.); *Nannophya pygmaea* RB.; *Nannophyopsis chalcosoma* LIEFT.; *Brachygonia oculata* (BR.); *B. ophelia* RIS; **B. puella* LIEFT.; *Tyriobapta laidlawi* RIS; *T. torrida* KIRBY; *Brachydiplax ch. chalybea* BR.; *Raphismia inermis* RIS; *Chalybeothemis fluviatilis* LIEFT.; **Acisoma panorpoides* RB.; *Diplacodes trivialis* (RB.); *Neurothemis fluctuans* (F.); *Crocothemis servilia* (DR.); *Rhodothemis rufa* (RB.); *Onychothemis coccinea* LIEFT.; *O. culminicola* FÖRST.; *Zyxomma petiolatum* RB.; *Tholymis tillarga* (F.); *Pantala flavescens* (F.); *Tramea* spec. indet.; *Rhyothemis aterrima* SEL.; *R. obsolescens* KIRBY; *R. pygmaea* (BR.); *R. ph. phyllis* (SULZ.); *R. triangularis* KIRBY; *Urothemis signata insignata* (SEL.).

Fam. PROTONEURIDAE

Elattoneura erythromma, sp. n. (fig. 1 a-e).

Material. — S. Borneo: 6 ♂, 1 ♀ (ad.), Sampit distr., 0-50 m, near Sampit, about 50 km inland, 21.vii.1953, M. A. LIEFTINCK. Holotype ♂ and allotype ♀ in the Leiden Museum; paratypes in M.Z.B. With collector's note: "Very dull, except brilliant cherry-red eyes". [Ground-colour russet-vinaceous marked with dark bronze-green. Eyes dragon's-blood red.] (RIDGWAY).

Male (ad.) — Labium vinaceous-buff. Anterior surface of head, as far upwards as a level slightly above fronto-clypeal suture, fawn-colour, only the postclypeus with indistinct brown T-shaped spot. Head otherwise dark bronze-green, the epicranial lobes with brilliant dark metallic lustre; a complete, rather broad transverse band of a russet-vinaceous tint connects the eyes on top of head, the anterior limit of this band situated mid-way between the insertion point of antennae and median ocellus, its posterior limit a short distance behind the lateral ocelli. Antennae brown, apex of first joint vinaceous. Occiput and rear of the head black.

Prothorax dark bronze-green marked with russet-vinaceous: anterior and posterior lobes each with small lateral spot, median division with much larger roundish dorso-lateral patch, and lower border of propleuron also narrowly pale-coloured. Posterior lobe much broader than long, evenly rounded, hind margin slightly but distinctly elevated.

Synthorax, dorsum as far down as the first lateral suture and including upper three-fourths of mesinfraepisternites, dark bronze-green with low metallic lustre; pale marks reduced to a pair of narrow russet-vinaceous juxta-humeral (mesepisternal) stripes, incomplete and tapering to a fine point upwards along humeral suture; and two points of the same colour at the extero-dorsal extremity of the shoulder-line. Sides light russet-vinaceous, metepimeron and metinfraepisternite marked with bronze-brown as in the ♀ of *longispina* [1]), but these spots all a little

[1]) See *Treubia* 1937, 16 : 75, fig. 10.

smaller; ventral surface of metepimeron moreover with a black stripe, one on either side and each about equal in size to the elongate spot on the middle of its lateral division.

Legs light russet-vinaceous, spines obscured; coxae and trochanters with vestiges of brown exterior spots, bases of femora also spotted, their apical portion gradually turning brown, as are also the bases and apices of tibiae and the tips of the tarsal joints; claws light brown, each carrying a distinct inferior sub-apical tooth.

Wings hyaline; neuration as for genus. Basal prolongation of *Ab* subequal in length to *Ac*. Cu_1 reaching the wing border at a level between Px_1 and Px_2 on fore wing, at Px_2 or between Px_2 and Px_3 on hind wing. Postnodals 12 on fore, 10 on hind wing. Pterostigma moderately oblique, slightly longer than high, distal side a little convex and somewhat longer than proximal side, especially so in hind wing; colour grey-brown surrounded by a fine creamy-white line.

Abdomen very slender, apical segments rather expanded, especially in dorso-ventral dimension. Ground-colour dirty ochreous, intermingled with vinaceous; dorsum of 1-2 bronze-black, the sides as well as the intersegmental ring between 1-2 pale-coloured; 3-6 each with a nearly complete brown dorsal band, ill-defined laterally, which expands apically and deepens in colour so as to form jet-black apical rings preceded by narrow subterminal pale constrictions; each segment moreover carries a fine whitish baso-dorsal ring, narrowly interrupted mesially by dark brown. Segm. 7-10 wholly black, only 7 with a pair of tiny baso-dorsal streaks, the lower tergal margins of 7 and 8 also slightly paler in colour.

Anal appendages shaped as shown in fig. 1 a; colour yellow to vinaceous-brown, the robust interior spine of the superior pair obscured and tipped with black, as are also the apices of the inferior appendages.

Female (ad., allotype) — Differs from the male only in details of coloration, the shape of the posterior lobe of the prothorax and in the genital structure. Eyes vinaceous-russet during life. Head markings somewhat paler and intermingled with light blue on the genae; transverse band on middle of head wider, extending from level of antennae as far as the anterior border of the lateral ocelli, light purplish-blue in colour. Prothorax: anterior lobe in frontal view with the side-portions elevated and rounded, the lower border of the median portion slightly protuberant (fig. 1 b) ; posterior lobe broader than in male, strongly raised and forming ear-like lobes, which in frontal view appear widely separated from each other by a very deep U-shaped space, which at its bottom is almost equally broad to the basal diameter of each side-lobe (fig. 1 c-d).

Colour-pattern of thorax and abdomen very similar to that of the male. Ground-colour pale vinaceous intermingled with light blue. Juxtahumeral thoracic stripes (though incomplete above) a little broader. Abdominal marks better defined and sides of all segments more conspicuously pale-coloured. Segm. 7 as in male, but 8-9 with a well-defined creamy yellow latero-ventral band and valves also partly yellowish ventrally. Anal appendages and tuberculum cream-coloured (fig. 1 e).

Measurements: ♂ abd. + app. 25.5-26.0, hw. 16.0-16.3; ♀ 25.4, 16.5 mm.

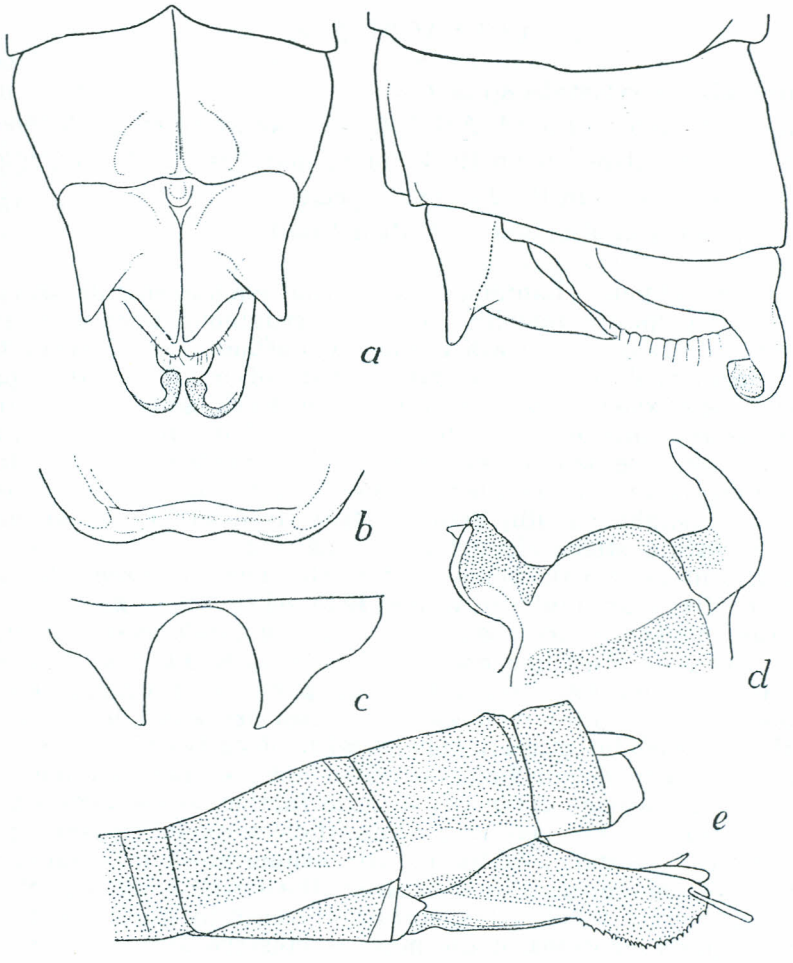


Fig. 1. — *Elattoneura erythromma*, sp. n., S. Borneo. ♂ anal appendages, dorsal and right lateral view (*a*); anterior lobe of ♀ prothorax, frontal view (*b*); posterior lobe of ♀ prothorax, frontal view (*c*); upper portion of ♀ prothorax, left lateral view (*d*); and terminal segments of ♀ abdomen, left lateral view (*e*).

