

STUDIES IN ORIENTAL CORDULIIDAE (ODONATA) I

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ABSTRACT

An attempt is made to prove the incongruity of attributing family rank to the *Macromia* alliance and the classification of Corduliinae as a subfamily of Libellulidae. Instead of this, arguments are put forward in favour of restoring and maintaining the group as a subfamily of Corduliidae. Idionychidae and Synthemistidae are regarded as groups so closely affiliated with Macromiinae that their family status is called in question. Contrasting characters are tabulated of *Idiophya*, *Idionyx* and *Macromidia*. The male of *Idionyx philippa* Ris and both sexes of *I. murcia* spec. nov. (Sumbawa) are described and a key is constructed for the S. E. Asiatic species, followed by a description and figures of the larva of *I. montana* Karsch. Some taxa in *Macromidia* are re-characterized and *M. asabinai* spec. nov. (Palawan) is added to the list. In *Macromia* several species are discussed and the list of Malaysian taxa is made up to date; new species are *M. dione* (Sumatra), and in the Papuan group *M. lachesis* (Bismarcks) and *M. astarte* (S. E. New Guinea). Lastly, a review is given of *Synthemis* in New Caledonia, with definitions of *S. campioni* spec. nov., the females of *S. fenella* Campion and *S. montaguei* Campion hitherto unknown, and a key to all insular species. Descriptions and illustrations of two New Caledonian *Synthemis* larvae lead to comments on the acquisition of adaptive structural features during larval development.

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I. REMARKS ON THE SUBFAMILY MACROMIINAE

In a historical survey of the "*Macromia* Group" of genera, a new family name, Macromiidae, was proposed by Mrs. L. K. Gloyd (1959). The diagnosis was based primarily on three genera, *Macromia*, *Didymops* and *Epophthalmia*, but the author added that the venational characteristics, at least, seemed to apply to *Macromidia* also. It was admitted that the features enumerated were not fully checked for species in all these genera, while the author also felt that her diagnosis and the composition of Macromiidae might require revision with further study. It is not the purpose of the present paper to

attempt any definitions of suprageneric taxa within the Corduliidae; but I merely wish to point out that the removal of the *Macromia* group from the Corduliidae and its elevation to family rank is based on the forsaken conception that "Corduliinae and Libellulinae are so closely related that they belong in one family, the Libellulidae", to quote Mrs. Gloyd's own words. I am unable to share this view, adhering instead to the well-considered arguments put forward by St. Quentin (1939)¹), in whose publication the reader will find substantial evidence in support of the view that Corduliidae and Libellulidae are different families, each with well-founded and unmistakable characters. In fact only few of the basic characters separating the extremely diversified Corduliidae from the Libellulidae were mentioned by Gloyd; she apparently failed to observe that her diagnosis, apart from the *Macromia* group, applies equally well to many (other) corduliid genera. Under these circumstances it is only natural that the author's family diagnosis includes but few characters serving to distinguish the *Macromia* group from its nearest relatives, i.e. the remainder and major part of the corduliids. Genera like *Macromidia* and *Synthemis* are mentioned only in passing, and the reader is left in doubt as to which of the rest of the corduliid genera the author prefers to leave in her Libellulidae ("including the Corduliinae, or Corduliidae of some authors") and which are considered "Macromiidae". In any case it would seem to me to be irrelevant to construct a family diagnosis upon characters incompatible with the morphology of the remotely allied Libellulidae, an independent family which, in its restricted sense as accepted by most present-day authors, omits the Macromiinae and all the rest of the Corduliidae. As to the morphology and anatomy of the corduliid larvae, I believe to have shown earlier (Lieftinck, 1950, 1952) that the remarkable diversity of structure, notably in tropical species of *Macromia*, is unmistakably correlated with a particular mode of life, many instances being known of larvae having modified their entire organization to adapt themselves to some peculiar environment. In the case of *Macromia* this is especially striking as whole sets of morphological adaptations go hand in hand with varying environmental conditions. Thus larval features like the development of posterolateral tubercles at the head, shape of labial ligula, gizzard armature, as well as palpal and mandibular dentition, are to a large extent so variable within the limits of each genus, that they can at best be used as group characters, certainly not as a means of subfamily division or even generic separation.

II. NOTES ON THE *Idionyx* - *Macromidia* ALLIANCE, WITH AN ACCOUNT OF THE LARVA OF *Idionyx* HAGEN

Idiophya Fraser, 1934

Idiophya was proposed by Fraser (1934: 553—554, fig. 1, wings ♀) for a single enigmatic corduliid, first described as *Phyllomacromia nilgiriensis* Fraser (1918: 383—384), and known only from seven females, all collected at the Burliyar river in the Nilgiri Hills (South India). The author subsequently (1957) expressed doubt as to the validity of a monobasic genus comprising a species of which the male had never been discovered, the more so because *Idiophya* was stated to differ from *Idionyx* only by

¹) With many other judicious publications of fundamental importance simply ignored in the revised edition of F. C. Fraser's "Reclassification of the Order Odonata" (1957).

having the costal side of the discoidal triangle of the fore wing fractured, "although this feature is not always present" (Fraser, loc. cit., 1957: 111). Indeed, the excellent wing photograph of *I. nilgiriensis* in Fraser's 1934 publication shows a venation so similar to that of *Idionyx* that *Idiophya* could easily be regarded as a slightly aberrant member, were it not that a second species had been recorded from Luzon I. (Philippine Is.). This is *I. salva* Needham & Gyger (1937: 57—58, pl. 1 fig. 16, ♀ genit. & pl. 3 fig. 58, ♀ wings), once again described after a single female and for that reason placed doubtfully in *Idiophya*. Through the kindness of Dr. Pechuman I have been able to examine this immature specimen (CUI). Owing to the fact that it was preserved in poor alcohol, the body has fallen to pieces, lost all colours and become practically unrecognizable. There are a pair of wings on a slide, evidently the same as those reproduced on pl. 3 fig. 58 in Needham's publication.

Needham (loc. cit.: 58) refers to two characters that would serve to distinguish his *Idiophya salva* from *Idionyx philippa*. In the former the single row of cells beyond the 4-sided triangle of the fore wing continues beyond the level of the nodus, whereas in *I. philippa* beyond a 3-sided triangle the cell-row is doubled well before the level of the nodus. This is true only for the right fore wing of *philippa* (the one figured by Ris), the double row of cells on the left wing beginning only a single cell-breadth before that level. The second character refers to the course of the veins Cu_1 and Cu_2 on the fore wing, which in *I. salva* diverge to the wing margin while in *I. philippa* they converge. In the left pair of wings of the type of *I. philippa* (not photographed by Ris), these two veins run parallel to each other up to a point two cells before reaching the anal margin, at which point Cu_2 gives off two weak branches, one running parallel to Cu_1 , the other curving away from it and meeting the anal margin at a right angle. This is obviously also a variable character, for not one of the other examples of *philippa* is exactly alike in this respect.

Yet it is impossible to associate *Idionyx philippa* Ris with this dragonfly. The venation is very similar, but the wings of *I. salva* appear more broadened midway their length and more pointed than in *I. philippa*, the type of which possesses a normal fore wing triangle. The yellow spots at the sides of the thorax seem to be arranged differently in the two species, *philippa* having no "long triangle pointing downward covering a good part of the metepimeron"; the femora of the latter are black, not pale "thrice faintly ringed with brown", as described for *I. salva*. It would appear, therefore, that *salva* and *philippa* are specifically distinct, although the remaining venational differences between the two, enumerated by Needham at the end of his description, are nonapparent (see under *I. philippa*).

It would be interesting to know more of the morphology of the occipital region and genital organs of the females of *Idiophya* since little information has been given about these structures in the existing descriptions. As to *I. nilgiriensis*, Fraser only says that the vulvar scale is "small, triangular, not visible in profile", while the sketch of the subgenital plate of *I. salva*, accompanying Needham's account, suggests *Idionyx*.

Considering the above, it remains impossible to establish the generic status of the two species described in *Idiophya*. All the same, for each of them we may expect a male resembling *Idionyx* more closely than any other genus, because the venation in nearly all respects corresponds with this, not with *Macromidia*.

Idionyx Hagen, 1867

This genus was first placed in a subfamily of its own, viz. *Idionychinae*, by Tillyard & Fraser (1940), only the aberrant *Idiophya* Fraser (see above) also forming part of it. The characters employed to distinguish *Idionychinae* from *Macromiinae* (= *Epophthalmiinae* Fraser et auct.) are such that they can be applied only to a limited number of representatives of either group, and then only when the extremes of both are taken into account. The differences between some of the larger species of *Idionyx*, i.e. those which are at home in continental south-east Asia, and the smaller-sized and slenderly built members of *Macromia* inhabiting the Oriental tropics, are certainly of no greater importance than those separating the latter from the sturdily built members of *Epophthalmia*, which no one would exclude from the *Macromia* assemblage. These characters in the writer's opinion are of generic rather than subfamilial or even tribal value. I do not hesitate, therefore, to discard *Idionychinae* and follow the example set by de Selys Longchamps (1878), who included *Idionyx* in the *Macromia* group of genera; if de Selys had also known *Macromidia*, he would certainly have added this genus too. In point of fact *Macromidia*, as we will see, neatly bridges the gap between *Macromia* and *Idionyx*, so that nothing can be gained by placing the last-mentioned genera in two separate subfamilies.

The larva of *Idionyx*, described below, shows many characters found also in other macromiines and bears a close resemblance to that of some sand-dwelling species of *Macromia* (Fig. 5).

In the Malaysian Subregion and 'Wallacea' the genus is represented only by a limited number of species, grouped around *I. yolanda* Selys, 1871, the type-species, first described after a female from Singapore. As has been pointed out by Lieftinck (1939), *I. dobrni* Krueger, 1899, from Sumatra, and its "subspecies" *I. dobrni borneensis* Laidlaw, 1913, from Borneo, are both synonyms of *I. yolanda* Selys. A second member of the group is *I. montana* Karsch, 1891, originally described from Java but subsequently discovered also in Sumatra and the Mentawai Is. A third species, *I. philippa* Ris, 1912, was described from the Philippines; this was known only from a single female but a characterization of both sexes will now be found in the next pages. A fourth regional species is *I. orchestra* Lieftinck, 1953b, which was reported from Sumba I. (Lesser Sunda Is.). Lastly, a species new to science, *I. murcia* spec. nov., from the island of Sumbawa, can be added to the list. Leaving aside the nondescript *Idiophya salva*, discussed before, this brings the number of southeastern *Idionyx* up to five.¹⁾

The distribution of these species, so far as at present known, is as follows:

I. yolanda Selys (= *dobrnei* Krueger) — Malay Peninsula (terr. typ.); Sumatra; Biliton; Borneo; Basilan I. (Philippine Is.); Hongkong.

I. montana Karsch — Java (terr. typ.); Sumatra; Mentawai Is.; Malay Peninsula (?).

I. orchestra Lieftinck — Sumba I. (Lesser Sunda Is.).

I. murcia spec. nov. — Sumbawa I. (Lesser Sunda Is.).

I. philippa Ris — Mindoro, Leyte and Mindanao Is. (Philippine Is.).

These species have the following characters in common:

Head large, considerably broader than thorax; eyes globular, broadly contiguous, median eye-line longer than occipital triangle. This triangular area raised perpendicularly

¹⁾ I agree with Fraser (1936a) that *I. laidlawi* Fraser, known only from the solitary female collected in Pahang (Malay Peninsula), belongs to a different species group, viz. that of *I. optata* Selys.

above level of eyes, finely pointed anterad with sharply acute side margins; smooth dorsal surface clothed with long erect hairs and vertical surface also with fringe of very long hairs behind rounded posterior margin. Vertex low and broad, evenly convex and of simple structure in both sexes. Labrum and anteclypeus at least partly chrome. Synthorax with or without incomplete yellow mesepisternal (juxtahumeral) spot, with yellow lateral spots or stripe at level of metaspiracle, and with variable spots or complete stripe on posterior portion of metepimeron. Legs at least with hind tibia partly yellow; all tibiae with membranous distal keel on flexor surface, the one at mid tibia very short; tarsal claws acute, bifid, the inferior tooth stronger and usually slightly longer than the apex (Fig. 12).

Wing neuration open. Nodus placed far distad, space between nodus and pterostigma on fore wing only half as long or less than that between nodus and wing base. Antenodal complex between *C* and *R + M* complete: no distinct primary (thickened) antenodals. Fork of M_{1-2} — M_3 strongly asymmetrical in fore and hind wing. Only the first, or first two, postnodal nervures of second series missing in all wings. Fore wing triangle placed far beyond arculus, distinctly smaller than that of hind wing, equilateral but costal side very rarely slightly fractured (5-sided) in one of the wings; hind wing triangle also distal to arculus, but distance separating it from arculus invariably shorter than its proximal (shortest) side. Subtriangle (*ti*) in fore wing nearly always irregular, its proximal side (distal *Cux*) very oblique, forming a 4- or 5-sided cell with proximal side of triangle, hence only 1 transverse *Cux* in fore wing (very rarely an additional cross-vein present in one of the wings); 2 transverse *Cux* in hind wing. Discoidal field of fore wing subparallel-sided, with single row of cells as far as level of nodus, or even further, thereafter frequently slightly expanded. *Rspl* present, its course mostly slightly fractured. Anal loop of hind wing elongate, fully twice longer than broad without toe-like prolongation, midrib slightly zigzagged, apex obtuse, not extending beyond level at apex of triangle. Proximal side of anal triangle of male hind wing strongly sinuous; cross-vein in triangle placed well beyond midway its length; anal angle rounded. Pterostigma small, less than 2 mm long but usually overlying two cross-veins. Membranula large, in male extending as far as apex of triangle or a little beyond.

Abdomen slender, slightly spindle-shaped; colour black with metallic gloss on proximal tergites. Yellow markings reduced to lateral and lateroventral spots and streaks on tergites 1—3 and 7—9 only. Male superior anal appendages long and slender, longer than segm. 9 + 10; appendix inferior subequal to or slightly shorter than superior pair. Branches of posterior genital hamulus subequally long, outer branch thick and strong, the inner branch a slender sickle-shaped hook. Female with apex of 8th sternite decidedly prominent in lateral view, longitudinally carinate, not projecting beyond apex of 8th tergite; 9th sternite long and likewise carinate; styli tubercular; supra-anal plate declivous and tapered; anal appendages shorter than 10th segment, conical.

It must be stressed that the above diagnosis applies only to the Malaysian species-group, the great length of the male appendages, for instance, being no peculiarity of all: on the contrary, several continental Asiatic species exhibit appendages distinctly approximating to the type found in *Macromia*. See also Laidlaw (1912) in his discussion of *Metaphya* Laidlaw.

Apart from the fact that *Idionyx* and *Macromidia* have several characters in common, it should not be forgotten that interspecific variation is considerable in both, a circum-

stance impeding their distinction from *Macromia*, which itself is far from homogeneous in character. To demonstrate the existing difficulty to construct an all-embracing diagnosis for each of these three genera, it is only necessary to consult Fraser's "Revision of genus *Idionyx*" (1934). In that paper not less than six definite groups are recognised, and from a consultation of the group characters employed it is obvious that corresponding characters can be used to split up the large genus *Macromia*. This indicates, in my opinion, that the two genera are genuinely related. Another peculiarity pointing in the same direction is found in the structure of the tarsal claws, which in all regional *Idionyx* are shaped similarly to those in certain groups of *Macromia* (see under that genus).

The five species presently included can be distinguished from each other by means of the following

Key to the males of *Idionyx*

1. Front of synthorax (mesepisterna) on either side with sharply defined, oval yellow juxtahumeral spot equal in size to and confluent with adjacent mesinfraepisternal yellow spot. Postclypeus bright yellow in middle. Sup. anal apps. in dorsal view at first slightly outbent, then gradually incurved, each bearing a minute subapical internal tooth followed by a shallow emargination, the apex somewhat swollen and downcurved, with small external fringe of longish, erect, golden brown hairs. Inf. app. with lateral prominence situated at about $\frac{2}{3}$ length from base, its terminal portion broadened towards apex, which bears a deep V-shaped emargination, the branches being upturned and pointed (Fig. 4). Dorsum of 10th abdominal segment with distinct, though low, median carina on each side of a depression, but lacking a triangular boss. Main body of posterior genital hamule swollen, its outer border in side view distinctly convex proximal to the hook-like inner branch (Fig. 3). Apicoventral border of abdominal tergite 7 slightly protuberant, end portions of 7 and 8 as well as sternite 8 sparsely clothed with soft erect yellowish pubescence. A complete, broad, almost parallel-sided yellow stripe at thoracic sides crossing the spiracle, continuous ventrally over metinfraepisternum; a similar, though slightly broader stripe, widest at middle, upon posterior portion of metepimeron. Larger species: abd. + app. 31.7 mm, hind wing 30.0 mm. Hab.: Sumbawa . . . *murcia*
- Front of synthorax either entirely metallic green or lower lateral area non-metallic and filled out diffusely with reddish-brown. Postclypeus wholly brown or black . 2
2. Inferior appendix very slender, simply tapered or with vestige only of a marginal tubercle placed slightly beyond halfway its length; apex gently upcurved, tip flattened dorsally, terminating abruptly in a short bluntly triangular point. Sup. anal apps. shaped much as in *I. murcia* but subapical internal prominence barely indicated and followed by a shallower emargination, the knob-like apex of each bearing a conspicuous external tuft of long golden brown hairs. Dorsum of 10th abdominal tergite raised, the middorsal carina replaced by a low triangular boss. Main body of posterior genital hamule in side view with straight outer border, but with tubercular swelling at base of hook-like inner branch. Apicoventral border of 7th abdominal tergite swollen and markedly projecting ventrad, clothed with conspicuous tuft of long erect golden hairs. Yellow stripes at thoracic sides complete, though narrower than in *I. murcia*, the spiracular stripe slightly more undulated. Larger species: abd.

- + app. 31.0—33.0 mm, hind wing 29.0—31.7 mm. Hab.: West Malaysia **montana**
- Inferior appendix broader, less strongly tapered and bearing a distinct marginal prominence or conspicuous tooth placed on either side beyond halfway its length. Erect pubescence at ventral borders of 7th abdominal tergite and apices of sup. anal apps. more or less developed, but hairs shorter and less closely set than in *I. montana* 3
3. Sup. anal apps. widest at base, but lacking a subbasal external angulation, then gradually incurved, each bearing a tiny subapical internal prominence followed by a shallow emargination, the apex slightly swollen, curved inward and downward, its extremity subtruncated or bluntly rounded. Inf. app. with distinct tooth-like lateral projection a little beyond halfway its length, the terminal portion slightly expanded before the upturned apex, which is bifid, the points shorter and more closely approximated than in *I. murcia* and separated by a crescentic emargination. Genitalia much as described for *I. murcia*. Middorsal crest of 10th abdominal segment as described for *I. murcia*. Abdomen shorter: abd. + app. 29.0—30.5, hind wing 29.0—31.5 mm. Hab.: Sumba **orchestra**
- Sup. anal apps. in dorsal view widest at base, their outer border weakly angulated at about $\frac{1}{4}$ the length from base, then straight and parallel-sided and finally abruptly and obliquely bent inward with knob-like external protuberance at the angulation, tips compressed and bluntly pointed. Apex of inf. app. gradually narrowed, hollowed out above and with pointed tip; lateral projections strong, subtriangular, placed well beyond midway length of appendix 4
4. Sides of synthorax with two complete broad yellow stripes, the spiracular stripe somewhat narrowed above but reaching upper margin of meso-metapleurae, the metepimeral stripe often somewhat undulated or irregular but never interrupted. Main body of posterior genital hamule greatly swollen, outer border in side view strongly convex proximal to the hook-like inner branch. Middorsal crest of 10th abdominal segment obtuse, forming a low, bluntly triangular boss. Size smaller: abd. + app. 28.0—29.0 mm, hind wing 27.5—28.0 mm. Malaysia, Basilan (P.I.) and Hong-kong **yolanda**
- Yellow spiracular stripe at thoracic sides narrower, widest at and below the spiracle but frequently constricted or interrupted at about halfway its length, the dorsal portion not quite reaching upper margin of meso-metapleurae; yellow stripe on posterior portion of metepimeron also obliterated, consisting of a large oval anterior (lower) and a smaller subtriangular posterior (upper) spot. Sup. anal apps. almost straight in side view, apex shorter, less abruptly inbent, external subbasal angulation barely indicated and subterminal protuberance likewise less pronounced than in *I. yolanda* (Fig. 2). Main body of genital hamule less bulging, outer border in side view but slightly convex proximal to the hook-like inner branch (Fig. 1). Middorsal crest of 10th abdominal segment more strongly raised, forming an acuminate ridge which slopes down steeply posteriorly. Size larger: abd. + app. 31.0—32.0 mm, hind wing 30.0—30.3 mm. Hab.: ? Luzon; Mindoro; Leyte; Mindanao (P.I.) **philippa**

Idionyx philippa Ris

Fig. 1—2

1912. Ris, Suppl. Entom. 1: 80 (♀ key), 81—82, fig. 16 (♀ right wings, ventral side), ♀ Naujan, Mindoro I., P.I. — ? 1937. Needham & Gyger, Philipp. J. Sci. 63: 57 (key *Idiophya* and *Idionyx*), 58—59, ♀ Luzon, Los Baños.