By its sombre colours and brilliant red eyes this new species was easily recognised in the field and could be distinguished at a glance from its congeners. In the forest swamps near Sampit it flew in company with *E. aurantiaca* (SELYS), among dense undergrowth on the banks of tiny brooks with a slow current. Some 100 kilometres to the north it was replaced by *E. analis* (SELYS), which flew over open water of other sluggish streams in the forest, and no further examples of *erythromma* were observed elsewhere in the area.

Fam. COENAGRIIDAE

Amphicnemis dactylostyla, sp. n. (fig. 2 [1]).

Material. — S. Borneo: 1 ♂, 1 ♀ (ad.), Sampit distr., 50-100 m, Pemantang, 150 km inland, 26.vii.1953, forest marshes, M. A. LIEFTINCK. Holotype ♂ and allotype ♀ in the Leiden Museum.

Allied to *A. martini* RIS, and *platystyla* LIEFT.

Male (ad., holotype) — Labium, maxillae and mandibles pale orange-yellow, maxillary palpi and mandibular teeth ferruginous. Labrum bright orange-yellow, its basal half rather sharply defined dark brown, the borderline irregular, dark area carrying a pair of minute diffuse pale spots on each side of the middle, basal impression black. Anteclypeus dirty yellowish, with two brown dots, one on each side of the median line. Genae, and a transverse band covering almost the whole anterior surface of frons (subinterrupted in the median line), orange-yellow; postclypeus deep black with slight metallic-green lustre. Head otherwise brilliant metallic-green, save a stripe along the margin of compound eyes, which is dull black. Antennae pale yellow anteriorly, metallic greenish-black posteriorly, the flagellar joints brownish. Rear of the head glossy black.

Prothorax shaped and coloured much as in *platystyla:* dorsal surface and a little more than the upper half of the sides brilliant metallic-green, including the posterior lobe, the remaining parts light orange-yellow; posterior lobe evenly rounded, its lateral angles not developed, hind margin very slightly elevated (identical in shape with *platystyla*).

Synthorax, ground-colour light orange-yellow, the brilliant metallic-green colour of the dorsum extending a trifle further downwards on the sides than in *platystyla*, i.e. well beyond the first lateral suture, occupying the upper (anterior) one-half of the metepisternum and surrounding the upper portion of the spiracle (in *platystyla* the lower boundary of the metallic colour merely touches the spiracle); ventrally this colour fills out also the upper four-fifths of the mesinfraepisternites as well as the postero-dorsal one-sixth of the metepisterna; lastly, there is also a tiny transverse spot bordering the upper margin of the metepimeron.

Legs, including the spines, pale orange-yellow; all femora with sharply delimited black apical rings, the basal one-fourth of the anterior tibiae and extreme bases of intermediate and posterior tibiae also black exteriorly; apices of tarsal joints slightly obscured.

Wings hyaline, neuration very similar to that of *platystyla: M_3* arising at the subnodus or a little distal to it, *Rs* slightly beyond that level. *Ac* very near *Ax_2* and *Ab* entering the wing-margin distal to *Ac* at a distance of 1½-2 times the length of *Ac* itself. Two postquadrangular ante-subnodal cells, i.e. two cells between the quadrilateral and junction of *M_3-Rs* beyond subnodus (similar to *platystyla*). 14 postnodals on fore, 12-13 on hind wing. Pterostigma practically identical in shape to that of *platystyla* but very differently coloured; hardly oblique, the square even a trifle higher than long, and quite similar on fore and hind wing, its borders a little convex; colour of *pt* on fore wing orange-brown (ochraceous-tawny)

surrounded by a very fine darker brown line, and with a distinct dark brown central eye-spot, the swollen nervures surrounding it pale yellowish-white; *pt* of hind wing light orange-yellow (RIDGWAY: buff-yellow, the central eye-spot light cadmium) between light cadmium nervures.

Abdomen, like that of *platystyla,* extremely slender, the apical segments only slightly inflated in dorso-ventral, markedly so in lateral dimension. Ground-colour pale yellow, darker towards the end. Metallic-green and bronze-brown markings very similar to those of *platystyla;* dorsum of 1-2 metallic-green, spot on 1 extending from base to apex but considerably more strongly narrowed towards base than in that species; marking on 2 with a slight postmedian constriction; bands on 3-6 rather ill-defined basally and laterally, all segments with narrow pale yellow basal rings, interrupted in the median line, the dark bands expanded apically so as to form fairly distinct apical annules; 7-9 almost wholly brownish-black, 8 and 9 with strong metallic-blue lustre; 10 and anal appendages palest yellowish-white. Median process along posterior border of 10th tergite short and blunt, scarcely projecting caudad but directed obliquely upwards.

Anal appendages shaped as shown in fig. 2[1]; upper branches of superior pair twice as long as the lower branches, both shaped similarly in principle to those of *martini* and *platystyla.* Inferior appendages very short and tubercular, their apices narrow, slightly incised, the branches rounded and directed obliquely upwards.

Female (ad.) — Labrum light yellow, its basal half shiny warm blackish-brown, the anterior limit of this marking rather irregular; side-edges and mid-basal impressed dot deep black. Anteclypeus pale yellow with a pair of triangular grey spots; postclypeus glossy black. Transverse yellow band in front of frons rather broad, sub-interrupted in the median line but confluent laterally with the pale colour of the genae. Head otherwise shiny metallic-blue above.

Prothorax dark blue-green above and laterally, only the rim of the anterior lobe with metallic lustre; posteriorly, this elevated ridge is bordered with a clear blue transverse line which is prolonged backwards to form a bright median spot of the same colour at the sulcus; posterior lobe not modified, its hind margin very slightly emarginate when viewed from above.

Dorsum of synthorax golden brown, or cinnamon, changing rather abruptly to glaucous-green beyond the humeral suture, the under surface a delicate lichen green; only the ante-alar triangles and a point below the calli of the wings, brilliant metallic-blue.

Legs cream-coloured, all femora marked externally with a fine deep black stripe, incomplete basally; knees also finely black, and anterior tibiae with a black exterior stripe along their basal one-fourth. Spines and apices of tarsal joints somewhat obscured; claws pale ochreous, black-tipped.

Wings hyaline; neuration as in male. 15 (14) postnodals on fore, 14 (13) on hind wings. Pterostigma squarish, like that of the male, but coloured dark grey between greyish-black nervures, and surrounded by a

conspicuous pale yellow line, so as to form large and slightly oblique, central blackish 'eye-spots'; shape as well as colour nearly the same in both pairs of wings.

Abdomen more stoutly built than in the male, gradually a little expanded towards the apex; colour-pattern quite similar to that of the male. Intersegmental membranes between 7-8 and 8-9 pale bluish dorsally; basal half of 9 metallic bluish-brown, its distal half palest blue; 10 and anal appendages cream-coloured, sides of 10 intermingled with pale blue. Valves creamy yellow, their apices slightly surpassing the tuberculum anale.

Measurements: ♂ abd. + app. 31.0, hw. 19.7; ♀ 31.0, 20.5 mm.

The present new species is the third member of a small group of Bornean *Amphicnemis*, which are characterized by a combination of characters, the most outstanding of these being the square form of the pterostigma, the unarmed posterior prothoracic lobe, and the short lower branch of the male superior anal appendages.

In *A. platystyla* LIEFT., described by me recently (*Treubia*, 1953, 22: 246-247, figs), the orange pterostigmata of the ♂, with their excentric brown 'eye-spots', are quite similar in fore and hind wing; this species is readily distinguished from the other two by its flattened rounded appendages and by having the lower branch of the sup. app. only little shorter than the upper.

In *dactylostyla* sp. n., and *martini* RIS, on the other hand, the pterostigma of the fore wing is much darker than that of the hind wing, the latter being unicolorous orange.

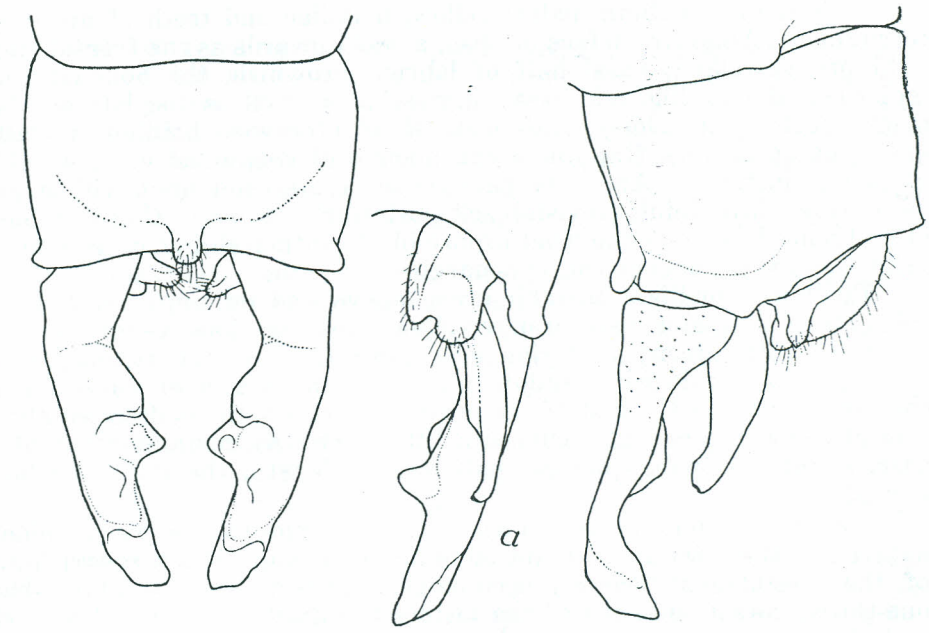
From *martini* our new species not only differs in being of smaller size, but also in the colour of the pterostigma of the fore wing (dull orange with squarish dark brown central spot instead of greenish-black centred with brown); they can be held apart also on comparing the shape of the upper branch of the sup. app., which in *martini* is not so straight and more inwardly curved, with the apex broader and club-shaped. The denticulation of the inner surface of the appendages is very similar in the two species, which are evidently very closely related.

I am unable to separate the only known female of *dactylostyla* from that of *martini*.

Amphicnemis pandanicola, sp. n. (fig. 2 [2]).

Material. — S. Borneo: 3 ♂, 2 ♀ (1 ♀ not fully matured), Sampit distr., 0-50 m, near Sampit, about 50 km inland, 20.vii.1953, M. A. LIEFTINCK. Holotype ♂ and allotype ♀ in the Leiden Museum; paratypes in M.Z.B.

Allied to *A. madelenae* LAIDLAW.



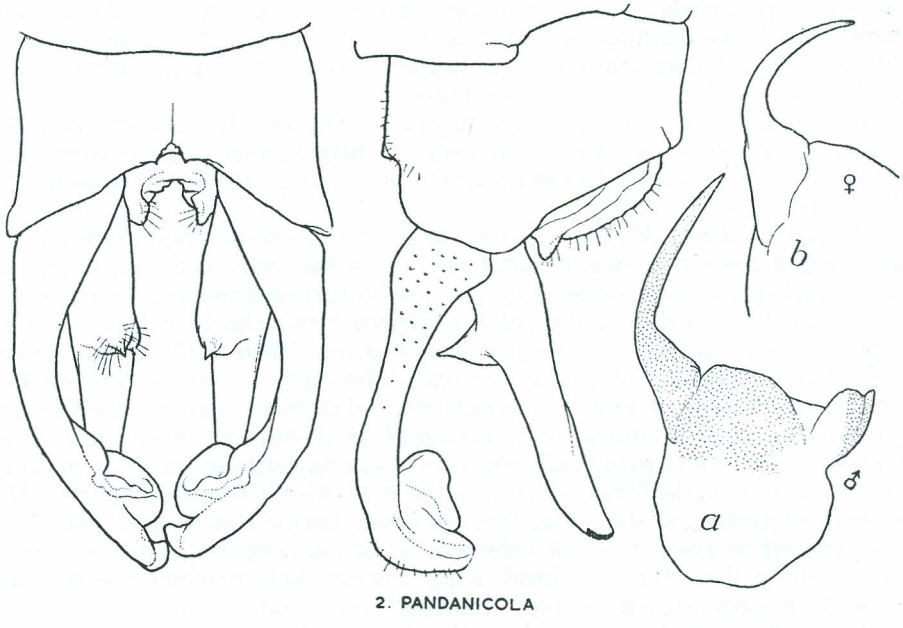


Fig. 2. — *Amphicnemis dactylostyla*, sp. n., S. Borneo (1), ♂ anal appendages, dorsal and right lateral view, and left half of anal app., seen from below (*a*). *Amphicnemis pandanicola*, sp. n., S. Borneo (2), ♂ anal appendages, dorsal and right lateral view, and right lateral view of ♂ prothorax (*a*) and of ♀ posterior lobe of the same (*b*), to show median spine-like process; fig. *a* and *b* drawn on the same scale.

Male (ad.) — Labium palest yellow, maxillae and teeth of mandibles ferruginous. Anterior surface of head, as far upwards as the frontal ridge, light orange-yellow; basal half of labrum brownish, the boundary line indistinct, the pit-like mid-basal impression as well as the lateral edges black; postclypeus glossy coal-black. Head otherwise brilliant metallic-green, except a very fine line along margin of compound eyes, which is black and lustreless. Antennae pale yellow, the second joint with a grey basal ring, third joint greyish-black posteriorly, and the flagellar joints also obscured. Rear of the head bronze-black, rather shiny; an incomplete yellow stripe bordering the eye-margin.

Prothorax brilliant metallic-green above and on upper half of the sides, the remainder pale orange-yellow; anterior lobe yellow, broadly bordered with green; posterior lobe subtriangular, the side-edges not developed, but produced on middle into an enormous, slender spine of about the same length as the rest of the prothorax; this spine is directed almost straight upwards and also curved a little forwards, metallic-green at its base, slightly brownish beyond half-way its length, the tip being black (fig. 2 [2a]).

Synthorax, dorsum and sides to a level mid-way between humeral suture and the spiracle, brilliant metallic-green, as is also a squarish area of the mesinfraepisternites, occupying approximately its antero-basal one-third; dorsal one-fifth of the metepisternum likewise filled out with metallic-green, this dot detached (or almost so) from the metallic-green band on the mesepimeron, the upper extremity of the latter being bordered by a small triangular yellow area (immediately exterior to the humeral suture) which is continued downwards along the suture for about two-fifth of its length. Pleurae otherwise unmarked, except blackish points bordering the upper edges of the metepimeron.

Legs, including the coxae, pale yellow, the femora unicolorous light orange-yellow; bases of all tibiae very slightly tinged greyish; spines on femora orange, those on tibiae and tarsi somewhat obscured; tarsal claws yellow tipped with black.

Wings hyaline; M_3 arises well beyond the subnodus, *Rs* twice that distance further outwards, but not as far as half-way between nodus and Px_1. *Ac* situated very near Ax_2 and *Ab* entering the wing-margin well away from *Ac* by a distance of at least three times the length of *Ac* itself. Three postquadrangular ante-subnodal cells, i.e. three cells between quadrilateral and junction of M_3-*Rs* beyond subnodus. 11 postnodals on fore, 10 on hind wings (10 and 9, respectively, of second series). Pterostigma irregular in shape, approximately equal in fore and hind wings, but differently coloured; proximal side very oblique, with acute interior angle, as long as or a little longer than costal side which itself is shorter than the slightly convex distal side, the anal side being the longest; colour of *pt* on fore wing greyish-black between black nervures, but surrounded by a pale yellow line, that on hind wing orange between orange nervures and with a grey-brown central eye-spot.