Material. — Philippine Is.: 1 ♀ (adult), Naujau (recte Naujan), Mindoro, Phil. Rolle 1910, phot. (in Ris's writing), with red label typus, holotype *I. philippa* Ris (SMF). 1 ♂ 1 ♀ (adult), Mindanao I., Misamis Or., Bal-ason, 2.IV.1960 (♂) and Mt. Emgagatao, 13.IV.1961 (♀), H. Torrevillas; 1 ♀ (adult), Mindanao I., Cotabato, Parang, 23.III.1953, Henry Townes; 1 ♂ 1 ♀ (adult), Leyte I., So. Leyte, Anahawan, Mainit Spring, 31.V.1970, Cristobal Plateros.

Previously known only from the type, *I. philippa* has remained a somewhat puzzling insect ever since it was described. Dr. H. Schröder has been kind enough to send me on loan Ris's female for comparison with recently acquired specimens of Philippine *Idionyx*, and this enabled me to decide upon its proper status. There are some discrepancies in the original description which need clarification. Thus the occipital triangle of the type is said to be "flach" and to have no "frontalwärts verlängerte Leiste der *I. claudia* ♀", a rather misleading statement since the whole structure, though indeed smaller and less protruding than in *I. claudia*, is raised well above level of compound eyes, the slightly convex upper surface being marked off from the steeply sloping sides by an acute carina, i.e. a shape quite similar to that seen in the remaining species dealt with in this paper. The tibiae, stated by Ris to be "trüb rötlichbraun" are, indeed, much obscured, yet the hinder pair are distinctly yellowish externally, as they are in all other regional species. Ris's description of the coloured spots at the thoracic sides is incomplete: the yellow metaspiracular stripe is broadest at the spiracle and, though tapering to a point and leaving off a short way above it, continues upward as a lanceolate streak placed in line upon the first suture; the much larger mark on the metepimeron is oval, not "fast kreisrund", thus conforming to the shape it has in the other individuals.

The specimens from Leyte and Mindanao listed above are undoubtedly conspecific with *I. philippa*. However, they differ among themselves, showing not only considerable variation in the extent of yellow thoracic markings but also in their dimensions and wing venation, no two specimens of either sex being exactly alike. As pointed out before, under *Idiophya salva*, even the left and right pair of wings in a single individual (e.g. the type of *I. philippa*) may show differences in the venation. This may go hand in hand with dense venation, the wings of the type being somewhat more closely reticulated than in the other females, the anal loop containing no less than 4 + 6 cells (see below).

The following descriptions and figures are based on the pair from Misamis Or. (Mindanao), which are rather larger than the remaining specimens.

Male. — Labium with the median lobe and basal one-third of the lateral lobes outwardly chrome, for the rest dark chestnut, except a narrow line bordering the free margin of the lateral lobes, which is black; marginal fringe of golden yellow bristles. Base of mandibles black, distal portion dark brown. Labrum deep black with a large bright ochreous bilobate marking, broadly connected with the base and occupying most of the

surface. Anteclypeus blackish with a subtriangular pale yellow dot placed in the middle. Postclypeus deep black, the lateral lobes with slight metallic green lustre basally. Frons anteriorly black with brilliant emerald green reflex on either side of the smooth deep black sulcus, the metallic colour changing to deep purplish-blue above; surface irregularly wrinkled by large superficial punctures. Vertex low, surface convex, barely impressed medially and more finely punctate. Occipital triangle somewhat raised and acutely ridged above level of compound eyes, surface smooth, black; rear of the head glossy black.

Prothorax brownish-black, anterior border and a spot low down upon the sides, yellow. Synthorax metallic green marked with ochreous, as follows. Posterior half of mesinfraepisternum; an adjoining indistinctly brownish-yellow whiff ventrally on the mesepisterna; an almost complete, slightly irregular, though barely constricted, stripe at the first lateral suture crossing the spiracle, widest at and below the latter and continued downward upon whole posterior half of metinfraepisternite; a large oval twin-spot placed in the long axis of the body and occupying the latero-ventral surface of the metepimeron. Ventral surface purplish black, with a yellow L-shaped stripe at the median and lateral dividing lines of the basal parts of the poststernum; yellow are also the metapostepimera and apical portion of the poststernum. Ante-alar triangles dull black.

Coxae and trochanters of fore and middle legs yellow, but outer surface of mid trochanter brown; those of the hind legs brownish black, the coxa with small yellow postero-basal spot. All femora brownish black, the tibiae yellowish with definite obscuration towards base and apex; keels light yellow, extending along more than distal one-third on fore tibia (36 : 100), about one-tenth on mid tibia and along more than seven-tenths (76 : 100) on hinder pair.

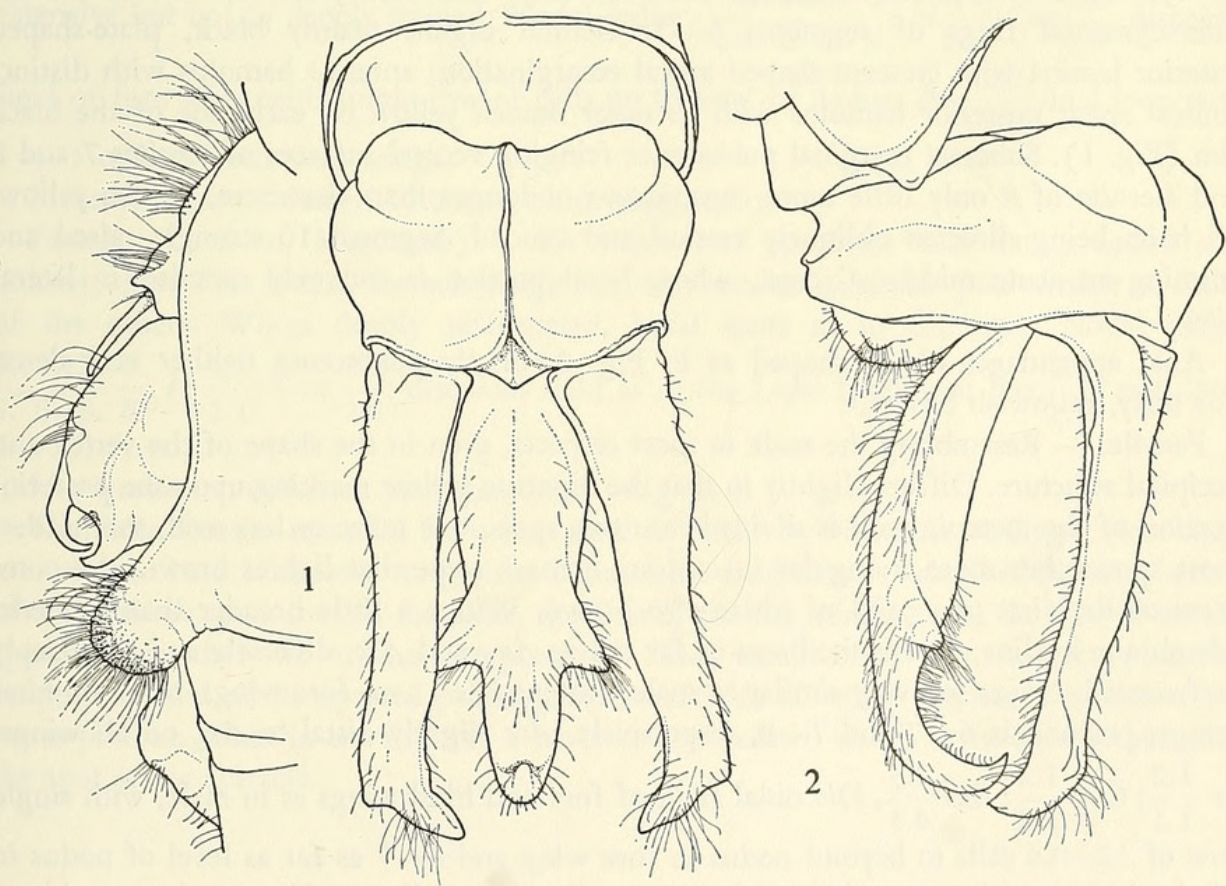


Fig. 1—2. *Idionyx philippa* Ris, ♂ from Mindanao. 1, genitalia; 2, anal appendages, dorsal, and left side view

Wings unspotted, membrane slightly tinged with greyish-yellow, especially towards the tips. Antenodals 12-13 on fore wings, 8 on hind wings; postnodals 6 and 9, respectively. Pterostigma unbraced, short, covering about $1\frac{1}{2}$ cells, deep black. *Arc* at Ax_2 , sectors originating low down at a point scarcely removed from $Cu + A$, fused together almost as far as first cross-vein beyond *Arc*. Only 1 cross-vein in *ht* and 2 *Cux* on all wings (inclusive of the 4- or 5-sided "internal triangles"); discoidal field of fore wing parallel-sided, with a single row of 13—14 cells followed by 3—4 double cells well beyond level of nodus, and 4—5 marginal cells; the same of hind wing with single row of 6 cells as far as level of nodus, then expanded, with 7 marginal cells; 2—3 *Bxs* on fore as well as hind wings. Anal loop of hind wing elongate, made up of 7 cells. Anal triangle two-celled, the angle after a distinct concavity rounded; only one basal cell between loop and anal triangle and two rows between triangle and anal margin of hind wing. Membranula about equal in width to the triangle midway its length, extending all along the strongly undulated marginal vein; colour grey, growing paler (almost white) towards base.

Abdomen slender, spindle-shaped, basal segments but slightly expanded, from base to apex of 7 widened, thereafter almost parallel-sided as far as end of 9, then again a little narrowed. Colour deep black, tergites 2—3 smooth and shiny, progressively less so posteriorly; 7—10 almost lustreless. Segm. 1 with tiny yellow lateral spot, 2 with complete broad yellow band bordering ventral margin but excluding the auricles; the colour also occupies the basal portion of the lobus posterior; a similar, though much narrower, stripe along basal half of lower margin of tergite 3, the distal half of 7 ventrally, and whole lengths of 8 and 9, likewise on their ventral surfaces (widest at end of 8). No dorsal yellow markings save for tiny transverse yellowish streaks on the intersegmental rings of segments 3—5. Genital organs mainly black, plate-shaped anterior lamina with crescent-shaped apical emargination; anterior hamulus with distinct conical apex; posterior hamulus with its outer branch yellow on each side of the black rim (Fig. 1). Suberect marginal pubescence fringing ventral surfaces of tergites 7 and 8 and sternite of 8 only little more conspicuous or longer than elsewhere, golden yellow, all hairs being directed obliquely mesiad and caudad. Segment 10 strongly raised and forming an acute middorsal crest, whose basal portion is convexly rounded in lateral view.

Anal appendages black, shaped as in Fig. 2; bristly pubescence neither very dense nor tufty, yellowish brown.

Female. — Resembling the male in most respects, even in the shape of the vertex and occipital structure. Differs slightly in that the bipartite yellow marking upon the posterior portion of the metepimeron is divided into two spots, one more or less oval, the hindermost spot rather more triangular in outline. Femora somewhat lighter brown, the outer faces of the first two pairs of tibiae also brown. Wings a little broader than in male. Membrane hyaline, except the bases as far out as Ax_2 and *Arc*, diffusely and not deeply saffronated. Neuration very similar to male. Antenodals 13 on fore wings, 8—9 on hind wings; postnodals 6—7 and 7—8, respectively. *Arc* slightly distal to Ax_2 on all wings; ht $\frac{1.2}{1.1}$; *Cux* $\frac{1.2}{2.2}$; *Bxs* $\frac{2.3}{4.3}$. Discoidal field of fore and hind wings as in male, with single row of 12—14 cells to beyond nodus in fore wing and 6—7 as far as level of nodus in hind wing. Anal loop consisting of 8 or 9 cells; three cell-rows between loop and anal

margin of hind wing. Membranula a little longer than first marginal cell, coloured as in male.

Abdomen of the usual cylindrical shape, nature and colour of tergal integument as described for the male. Yellow markings reduced to a point at the sides of 1, a stripe along tergal margins of 2 and 3 (widest basally on 2) and a fine yellow line bordering the lower margin of tergites 4—8, the 8th in addition having a small postmedian spot near ventral margin. Valvula vulvae not projecting beyond apical border of 8th tergite, apparently shaped similarly to that described and figured for *I. yolanda* Selys by Lieftinck (1939, Fig. 2), although the terminal segments are rather compressed, preventing appropriate comparisons.

Measurements: ♂ abdomen + app. 32.0 mm, hind wing 30.3 mm, pt. fore wing 1.2 mm; ♀ 32.0, 34.0, 1.8 mm, respectively.

Male (Leyte). — Differs from the former only in being a little smaller and in that the yellow metaspiracular stripe is so much constricted as to become almost interrupted at its middle. Wings entirely hyaline. Nodal index $\frac{6.12.12. 6}{8. 9. 8.10}$; $bt \frac{1.2}{1.1}$; $Cux \frac{2.2}{2.2}$; discoidal

field of fore and hind wings as in the Mindanao example; $Bxs \frac{2.2}{3.2}$; anal loop with 4 + 5 and 3 + 5 cells. Genitalia and anal appendages as in the previous male.

Measurements: abd. + app. 31.0 mm, hind wing 30.0 mm, pt. fore wing 1.5 mm.

Female (Leyte). — Generally similar to the male. First pleural thoracic stripe completely divided into two portions, as described for the type, but separate spots are a little larger. Wing membrane coloured similarly to the type, the basal spots equally extensive but not so deeply stained. Nodal index $\frac{7.13.13. 6}{10. 8. 8. 9}$; $bt \frac{2.2}{1.1}$; $Cux \frac{2.2}{2.2}$; discoidal

field of fore wing with single row of cells up to level of nodus; $Bxs \frac{2.2}{3.3}$; anal loop with 3 + 5 cells in both hind wings.

Measurements: abdomen 30.0 mm, hind wing 32.2 mm.

Female (Cotabato, Mindanao). — A small-sized specimen with rather broad and uninterrupted first lateral thoracic stripe but with the metepimeral spots similar to those of the others. Wings deeply saffronated, basal spots as in the type. Nodal index $\frac{6.12.12. 6}{8. 8. 8. 8}$; $bt \frac{1.1}{1.1}$; $Cux \frac{2.2}{2.2}$; discoidal field as in the Leyte specimen; $Bxs \frac{2.2}{2.1}$; anal loop 4 + 5, 4 + 5.

Measurements: abdomen 30.5 mm, hind wing 30.0.

The three females recorded from the island of Luzon by Needham & Gyger (loc. cit.), are referred here with some misgivings because the synthorax is described to bear "a row of four yellow spots low on the sides, the first above the middle coxa, the second on the spiracle, the other two on the metepimeron". This would mean that the metaspiracular stripe is devoid of its upward prolongation, which in all other specimens examined by me is present, either in the form of a more or less isolated streak or fused together with the spot at the spiracle.

***Idionyx murcia* spec. nov.**

Fig. 3—4

Material. — Lesser Sunda Is.: 1 ♂ 2 ♀ (1 ♀ immature), Sumbawa I., Central Sumbawa, Semongkat-atas, 21.IV.1961 (♂), Semongkat, 300 m, 27.IV.1961 (♀), and Route Batu dulang, 600 m, 10.IV. 1961 (♀ juv.), all P. Jauffret & R. Pujol, ex coll. A. Heymer. The ♂ is the holotype.

The characterization of this new species is the result of a direct comparison with *I. philippa* Ris, described in the previous pages.

Male. — Lateral lobes of labium with angulated yellow extero-basal spot, the remaining parts of labium brownish-black. Labrum entirely chrome, narrowly bordered anteriorly with black. Anteclypeus likewise chrome, only the somewhat impressed side-angles obscured. Postclypeus dark metallic green with conspicuous chrome spot in the middle, the latter shaped like a broad triangle whose apex is transversely cut off. Frons emerald green changing to blue-green above; anterior surface less protuberant, more closely and deeply corrugated on either side of the black sulcus and also less shiny, than in *I. philippa*, but occipital triangle and vertex much as in that species. Rear of the head glossy black.

Wings unspotted, membrane slightly tinged with brownish-yellow. Neuration much as described for *I. philippa* and *I. orchestra* Lieft. (from Sumba I.), except for the following slight differences. Antenodals 12—13 on fore wings, 8 on hind wings; post-nodals 6—7 and 9, respectively. Pterostigma covering little more than the underlying cell, dark brown. One cross-vein in *ht* and 2 *Cux* on all wings (inclusive of the 4- or 5-sided *ti*); discoidal field of fore wing with a single row of 11—12 cells to a little beyond level of nodus, followed by 3—4 double (or triple) cells and 5 marginal cells; the same of hind wing with single row of 6 cells to level of nodus and with 6 marginal cells; 1 *Bxs* on fore, 2 on hind wings. Shape of anal triangle, angulation and membranula exactly as in *I. philippa*.

Anterior lobe of prothorax clear yellow, pleurae largely yellow, posterior lobe brown. Synthorax brilliant metallic green, extensively marked with bright ochreous, as follows. A sharply defined, elongate-oval juxtahumeral band that occupies also the posterior two-thirds or more of the mesinfraepisternum, extending two-fifths up the dorsum; a similarly coloured, broad and almost parallel-sided stripe (ca. 0.7 mm broad) crossing the spiracle and extending from just below the dorsal crest right down onto the posterior part of the hind coxa, on which it is much narrower; a still broader, somewhat curved, metepimeral band covering only little less than its posterior half. Ventrally these metepimeral bands are confluent across metapostepimera and apical portions of the post-sternum, forming together a U-shaped marking which itself encloses a metallic blue-black spot of the same form, the central area of the ventral surface remaining largely yellow. Ante-alar triangles black.

Legs coloured as described for *I. philippa*; tibial keels yellow, those on fore tibia occupying their apical two-fifths (40: 100), on mid tibia about one-eleventh and on hinder pair about seven-tenths (71: 100).