Abdomen extremely slender, the terminal segments distinctly inflated; ground-colour pale yellow, growing a little darker backwards. Segm. 1-6 metallic-grey above, these bands only very slightly expanded

apically and not forming distinct apical rings; all marks suddenly and strongly constricted sub-basally so as to form a pair of tiny dorso-lateral basal spots of yellow. Dark band on 7 much broadened towards apex and forming a nearly complete apical ring; 8 and 9 almost wholly obscured; segm. 10 and anal appendages yellowish- or ivory-white, dorsum of 10 obscured on middle. Posterior border of 10th segment V-shaped and provided with two short denticulate protuberances which carry some fine pencil-hairs at their apex.

Anal appendages long and rather forcipate, deeply divided into upper and lower branches, which are approximately equal in length and shaped as in fig. 2 [2], the lower branch provided with a robust ante-median tooth, which is directed straight upwards; inferior appendages very short, a little upcurved, their apex subtruncate and carrying a small nipple-shaped exterior tubercle.

Female (ad., androchromatic) — Resembles the male in most respects, but differs as follows. Basal half of labrum black instead of brown; transverse band in front of frons light green; head otherwise coloured as in male.

Ground-colour of prothorax pale lumière green, brilliant metallic-green on the dorsum; median spine on posterior lobe scarcely shorter than in the male but strongly curved, its apex directed forwards (fig. 2 [2b]).

Thorax pale turtle green laterally, fading to pale lumière green laterally and underneath; dorsum and part of sides brilliant metallic-green, similar to the male. Coxae and trochanters palest yellow-white, rest of legs cream colour; all femora with a sharply defined black exterior stripe and a blackish dot at the knees, the anterior tibiae with a brown exterior streak near base.

Wings as in male; pterostigma also similar, that of hind wing not differing in colour from that of the fore wing, both greyish-black between black nervures and surrounded by a pale yellowish line.

Abdomen with the greenish bronze-black dorsal bands similar to those of the male, progressively broader from before backwards; dorsal mark on segm. 1 strongly narrowed basally; interrupted yellowish-white basal spots clearly defined. Segm. 8 with complete bronze-green band narrower than those on the two preceding segments and restricted to the dorsum; 9 and 10 light blue above and pale ochreous intermingled with green on the sides, dorsum of 9 with ill-defined bronze-green mark restricted to its basal two-thirds and 10 only with some obscuration near base. Genital valves slightly surpassing the apex of 10th segment but not projecting beyond the tips of the appendages; all terminal appendages pale-coloured.

The second, not fully adult female, does not differ from the allotype save in the colour of its legs, which have partly retained the coral red tint of the teneral stage, the femora moreover showing no sign yet of a black exterior stripe.

Measurements: ♂ abd. + app. 29.0-30.0, hw. 18.0; ♀ 29.5-30.0, 19.0 mm.

By the differently coloured pterostigmata of the fore and hind wings, the ♂ of this new species most nearly approaches *madelenae* LAIDLAW, which also has a long median spine along the border of the posterior lobe

of the prothorax and in which the lower branch of the sup. app. also carries a robust spine. However, *pandanicola* is smaller in size and has the appendages shaped differently. Although both species agree in having the dilated part of the upper branch of the superiors folded over on itself so as to form a ventral groove or channel, in *pandanicola* there is no trace of an internal projection at about the middle of the length of the upper branch, the appendage itself being much more strongly downcurved and expanded apically; lastly, the strong tine on the dorsal surface of the lower branch in *pandanicola* is situated distinctly more basad than in *madelenae*.

Individuals of *Amphicnemis* were fairly abundant in the vast forest swamps west of Sampit and further inland. The insects, which are weak flyers with a short flight range, were repeatedly noticed fluttering around clumps of Pandanus, disappearing into the fronds or alighting on the slender spiny leaves of these plants.

The present new species kept company with *A. erminea* among the dense undergrowth in the forests near Pemantang. In these forests Pandanus grew abundantly, either as individual plants or in clusters which consisted of stocks with their crown of leaves close together or intertwining. They grew at varying distances from the ground, but only the lower crowns that reached a height of ½ - 1½ metres above the ground were examined. As a rule the leaf axils did not contain water, but some of the larger plants growing in the bed and on the low mud banks of a sluggish brook contained small bodies of water and decaying vegetable matter, and it was in these tiny receptacles between the leaf bases that a small number of larvae, apparently of *A. erminea*, were found. A description of these larvae, which greatly resembled that of *Pericnemis stictica*, will be given on another occasion.

Mortonagrion forficulatum, sp.n. (fig. 3).

Material. — S. Borneo: 6 ♂, 10 ♀ (ad.), Sampit distr., 0-100 m, Sampit and Pemantang, 40-150 km inland, 21-29.vii.1953, forest-marshes, M. A. LIEFTINCK. Holotype ♂ and allotype ♀: Pemantang, 27.vii.1953, in the Leiden Museum; paratypes in M.Z.B.

Allied to *M. appendiculatum* LIEFT.

Male (ad.) — Labium pale ochreous; palpi, mandibles, genae and clypeus orange-yellow; labrum brilliant xanthine orange. Frons, vertex and epicranium deep velvet black. First antennal joint brownish-black, second joint pale orangish, flagellar joints obscured. Ocelli yellow. Postocular spots bright blue, widely distant, placed in the long axis of the head, reniform, situated very near to the margin of compound eyes, each deeply

and rectangularly excised mesially and in 3 out of 6 specimens divided up into two spots of unequal size, the posterior spot about three times larger than the anterior one. Occiput black; rear of the head canary yellow.

Prothorax deep velvet black, save a narrow yellow line along latero-ventral margin. Posterior lobe relatively of large size, its lateral divisions vestigial and hardly elevated, the median lobe much thinner, broader, and also larger than in *appendiculatum* (fig. 3 b), lamellate, directed obliquely upwards and backwards, its dorsal surface concave, hind margin rounded (fig. 3 a).

Dorsum of synthorax, to a level about half-way between first and second lateral suture, and including most of the mesinfraepisternites, deep velvet or bronzy black; median carina and humeral suture unmarked. Antehumeral stripes in all specimens (except one male, in which they are complete) narrow and elongate, each divided up into a pair of widely separated bright blue streaks, situated immediately interior to the humeral suture, both spots approximately equal in size and pointing towards each other. Metepisternum with the blue obliterated stripe much less broadly interrupted near its upper end than in *appendiculatum,* sharply defined, the ground-colour deep rusty brown. Metepimeron and ventral surface of thorax light yellow to pale ochreous.

Legs, including the coxae, orange-yellow; femora with indistinct subterminal grey-brown ring, apices of tibiae and tarsi slightly obscured; spines and tarsal claws reddish-ochreous, the latter provided with a distinct sub-apical tooth.

Wings slightly tinged grey-brown. Pterostigma smaller than the underlying cell, deep black surrounded with a very fine orangish line, elongate lozenge-shaped, but more oblique and with the outer apical angle more acute than in *appendiculatum.* Postnodals 8-9 on fore wing, 6-7 on hind wing.

Abdomen of the same slender build as *appendiculatum,* but with a much darker and more extensive brown and black pattern than in that species. Segm. 1 with the dorsum black, fading to brown towards the base and with the sides blue; 2 brownish-black with a pair of clear blue transverse baso-dorsal spots and with similar, though smaller, blue dots on either side at the posterior constriction of the dark mark on the back; sides turning at first brown and then green towards the lower margin. Ground-colour of segm. 3-6 bright ochreous, but all segments carry well-pronounced blackish-brown bands occupying most of the dorsum and sides; these marks are strongly constricted before the end, expanding laterally to form complete and broad apical rings of a deep black colour, which occupy about one-sixth of the length of segment; each segment moreover carries a sharply defined basal ring, sky-blue on dorsum, fading to ochreous aside, occupying a little less than one-seventh of the total length of each segment. Segm. 7 similar to the preceding ones but still darker, the sub-apical constriction of the dorsal mark only slightly indicated. Segm. 8, with the exception of its apical one-fourth, sky-blue, the black apical mark in the median line only slightly produced forward, but laterally tapering to a long point directed towards the base of segment.

Segm. 9-10 wholly deep black, but 9 occasionally with a pair of small sky-blue baso-dorsal spots.