Abdomen with the terminal segments less expanded than in *I. orchestra* and *philippa* but for the rest very similar in shape and colouring, lacking metallic reflections. Segm. 1

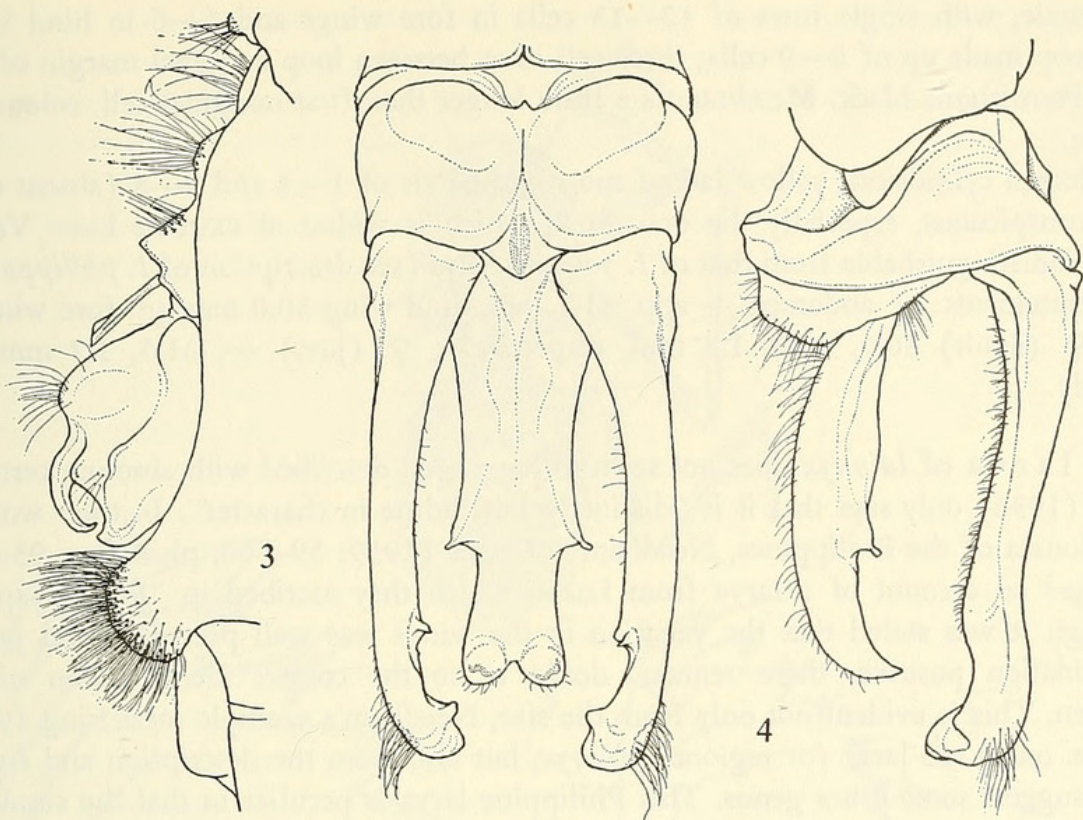


Fig. 3—4. *Idionyx murcia* spec. nov., ♂ holotype from Sumbawa. 3, genitalia; 4, anal appendages, dorsal and left side view

with large cuneiform yellow lateral spot; 2 with complete very broad band running along ventral margin not covering the auricles but occupying also the lobus posterior, which is obscured only at its apex; a similar though narrower stripe, tapered posteriorly along basal one-third of lower margin of tergite 3; broader stripes along whole lengths of tergites 7, 8 and 9 on their ventral surfaces. No dorsal pale markings. Genital organs shaped and coloured much as in the allied species but anterior hamulus triangular; lobus posterior rounded, with dense fringe of long radiating golden yellow bristles (Fig. 3). Marginal pubescence on ventral surface of tergites 7 and 8 and of sternite 8 erect, rather long but not very dense, all hairs brown and directed ventrad. Segment 10 impressed on either side of a small and rather low (though acute) middorsal crest, which is barely visible in lateral view.

Anal appendages black, shaped as in Fig. 4; pubescence short and inconspicuous, except a subapical fringe of much longer light brown hairs at the outer faces of the superior pair.

Female. — Differs from the male only in having all yellow markings on thorax and abdominal tergites a little more expanded; also in that only the hind tibiae (save the bases and apices) are bright yellow. Wings broader, bases bright orange-yellow as far distally as Ax_3 , the arculus and base of discoidal triangles in *cu*; membrane otherwise either entirely hyaline (immature ♀) or smoky yellowish-brown (adult ♀). Antenodals 12—14 on fore wings, 8—9 on hind wings; postnodals 6—7 and 8, respectively. *Arc* at or a little proximal to Ax_2 ; ht $\frac{2.1}{1.1}$ and $\frac{1.1}{1.1}$; Cux $\frac{1.1}{2.2}$; Bxs $\frac{2.1}{2.2}$ and $\frac{1.1}{2.3}$. Discoidal field

as in male, with single rows of 12—13 cells in fore wings and 5—6 in hind wings. Anal loop made up of 8—9 cells; three cell rows between loop and anal margin of hind wing. Pterostigma black. Membranula a little longer than first marginal cell, coloured as in male.

Abdomen cylindrical; yellow lateral spots and bands of 1—3 and 7—8 (absent on 9) more conspicuous, especially the one on 2, which is widest at extreme base. Valvula vulvae indistinguishable from that of *I. yolanda* Selys (see description of *I. philippa* Ris).

Measurements: ♂ abdomen + app. 31.7 mm, hind wing 30.0 mm, pt. fore wing 1.0 mm; ♀ (adult) 30.5, 33.0, 1.8 mm, respectively; ♀ (juv.) —, 31.5, 1.7 mm, respectively.

The larva of *Idionyx* does not seem to have been described with absolute certainty. Fraser (1936) only says that it is "distinctly Libelluline in character". In their work on the Odonata of the Philippines, Needham & Gyger (1939: 59—60, pl. 8 figs. 93—95) published an account of a larva from Luzon which they ascribed to "*Idionyx spec.?*" Although it was stated that the venation in the wings was well preserved and generic determination positive, there remains doubt as to the correct identification of this specimen. This is evident not only from the size, Needham's example measuring 19—20 mm, i.e. much too large for regional *Idionyx*, but also from the description and figures, which suggest some other genus. This Philippine larva is peculiar in that the crenulated labial palpus bears only "six coarse teeth on the terminal border (five only being shown in the figure!)", the three large middle teeth wider than high, obliquely rounded, each armed with about a dozen spinules in double array longer and shorter". Lateral abdominal spines are present on 8 and 9, and there are no dorsal hooks, features applying to *Idionyx*. Other details in the description do not fit any other regional corduliid genus, although the facies is reminiscent of *Hemicordulia* and *Procordulia*. However, the larvae of *Procordulia sambawana* Foerster and *artemis* Lieftinck possess seven rounded teeth at the distal border of the palpus (inclusive of the divided outermost tooth) and dorsal abdominal hooks are present on segm. 4—8 in *sambawana* but absent in *artemis* (Lieftinck, 1933: figs. 9—10). The larva of *Hemicordulia mumfordi* Needham also has seven palpal teeth while middorsal hooks on the abdominal segments are wanting (Needham, 1932, fig. 34). *Hemicordulia australiae* (Ramb.) is similar but possesses middorsal hooks on 3—9 or 4—9 (Watson, 1962: 14). It is evident, therefore, that it remains impossible to express any definite opinion on the identity of Needham's larva from Luzon. For a description of *Macromidia donaldi* Fraser (1936), see under that genus.

The following authenticated material of *Idionyx* larvae has been studied by the present author.

Idionyx yolanda Selys. — Malay Peninsula: 1 ♂ (with exuviae), Central Perak, 10 mi. N. of Ipoh, Sungai Chepor, 6.III.1963, M. A. Lieftinck; 1 ♀ (with exuviae), Selangor, 6 mi. Bukit Tiga-Subang Rd., Klang distr., Sungai Pelumut, 5.VI.1963, emerged Kuala Lumpur, 15.VIII.1963, J. I. Furtado.

Idionyx spec. indet. — Malay Peninsula: 3 ex. ult, 1 ex. penult, Perak, Sungai Yum, 15.III.1933, M. W. F. Tweedie. A number of other unidentified specimens, collected by J. I. Furtado and the author during their explorations of streams in various provinces of the Malay Peninsula (1963—64), are not now available for comparison.

Idionyx montana Karsch. — Central W. Sumatra: 1 ♂ 1 ♀ ult (reared from larvae), Benkulen, S.W. slope of Mt. Dempo, 300 m, received 24.X.1941, from W. C. Verboom;

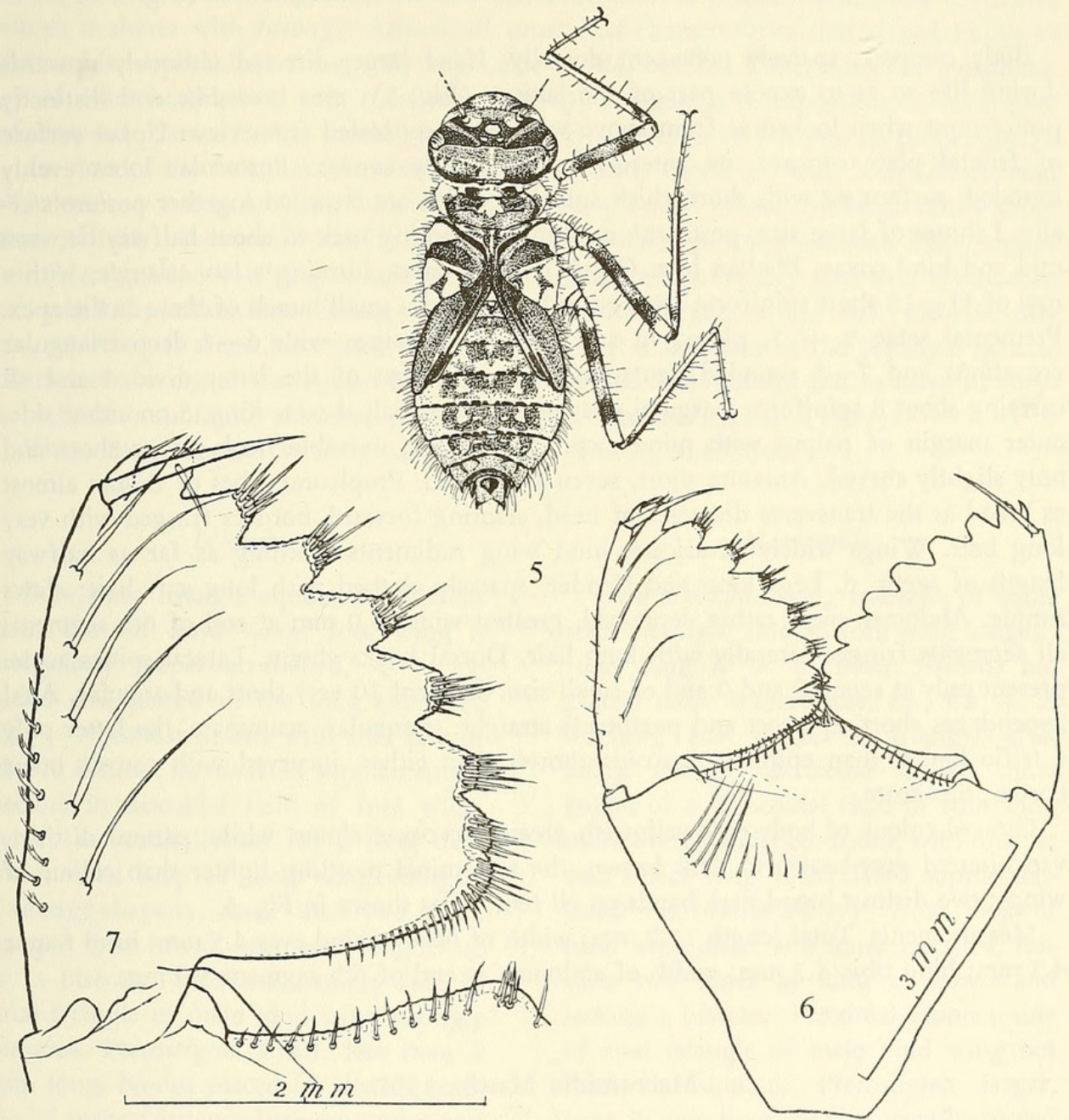


Fig. 5—7. *Idionyx montana* Karsch. 5, ultimate instar larva from Mt. Dempo (Sumatra), live specimen; 6, inner view of exuvial labium; 7, left palpus, more enlarged

emerged in Buitenzorg laboratory, 15.XII.1941 (♀), and 23.XII.1941 (♂). West Java: 1 ♂ ult, Djasinga, Tjibarangbang (stream), ca. 150 m, sifted from algal growth on bottom of tiny rivulet, 31.VIII.1937, M. A. Lieftinck; died in captivity at Buitenzorg (Bogor), 10.X.1937.

The above larvae resemble each other so much in outward appearance and structure, that I have abstained from making a careful study of all. The illustration of the whole larva (Fig. 5) was made from one of the Sumatran specimens shortly after its penultimate ecdysis.

Description of full grown larva of *I. montana* Karsch from Sumatra (Fig. 5—7)

Body compact, sparsely pubescent dorsally. Head large, directed obliquely upwards during life so as to expose part of the labium (Fig. 5); eyes knob-like and distinctly protuberant when looked at from above with mask concealed from view. Upper surface of frontal plate concave, its anterior border evenly convex. Postocular lobes evenly rounded, surface set with short, thick spicules, which are crowded together posterolaterally. Labium of large size, postmentum (hinge) reaching back to about halfway between mid and hind coxae. Median lobe (ligula) rather short, forming a low triangle, with a row of 11—13 short spiniform setae on each side and a small bunch of these at the apex. Premental setae 5 + 5, placed in a curve. Labial palpus with 6—7 deep triangular crenations and 7—8 rounded dentations, the outermost of the latter divided and all carrying about 8 spiniform marginal setae at the apex; palpal setae long, 5 on either side, outer margin of palpus with minute spiniform setae; movable hook rather short and only slightly curved. Antenna short, seven-segmented. Propleural lobes of thorax almost as broad as the transverse diameter of head, slanting forward, borders fringed with very long hair. Wings widely divaricate, hind wing rudiments reaching as far as halfway length of segm. 6. Legs long and slender, sparsely clothed with long soft hair; claws simple. Abdomen oval, rather depressed, greatest width 5.0 mm at end of 6th segment; all segments fringed laterally with long hair. Dorsal hooks absent. Lateral spines acute, present only at segm. 8 and 9 and of small size. Segment 10 very short and annular. Anal appendages short, epiproct and paraprocts straight, triangular, acuminate, the latter only a trifle longer than epiproct; cercoids shorter than either, incurved with convex outer border, tips acute.

Ground colour of body pale yellowish green, the coxae almost white; pattern distinct, varicoloured grey-brown to dark brown, the abdominal mottling lighter than colour of wings; two distinct broad dark bands on all femora, as shown in Fig. 5.

Measurements. Total length 13.7 mm; width of head behind eyes 4.5 mm; hind femur 4.5 mm; hind tibia 4.7 mm; width of abdomen at end of 6th segment 5.0 mm.

Macromidia Martin, 1907

Syn.: *Indomacromia* Fraser, type-species *I. donaldi* Fraser, 1924.

In current classifications, *Macromidia* figures as a member of the Macromiinae (= Epophthalmiinae of Fraser, 1957). More recently still, this was done, with some misgivings, also by Gloyd (1959), who gave Macromiinae family rank. *Idionyx*, on the other hand, which Needham (1937) still left in the Corduliinae, was removed therefrom by Tillyard & Fraser (1940), who erected a new subfamily, Idionychinae, to hold it. Their arguments were the long fusion of the arculus sectors, the shape of the anal loop, the distal position of the nodus on the fore wing, the incompletely recessed discoidal triangle on the hind wing; and, coupled with these venational characteristics, the large head, weak sclerotization of the body, and the highly organized and intricate anal appendages of the male (often correlated with a peculiar form of the vertex in the female).

Taken on the whole, the venation of *Macromidia* resembles that of *Macromia* more closely than *Idionyx*. Yet *Macromidia* differs strikingly from the majority of *Macromia*

in its more rounded wings and the less markedly sinuous primary veins, two characters which it shares with *Idionyx*. Almost all venational characteristics that served Fraser to define his Idionychinae are equally applicable to *Macromidia*. Concerning the morphology of other body parts, with their manifold appendages, it is impossible to find a set of clear-cut characters that would guarantee every species to be put into its proper genus.

In view of the fact that *Macromidia* shares so many characters with both *Idionyx* and *Macromia* — not to mention the problematical *Idiophya*! — there can be no doubt about their affinity, *Macromidia* taking rather an intermediate position between Idionychinae and Macromiinae but lying closest to *Idionyx*. This will inevitably lead to a revaluation of subfamily characters. Seeing how many corduliid genera are still insufficiently characterized, it seems best therefore to attempt first a summary of the principal generic characters serving to distinguish between *Idionyx* and *Macromidia* and to leave in abeyance Fraser's subfamily divisions proposed in the "Reclassification" (1957).

These characters can be recapitulated in tabular form, as follows:

Idionyx

Fore wing triangle equilateral, smaller than that of hind wing; fore wing *ti* irregularly trapezium-shaped, 4- to 5-sided and placed in the long axis, i.e., $Cu + A$ almost in line with anal side of *ti*. No distinct intercalated supplementary sectors in discoidal field of fore wing, which is parallel-sided for a long distance. Anal loop of hind wing elongate (sausage-shaped), more than two times longer than broad, traversed lengthwise by a bisector. Proximal (inner) side of anal triangle of male hind wing strongly sinuous. Pterostigma small, less than 2 mm long. Nodus placed far distad: postnodal space (distance between nodus and pterostigma) at most half as long as antenodal. Only 1 (fore wing) or 2 (hind wing) proximal postnodal cross-veins discontinuous into adjacent space between *R* and M_1 .

Apical keel on mid tibia present though vestigial. Tarsal claws with robust inferior tooth longer and stronger than the apical tooth (Fig. 12).

Outer branch of male posterior genital hamule thick and equal in length to sickle-shaped inner branch.

Macromidia

Fore and hind wing triangles of equal size, the distal side on fore wing longest; fore wing *ti* 4- or even 5-sided, but placed more transversely, i.e., $Cu + A$ reaching anal angle of triangle after being strongly deflected around inner angles of *ti*. Discoidal field of fore wing more evenly widened distad, with distinct and rather long intercalated supplementaries (including *Mspl*). Anal loop of hind wing short and more rounded, less than two times as long as broad and lacking a bisector. Proximal (inner) side of anal triangle of male hind wing not markedly sinuous. Pterostigma larger, over 2 mm long. Nodus usually placed more proximad, antenodal space only twice as long as postnodal, or less. Usually 3 or 4 proximal postnodal cross-veins not continued into adjacent space between *R* and M_1 in all wings.

Keel on mid tibia extending along its distal half. Tarsal claws with inferior tooth distinctly shorter and less acute than apical tooth, both about equally strong (Fig. 13).

Outer branch of male posterior genital hamule longer, thinner and incurved, projecting much beyond hook-shaped inner branch.

Male anal apps. long and slender, longer than segm. 9 + 10.

Apical portion of female 8th sternite abbreviated but prominent in side view and scoop-shaped, not at all emarginate and lacking leaf-like lobes.

Male anal apps. of normal length, shorter than segm. 9 + 10.

Valvula vulvae of female well marked off, extending caudad almost or fully half the length of 9th segment, deeply emarginate forming two pointed lobes.

From this table it will be clear that there is no evidence whatsoever that would justify a classification of *Idionyx* and *Macromidia* in separate subfamilies, as has been done in the past. An interesting feature which the two genera share alike with *Macromia* is the characteristic shape of the occipital triangle, with its acute-angulate lateral borders, a character perhaps found also in other allied genera of doubtful position. For instance, in the present context it should be emphasized that this part of the occiput is shaped similarly in most, if not all, species of *Synthemis*, and I have observed the same structural feature in the Australian *Micromidia* Fraser.

The genus now includes the following species:

M. rapida Martin, 1907, type-species. — ♂ ♀ Tonkin.

M. fulva Laidlaw, 1915. — ♂ N. Borneo; ♀ Sarawak (Laidlaw, 1920).

M. g. genialis Laidlaw, 1923. — ♂ Malay Peninsula; ♀ unknown.

M. g. erratica Lieftinck, 1948, stat. nov. — ♂ ♀ S. Sumatra; ♂ S. Java.

M. donaldi (Fraser, 1924). — ♂ ♀ Peninsular W. India.

M. shanensis Fraser, 1927. — ♂ ♀ Upper Burma.

M. atrovirens Lieftinck, 1935. — ♀ S.W. Sumatra; ♂ unknown.

M. samal Needham & Gyger, 1937. — ♀ Mindanao (P.I.); ♂ unknown.

M. asabinai spec. nov. — ♂ Palawan (P.I.).

Brief diagnoses of six of these have been given by Lieftinck (1935: 195—196). The species are more diversified in their venation and markings than *Idionyx*. Two of them, *M. rapida* and *fulva* have more densely veined wings than the rest, the discoidal field in both fore and hind wings commencing with two rows of cells, whereas in all others only a single row extends outwards from a point varying between 3—4 cells proximal to *Nod* to about as far as that level on the fore wings, and to 3—5 cells beyond *t* in the hinder pair. *M. samal* (♂ unknown) is intermediate in this respect inasmuch as the field in the fore wing expands to two cell-rows already midway between *t* and *Nod*, there being only two undivided cells distal to *t* in the hind wing. *M. rapida*, *donaldi* and *fulva* also differ from the other species in that the body is metallic black with well defined middorsal yellow spots on segm. 3—7 (*rapida* and *donaldi*), or marked with light brown rings (*fulva*). *M. samal* seems to come nearest *shanensis* from Burma; the female genital organs of the latter have recently been figured by Asahina (1970). *M. atrovirens* is a large and very dark-coloured species with no near allies. The rediscovery of the much smaller *M. genialis* in the island of Penang, off the westcoast of Malaya, leads me to point out some features separating it from *M. erratica*, which I now consider to be only a subspecies of the former. Lastly, one new species from Palawan can be added to the list. Asahina (1968) supposed this to be the undescribed male of *Idionyx philippa* Ris, but it is a true *Macromidia*, which I have renamed *M. asabinai* spec. nov.

The larva of *Macromidia donaldi* (Fraser) was briefly described and figured by Fraser (1936b: 208, fig. 48A, A', whole larva and labial mask). The following characters are taken from the description.

Eyes rather prominent (more strongly so than in *Idionyx*, according to Fraser's sketch); head across the eyes only little less broad than the thorax. Midlobe of labium produced slightly; 13 mental setae in a curved row on each side; palpi bordered with 7 crenulate spined teeth, the last one duplicated, and with 8 marginal lateral setae; movable hook strong. Abdomen broadly fusiform, rather strongly carinated middorsally but lacking dorsal spines; a robust apical spine on each side of segments 8 and 9. Legs of moderate length, almost naked, and with two broad dark brown annules on all femora. Total length 15 mm, head 6 mm wide, abdomen 9 mm long and 5 mm in width.

Macromidia genialis Laidlaw

Fig. 13

1923. Laidlaw, J. Mal. Br., Roy. Asiatic Soc. 1: 231—232, pl. 5 (♂ wings, genit. & apps.), ♂ Malaya.

Material. — Malay Peninsula: ♂ (holotype), Pahang, Gunong Tahan, 10.XII.1921, *M. genialis* ♂ Type, det. F. F. Laidlaw (BM); ♂ (adult), Penang Island [off Prov. Wellesley], W. Malaya, stream in Catchment area near Batu Feringgi, 1.III.1963, M. A. Lieftinck.

The wing venation of the type is well shown in Laidlaw's photograph of the right pair. To his description may be added that the labium is bright orange-yellow. Wings unspotted; discoidal field in fore wing with a single row of eight-nine cells to about two cells proximal to level of nodus, in hind wing with four and five single cells following the triangle. Cross-veins in $cu \frac{2.2}{3.3}$ inclusive of the 4-sided "internal triangle"; $bt \frac{2.2}{1.1}$. The rather brief description can be further emended by a number of characters taken from the second specimen, which is a little larger than the type.

Male (Penang). — Labium orange-yellow; mandible-bases blackish, surface shiny; labrum black, sides faintly metallic blue with a pair of slightly impressed areas on either side of the middle; anteclypeus yellowish brown, postclypeus metallic blue, frontoclypeal groove black. Frons and vertex brilliant metallic blue-green, rather densely punctate; frons short, hardly projecting beyond the vertex when viewed laterally, its surface flattened anteriorly, pubescence black; vertex broader than long, surface evenly and strongly convex and clothed densely with long erect dark hair. Occipital triangle raised above level of compound eyes, shorter than median eye-line with sharply acute sides, its shape exactly as described for the regional species of *Idionyx*. Prothorax entirely chrome. Synthorax brilliant metallic green; dorsum with a bright yellow spot between the axillaries of the fore wings and the metallic ante-alar triangles. Outer half of each mesepisternum with well-defined, broadly oval, brown spot continued ventrad on to the mesinfraepisternum and extending dorsad for about half the length of the dorsal surface. Metinfraepisternum yellow, its anteroventral two-fifths metallic green; metepisternum with slightly oblique, yellow, lanceolate stripe, pointed at either end, situated well behind the spiracle, incomplete above and extending about as far upward as 1 mm before the

base of fore wing. Metepimeron ventrolaterally with short upward extension from the yellow colour underneath and with the metapostepimeron also yellow. Ventral surface mainly yellow but anterior portions of metepimera (except medially) metallic green and posterior belt of metasternum with transverse streak of metallic purple.

Coxae of fore legs yellow, the remainder grey-brown; legs brownish black or black; tibial keels yellow, those on fore tibia occupying about the apical two-fifths (40: 100), on mid tibia slightly less than one-half (44: 100) and on hind tibia about the apical two-thirds (70: 100).

Wings clear; nodal index $\frac{7.15.16.8}{10.10.10.10}$; *Arc* slightly distal to *Ax*₂ on all wings; *Cux* $\frac{2.2}{3.4}$; *bt* $\frac{3.2}{1.1}$; *Bxs* $\frac{2.3}{2.4}$; anal loop of hind wing with 8.7 cells. A single row of 6—7 cells in discoidal field of fore wing up to level of fork *M*₁₋₃—*M*₄, only 3 or 4 continuous cross-veins in that of hinder pair. Proximal side of anal triangle only slightly sinuous; anal angle bluntly angulated, rounded.¹⁾ Pterostigma brownish-black surmounting 2½ or even 3 cells. Membranula extending as far as the cross-vein in anal triangle, light grey at base, growing darker apically.

Abdomen deep black, dorsum and part of the sides of segm. 2 metallic green. Yellow are: the auricles; a continuous stripe and fine lines along lateroventral margins of tergites 2—3 (including whole lobus posterior) and 4—6, respectively; a fine middorsal line on 2 and basal one-third of 3; a narrow but sharply defined longitudinal lance-shaped median spot on posterior three-fourths of segm. 6; and complete stripes bordering lateral margins of tergites 7 and 8, ventrally. Innermost portions of the ventral surfaces of these latter tergites clothed rather densely with short dark hairs, which are directed obliquely mesiad and caudad.

Genitalia and anal appendages shaped much as described and figured for *M. erratica* Lieft. (loc. cit.), the outer branches of the hamuli bright yellow.

Measurements: abd. + app. 33.0 mm, hind wing 29.0 mm, pt. fore wing 2.7 mm.

The specimen from Penang was taken by chance in dense jungle, flying rapidly low over a trickle in a leafy tunnel formed by overhanging shrubs.

Macromidia genialis erratica Lieftinck, 1948, stat. nov.

1948. Lieftinck, Treubia 19: 274—278 (as species), figs. 18—19 (♂ ♀ genit. structures), ♂ S. Java. 1954. Lieftinck, Treubia 22 Suppl.: 121.

This dragonfly resembles *M. genialis* Laidlaw so much in the majority of its characters that I am of the opinion that *erratica* can hardly be maintained as a full species. It is, therefore, classified more appropriately as a subspecies of *genialis*. The Javan example is a freshly emerged male, but all *erratica* from Sumatra differ from the two Malayan individuals in having the lower half of the thoracic dorsum entirely metallic, lacking the sharply delimited oval brown patch of *genialis*. They are also distinguished from *genialis* by the design of the abdomen: the dorsal carina of abdominal segments 3—7, as well as the tergal margins of 3—8 ventrally, are lined finely with citron-yellow, whereas

¹⁾ The strong angulation shown in the photograph of the type is exaggerated and caused by the wing-base having been damaged.

in *genialis* these lines are unapparent on the dorsum of 4—5 but broadened to form a definite lanceolate spot on the 6th. Lastly, the superior anal appendages of *erratica* are slightly but distinctly more expanded after their middle than they are in typical *genialis*.

I took both sexes of *M. g. erratica* over a small stream in a jungly habitat resembling greatly the one which yielded the example of *M. g. genialis* in the island of Penang. The Sumatran insects flew in company with males of *Chlorogomphus magnificus* Selys, which I first mistook for some of the larger *Macromia*.

Macromidia asahinai spec. nov.

1968. Asahina, Jap. Jour. Zool. 15: 357—358, pl. 2 fig. 11 & figs. 5—10 (♂ wings, head & thorax, and abd. structures), ♂ Palawan I. (sub *Idionyx philippa* Ris). Holotype in B. P. Bishop Museum, Honolulu.

This little species has been so well described and figured by Asahina that it will suffice to summarize its principal characters, which are taken from the description. The insect was misidentified by its author, who thought it to be the underscribed male of the puzzling *I. philippa* Ris, a species now definitely placed in *Idionyx*.

Male. — Anteclypeus yellow, labrum and postclypeus blackish-brown. Synthorax with four yellow spots low down on the sides: one mesinfraepisternal posterior spot; a second, metinfraepisternal, coalescent with a smaller, triangular metepisternal spot terminating just above (and including) the spiracle; a third elliptical stripe traversing obliquely the middle of the metepimeron; and a much smaller, triangular mark in the posterior corner of the metepimeron and metapostepimeron. Tibial armature not described.

Wing neuration typical for the genus. Nodal index (partly of right pair only) $\frac{14.14.7}{10.9.10}$; $ht \frac{.2}{.2}$; $Cux \frac{.1}{.3}$; $Bxs \frac{.3}{.3}$. Discoidal field commencing with 8 single cells as far as about 3 cells proximal to nodus on right fore wing, and 3 undivided cells beyond t on right hind wing. Anal loop comprising 7—8 cells. Pterostigma relatively long, as for genus.

Abdomen brown, broadened at segments 7—8, with narrow middorsal line on 2—4, a lateroventral marginal stripe running from the auricles to as far as tergite 9 (very narrow on 4—9), and a pair of conspicuous, closely approximated, circular spots of yellow just before the middle on the dorsum of 7. Genital organs and anal appendages shaped much as in the other members of the genus. Superior pair sub-parallel, somewhat sinuous in dorsal view with acute incurved tips, which are a little upturned in lateral view; no subapical inferior ventral projection.

Measurements: abdomen + app. 29 mm, hind wing 27 mm.

This is the smallest known species of *Macromidia*, which I have much pleasure in naming after my colleague, Dr. S. Asahina, who first described it.

III. SOME MALAYSIAN SPECIES OF *Macromia* RAMBUR*Macromia gerstaeckeri* Krueger

1954. Liefstinck, Treubia 22 Suppl.: 118 (full references).

Since last discussing this species and its immature stages (Liefstinck, 1950), more material of both adults and larvae have come under my notice. In 1963, during our joint investigation of the Malayan Odonate fauna, Dr. J. I. Furtado and I found *gerstaeckeri* to be widely-spread at forest streams in the Malay Peninsula; but owing to their rapid flight and remarkable inconspicuousness, only few imagines (mostly ovipositing females) were obtained, the remainder having been reared from larvae.

Additional material. — **Malay Peninsula**: 1 ♀ (adult), Selangor, Ulu Langat area, Dusun Tua, 2—500 m, 9.IV.1963, M. A. Liefstinck; 2 ♀ (id.), Selangor, Sungai Gombak, 11½ mi. Kuala Lumpur-Bentong Rd., 22.V and 27.XI.1963, J. I. Furtado; 1 ♂ (juv., with exuviae), Selangor, same locality, 16.III.1963, J. I. Furtado & M. A. Liefstinck, emerged at Kuala Lumpur, 30.III.1963; 1 ♀ (adult), Perak, 8 mi. E. of Sungai Siput, kp. Talong, Sungai Korbu, 9.IV.1964, J. I. Furtado; 1 ♂ (juv., with exuviae), Pahang, 29½ mi. Kuala Lumpur-Bentong Rd., Sungai Tangli, 13.V.1963, emerged at Kuala Lumpur, 5.VI.1963, J. I. Furtado. **Borneo**: 1 ♀ (adult), North Borneo, Keningan, 1000—1500 m, 24.XII.1962, Y. Hirashima (BISH).

A detailed characterization is to be found in the writer's 1950 publication. Were it not for the distinctive form of its posterior hamule, the male of *gerstaeckeri* would be easily mistaken for *M. callisto* or *erato*, which are otherwise closely similar and may occur together in one locality. This proved to be so with *callisto* and *gerstaeckeri* in Malaya, where we captured both indiscriminately.

Female (Malaya). — Labium dark chestnut to brownish-black, except the median lobe which carries a pair of transverse citron-yellow spots at base; a circular spot of the same colour at the mandible-bases. Anteclypeus dark brown; postclypeus either entirely yellow or rather intermingled with brown on the anterior part, the yellow being restricted to an ill-defined undulated basal stripe, the side portions for the greater part also remaining yellow. Thorax beneath brownish-black, slightly metallic, lateroventral ridge of metepimeron and all sutures sharply outlined in yellow.

Neuration open. Nodal indices and other details of 4 adults: $\frac{6.15.15.6}{9.10.10.8}$, $\frac{6.15.15.5}{9.10.11.9}$, $\frac{6.15.16.6}{9.10.11.9}$ and $\frac{5.15.15.5}{7.9.10.8}$; *ht* $\frac{4.3}{2.2}$, $\frac{4.4}{2.2}$, $\frac{3.3}{2.3}$ and $\frac{4.3}{2.2}$; *Cux* $\frac{4.5}{4.4}$, $\frac{5.6}{4.4}$, $\frac{6.6}{4.4}$ and $\frac{4.5}{4.5}$; cells in anal loop 9.10, 6.7, 9.10 and 8.8, all except the second including 1 (rarely 2) central cells. Costa black with fine posterior yellow line from base about half-way up to nodus. Pterostigma black. Membranula ashy grey, almost black.

Abdomen sparsely marked with yellow: 2 with transverse lanceolate streak, widest at middle and tapering on either end, upon middorsum and a large, oblique, slightly irregular and constricted patch at the sides not attaining the jugal suture; 3 and 4 each with a pair of very small, oval middorsal spots placed immediately in front of the jugal suture, those on 4 vestigial; sides of 3 moreover with longitudinal stripe along ventral margin but lacking a transverse streak at its base; 7 with large prejugal dorsolateral mark, widest at base, rounded off laterally and slightly indented by black from behind at the

crest, occupying from one-fifth to one-fourth of the segment's length; in one specimen this basal marking is much smaller and finely interrupted in the median line. Terminal segments unmarked. Valvula vulvae undeveloped: apical border in ventral view somewhat swollen, very slightly undulated, the receding part of the sternite sloping down abruptly (dorsad) and forming a pair of parallel swollen ridges fitting closely against the body wall. Anal appendages awl-shaped with finely acuminate tips.

Female (discoloured). — Similar to Malayan individuals but median lobe of labium and basal edges of palpi entirely ochreous. Yellow areas of postclypeus darker and invaded by brown on either side of middle. Nodal index $\frac{6.14.14.6}{8.11.11.8}$; $ht \frac{3.3}{2.2}$; $Cux \frac{5.5}{4.4}$; anal loop with 9—10 cells inclusive of a central cell. Genitalia and appendages as described.

Measurements: ♀ abdomen 38.3—40.0 mm, hind wing 34.7—36.0 mm, pt. fore wing 2.0 mm (Malaya); 40.0, 36.0, 2.0 mm, respectively (Borneo).

The females from Malaya differ somewhat from the allotype described from Java and also from the one taken at Jor Camp in Perak, figured in my previous paper (1950, fig. 7). In them the sides of the 3rd abdominal segment are unmarked at base, while minute paired dorsal spots are present on 3—4. I am unable to say whether or not these differences are due to individual variation.

Macromia callisto Laidlaw

Fig. 10—11, 14

1954. Lieftinck, Treubia 22 Suppl.: 116 (full references).

Material. — Malay Peninsula: 1 ♂, 1 ♀ (ovipositing, both adult), Selangor, 11½ mi. Kuala Lumpur-Bentong Rd., Sungai Gombak, 12.VI.1963, J. I. Furtado; 1 ♀ (adult), Central Perak, 10 mi. N. of Ipoh, Sungai Chepor, 6.III.1963, M. A. Lieftinck.

These specimens are undoubtedly conspecific with the immature type described by Laidlaw. Similar to *M. erato* but smaller, the male with slenderer and more spindle-shaped abdomen. Immediately distinguished by the darker clypeus and other details of coloration but resembling *erato* in the shape of the male genital organs and anal appendages.

Male (adult, Malaya). — Labium and mandibles as described for *gerstaeckeri* and *erato*. Labrum black, its extreme base on each side of the impressions chestnut. Anteclypeus dark brown; postclypeus likewise brown but diffuse dark yellow areas are clearly discernible in the middle, in the depressions and at base of the lateral divisions. Frons black with slight metallic gloss, shape and surface sculpture of the tubercles as in *erato*.

Ground colour of thorax deep black, dorsally with steely blue, laterally with purplish and blue reflections; all yellow markings a little narrower and more restricted than in *erato*. Legs as in that species, length of hind femur 8.0 mm; keel on fore tibia a little shorter, 37.5 : 100 (*erato*: 44 : 100).

Wings clear, nervures black, only the costa finely yellow posteriorly for about half the distance from base to nodus on fore wing. Neuration open. Nodal index $\frac{5.14.14.6}{9.10. 9.8}$; ht

$\frac{3.3}{2.2}$; $Cux \frac{5.4}{3.3}$. Two cell-rows in discoidal field of fore wing; only a single cross-vein running directly from M_4 to Cu_1 in hind wing. Anal loop made up of 6 or 7 cells. Whole anal area of hind wing, including the triangle and rounded angle, shaped similarly to *erato*. Pterostigma black. Membranula dark grey, slightly lighter basally, extending to a little beyond the transverse cross-vein in anal triangle, as in *erato*.

Abdomen with the basal and terminal inflated segments much as in *erato*, but intermediate segments distinctly narrower; from the base as far as the apex of 7 markedly expanded in lateral dimension, the next segments diminishing in breadth from the base of 8 as far as the end of 9, the 10th being narrower than 9 (*erato*: end segments expanded gradually and widest across segm. 10). Middorsal carina of 10th segment acute, extending caudad as far as about half-way length of segment but becoming indistinct posteriorly. Markings of proximal segments much as in *gerstaeckeri*, hence much more reduced than in *erato*: transverse middorsal yellow mark of 2 isolated, constricted in the median line, lateral patch including the auricles narrowly detached from it; 3 with very narrow latero-ventral line and lacking a transverse lateral stripe at base; middorsal antejugal paired spots small and present only on 3, the succeeding segments unmarked; basal spot of 7 small, cordiform, not quite touching base or jugal suture, bluntly pointed caudad at the median crest; 8 with vermiform latero-ventral spot extending from the base obliquely upward and backward, terminating about half-way the segment's length. Remainder of abdomen, inclusive of the sternites, black.

Genitalia and lobus posterior practically identical in shape to those of *erato* (Fig. 10). Anal appendages, superior pair a little shorter and broader than in *erato* but otherwise very similar, the subterminal tooth perhaps a trifle less strong than in that species.

Male (ad., Borneo; in fragments). — Agrees with the above description in almost every respect. Differs in that the labium is of a lighter brown, and in that the incomplete antehumeral thoracic stripe extends only half-way up the dorsum, tapering to a point.

Wing membrane strongly tinged brownish-yellow. Nodal index $\frac{6.15.16.7}{9.10.10.8}$; $ht \frac{3.4}{2.2}$; $Cux \frac{5.5}{4.4}$; 6 cells in the anal loop, no central cell.

Anal appendages and genital organs not differing from those of the Malayan example (Fig. 11).

Female (Malaya). — Labium brown, the median lobe with a pair of suboval lemon-yellow spots coalescent at extreme base. Mandibles brown, main body with yellow external dot. Labrum black, with crescentic brown median spot at its base. Anteclypeus brownish-black, postclypeus dirty ochreous, save for a cloudy brown spot placed on each side of the impressed areas. Frons, vertex and rear of the head deep black, not metallic. Yellow markings of thorax and abdomen as in the male; the orange prejugal patch at the base of the 7th abdominal segment is broader than long, placed transversely, somewhat narrowed posteriorly and rounded off at the sides in one example, occupying slightly less than one-third of the segment's length; latero-ventral border of same tergite finely lined with yellow and traces of yellow also basally at the lower margin on the 8th.

Wing membrane in one old specimen strongly dark flavescent, in the second example hyaline. Nodal indices $\frac{6.14.15.6}{8.10.11.8}$ and $\frac{6.14.15.5}{6. 9. 9.8}$; $ht \frac{4.4}{2.2}, \frac{3.3}{2.2}$; $Cux \frac{5.4}{4.4}, \frac{5.5}{4.4}$. Anal loop with 8.8 or 9.9 cells, without or including 1 or 2 central cells.

Valvula vulvae at 8th sternite scarcely developed, not reaching apex of the corresponding tergite; the lower margin (i.e. the upper, when looked at from below) bears a distinct V-shaped median incision, instead of being straight or slightly undulated, the rest of the thickened sternite being directed upwards to fit against the body wall as a pair of rounded parallel-ridges, similar in form to that in the allied species.