Anal appendages black, shaped similarly in principle to those of *appendiculatum;* superior pair considerably higher and more swollen dorso-ventrally than in that species, their apical portion more distinctly hollowed out above, the interior sulcus-like depression whitish in colour; inferior pair relatively longer and more strongly downcurved apicad (fig. 3).

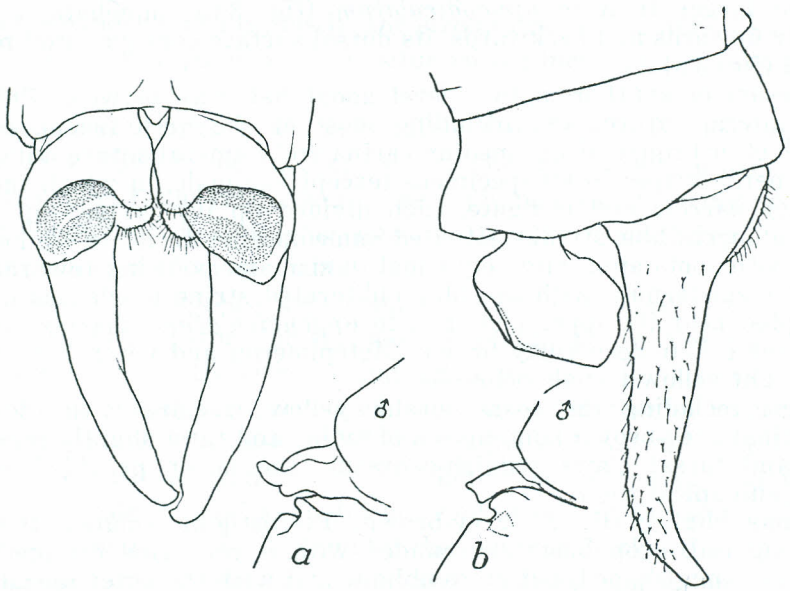


Fig. 3. — *Mortonagrion forficulatum*, sp. n., S. Borneo. ♂ anal appendages, dorsal and right lateral view, and right lateral view of posterior lobe of ♂ prothorax of the same (*a*), and of *M. appendiculatum* LIEFT., from Billiton (*b*).

Female. — Resembling the male in many respects, but differs as follows. Anterior surface of head grass green instead of yellow. Frons and entire upper surface dark purplish to brownish-black, lacking pale postocular spots.

Prothorax warm golden brown, unmarked; posterior lobe with the lateral divisions vestigial, slightly angular on either side, but the median lobe of great size and very conspicuous when viewed laterally; at first it projects almost straight upwards and then curves backwards so as to form a narrow, more or less rectangular lobe, which is about twice longer than wide, convex anteriorly and strongly hollowed out posteriorly; its apex bears a shallow, saddle-shaped incision, but the side-edges are rounded.

Synthorax warm golden brown, marked with apple-green similarly to the male, but the antehumeral and obliterated metepisternal bands are both a little wider, the antehumerals being interrupted only in 2 out of 10 specimens. Ground-colour of metepisterna rusty-brown fading to pale greenish-ochreous on the metepimeron and under surface of thorax.

Wings as in the male, the pterostigma brownish-yellow between black nervures, not differing in colour in fore and hind wing.

Abdomen, ground-colour pale ochreous marked with warm and rather dark reddish-brown; markings on 2-6 less strongly constricted sub-apically and apical brown rings considerably shorter than in the male; on the other hand, each of the segments 2-8 carry very conspicuous, bright blue-green baso-dorsal spots, which are all approximately equal in size and almost straight cut off posteriorly (on 2-4 they are slightly excised in the median line), the spot on 8 occupying about the basal two-fifth of the dorsum; 9-10 and anal appendages unicolorous brown, the latter a little shorter than tenth segment. Valves yellowish, not or only very slightly surpassing apex of last segment.

Semi-adult females differ from matured examples in having the upper surface of the head and thorax more conspicuously coloured, orange-cinnamon, the thorax marked with pale blue; the clypeus and labrum in such specimens are of a light ochraceous-buff tint, as are also the legs.

Measurements: ♂ abd. + app. 20.5-21.0, hw. 11.5-12.0; ♀ 19.0-21.0, 12.0-12.7 mm.

This handsome little species was not rare in the marshy forests of the Sampit area and will probably prove to be widely distributed throughout the alluvial forests of southern Borneo. It prefers shallow forest pools; the adults keep close to the water's surface flying only short distances, so that they are easily overlooked insects. Females were more easily detected than males, on account of the series of clear blue spots decorating their abdomen, the male having only a single, very conspicuous, blue 'recognition mark' on its 8th segment.

M. forficulatum comes nearest to *appendiculatum* LIEFT., from Billiton (*Treubia*, 1937, 16 : 102-104, fig. 24). Apart from structural differences in the prothorax and anal appendages, both sexes of *forficulatum* are most easily distinguished by their darker and more contrasting colour-pattern and also by their superior size. The differences in the colour-marks on the terminal abdominal segments of the ♂ are constant and very striking.

Fam. CORDULIIDAE

Macromia arachnomima, sp. n. (fig. 4 - 7).

Material. — S. Borneo: 1 ♂ (juv.), Sampit distr., ca 50 m, Pemantang, 150 km inland, 26.vii.1953, forest brook, M. A. LIEFTINCK. The specimen is the holotype, bred from larva in ultimate instar and transformed at Bogor (Java), 2-3.ix.1953, deposited in the Leiden Museum. One larva (ult.), 2 larvae 3-4 ult, 1 larva, 5-ult, Pemantang, 26.vii.1953, same locality, M. A. LIEFTINCK; live specimens still under observation in the laboratory.

A small, slenderly built species with long wings, extremely slender legs and a short, narrow abdomen.

Male (holotype, bred from larva). — Head comparatively broad, width across the eyes 7.3 mm. Labium snuff brown. Mandibles cinnamon, the maxillary palpi more reddish-brown. Labrum dark brown, indistinctly cinnamon-coloured on middle and along base. Clypeus and frons anteriorly rather uniform tawny-olive, the anteclypeus obscured mesially; no yellow spots or bands. Frons short and broad, pyramidal processes distinct, conical, well-rounded above, their anterior surface slightly shiny, finely wrinkled, smoothly convex and not at all forming flattened of framed areas; furrow very deep, V-shaped; brilliant metallic dark blue colouring restricted to the upper portions of the pyramidal processes. Vertex moderately high, forming two bluntly pointed small tubercles; surface rugose, colour dull metallic blue-black. Antennae long and fine, black. Occiput and rear of the head unicolorous glossy black.

Prothorax brown, the pronotum with darker brown T-shaped mark, the horizontal portion of which covering the anterior border.

Synthorax rather short and narrow, greatest width across the shoulders 5.6 mm. Ground-colour very dark brown; dorsum vinaceous-russet, the mesial portions of the episterna and all of the sides (except the yellow markings) with metallic purplish-blue lustre. Mesepisterna lacking the usual pair of yellow marks on either side of the middle, but instead of these with yellow juxtahumeral stripes, ill-defined laterally and incomplete above; each of these stripes starts low down on the mesinfraepisternum, which it nearly completely fills out, then extends upwards a short distance away from the humeral suture, diminishing in width gradually until it leaves off about 1.5 mm before the ante-alar triangles, which are bright yellow. Thoracic sides with a very broad and sharply defined yellow metepisternal band across the spiracle and bordering the suture; this band completely encircling the thorax, widest (1.3 mm) at its upper end just under the anterior wing and narrowest (0.9 mm) between the second and third pair of coxae. Metepimeron more narrowly bordered with yellow posteriorly, this stripe about 0.6 mm broad at its dorsal extremity. Ventral surface of thorax brownish-yellow, the sutures indistinctly and narrowly brown; a more or less triangular metallic dark brown streak on the extero-basal portion of the metepimera, and a similar transverse line bordering the poststernum.

Legs long and extremely slender. Posterior femur reaching back 2 mm beyond apical margin of 2nd segment of abdomen; hairless, but lower (anterior) border with a row of microscopical serrulate teeth along full length. Anterior femur and tibia both distinctly curved, those of intermediate and posterior pair of legs straight. Length of fore, middle and hind legs 19.0, 22.7, and 26.2 mm, respectively; posterior femur (excl. troch.) 9.0, tibia 10.0, tarsus 3.7 mm long. Colour of coxae and trochanters dirty brownish, legs otherwise black. Tibial keels as for genus, their colour whitish; keel on anterior tibia extending along its distal one-half and leaving off shortly before apex, that on posterior tibia nearly along full

length, but commencing 1.8 mm from base and ending 1.0 mm before the apex.