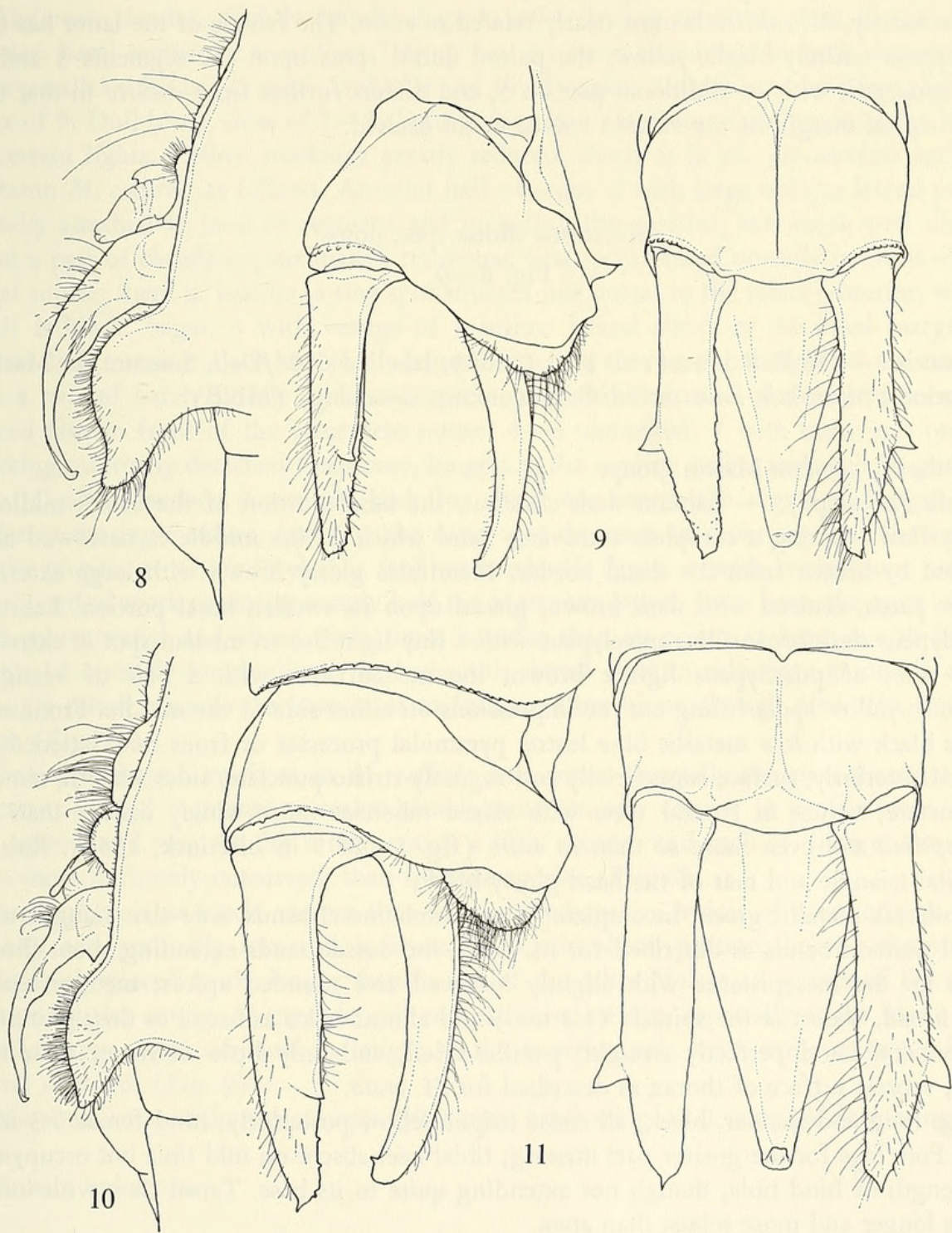


Fig. 8—9. *Macromia dione* spec. nov. ♂ holotype from N. E. Sumatra. 8, genitalia; 9, anal appendages, right lateral and dorsal view. — Fig. 10—11. *Macromia callisto* Laidlaw, ♂ genitalia; 10, from Malaya; 11, anal appendages of ♂ from Borneo

Measurements: ♂ abd. + app. 41.0 mm, hind wing 33.8 mm, pt. fore wing 2.0 mm (Malaya), 41.5, 32.5, 2.0 mm, respectively (Borneo); ♀ 37.0—38.8, 34.0—36.0, 2.0 mm, respectively.

Except for the dissimilar shape of the vulvar lamina, it was found impossible to separate the female of *callisto* from that of *gerstaeckeri*. The individual differences in the venation of each have been given merely to demonstrate the existing variation and are evidently of no importance specifically.

Structurally, *M. callisto* is most nearly related to *erato*. The female of the latter has the postclypeus entirely bright yellow, the paired dorsal spots upon the segments 3 and 4 more enlarged, with an additional pair on 5, and differs further from *callisto* in that the ventro-apical margin of the valvula vulvae is not excised.

Macromia dione spec. nov.

Fig. 8—9

Material. — N. E. S u m a t r a: 1 ♂ (adult), labelled 6594/Deli, Sumatra, L. Martin G. (print), *Macromia ? westwoodi* Selys (unknown writing) (MNB).

Of the *M. septima* Martin group.

Male (holotype). — Labium dark chestnut, the basal portion of the broad midlobe pale yellow forming a complete transverse band which in the middle is narrowed and invaded by brown from the distal border. Mandibles glossy brown with large external yellow patch, centred with dark brown, placed upon its swollen basal portion. Labrum and clypeus dark brown, the anteclypeus with a tiny light brown median spot at extreme base; sides of postclypeus lighter brown, the median area with a pair of vestigial brownish-yellow spots filling out the impressions on either side of the middle. Frons and vertex black with low metallic blue lustre, pyramidal processes of frons not flattened or framed anteriorly, surface superficially and rugosely striato-punctate, sides smooth, almost impunctate; vertex in frontal view with raised tubercles more widely distant than in *M. septima* and even more so than in *erato* (fig. 1 and 5 in Lieftinck, 1950). Raised occipital triangle and rear of the head glossy black.

Synthorax metallic green. Incomplete yellow antehumeral bands, ante-alar triangles and lateral thoracic bands as described for *M. erato*, the dorsal bands extending about three-fifths up the mesepisterna with slightly incurved and rounded apices; metaspiracular band broad, widest at the spiracle (1.2 mm) and almost twice as broad as this; posterior metepimeral band perfectly straight, parallel-sided, and only little narrower than the latter; ventral surface of thorax as described for *M. erato*.

Legs long and slender, black; all coxae bright yellow posteriorly; hind femur 7.3 mm long. Fore legs for the greater part missing; tibial keel absent on mid tibia but occupying full length of hind tibia, though not extending quite to its base. Tarsal claw with inner ramus longer and more robust than apex.

Wings unspotted, membrane faintly suffused with greyish-yellow all over, especially toward the tips. Costa with fine interior yellow line extending outwards from base almost as far as the nodus. Neuration open, nodal index $\frac{4.13.13.5}{6.10.9.6}$; *ht* $\frac{3.3}{2.2}$; *Cux* $\frac{4.4}{4.3}$.

Two or only a single cross-vein running directly from M_4 to Cu_1 in hind wing. Only one large basal cell between anal triangle and anal loop of hind wing, the latter with only 6 cells, without central cell. Two cell-rows between loop and posterior border of hind wing. Distal side of anal triangle almost straight from base to tornal angle, which is rounded; margin of hind wing between membranula and anal angle concave. Pterostigma black. Membranula dark grey with distinct, almost pure white spot at extreme base.

Abdomen slender, slightly spindle-shaped, rather longer relatively than in the allied species; basal segments, as well as 7 from base to apex, broadened in both dimensions, then parallel-sided as far as the end of 8 and finally again slightly narrowed from base to apex of 9. Dull black, sides of 1—3 slightly shiny and with faint dark bronze-green lustre in certain lights. Yellow markings greatly reduced, much as in *M. gerstaeckeri* and the Bornean *M. corycia*, as follows. Anterior half of segm. 2 with large oblique lateral patch, broadly attached to base of segment and including the auricles; this mark well distant from a pair of closely approximated, transverse oval spots placed dorsally in front of the jugal suture; there is, besides, a tiny spot situated just dorsal to the lobus posterior, which itself is black. Segm. 3 with vestige of a yellow lateral streak at the basal margin, a yellow line terminating at the jugal suture bordering the ventral margin of the tergite, and a pair of barely visible middorsal specks, one on either side of the median carina, placed also in front of the transverse suture; 4—6 unmarked; 7 with transverse orange marking, narrowly detached from base, longest at the median carina and with its pointed apex directed caudad; it extends back for about one-fourth the segment's length, i.e. as far as the jugal suture; laterally, the same spot descends to about one-half the height of the tergite, at which level it is well rounded off. Segm. 8 with conspicuous orange latero-ventral mark attaining exactly half the segment's length from base, the apex of the spot subtruncated and about three times broader than its width at base; 9—10 black. Segm. 10 strongly longitudinally carinate, this dorsal crest in side view gradually more strongly raised towards the base so as to form a rather blunt, though distinctly elevated ridge (Fig. 11).

Genitalia shaped much as in *M. callisto* and *erato*, especially the pear-shaped lobus posterior of 2nd segment; posterior hamuli more strongly convex in profile view, with the narrow and very slender distal portion a little shorter, and each of them at the same time more definitely outcurved, than in these species (Fig. 8).

Anal appendages black, shorter than in the allied species, apices of superior pair only slightly and gradually incurved in dorsal view, the distal portion, beyond the strong transversely placed tooth, longer than in any of the other Malaysian species of the same group; bristles strong, of great length and rather numerous, especially at the blunt tips. Inferior appendage subequal in length to the superior pair, apex carrying two minute dorsal denticles (Fig. 9).

Measurements: abdomen + app. 39.0 mm, hind wing 32.0 mm, pt. fore wing 2.0 mm.

Female unknown.

A very distinct species that runs out into couplet 12 of my key (1950: 681), to near *M. callisto* and *erato*, with which it shares the slender form of the posterior genital hamulus and the pear-shaped lobus posterior. It differs from both in the more proximal position of the external tooth at the superior appendage, the presence of an elevated

middorsal crest on the 10th abdominal segment, as well as in details of coloration. The open neuration and the relatively great length of the abdomen are additional specific characters.

Macromia arachnomima Lieftinck

1953. Lieftinck, Treubia 22: 395—406, figs. 4—7, ♂ struct., whole larva and larval struct. (♂ S. Borneo); 1954. Lieftinck, Treubia 22 Suppl.: 116; 1955. Lieftinck, Zool. Meded. 33: 263—266, fig. 14, ult larva (♀ S. Borneo); 1969. Lieftinck, De Lev. Natuur 72: 103—109, figs. 2—3, whole larva & struct., ecol. notes (Borneo). — 1969. Furtado, Verh. Intern. Verein. Limnol. 17: 881.

Additional material. — *Malay Peninsula*: 1 ♂ (ad.), Central Perak, Plus river area, Sungai Chior, low country, 7.III.1963, M. A. Lieftinck. — *Borneo*: 1 ♀ (juv.), W. Borneo, Singkawang, stream at Montrado Rd., 24.III.1932, L. Coomans de Ruiter; 2 ♀ (ad.), Central E. Borneo, Samarinda distr., 250 m inland, 125 m, Tabang, Sungai Bengen (trib. of Belajan river), 4.IX and 15.X.1956, A. M. R. Wegner.

The Malay Peninsula is a new record for this extraordinary species. The types, male and female, were described after specimens reared from larvae collected in southern Borneo (loc. cit., 1953, 1955). A second immature female from western Borneo, collected as early as 1932, had to be left unnamed by the absence of a male; this can now be recorded also. The discovery of the perfect dragonfly in the Malay Peninsula definitely confirms previous determinations of a number of larvae extracted from submerged rootlets and collected by Messrs. D. S. Johnson and J. I. Furtado (1969: 881) from various lowland streams (not specified here) in Selangor and Johore.

The following notes are based on the first mature examples of either sex.

Male (ad., *Malaya*). — Conforms to the type, except for the following colour differences and other details. Mouth-parts brown, a cloudy yellowish patch at the mandible-bases. Clypeus uniform dark brown. Wings hyaline; rusty blackish-brown spots at extreme base vestigial in *c-sc* and *cu* on fore wings, slightly larger (though smaller than in the type) on the hinder pair. Nodal index $\frac{5.14.13.5}{8. \ 9. \ 9.8}$; cross-veins in *ht* $\frac{2.3}{1.1}$; *Cux* $\frac{6.6}{3.3}$; cells in anal loop 6.6 without central cell. Anal triangle wider at base than in most other species; membranula almost pure white. Pterostigma black.

Abdomen of normal length, segments parallel-sided from base of 4 almost as far as end of 6, thereafter gradually broadened and widest at apex of 7, then again a little narrowed to the end of 8; 9—10 parallel. Segment 9 of normal shape, its dorsal crest acute. Abdominal markings bright yellow on a deep black ground; no metallic reflections. Undulated middorsal band across segm. 2 subinterrupted in the median line, otherwise all abdominal markings as described for the type, except that the prejugal annular spot on segm. 7 is rather obscured basally, and there is no yellow colouring on 9—10 ventrally.

Female. — All specimens differ conspicuously from the other sex in that the dark spots at the bases of all wings are much more extensive: deep rusty brown in the immature female and extending to beyond *Ax*₁ in fore wing and as far as *Ax*₂₋₃ in the hinder pair, all surrounded by a golden yellow areola covering the entire anal area; in the adult females the dark spots occupy a little less of the basal cell surfaces and lack

the golden areolae. The rest of the wings in the mature examples is hyaline, except in one female, which has the apices cloudy yellow. Venation denser than in the males but indices variable; there are from 12 to 15 cells in the anal loop of the hind wing, which invariably includes 1—2 central cells. Head in front uniform dark brown including the mandibles; upper portion of frons anteriorly and above, as well as the vertex, metallic blue-black. Yellow juxtahumeral thoracic bands obsolete. Abdominal markings greatly enlarged on segm. 2, though varying in extent, occupying almost the entire anterior (prejugal) part of the dorsum and sides in the juvenile specimen, indented by black posteriorly or obliterated middorsally, in the adulti. Basal spot of segm. 7 larger than in male, covering basal two-fifth of segment, otherwise as in the opposite sex.

Measurements: ♂ (Malaya) abd. + app. 43 mm, hind wing 37.7 mm, pt. fore wing 2.1 mm; ♀ 45.2, 43.5, 3.0 mm (W. Borneo) and 42.5—43.5, 40.0—40.5, 2.2 mm, respectively (E. Borneo).

Possibly widely distributed in the lowlands of Malaysia but so far known only from Borneo and the Malay Peninsula.

GEOGRAPHICAL DISTRIBUTION OF *Macromia* IN MALAYSIA

It was foreseen at the end of an earlier summary (loc. cit., 1950: 676—677) that explorations in Malaysia during the next 20 years would result in the discovery of some more species and a better knowledge of the distribution of those already described. The following table gives an idea of the present state of our knowledge. Of the 15 species listed there are still eight which are known only from one of the six geographical "provinces" of Malaysia here included (all, except one, insular). Endemic species are marked with an asterisk *

Species	Malay Peninsula	Sumatra	Java	Borneo	Bangka	Billiton	Further range
<i>arachnomima</i>	+			+			
<i>callisto</i> *	+						
<i>cincta</i>	+	+	+	+	+	+	Palawan
<i>corycia</i> *				+			
<i>cydippe</i>	+	+	+	+	+	+	
<i>dione</i> *		+					
<i>erato</i> *			+				
<i>euterpe</i> *				+			
<i>gerstaeckeri</i>	+	+	+	+			?Philippines
<i>jucunda</i> *			+				
<i>mnemosyne</i> *				+			
<i>moorei fumata</i>	+	+	+				Celebes
<i>polyhymnia</i> *		+					
<i>septima</i>			+				Tonkin
<i>westwoodi</i>	+	+	+	+			
Total	7	7	8	8	2	2	

IV. THE PAPUASIAN GROUP OF *Macromia* RAMBUR

Since the last revision of the Papuan representatives of this genus (Lieftinck, 1952) several fresh captures of these impressive insects from all over the Papuan Region have come into my hands. Besides a fair number of additional specimens pertaining to earlier described forms, these collections yielded three (and possibly more) species new to science. One of these was described only few years afterwards (Lieftinck, 1955), but the rest still awaited closer examination. It is the purpose of this chapter to characterize the novelties, to give further information, where necessary, on related species, and to supply new locality records for the species already known.

All regional species are very much alike and obviously closely interrelated; I have, therefore, merely accumulated comparative notes and, in one instance, also a key, to facilitate their recognition, a more elaborate descriptive table for eight of the then known taxa being found in my 1952 paper (loc. cit.: 438—444). The present survey deals with eight species known to inhabit those islands and land masses of the Indo-Australian archipelago which are situated east of the Philippines and Celebes.

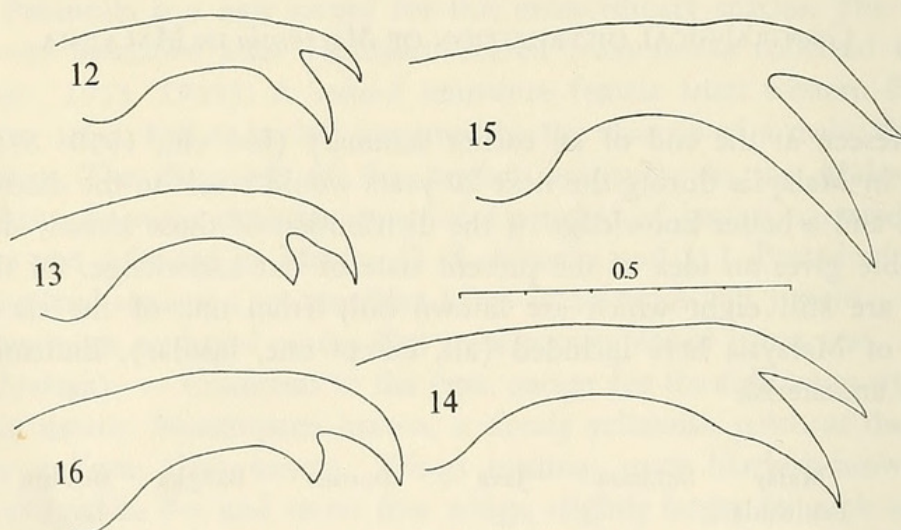


Fig. 12—16. Metatarsal claws of ♂. 12, *Idionyx montana* Karsch, from Java; 13, *Macromidia genialis erratica* Lieft., from Java; 14, *Macromia callisto* Laidlaw, from Malaya; 15, *Macromia celaeno* Lieft., from New Guinea; 16, *Synthemis miranda* Selys, from New Caledonia

The Australo-Papuan members of *Macromia* form a distinct section of the genus. All agree in being of large size and by having most of the body brilliant metallic green (except the more terminal segments of abdomen), yellow markings being much reduced: a single orangish patch at the base of the 7th tergite being the only conspicuously coloured area ornamenting the abdomen dorsally. All are characterized by the exceedingly small pterostigmata and the remarkably diminutive size of the discoidal triangle of the hinder wing. Special attention must be paid to the extraordinary form of the tarsal claws in this and probably several other sections of *Macromia*¹⁾. The claws are deeply

¹⁾ Up to now only few other species were examined upon this character, i.e. all members of the Malaysian section of *M. septima* Martin, which appear to be similar in this respect; the Palaearctic *M. splendens* Pictet, however, possesses normally shaped claws.

cleft; but whereas in most other corduliids the inner ramus (or inferior tooth) is usually shorter and slenderer than the outer (main) branch, in them the inner branch follows the strong main curve, being at the same time the most robust and longest of the two, whilst the outer is finer, branching off slightly asymmetrically (Fig. 15). Distinctive characters common to all males are the slender and very narrow genital hamule and the sharply pronounced acute anal angle of the hind wing. Like the majority of Corduliidae useful criteria for the recognition of species are most evident in the males. In this sex the shape and armature of the 10th abdominal segment, the accessory genital organs and anal appendages, are quite distinctive.

The distribution centre is New Guinea, only three species occurring outside the continent including its satellite islands, viz. one on Halmahera and Batjan in the northern Moluccas, a second in New Britain and New Ireland (Bismarck Archipelago), while a third, the rather enigmatic *M. viridescens* Till., from the Cape York peninsula in northern Australia, is known only from a single female.

The regional section can be split up conveniently into three groups based on colour characters shared by both sexes; these do not, however, appear to reflect relationships.

Group I of *M. terpsichore* Foerster

Postclypeus with conspicuous transverse yellow band, or at least spotted with yellow on either side of the middle. Dorsum of thorax (mesepisterna) with a pair of clearly defined yellow antehumeral bands extending at least half-way up the dorsum.

The species are:

M. amymone Lieft., 1952 (W. and S.W. New Guinea)

M. celaeno Lieft., 1955 (E. New Guinea; d'Entrecasteaux and Louisiade Arch.)

M. eurynome Lieft., 1942 (S. New Guinea)

M. hermione Lieft., 1952 (Misool I.)

M. lachesis spec. nov. (Bismarck Arch.)

M. sophrosyne Lieft., 1952 (Waigeu I.)

M. terpsichore Foerster, 1900 (N. and N.E. New Guinea)

M. viridescens Tillyard, 1911 (Cape York, N. Australia).

Group II of *M. melpomene* Ris

Postclypeus reddish- to dark brown or almost black, agreeing in colour with that of the rest of the head anteriorly. Dorsum of thorax metallic green lacking well defined antehumeral bands, but lower part of mesepisterna frequently reddish brown, dorsally acquiring a metallic green lustre.

The species are:

M. astarte spec. nov. (S.E. New Guinea)

M. euphrosyne Lieft., 1952 (Waigeu I.)

M. melpomene Ris, 1913 (New Guinea, universal ?)

M. spec. indet. (d'Entrecasteaux Is.).

Group III of *M. chalciope* Lieftinck

Postclypeus as in Group II. Dorsum of thorax with a pair of short, lanceolate, orange or yellow antehumeral bands tapering dorsally to a blunt point.

There is only one species:

M. chalciope Lieft., 1952 (N. Moluccas), with one subspecies (?) off N.W. New Guinea (Schouten Is.).

It is of interest to note that the structural characters separating the members of each of the two main groups are allotted analogously, so that if these group characters were lacking, specific recognition would become much more difficult.

Macromia amymone Lieftinck

1952. Lieftinck, Treubia 21: 444 (♂ key), 446—449, 465—467, figs. 2, 6, 19—21 (♂ genit. & apps.; head & labium of larva), and 448—449 (remarks on supposed synonymy), ♂ ♀ W. New Guinea (Vogelkop, Sorong). — 1915. Campion, Trans. zool. Soc. Lond. 20: 488, ♂ S. New Guinea, Utakwa River (*M. terpsichore* Foerst.).

Further material. — S. New Guinea: 2 ♂ 1 ♀ (adult), Utakwa River, Feb. 1913, A. F. R. Wollaston Exped., over drawer-label *M. terpsichore* Foerst., probably named by H. Campion (BM). 3 ♂ (adult), S. New Guinea, Fly River, Kiunga, 6, 14 and 21.X.1957, W. W. Brandt (1 ♂ BISH); 1 ♀ (adult), Papua, Western Div., same area, Fly River, 5 mi. below Palmer Junction, 20.V.1936, coll.? previously named *M. terpsichore* Foerst., by the present writer.

When describing this species in 1952, I believed Campion's examples of "*M. terpsichore* Foerst." to be wrongly associated with that species and to belong to *M. amymone* instead. Since re-examining them in the British Museum collection this supposition proved to be correct, as the males do agree with *amymone* by possessing the peculiar tuft of long hairs at the apex of the superior appendages and tallying with the description also in other characters. Now the discovery of this species at Kiunga (low country, 6° 07' S lat., 141° 17' E long.), extends its range even further eastwards so that the species is at present known to occur from Sorong at the western extremity of the continent probably all along the southcoast as far as the Fly River area.

Male (Kiunga). — Conforming with the description and figures. Postclypeus with broad, uninterrupted orange band. The very broad and almost parallel-sided yellow stripes crossing the spiracle at the thoracic sides extend upward almost to the dorsal crest of the metepisternum. The orange band at the base of the 7th abdominal segment encircles the whole tergite and is intersected laterally only by a blackish line at the jugal suture, thus occupying only little less than one-half the segment's length and on the ventral surface reaching even further caudad. Other specific features worth attention are the unusually prolonged and very acute anal angles of the hinder wings and the spindle-shaped abdomen, the breadth at the junction of the 7th and 8th segments measuring about 4 mm.

Female (Palmer Junction). — Except for its much smaller size (the specimen from Sorong measuring 48.7, 49.5, 1.8—1.9 mm, respectively), the two females agree in all essential characters; the present specimen is a very mature one, the wing membrane being strongly coloured, brownish yellow all over, with the bases more deeply and diffusely stained with orangish.

Measurements: ♂ abd. + app. 49.2—49.5 mm, hind wing 47.0—47.2 mm, pt. 1.2 mm; ♀ abdomen 45.0 mm, hind wing 43.8 mm, pt. fore wing 1.2 mm.

Macromia eurynome Lieftinck

1942. Lieftinck, Treubia 18: 563-564 (nom. nov. pro *M. terpsichore* Ris nec Foerster; descr. notes & supposed synonymy), ♂ Kloof-bivak, Lorentz River; 1952, Lieftinck, Treubia 21: 443 (key ♂), 445, Ris's ♀ allotype, Lorentz River. — 1913. Ris, Nova Guinea 9 Zool. 3: 494—495, fig. 13 (♀ wings), ♀ Bivak-Insel, sub *M. terpsichore* Foerst.; 1915. Ris, Nova Guinea 13 Zool. 2: 84—85, figs. 2—3 (genit. & apps.), ♂ Lorentz River, sub *M. terpsichore* Foerst.

Material. — S. New Guinea: ♂ (lectotype by present designation), Lorentz River, Kloof-bivak, 17.XI.1912, G. M. Versteeg, Lorentz Exp., *M. terpsichore* Foerst., det. F. Ris, ex SMF IV.1970 (MA).

This is the male discussed by me in 1942, at that time erroneously called "allotype" and stated to be lodged in the Amsterdam Museum. In fact, this example was shown to me in 1929 by the late Dr. Ris at his home in Rheinau, from where it was finally returned to the Amsterdam Museum via the Natur-Museum Senckenberg at Frankfurt a/M.

The species is immediately distinguished from other Papuan *Macromia* by the characteristic shape of the genital organs. Another peculiarity not mentioned before is the presence of a small tubercular swelling at the lower border of the second abdominal segment, which is beset with radiating stiff light brown bristles. An indication of this tiny tubercle is perceivable also in some individuals of *M. melpomene* and *M. celaeno* (Fig. 19 and 22).

The lectotype and the female first described by Ris (1913) are the only specimens of *M. eurynome* so far known.

Macromia chalciope Lieftinck subsp.?

Fig. 17—18

1952. Lieftinck, Treubia 21: 438—439 (key ♂), 456—460, fig. 5, 10 (♂ genit. & apps.), ♂ ♀ Halmahera I. (N. Moluccas).

Further material. — N.W. New Guinea: 1 ♂ (slightly immature), 3 ♀ (adult), Schouten Is., Biak I., Base, 29.XII.1954 (♂ ♀), and Sorido, 28.XII.1954 (2 ♀), all L. B. Holthuis.

Very similar in most respects to our series from Halmahera (and an additional ♂ from Batjan I.), but a direct comparison with typical *M. chalciope* reveals the following slight differences.

Male. — Lateral yellow stripe crossing the spiracle at the sides of thorax a little narrower and more distinctly constricted at some distance above the spiracle, the latter being, however, completely surrounded by yellow. Orange basal spot on dorsum of 7th abdominal segment distinctly larger and, though still detached from basal margin of segment and also more or less diamond-shaped, prolonged triangularly about half-way down the tergite, the spot being widest at the transverse suture; posteriorly it projects a little beyond the suture so as to form a tiny, arrow-shaped off-shoot, the middorsal length of the spot taking approximately $3/8$ of the whole length: hence distinctly larger than in any of the 19 Moluccan examples compared. The "penis" is exerted but unfortunately

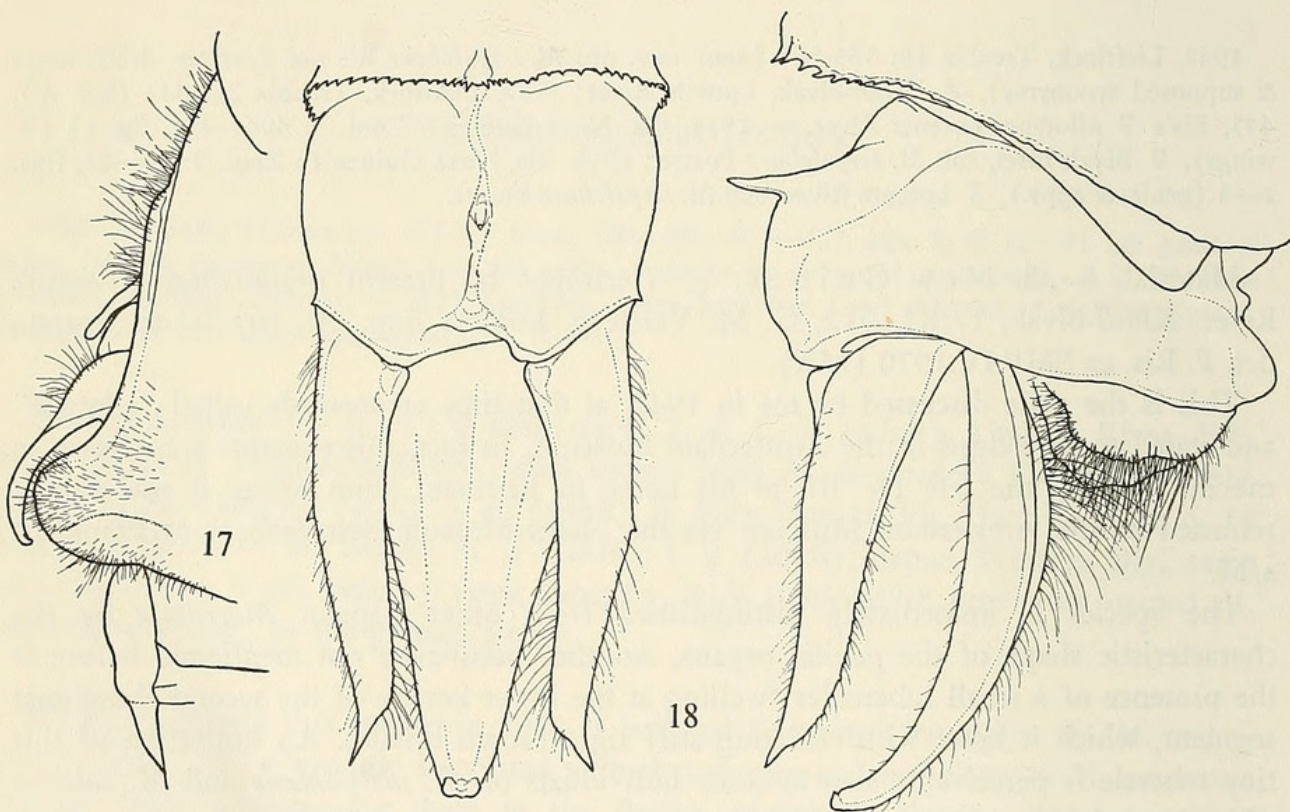


Fig. 17—18. *Macromia chalciope* Lieft. subsp., ♂ from Biak I. 17, genitalia; 18, anal appendages, dorsal and right lateral view

damaged at the apex of the terminal segment; otherwise the accessory genitalia are shaped similarly to those of typical *chalciope*, even the lobus posterior having the same blunt form (Fig. 17). Anal appendages also resembling greatly those of the Moluccan insect, yet the superior pair are more slender, especially the distal portion when viewed obliquely from within, each furnished with a minute exterior tooth at about half-way their length (lacking in typical *chalciope*!); also the tips are slightly more upturned in the Biak specimen and do not project beyond the apex of the appendix inferior, which in Moluccan *chalciope* is somewhat longer and appears to be less strongly upcurved (Fig. 18). The slender middorsal spine on the 10th segment is equally well developed and situated at the same place of the tergite.

Female. — All three individuals are nearly identical morphologically with the Halmahera examples, the first three abdominal segments showing the same brilliant metallic lustre. Diamond-shaped orange spot on dorsum of 7 about twice as large as in typical

chalciope, attached to the basal margin and not constricted directly beyond the suture (as in the male) but projecting posteriorly well beyond it and extending caudad to nearly half the segment's entire length. Valvula vulvae shaped as described earlier, the almost circular lobes being equally characteristic.

Measurements: ♂ abdomen + app. 48.4 mm, hind wing 44.0 mm; ♀ abdomen 46.2—48.3 mm, hind wing 47.5—49.0 mm; pterostigma as in typical *chalciope*.

In spite of the above differences, the present individuals are determined, with some reserve, as *M. chalciope*. More material, especially of the male, will be necessary to establish its proper identity, — most likely as a subspecies of the better known Moluccan dragonfly. This seems at present the best surmise in view of the widely different habitats and discontinuous distribution of the insects.

Macromia celaeno Lieftinck

1955. Lieftinck, Zool. Meded. Leiden, 33: 274—277, figs. 27—28 (♂ genit. & apps.), ♂ ♀ NE New Guinea. — 1900. Foerster, Termész. Füzetek 23: 86—88 (pars, excl. fig.), ♂ Kaiser Wilhelm-Land, Bongu (*M. terpsichore* n.sp., partim). — 1942, Lieftinck, Treubia 18: 563 (note on Foerster's males of *M. terpsichore* Foerst.).

Further material. — N.E. New Guinea: ♂, Astrolabe Bay, labelled "Im Urwald bei Bongu bei Constantinhafen, D. Neuguinea 10—12/1898", and "Macromia Terpsichore Foerster Type" (UMMZ); 1 ♂, Madang distr., Saidor subdistr., Finisterre Range, Kiambavi, 5000 ft., 22.VII.1958, W. W. Brandt. 2 ♂, Papua, 75 km W. of Pt. Moresby, Doa Estate, 2.IX and 14.X.1962, R. Straatman (1 ♂ BISH); 1 ♀, Papua, 60 mi. W. of Pt. Moresby, 17.IX.1961, R. Straatman; 2 ♂, Papua, Sogeri, N. of Pt. Moresby, 500 m, 27—28.X.1969, R. Straatman; 1 ♀ (juv.), Papua, Kokoda, 25—29.VII.1964, R. Zweifel & K. Sluder, 7th Archbold Exped. (AMNH). 1 ♂, d'Entrecasteaux Is., Fergusson I., Agamoia, 200 m, 21.VI.1956, L. J. Brass, 5th Archbold Exped. 2 ♂, Louisiade Archip., Sudest I., Mt. Riu, west slopes, Camp 10, 250—350 m, 26 & 29.VIII.1956, L. J. Brass, 5th Archbold Exped.

The 10 males presently available for comparison are not quite alike. They were collected in a variety of habitats all over the eastern part of the mainland and in more or less isolated island groups far beyond. The structural differences observed are slight and possibly due to clinal variation; yet it would be unwise to ignore them.

The original description of *M. terpsichore* Foerster was based on two males originating from the same locality. Since it became evident that these specimens were not conspecific (see Lieftinck, 1942: 562—563), I decided in 1957 to write to Dr. E. Kormondy, who at that time studied the Foerster collection in the Michigan Museum, Ann Arbor. He kindly complied with my request by sending me one of Foerster's males for comparison with allied species, and this example proved, indeed, to be quite distinct from *M. terpsichore* auct. We then agreed that a selection of a lectotype of *M. terpsichore* should be made. This was done by Kormondy, who wrote (August 21, 1957): "The lectotype, here designated, lacks the spine [on the 10th segment of abdomen] but has the protuberances on the 10th segment, as described by Foerster; the genitalia and anal appendages of the

lectotype agree with those figured by Lieftinck in 1942. The paratype [syntype] here designated, bears the spine, as described by Foerster; it also differs from the lectotype by bearing on each superior anal appendage a pronounced laterally directed angle at one-half the distance to the tip". Meantime, a new species, *M. celaeno* Lieft., had been described from the N.E. Division of Papua (Kwagira River). As this turned out to be conspecific with Foerster's *terpsichore*, from the eastern part of the Astrolabe Bay, no new name is required for the latter. It corresponds closely with the holotype of *M. celaeno*, this being only slightly larger. The latter also has the yellow thoracic markings and the spot on the 7th abdominal segment a little more reduced; otherwise the two are very similar. Unfortunately, the type of *M. celaeno*, and Foerster's Bongu male as well, are the sole individuals known from their respective localities. They differ from all others in the relatively great length of the inferior appendage, which in the males from the Madang district (N.E. New Guinea) and those from the islands of Fergusson and Sudest, are only little longer than the superior pair. The type also differs from the rest by having a more parallel-sided and broadly rounded lobus posterior (genital lobe),

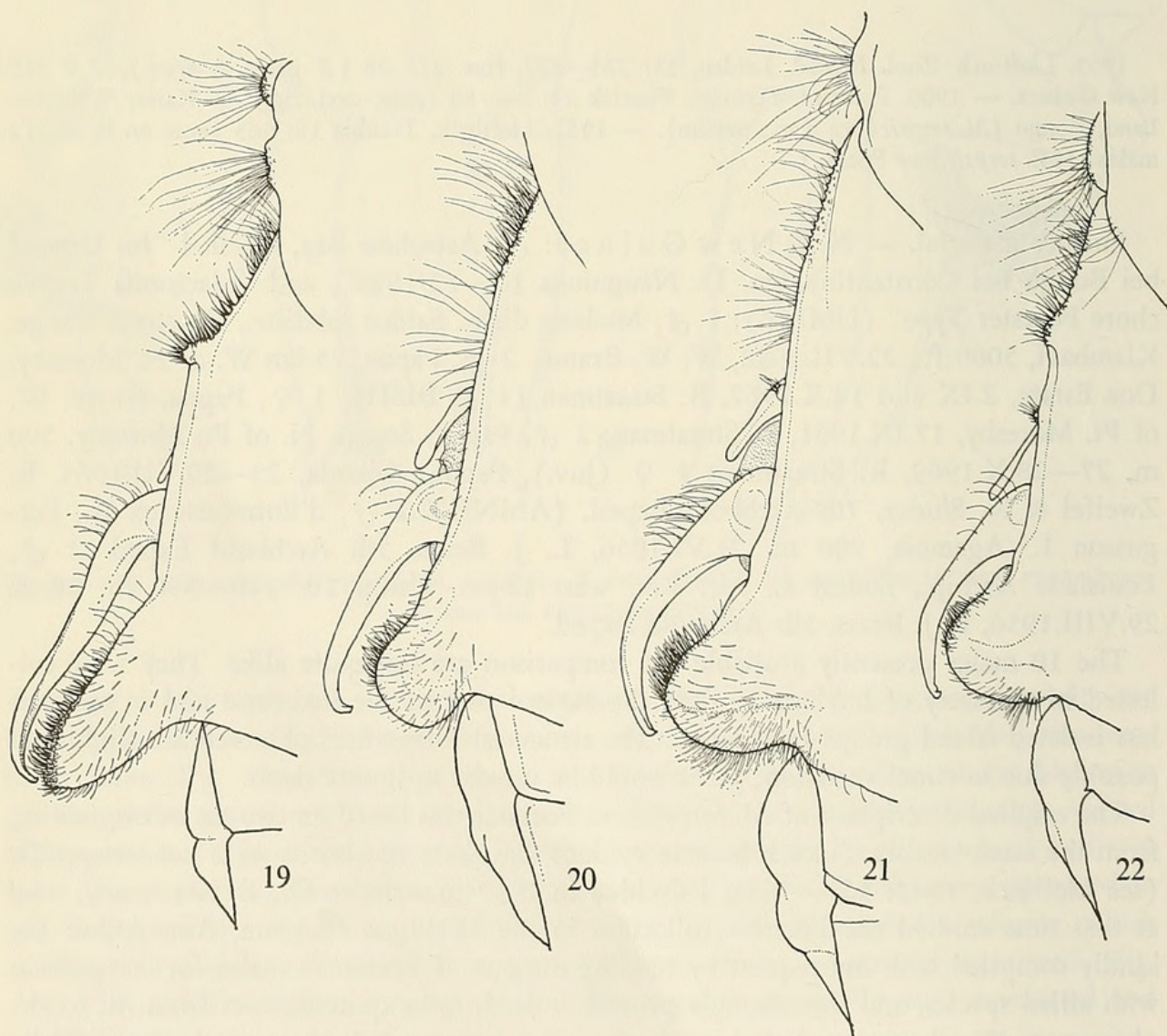


Fig. 19—22. Genitalia of ♂ *Macromia*. 19, *M. celaeno* Lieft., from Pt. Moresby; 20, *M. lachesis* spec. nov., from New Britain; 21, *M. astarte* spec. nov., from Kokoda trail; 22, *M. melpomene* Ris, from Upper Jimmi

which in all others appears more drawn out and tapering towards a narrower apex (Fig. 19).