Wings comparatively long, slightly suffused with yellow all over the membrane, this colour deepening in tint at the bases, the entire anal area of the posterior wing, as far out as the discoidal triangle, saffronated, the cells in the loop and those basal to it with indistinct and diffuse greyish-brown centres. Both pairs of wings carry a deep velvet-black spot at extreme base, this spot on fore wing vestigial and confined to *c-sc*, that on hind wing a little larger, extending two-fifths into *c-sc* between base and Ax_1 and a vestige in *m*, all spots followed by a deep golden-yellow area in *c-sc*, ill-limited distalwards and not reaching beyond Ax_2. Neuration open, black, including the costa. 14 antenodals and 7 postnodals on fore wing, 9-10 antenodals and 9-10 postnodals on hind wing. Cross-veins in *ht* $\frac{3.3}{1.2}$; *Cux* $\frac{6.6}{4.4}$. *Arc* at Ax_2 in all wings. Course of main longitudinal veins normal, not strongly curved apically. *Rspl* not indicated. Anal area of fore wing commencing with two single cells followed by two rows up to the triangle; area posterior to Cu_2 with a maximum of two cell-rows. Discoidal field of fore wing with only a single row of cells up to the level of the 10th antenodal, then widening out with two and more cells between. Hind wing with only one large basal cell between anal triangle and anal loop, with two cell-rows between loop and posterior border of wing, and likewise between Cu_2 and the border. Triangles of fore and hind wing unequal in shape, but exactly similar in size. Anal loop made up of 7 cells without central cell. Anal triangle rather broad, about twice as wide as the membranula, its proximal side rather outbent at the end of the membranula; distal side (A_3) at first undulated but apically rather strongly incurved at the anal angle, which (though rounded) projects markedly and rather abruptly inwards, so that the margin between the membranula and the angle is strongly concave at its distal extremity only; this portion almost twice as long as the curved cross-nerve in the anal triangle. Membranula greyish-white, rather narrow, extending slightly over halfway the length of the triangle and ending just before the cross-vein. Pterostigma normal, not braced.

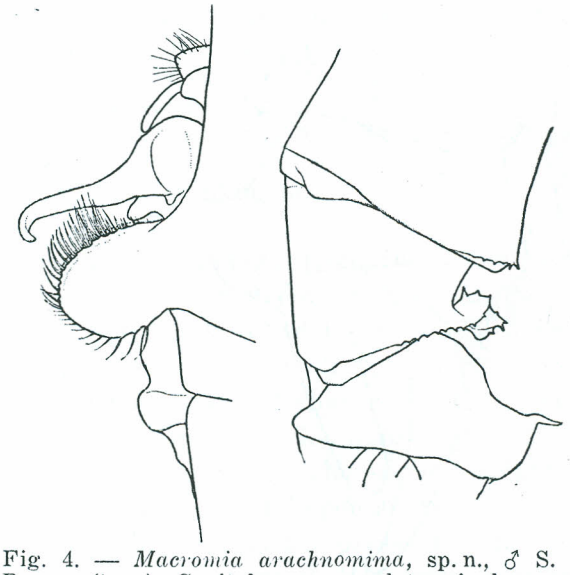


Fig. 4. — *Macromia arachnomima*, sp. n., ♂ S. Borneo (type). Genital organs and terminal segments of abdomen, left side view. (Anal appendages omitted.)

Abdomen short, but very slender; basal and terminal segments markedly inflated in dorso-ventral aspect, 2-3 much less so in lateral dimension; width of abdomen at middle of 2nd segment 2.9, at base of 5th segment 1.2, and at its widest point (end of 8th segment) 3.0 mm; greatest height at apex of 8th segment 2.9 mm. Colour deep black, segm. 1-6 rather shiny, especially the basal ones, but lacking metallic-green or -blue reflections; 7-10 and appendages dull black. Markings yellow, as follows: base and sides of 1 anterior to the transverse suture; 2 with complete, broad, rather oblique ring occupying the entire basal half of the sides (including the auricles), but rather irregular and narrowed above that level so as to cover the middle one-third of the back and interrupted in the median line; 3-5 each with very small dorso-lateral yellow spot situated about half-way the length of segment and placed immediately in front of the transverse suture, that on 3 largest though occupying only $^1/_7$ - $^1/_8$ of the segment's length and indented anteriorly by black at the carina, that on 5 reduced to a pair of dorsal points; 6 unmarked; 7 with an almost complete orange-yellow sub-basal ring occupying approximately

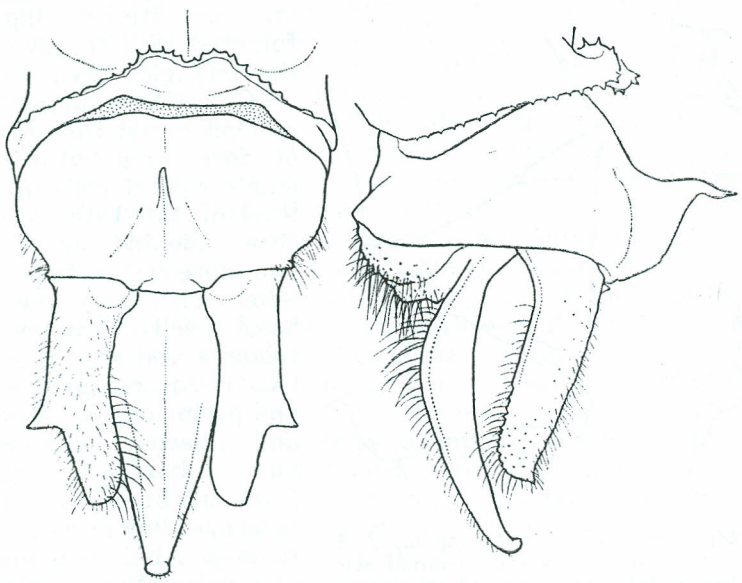


Fig. 5. — *Macromia arachnomima*, sp. n., ♂ S. Borneo (type). Anal appendages, dorsal and left lateral view.

$^1/_6$ of the length of segment, the extreme base dorsally and the mesial borders of the tergite ventrally, remaining black. Dorsum and most of the sides of 8-10 black; 8 with a pair of large, latero-ventral squarish orange spots occupying the basal two-fifths of the tergite; 9th tergite basally with a latero-ventral yellowish streak, the basal one-third of the sternal plates of 9-10 also pale-coloured.

The 9th segment exhibits a peculiar abnormality, where the upper part of the tergite is considerably shortened, the posterior border on its middle appearing crumpled up and folded over so much as to form a spinulose ruff that nearly meets the hind margin of the preceding segment. By this shortening of the dorsal portion, the whole 9th segment has become a seemingly distorted, wedge-shaped appearance when viewed laterally, the terminal segments with appendages forming accordingly an obtuse angle with the previous segments (fig. 4 and 5).

Dorsum of segm. 10 pinched in distal half and raised into a slender acute median spine, shaped as shown in fig. 5. Anal appendages with the superior pair straight and thick, carrying a robust exterior tooth a little beyond half-way their length; apices blunt, abruptly and minutely acuminate, the lower surface of the distal one-third covered with a number of small wart-like tubercles; appendix inferior much longer than superiors, narrowly triangular and strongly upcurved.

Genital organs shaped as in fig. 4. Basal portion of second abdominal tergite with a bunch of short golden-brown bristles placed in a row along ventral margin. Hamuli very slender, closely approximated, but with the curled tips distinctly outbent; posterior lobe with a row of very strong, closely set, curved marginal bristles, which are directed cephalad.

Measurements (of freshly killed specimen) : total length 54.0; abd. + app. 39.7; hind wing 38.4, greatest width of same 11.0; pt. fw. 2.4, pt. hw. 2.2 mm.

Female unknown.