Our males from the environs of Pt. Moresby (Doa Estate and Sogeri) are smaller in size and decidedly more slenderly built than the remaining specimens. They were first thought to represent a distinct species on account of the short inferior appendage, and based also on the fact that the external tooth at the superior pair is situated just a little more proximad than in most others, including the type. However, since we know little still about the amount of individual variation existing with regard to the above characters, I hesitate to lay too much stress on them as specific criteria. To take an other example: the presence or absence of a bristled tubercle at the base of the ventral border of the 2nd abdominal tergite, figured for one of these southern males (Fig. 19), does not seem to be a reliable character either: it is present in all of them, but barely indicated in the type and some other males.

Summarizing the above, it seems best for the present to consider *M. cелаeno* a polytypic species that can, perhaps, be split up later into a number of geographical races.

Female. — A full description of the topotypical specimen is found in the original description. The female from the Pt. Moresby area, though being a good deal smaller, agrees with it in all essential characters and so does the Kokoda specimen, which is rather immature; as to its dimensions the latter nearly corresponds with the allotype. Wings hyaline; bases diffusely yellow about as far out as Ax_1 ; tips of fore wings deep golden yellow from a little beyond nodus as far as the apex. Anal loop of hind wing enclosing 14—16 (Pt. Moresby) or 18—21 cells (Kokoda).

In the fully adult Pt. Moresby specimen the leaf-like blades of the genital valve are a little broader than in the allotype and extend back about three-fourths the length of the 9th tergite, measured along the middorsal crest; they are directed obliquely ventrad and caudad, each blade being hollowed out with upcurved tip. Anal appendages hairy, distinctly outcurved; tips slender, acuminate.

Measurements (in mm)

	abd. + app.	hind wing	pterostigma
♂ Kwagira River (holotype)	49.8	44.4	1.4—1.5
♂ Madang	48.4	44.0	1.3—1.4
♂ Bongu (syntype <i>terpsichore</i>)	47.8	43.0	1.3
♂ Fergusson I.	50.0	45.0	1.9
♂ Sudest I.	48.0	45.2	1.3
♂ Sudest I.	48.0	46.0	1.4
♂ Papua (Sogeri)	45.8	42.9	1.2
♂ Papua (Sogeri)	45.5	42.7	1.3—1.4
♂ Papua (Pt. Moresby)	45.8	41.8	1.2
♂ Papua (Pt. Moresby)	44.3	41.3	1.2
♀ Kwagira River (allotype)	51.0	49.3	1.5
♀ Papua (Kokoda, juv.)	50.0	50.0	1.0—1.2
♀ Papua (Pt. Moresby)	45.5	46.0	1.2

Macromia lachesis spec. nov.

Fig. 20, 25—26

1942. Lieftinck, Treubia 18: 562—563, pars: ♀ Herbertshöh, New Britain, sub *M. terpsichore* Foerst.; 1949. Lieftinck, Treubia 20: 361, no descr., sub *M. terpsichore* Foerst.

Material. — Bismarck Archipelago: 7 ♂ (one imperfect) 1 ♀, New Britain, Gaulim, 130—160 m, 20—28.X.1962 (2 ♂ 1 ♀) and Illugi, 8—15.XII.1962 (5 ♂), all J. Sedlacek. Holotype ♂, New Britain, Illugi, 8.XII.1962, J. Sedlacek; paratypes ♂ and ♀ (BISH), from the above localities. 2 ♂, New Britain, Yalom, 1000 m, 15.V.1962, Noona Dan Exped. 1961—62 (MC); 1 ♂, New Britain, 15 km SE of Kokopo, 10.VII.1962, Noona Dan Exped. 1961—62. 1 ♀, New Ireland, Danu, Kalili Bay, 29.IV.1962, Noona Dan Exped. 1961—62 (MC).

Very similar to *M. celaeno* Lieft. and obviously nearly related with it.

Male (ad., holotype). — Head a little smaller than in *celaeno*, width across the eyes 8.9 mm; shape, texture and colour of face, frons and vertex not differing from that species. Labium brown, generally darker than in *celaeno*. Labrum and mandibles deep black, surface shiny. Anteclypeus dark brown with an indistinct greyish-yellow spot upon middle. Postclypeus blackish-brown marked with a pair of large, bright chrome lateral spots, each of which occupies the whole of the side portions save the anterior border narrowly, the latter remaining black; these transverse spots are more sharply defined than in *celaeno*, each tapering to a point inward, the distance separating them subequal to, or a little less than, their own breadth. Frons and vertex brilliant metallic green. Occipital triangle black, raised slightly above level of compound eyes, the lateral margins acute, as in the allied species; rear of the head glossy black.

Thorax brilliant metallic green; yellow markings as in *celaeno*, median crest, ante-alar triangles (except black anterior rims) as well as a transverse lanceolate spot on each side in front of the latter, chrome; metaspicular stripe moderately broad, a little shorter than in *celaeno*, leaving off fully 1 mm before reaching dorsal margin of metepisternum; latero-ventral border of metepimeron more narrowly yellowish but ventral surfaces coloured as in that species.

Legs a little shorter than in *celaeno*, coloured as described for that species; hind femur (incl. troch.) 10.0 mm long, not reaching beyond apex of lobus posterior of genitalia. Keel on flexor side of fore tibia extending less than half (41%) the total length, i.e. a little shorter than in *celaeno*, armature otherwise similar, the inner ramus of the tarsal claws equally robust and longer than the apex itself.

Shape and neuration of wings, including the anal area and excavated angle, hardly differing from the allied species (see description of *M. celaeno*), but as compared with the latter the venation is somewhat denser and the membranula is of a darker grey.

Nodal index $\frac{8.16.17.8}{12.10.11.12}$; cross-veins in *ht* $\frac{4.4}{1.1}$; *Cux* $\frac{5.6}{4.4}$; anal loop with 11 and 9 cells, with or without central cell. Pterostigma brownish-black, almost black.

Abdomen relatively shorter than in *celaeno*, with the intermediate segments less constricted and the terminal ones more gradually expanded: in *celaeno* the greatest breadth of the abdomen is attained at the apex of the 9th segment, whereas in *lachesis* it is widest at the end of the 7th, the 8th being almost parallel-sided while the apical

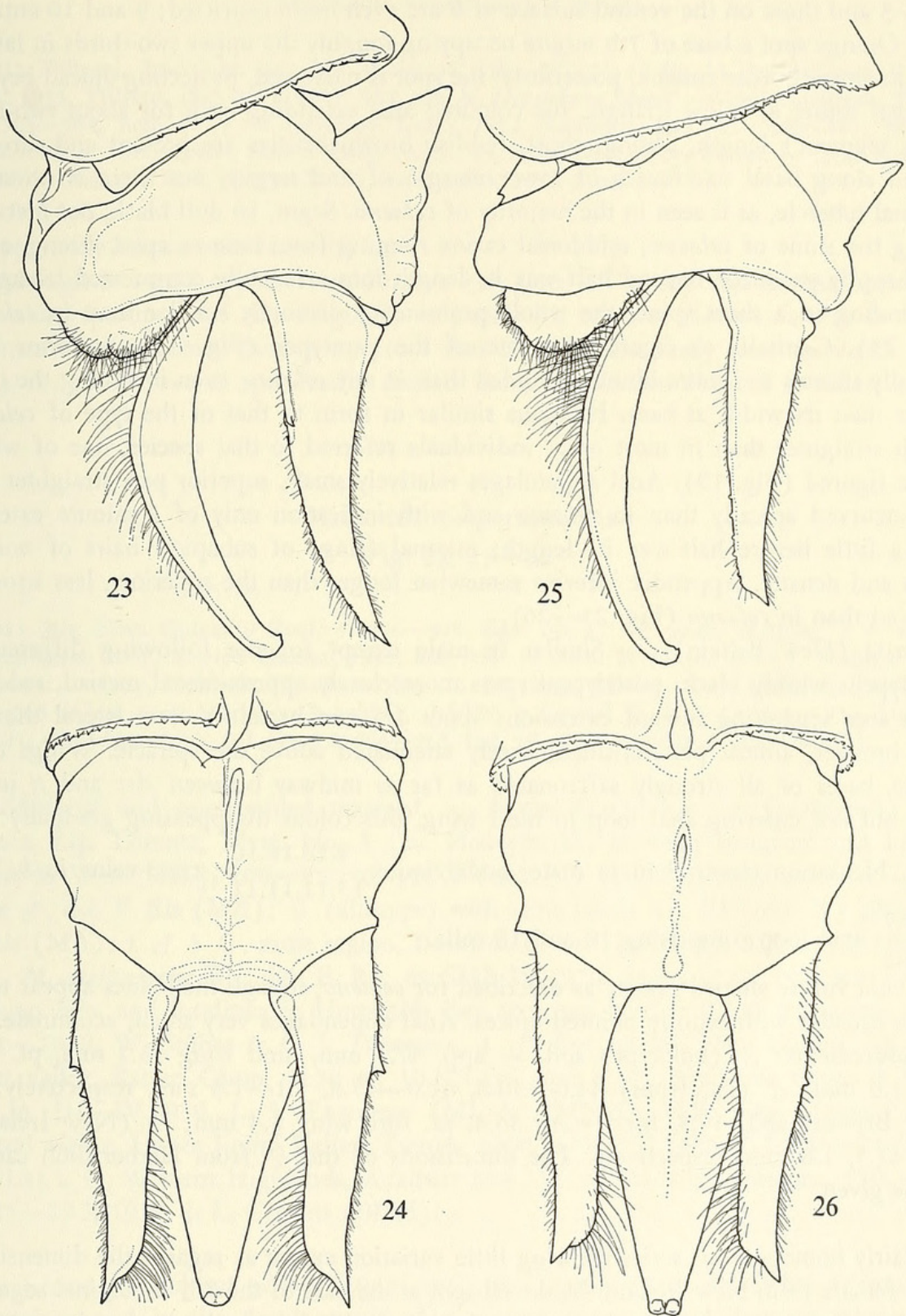


Fig. 23—24. *Macromia celaeno* Lieft., from Pt. Moresby, ♂ anal appendages. 23, left side; 24, dorsal view. — Fig. 25—26. *Macromia lachesis* spec. nov., from New Britain, ♂ anal appendages. 25, left side; 26, dorsal view

segments again diminish gradually in width toward the end. Moreover, the segments 8, 9 and 10 are markedly less highly crested when viewed from the side, 8 and 9 being less protuberant posteriorly. Colour and markings not different, except that the yellow spots

on 2—3 and those on the ventral surface of 8 are even more restricted; 9 and 10 entirely black. Orange spot a base of 7th tergite occupying roughly the upper two-thirds in lateral view, its lower border convex; posteriorly, the spot is narrowed, projecting apicad beyond the jugal suture as a low triangle, the coloured area extending back for about two-fifths of the segment's length. Strong, short, reddish brown bristles are present and directed ventrad along basal one-fourth of lower margin of 2nd tergite, but there is no small marginal tubercle, as is seen in the majority of *celaeno*. Segm. 10 dull black, not metallic, lacking the shine of *celaeno*; middorsal carina running from base to apex, strong, acute and abruptly produced beyond half-way its length into a laterally compressed triangular boss ending in a short spine, the whole prominence distinctly smaller than in *celaeno* (Fig. 25). Genitalia as figured for one of the paratypes (Fig. 20); posterior lobe markedly shorter and more bluntly rounded than in any *celaeno*, even including the type, shorter than its width at base. Hamulus similar in form to that of the type of *celaeno* though straighter than in most other individuals referred to that species, one of which is here figured (Fig. 19). Anal appendages relatively small, superior pair straighter and less outcurved apically than in *celaeno* and with indication only of a minute external tooth a little before half-way its length; internal fringe of subapical hairs of normal length and density. Appendix inferior somewhat longer than the superiors, less strongly upcurved than in *celaeno* (Fig. 25—26).

Female (New Britain). — Similar to male except for the following differences. Anteclypeus wholly black; postclypeal spots more closely approximated mesiad, reddish-brown area separating inward extensions about 1.5 mm broad. Yellow lateral thoracic stripe broader, almost parallel-sided, barely attenuated above the spiracle. Wings clear hyaline, bases of all strongly saffronated as far as midway between *Arc* and *ti* in all wings but not entering anal loop in hind wing, this colour disappearing gradually outwards. Neuration closer than in male, nodal index $\frac{9.18.18.10}{13.11.11.11}$; cross-veins in *ht* $\frac{5.5}{2.3}$;

Cux $\frac{6.7}{4.3}$; anal loop comprising 18 and 18 cells.

Valvula vulvae shaped exactly as described for *celaeno*, though the blades appear to be a trifle broader with bluntly pointed apices. Anal appendages very small, acuminate.

Measurements: ♂ (holotype) abd. + app. 47.7 mm, hind wing 43.2 mm, pt. fore wing 1.0 mm; ♂ (paratypes) 44.0—50.8, 41.0—47.8, 1.1—1.3 mm, respectively; ♀ (New Britain) abd. 44.3, hind wing 46.8, pt. fore wing 1.4 mm; ♀ (New Ireland) 45.5, 47.5, 1.8 mm, respectively. The dimensions of the ♀ from Herbertshöh cannot now be given.

A fairly homogeneous series showing little variation except as regards the dimensions. In the female from New Ireland the dorsal spot at the base of the 7th abdominal segment is oval, widest at its middle and placed in the long axis of the body; it occupies only the upper one-fourth of the tergite in lateral aspect. Unlike *M. celaeno*, this sex shows no sign of a postnodal golden yellow area on the fore wings. *M. lachesis*, along with *celaeno*, runs out in my key (1952: 441) to near *sophrosyne* from Waigeu Island. The males of these three species can be held apart most satisfactorily by a comparison of their anal appendages and accessory genital organs, illustrations of the parts being now available for all. Here again, the differences are slight and should be evaluated in conjunction with other characters, such as body form and markings.

Macromia viridescens Tillyard

1911. Tillyard, Proc. Linn. Soc. N.S. Wales 36: 380—381, pl. 10 fig. 11 (pterostigma) ♀ Cape York; 1913. Tillyard, *ibid.* 37 (1912): 584, sub *M. terpsichore* Foerst. — 1942. Lieftinck, Treubia 18: 563—564, note = ? *M. eurynome* Lieft.; 1952. Lieftinck, *ibid.* 21: 444—445, holotype redescribed. — 1960. Fraser, Handb. Drag. Austr.: 49, sub *M. terpsichore* Foerst. — 1968. Kimmins, Bull. Brit. Mus. nat. Hist. (Ent.) 22: 301, note on holotype (♂ err. pro ♀).

Apparently known only from the type.

Although it would appear from Fraser's key (loc. cit. 1960) that he had seen more Australian specimens of this dragonfly to justify his opinion that *viridescens* is only a synonym of *terpsichore*, there is no proof that Fraser had actually seen the insect. Most likely *M. viridescens* is specifically distinct from the known Papuan members of the genus.

Macromia melpomene Ris

Fig. 22, 29—30

1913. Ris, Nova Guinea 9 Zool. 3: 496—499, figs. 14—17 (♂ genit. & apps., ♂ ♀ wings), Lorentz River territ., S. New Guinea; 1915, Ris, *ibid.* 13 Zool. 2: 85 (no descr.), Beaufort River, same area. — 1929, Lieftinck, Tijdschr. v. Ent. 72: 63 (key), 68—69; 1942, Lieftinck, Treubia 18: 564—565 (addit. descr., variation & habits), ♂ ♀ N. & Central W. New Guinea; 1952, Lieftinck, *ibid.* 21: 441 (descr. key), 461 (key) & 464—465, figs. 14—15, 17 (descr. & larval struct.).

Additional and re-examined material. — New Guinea: ♂ (holotype), Nova Guinea Exp. Lorentz, Bivak No. 3 [= Heuvelbivak, between Beaufort and Lorentz Rivers in Went Mts.], 700—750 m, 12.XI (rect. X) 1909, *M. melpomene* n. sp. Ris Type ♂, det. F. Ris (MA); ♀ (allotype) with same labels, 13. XI (rect. X) 1909, det. F. Ris (MA); 1 ♂ 1 ♀, same region, Beaufort River, 12.XII and 8.XII.1912, Lorentz Exp., *M. melpomene* Ris, det. F. Ris, ex SMF IV.1970. Series ♂ ♀, N. New Guinea, Cycloop Mts. and localities in Humboldt Bay area, sea level to 1100 m, various dates, 1931—1938, W. Stüber & L. J. Toxopeus; 1 ♂, Central W. New Guinea, Idenburg River valley, Rattan Camp, 1150 m, 10.II.1939, and 8 ♂, Araucaria Camp & River, 800 m, III—IV.1939, L. J. Toxopeus (ML & AMNH). N.E. New Guinea: 2 ♂, Central region, Upper Jimmi Valley, Tsenga, 1200 m, 14.VII.1955, J. L. Gressitt (BISH & ML); 1 ♀, Western Highlands, Adalbert Mts., W. of Madang, Wanuma, 750—1050 m, 25—29.X.1958, J. L. Gressitt (BISH).

As I have pointed out earlier (1942: 565), this species varies somewhat in respect of dimensions and in the development of a minute extero-lateral denticle at the male superior appendage, which latter occasionally may be obsolete. Variation also exists in the extent of the basal mark upon the 7th abdominal segment. This occupies almost the basal half of the dorsum in both male and female from the typical locality but is much smaller in northern individuals and in those from the Upper Jimmi valley in the east, where the spot barely projects beyond the jugal suture. These eastern specimens differ from the others also in that the lateral thoracic stripe is much narrower, being hardly 0.5 mm broad at its upper portion. In them the posterior hamule is not so strongly

curved as in the type, and in one the dorsal process of the 10th segment is less compressed, approaching the form it has in *M. astarte* spec. nov.; this is, however, a smaller and more obscurely coloured insect.

I must confess not to feel sure about the correctness of the identification of the insects from north-central and eastern localities in New Guinea, reported above. Unless *M. melpomene*, like some others, varies individually all over the continent and even within a restricted area, all of them may prove ultimately to represent geographical subspecies, each with a limited range, or even belong to distinct species intimately allied with it.

The measurements of the examples from N.E. New Guinea are: ♂ abd. + app. 49.0—50.0 mm, hind wing 47.0—47.5 mm, pt. fore wing 1.1—1.2 mm; ♀ 48.5, 49.0 and 1.3 mm, respectively. The genital organs and anal appendages of a Tsenga male are here figured (Fig. 22, 29—30).

Macromia spec. indet.

Material. — D'Entrecasteaux Is.: 2 ♀ (ad.), Goodenough I., 900 m Camp, East slopes, 25 & 26.X.1953, K. M. Wynn & L. J. Brass. 1 ♀ (ad.), Normanby I., Mt. Pabinama, 820 m, 10.V.1956, L. J. Brass.

This is another near ally of *M. melpomene*, collected by members of the 4th and 5th Archbold Expeditions in the islands east of the Papuan mainland and received by courtesy of the American Museum of Natural History, New York. The specimen from Normanby is an aged individual having the entire wing membrane coloured a smoky brown. The two females taken on Goodenough have hyaline wings with a cloudy yellow spot occupying most of the postnodal portion of the fore wings. They are darker than the allotype female of *M. melpomene* and even superior in size to the latter, differing also by having an almost black pterostigma.

By the absence of a male I prefer to leave these examples without a name. Their proportions are: abd. 49.0—50.0, hw. 49.0—51.0, pt. fore wing 1.2 mm (Goodenough), 50.0, 49.0, 1.2 mm, respectively (Normanby).

Macromia astarte spec. nov.

Fig. 21, 27—28

Material. — S.E. New Guinea: 4 ♂ (adult), Papua, Kokoda trail, 700 m, 14.X.1969 (1 ♂) and 4—7.XI.1969 (3 ♂), R. Straatman; 1 ♀ (semi adult), Papua, Sogeri, N. of Pt. Moresby, 500 m, 3.XI.1969, R. Straatman. Holotype ♂, Kokoda trail, 5.XI.1969, R. Straatman. Paratypes: 3 ♂ from Kokoda trail (BISH and ML); ♀ from Sogeri.