As may appear from the above description and figures, this new species — the thirteenth *Macromia* known from the Malaysian subregion — is not closely allied to any of its congeners, taking in fact rather an isolated position. It is distinct from all that have been described hitherto by a combination of characters, the most outstanding of these being the long fine legs and the remarkable configuration of the 9th and 10th abdominal segments. The species is further characterized by its slender build, long wings and open neuration; an additional peculiarity not shared by the others being the presence of a yellow shoulder-stripe, which in all remaining members of *Macromia* is either entirely wanting or replaced by an incomplete mesepisternal band situated more distant from the humeral suture. Yet, the adult of *arachnomima* possesses all essential features of a true *Macromia*, and it has lost most of the numerous specializations and oddities exhibited by its larva.

Though the species was reared from its larva, nothing being of course known of its behaviour, there is an indication of the adult having crepuscular habits; for, during the three days that the unique specimen was kept alive in confinement, it remained motionless and quite inert till about 3 *p.m.* Then it began to fly around restlessly in its cage and continued

to do so till shortly after sunset, when it settled down for the night against the mosquito screening of its room.

The name of this remarkable species in an allusion to the spider-like appearance of the larva, a description of which follows.

Description of the full-grown larva

Surface smooth. Antennal joints with a fringe of very long and conspicuous hairs roundabout each segment; vertex with a few still longer and thicker erect hairs on either side of the dorsal tubercles; cheeks below with a dense patch of whiskers, placed close together in a row. Propleural processes with some long hairs at the apex; a single long bristle-like hair on middle of propleuron and a pair of still longer, erect bristles at the calli of the fore wings. Abdominal segments 3-8 each with a similar bristle-like hair on middle before posterior margin (occasionally two on some of proximal segments), and 7-8 in addition with a pair of long bristles, one on each side of the dorsal spines. Tufts of soft hair on coxae and trochanters. Pubescence otherwise as shown in the figures.

Head of very large size, roughly rectangular, widest across the eyes, the facetted portions of the eyes small and knob-like; shape and armature as shown in the figures. The strong tubercles upon the vertex are longer than those on the occipital lobes and quite characteristic. Frontal horn distinct, sub-acute, furnished with scale-like hairs apically. Antennae 4.7 mm long, shaped as shown in fig. 7 *c*. Labium of huge size, submentum reaching back as far as the first abdominal segment and the base of posterior pair of coxae, slightly projecting beyond anterior border of head though not surpassing frontal horn. Median lobe obtusely triangular, the distal borders almost straight, free margin with 10-11 strong spine-like setae on either side. Mental setae 7 on each side, the 5 outermost placed together in a row and of great length, the remainder short, weaker and more widely spaced. Lateral setae 5, with 1 additional short seta at the base of each lateral lobe. Lateral lobes with 5 V-shaped indentations and 6 rather short and rounded projections; last projection divided; 2-7 marginal setae on projections; movable hook short and slender.

Prothorax large and broad; pronotum with the postero-lateral angles produced laterally, forming strong, slightly curved, nipple-shaped processes, which are equal in size to the occipital tubercles; lateral propleural process well-developed, its apex rectangulate.

Thorax of moderate size, strongly roof-shaped and unusually high. Wing-sheaths extraordinary long, reaching backwards as far as the apex of the 9th abd.-segment or even a little beyond that level in sober specimens, and as far as the apex of the 8th in full-fed individuals; the two pairs of wing-sheaths are strongly raised, meeting each other in the middle line under an acute angle, the costal border of the anterior pair forming together an almost sharp longitudinal ridge of great length.

Legs extremely long and spidery. All femora laterally compressed and distinctly curved, with convex posterior border, and each provided along posterior margin with two pairs of very long and conspicuous erect

marginal bristles. Tibiae about equally long but perfectly straight: exterior bristles more numerous and interior surface fringed with two rows of shorter pubescent hairs. Tarsi curved, carrying strong bristle-like hairs along inner carinae; claws slender, toothless, slightly exceeding one-half the length of the last tarsal joint.

Abdomen of exceptional small size, rather high, triangular in cross-section, dorsal ridge very acute; ventral surface slightly convex. Surface smooth. Lateral spines present only on segm. 8 and 9, both spines very strong, acute and curved inwards; postero-lateral angles of preceding segments rectangulate and carrying a bunch of short scale-like hairs apically. Dorsal hooks present on segm. 7-9, very long, strongly laterally compressed and sharply acute; hooks on 6 and 10 vestigial, in the form of obtuse tubercles. Mid-dorsal keel of segm. 10 short and blunt. Appendices shaped as shown in fig. 7 *f*.

Colour-pattern very distinct, sandy greyish-yellow mottled and banded with dark blackish-brown as shown in fig. 6. Legs conspicuously straw-coloured exteriorly; femora indistinctly ringed with brown. Ventral surface of abdomen unicolorous pale brownish.

Measurements (live specimen, ♂ type). — Total length of body 16.7, greatest height of body at insertion-point of wings 6.0 mm. Height of head 6.3, width of head across eyes 5.4, length of head 3.3; length of labium 7.2; length of abdomen 9.2, greatest width of abdomen at apex of 5th segment 6.9; length of legs 20.0, 24.0 and 25.5, respectively; posterior femur 9.0, posterior tibia 11.0 mm.

In a previous paper [1]) I have endeavoured to state and illustrate the more important features of several types of *Macromia* larvae found in the Sunda Islands. That excellent characters are available for separating these larvae into groups will be seen by comparing the descriptions and figures supplied in the afore-cited paper. The three types recognized, besides being different from each other morphologically, were found to differ considerably in their habitations and behaviour. To some extent, the adaptability of these larvae to a great variety of situations, coupled with their divergences in structure, threw more light on the relationship between the species: the true affinities being far more difficult to establish for the perfect insect than for the larva since most of the distinctive features of the latter become lost after metamorphosis. To accumulate more data concerning the life history of *Macromia* was therefore one of my chief purposes in searching for aquatic animals during my stay at Pemantang in southern Borneo.

Owing to lack of prolonged sunshine, not a single *Macromia* was seen on the wing during this brief period, but thanks to a spell of dry weather

1) M. A. LIEFTINCK. Further studies on southeast Asiatic species of *Macromia* RAMBUR, with notes on their ecology, habits and life history, and with descriptions of larvae and two new species. *Treubia* (1950) 20 : 657-716, 61 figs.

the water was low and the muddy brooks and rivulets were easy of access; so that, one day, I succeeded to collect a considerable number of nymphs, which were all obtained in a limited portion of a very unattractive slow-running brook meandering through a forest swamp.

The remarkable divergences in structure of the early stages of *Macromia,* referred to above, have been further evidenced by the discovery in this stream of two or three other larval types whose characters caused them to be recognizable at a glance when dredged up. As several of these nymphs are not yet bred out, I will only supply notes on a few of them at this time.

One of them is *M. cincta* (RAMB.), which resembles *westwoodii* in habits and was found hidden in accumulated trash on the bottom of pools and the more muddy tracts of the stream, away from the main current. It has a dark colour-pattern and possesses a thin flat body with very long legs that are held in a horizontal position, except the posterior pair, which are folded inwards over the back so that the knees touch or even cross each other in the median line.

A second (already known) species, *M. cydippe* LAIDL., was concealed among rotten vegetable matter in places where projecting twigs catch the floating driftwood and dead leaves.

The third larval form again had a much depressed body, showing a finely mottled colour-pattern; it was sifted from among a thin layer of silt and fine sand in shallow water, but its identity remains still unknown [1]).

Lastly, the larva of the species here described as *arachnomima* I was at first quite unable to recognize as belonging to any known genus. The excessively long wings and enormous legs of this strange form were reminiscent of some large spider or opilionid and did not seem to foreshadow the proportions these parts have in any of the known species of *Macromia;* the curious tubercles on the head and the stiff spiny bristles on the femora being additional ornamentations found in places where no such outgrowths would normally be expected. Hence I had to content myself with considering this larva Epophthalmiine until it should have been possible to breed it out.

Ecologically, the *arachnomima* larva differs from its congeners by frequenting those parts of the stream where a sufficient current it maintained under all circumstances, living suspended in the water instead of

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[1]) I have since bred out this sand-dwelling larva which, though yielding so far only a female that died in transformation, probably belongs to yet another undescribed species.

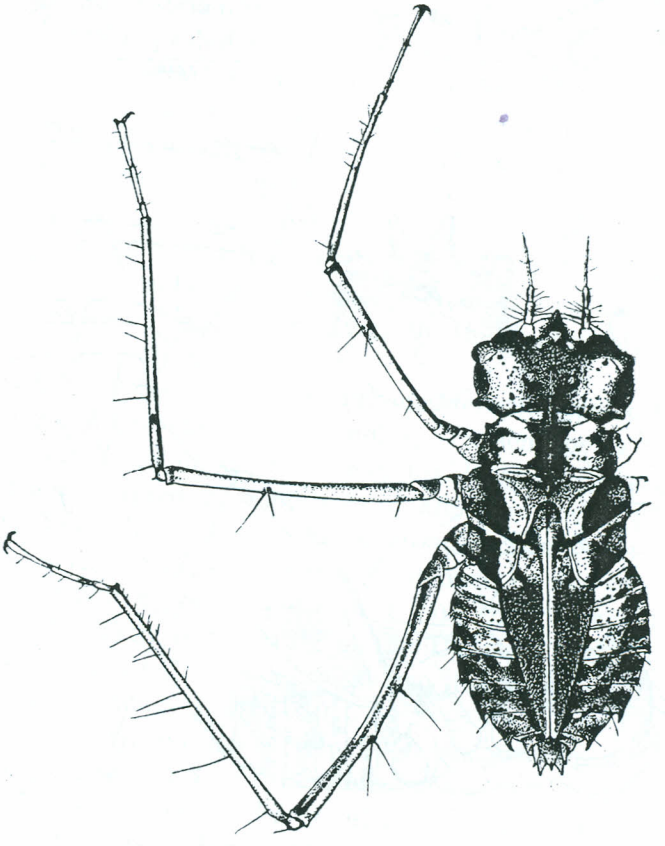

Fig. 6. — *Macromia arachnomima*, sp. n., S. Borneo. Ultimate larval instar (live specimen). Legs bent in unnatural position, slightly foreshortened and adjusted in approx. horizontal plane.

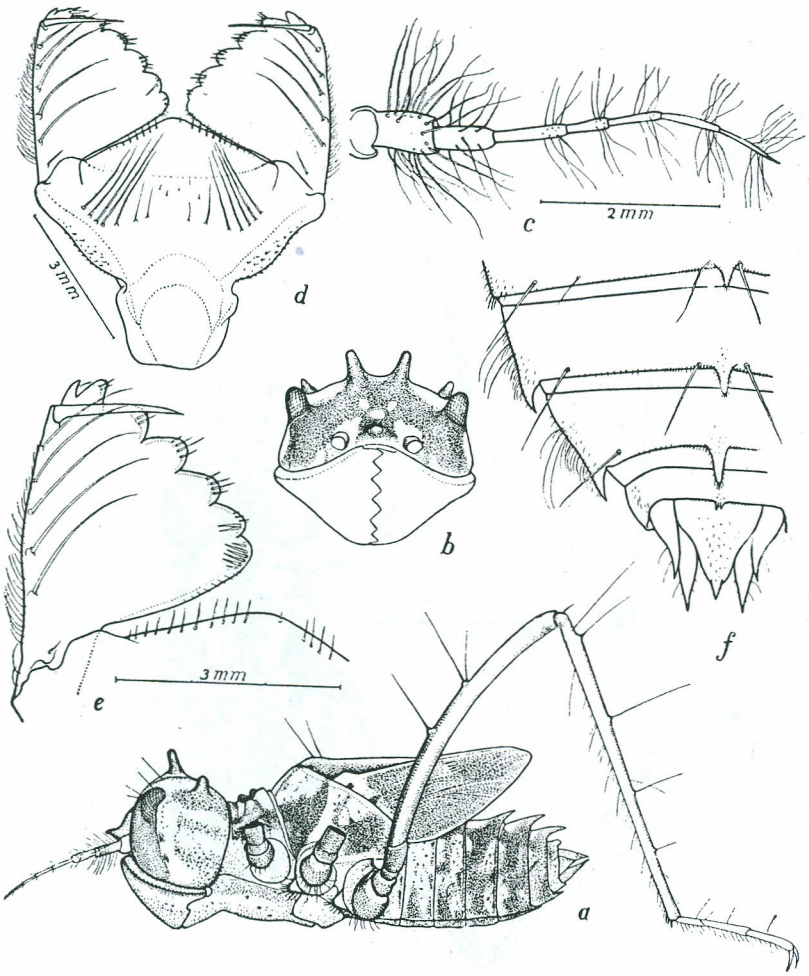

Fig. 7. — *Macromia arachnomima*, sp. n., S. Borneo. Larval structures. *a*. Full-grown larva (live specimen), left side view (fore and middle legs omitted); *b*. Head of same, frontal view; *c*. Antenna (exuvia, same specimen); *d*. Head of same, frontal view; *e*. Antenna (exuvia, same specimen); *d*. Interior view of labium (exuvia, same specimen); *e*. Left lateral and portion of median lobe of labium, interior view (idem, pressed flat under cover-glass); *f*. Apical portion of abdomen, highly magnified (exuvia, same specimen).

on the bottom. They were caught by shaking out the exposed mats of stiff, very finely branched rootlets of trees and Pandanus (Dayak name: r a s a u) that hung down freely into water under the bank of the stream. Here they rested, firmly anchored amidst the intertwining root mats, with their sprawling fore and middle legs extended and with the 'knees' of the hind legs bent up at an acute angle, taking up a position similar to that of a locust. When taken out of the water they stuck rigidly to the substratum, which probably affords the most suitable medium for concealment and for attacking their prey, because I found it difficult to disentangle them from these "brooms", the thorny legs and spiny surface of the body catching against all obstructions. In the aquarium these creatures proved equally helpless on a bottom of clean sand or ordinary vegetable matter, clinging desperately to individuals of their own kind as soon as they got the chance. Thus it is no doubt chiefly by means of its legs that the *arachnomima* larva is enabled to resist the onrush of water, preventing it being swept away by the current during a flood or heavy spate in the stream.

It is worthy of remark that no other *Macromia* has so far been found concealed between pendant root bundles, — a semi-pelagic niche usually occupied by a remarkable assemblage of highly specialized animals, which are all of them adapted in some way or another to this particular environment [1]). When dredged the *arachnomima* larva is perfectly clean and the effect of living pelagic is also seen at once by the development of a beautifully contrasting colour-pattern of dark brown and black on a pale yellow ground, which is probably eminently suited to its habits. It is curious also to note the tendency shown towards compactness and a shortening of its abdomen (fig. 6-7).

The two grown larvae of *arachnomima* were not yet ready for transformation and therefore I provisionally put them in metal cans supplied with matted roots and a quantity of water just sufficient to keep the rootlets submerged. Herein they remained for about a week, along with several other nymphs of various stages. Finally they could all successfully be transported to Java, transferred to flat dishes in the laboratory, and kept alive ever since.

The nymphs are remarkably inert and slow moving creatures; placed in the dishes they invariably take shelter in and under the root mats, resting upside down when the substratum is kept floating, and vertically with the head directed towards the bottom when the roots are suspended

[1]) Its Odonate associates here were *Libellago hyalina* (SEL.), *Rhinagrion borneense* (SEL.), and two Protoneurid larvae.

to some twig. They remain in the same position day after day for weeks, without taking the slightest interest in moving objects in the day-time. Possibly they are nocturnal feeders, for a continuous succession of newly hatched mosquito-larvae (emerged from floating egg-masses) always disappeared completely before the pupal stage was reached. So far, they did not show cannibalistic tendencies, there being no need to keep them apart from their own kind. They grow very slowly and I suspect that their inactive habits are correlated with a relatively very long period of larval life and a short period of life as an imago [1]). I have little doubt, either, that the normal time for reaching complete maturity is at least one year.

Transformation takes place in the night and the larva crawls a considerable distance out of the water before fixing itself for emergence, which happens before day-break, the perfect insect being ready to take flight very early in the morning.

An item not generally known is that full-grown *Macromia* larvae before the time of transformation become dormant for a very long time, varying from one month to six weeks, hence considerably longer than in most other Odonata. The last larval instar of *arachnomima* probably requires at least four months, including the period of rest.

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[1]) Similarly, two 3-ult larvae of *M. cincta*, collected July 26, 1953, cast off their skins almost simultaneously on October 15-16, the ante-penultimate instar thus requiring about three months or even longer.