As compared with the two males (type and paratype) of *M. melpomene* that are known from the hill-country of southwest New Guinea, this new species is readily distinguished by its smaller size, slenderer forms, much narrower metepisternal stripe, and reduced orange marking at the base of the 7th abdominal tergite. The structure of the facial parts, leg armature, wing venation and body colour, are all so much alike in the two species that there is no need for descriptions. The principal features by which the two can be held apart are summarised below and are best appreciated by a comparison of the existing illustrations, including those given by Ris (1913).

M. astarte. — Smaller, ♂ abdomen + app. not exceeding 46 mm, hind wing 43—44

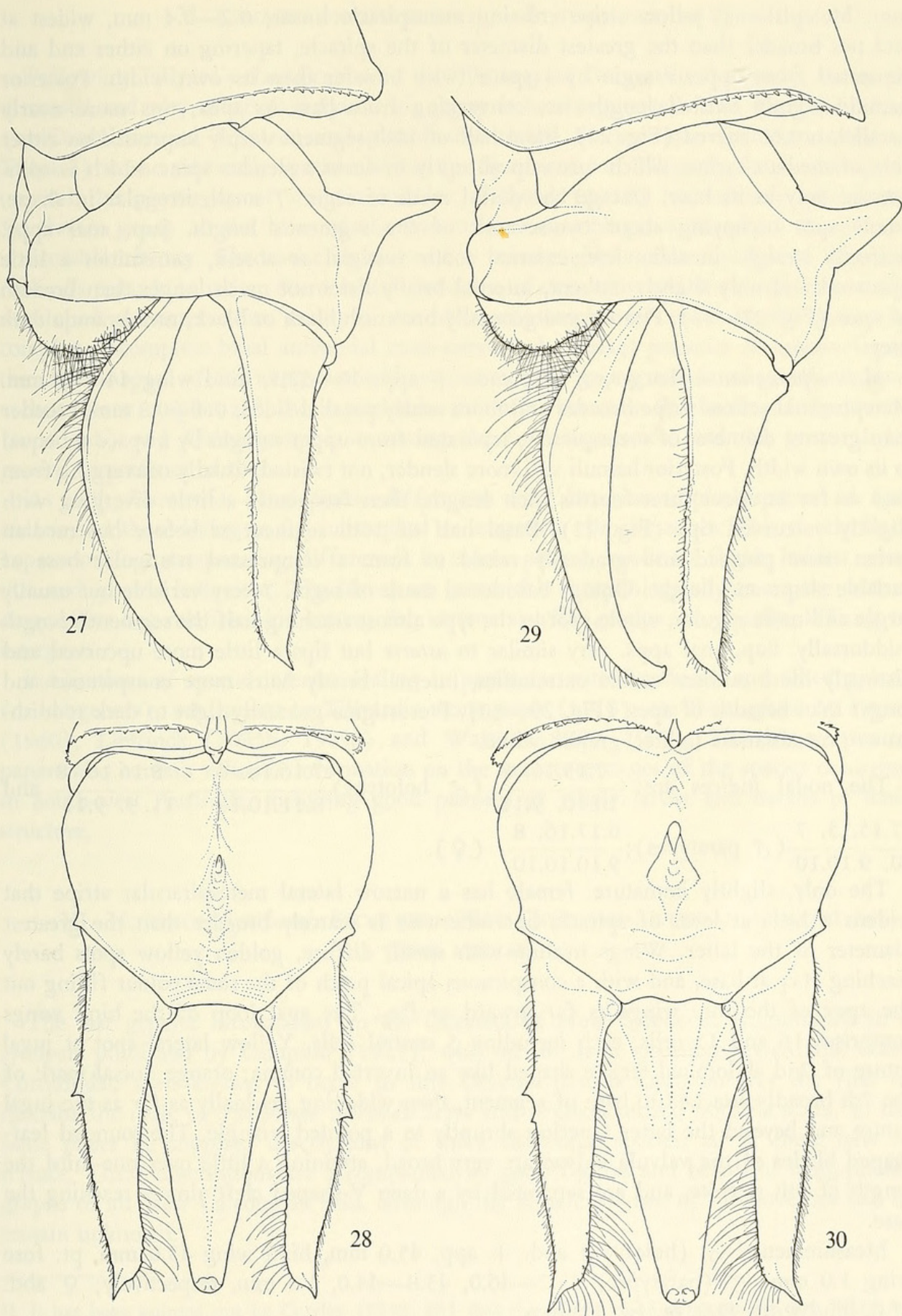


Fig. 27—28. *Macromia astarte* spec. nov., from Kokoda trail, ♂ anal appendages. 27, left side; 28, dorsal view. — Fig. 29—30. *Macromia melpomene* Ris, from Upper Jimmi, ♂ anal appendages. 29, left side; 30, dorsal view

mm. Metepisternal yellow stripe crossing metaspiracle linear, 0.2—0.4 mm, widest at and not broader than the greatest diameter of the spiracle, tapering on either end and separated from upper margin by a space twice broader than its own width. Posterior hamuli slightly twisted lengthwise, converging from base to apex, tips more nearly parallel, not outcurved (Fig. 21). Basal half of 10th segment deeply impressed on either side of median carina, which turns up abruptly to form a slender spine which is compressed only at its base. Orange basodorsal mark of segm. 7 small, irregular in shape, whole spot occupying about two-seventh of the segment's length. Sup. anal apps. perfectly straight in side view, external tooth vestigial or absent, extremities a little upcurved and only slightly outbent, internal bristly hairs not much longer than breadth of apex (Fig. 27—28). Pterostigma generally brownish-black or black; membranula dark grey.

M. melpomene. — Larger, ♂ abdomen + app. 49—52.5, hind wing 44—49 mm. Metepisternal yellow stripe broader and more nearly parallel-sided, 0.4—0.8 mm, broader than greatest diameter of metaspiracle, separated from upper margin by a space subequal to its own width. Posterior hamuli still more slender, not twisted, usually converging from base as far as about three-fourths their length, then frequently a little diverging with slightly outcurved tips (Fig. 22). Basal half of 10th segment as before but median carina more pinched and gradually raised to form a compressed triangular boss of variable shape and height. Orange basodorsal mark of segm. 7 very variable but usually larger and more regular, whole spot in the type almost reaching half the segment's length middorsally. Sup. anal apps. very similar to *astarte* but tips a little more upcurved and distinctly more outbent at the extremities, internal bristly hairs more conspicuous and longer than breadth of apex (Fig. 29—30). Pterostigma generally light to dark reddish-brown; membranula lighter, greyish white.

The nodal indices are: $\frac{7.15.16.8}{10.10.9.11}$ (♂ holotype), $\frac{7.16.16.6}{8.11.10.10}$, $\frac{8.16.16.8}{11.9.9.11}$ and $\frac{7.15.15.7}{10.9.10.10}$ (♂ paratypes); $\frac{6.17.16.8}{9.10.10.10}$ (♀).

The only, slightly immature, female has a narrow lateral metaspiracular stripe that widens a little at level of spiracle but otherwise is scarcely broader than the greatest diameter of the latter. Wings hyaline with small, diffuse, golden yellow spots barely reaching Ax_1 at base, and with a conspicuous apical patch of the same colour filling out the apex of the fore wings as far inward as Px_2 . The anal loop of the hind wings comprises 16 and 15 cells, each including 3 central cells. Yellow lateral spot at jugal suture of 2nd abdominal tergite shaped like an inverted comma; orange dorsal mark of the 7th broadly attached to base of segment, then widening gradually as far as the jugal suture and beyond the latter tapering abruptly to a pointed triangle. The rounded leaf-shaped blades of the valvula vulvae are very broad, attaining a little over one-third the length of 9th sternite, and are separated by a deep V-shaped cleft almost reaching the base.

Measurements: ♂ (holotype) abd. + app. 45.0 mm, hind wing 43.0 mm, pt. fore wing 1.0 mm; ♂ (paratypes) 43.2—46.0, 43.8—44.0, 1.2 mm, respectively; ♀ abd. 47.0, hind wing 47.0, pt. fw. 1.2 mm.

As explained before, populations of *M. melpomene* from geographically remote habitations show slight differences in one way or other; but considering all characters of both, there can be no doubt that *astarte* should be regarded as a distinct species.

V. REMARKS ON THE SUBFAMILY SYNTHEMISTINAE¹⁾

Following Tillyard's classification in the "Biology of Dragonflies" (1917), the much discussed and very diversified *Synthemis* group is here segregated from the Corduliidae (or Corduliinae of Tillyard) and placed next to the Macromiinae (or Macromiini of Tillyard) in the subfamily Synthemistinae (or Synthemini of Tillyard). In an attempt to unravel the phylogeny of the Corduliidae, Tillyard (1910) had already placed the *Synthemis* group at the base of the macromian assemblage, with which there exist undeniable affinity. The above units are thus merely given subfamily instead of tribal rank. As regards venation, its members present a mixture of very archaic and secondarily developed characters. For example, the alternate strength of veins in the antenodal complex, incomplete basal antenodal cross-nerve and constant presence of cross-veins in the median space of the wings are without counterpart among associated genera. Several authors have emphasized the remarkable similarity between the larvae of *Synthemis* (sens. lat.) and Chlorogomphinae among the cordulegasterids, and the great phylogenetic importance of this.

As with *Macromia*, considerable differences exist between tropical species of *Synthemis* and those living in the subtropical or temperate climatic zones. This clearly finds expression in corresponding differences in colour pattern, mode of flight, habitat selection and general behaviour. The larvae are as variable morphologically as are the mature dragonflies but relationships among the various specific groups are equally difficult to interpret.

Publications of special interest dealing in particular with *Synthemis* and allied genera (or subgenera), subsequent to Tillyard's monograph (1910), are those given by Fraser (1960), Lieftinck (1935b, 1953a) and Watson (1962, 1967). The last-mentioned papers also contain valuable information on the immature stages of the species occurring in South-west Australia, including good pictures of whole larvae and details of their structure.

VI. NOTES ON *Synthemis* SELYS FROM NEW CALEDONIA, WITH AN ACCOUNT OF THEIR LARVAE

The last general information on the Odonata of New Caledonia is contained in a synopsis published by Campion (1921), who on the same occasion revised the other Corduliidae then known to occur in this Oceanic island. Campion was the first to describe the male of *Synthemis miranda* Selys and re-characterized both its sexes. In the same paper he supplied descriptions of three additional species, all of them new to science. These descriptions are accompanied by good figures and beautiful wing-photographs of all New Caledonian taxa, although the females of two of the novelties had to remain unknown.

¹⁾ It has been pointed out by Cowley (1942: 63) that the names of all suprageneric taxa based on generic names ending in *-themis* should be emended. The present writer has accepted Cowley's suggestion to adopt *themist-* as being the Homeric form which occurs in names like Themistocles, instead of regarding the stem to which the group-ending is added as *them-*, the former selection being the more correct one.

In the following pages some more data can be supplied concerning the imagines of New Caledonian *Synthemis*, with descriptions of the females of two species already dealt with by Campion and both sexes of one previously unknown. I have taken the present opportunity also to give an account of the highly peculiar larvae of two different species, with drawings of their most remarkable morphological parts. Campion (loc. cit.) had already given a brief diagnosis of an unidentified *Synthemis* larva, the first of its kind found in New Caledonia. This larva was like that of the Australian

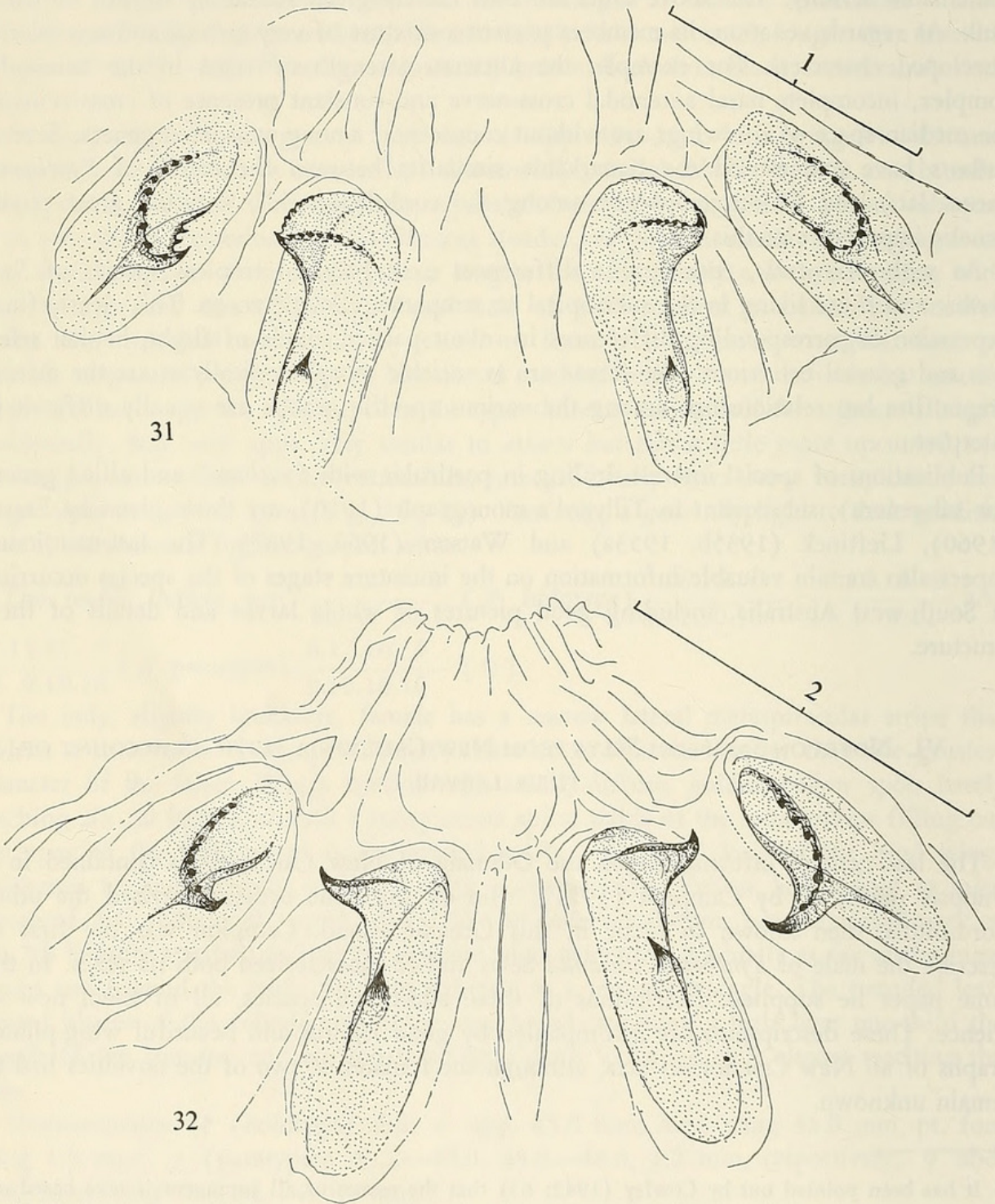


Fig. 31—32. Proventriculi of ultimate instar larvae of New Caledonian species. 31, *Synthemis fenella* Campion (supposition); 32, *S. miranda* Selys (supposition), showing dentition of dorsal and ventral plates from within

Eusynthemis guttata in having the median lobe of the labium produced anteriorly and a conspicuous semicircular plate projecting from the frons. In other ways, however, it failed to agree with that of any other known species in the subfamily, especially on account of its smooth body and scantiness of setae at the labial palpus. These features are manifest also in the two kinds presently discussed, but all three are easily distinguished from one another and obviously belong to three distinct species. At the same time they can be distinguished from most, if not all, other congeners from outside New Caledonia.

The proventriculus (gizzard) of the two available species was cut open longitudinally and spread out, showing from within the set of four teeth-bearing folds arranged in bilateral symmetry. The armature of the plates is much alike in the two species described (Fig. 31—32) and needs no further explanation, except that their shape conforms in almost every detail to that shown by a host of other Corduliidae and Libellulidae, inclusive of *Macromia* and *Idionyx* among members of the first family.

Synthemis miranda Selys

Fig. 16, 32

1871. Selys, Bull. Acad. Belg. (2) 31: 557—558 (121—122 sep.), ♀ Nouvelle Calédonie. — 1921, Campion, Ann. Mag. Nat. Hist. (9) 8: 34, 47—55, figs. 6—8 (♂ and ♀ app. & ovip.), pl. 8 fig. 12 (♂ wings.).

Besides a number of specimens which had been examined at an earlier date and returned to the Bishop Museum (Honolulu), the following are still before me.

Material. — New Caledonia: 2 ♂, Bourai-Houailou Rd., III.1959, N. & L. H. Krauss; 1 ♀, La Foa, 17.III.1961, J. Sedlacek; 1 ♀, La Crouen, 16.III.1961, J. Sedlacek; 1 ♀, Forêt de Thi, 550 m, 6.III.1960, J. L. Gressitt; 1 ♂, Mt. Mou, 11.II.1962, N. & L. H. Krauss; 1 ♂, Col de Pirogue, 13.II.1962, N. & L. H. Krauss; 1 ♂, Nakety, 400 m, 23.XII.1963, R. Straatman; 1 ♂, Col de Rousettes, 550 m, 6.II.1963, J. L. Gressitt; 1 ♀, Mt. des Sources, 550 m, 30.XII.1963, R. Straatman; 1 ♀, Canala, 23.XII.1963, R. Straatman; 2 ♀, Pouébo, 12.I.1964, R. Straatman. (All in BISH & ML).

Both sexes of this extremely handsome dragonfly have been discussed at some length by Campion, who gave good figures of the terminalia of either sex as well as a wing-photograph of the male. The same author commented upon the variation in extent and depth of the coloured areas on the wings of the female. I have examined good series of this species from various localities in New Caledonia and it seems that *S. miranda* is the least rare of its large-sized congeners inhabiting the island. From the present series it would appear that there are two main colour forms of the female, which differ markedly from one another as far as the wing colour is concerned, evidently quite independent from the age of the individual, intermediates occurring at the same time, though apparently more rarely.

Following Campion's notes, some additional characteristics can now be given, which are based on five males and seven females.

Male. — Agreeing with Campion's description of the allotype but for the following details. Anteclypeus dirty yellow, postclypeus in the middle likewise, but lateral divisions

wholly cream-coloured. Frons metallic blue-black with a pair of small creamy oval spots, one on either side towards the eye-margin, and often also a very small, slightly impressed yellow spot on each of the frontal tubercles anteriorly. Creamy yellow bands at the thoracic sides complete, the one at the first suture leaving off shortly before reaching the dorsal crest, the metepimeral stripe slightly curved and complete. Legs black, the coxae and trochanters somewhat more brownish; fore tibia with yellow-green interior stripe, incomplete basally. Tibial keels whitish, extending along about distal one-half on fore and mid tibiae, along distal 7/9 on hind tibia. Pterostigma deep black.

Abdominal segment 1 usually with two small yellow dots low down at the sides, 2 with a broad subinterrupted yellow stripe bordering lower margin of tergite, and 5 occasionally with additional tiny yellow spot on either side at extreme base. Genital organs black; hamulus strongly protuberant, thick and subcylindrical for its basal three-fourth, then rather abruptly narrowed, directed caudad and tapered, with slender out-curved tip.

Female. — All specimens are fully coloured. Three of these differ from the type in respect that the deep golden area in the wings in no case extends beyond the level of the arculus, though in all of them brown rays are present also in *sc*, fading away at about the same level. In three other females the wing membrane is as conspicuously coloured as in the holotype: in them not only the bases of fore and hind wings are deeply stained with golden yellow as far as the arculus and rich brown in *sc* to beyond the nodus, but there are also broad oblique brown bands which extend as far out as about midway between base and nodus. One specimen (from Pouébo) in this respect is exactly intermediate between the extremes just mentioned.

The shape of the ovipositor valves corresponds with the description given by Campion, inasmuch as the paired outer and inner processes, although fused together for their whole length on each side of a narrow V-shaped emargination, are still recognizable by a longitudinal furrow separating them.

Measurements. — ♂ abdomen + app. 48.0—51.0 mm, hind wing 39.0—42.0 mm, pt. fore wing 2.5—2.8 mm; ♀ abdomen 50.0—53.0 + 1.5—1.7 mm, hind wing 46.0—47.5 mm, pt. fore wing 3.0 mm.

Synthemis campioni spec. nov.

Fig. 33—35

Material. — New Caledonia: ♂ (adult, holotype), N.E.-side, Pouébo, 200 m, 24.I.1964, R. Straatman; ♂ (subadult), Mt. Mou, 11.II.1962, N. & L. H. Krauss (BISH); ♀, La Crouen, 16.III.1961, J. Sedlacek; 2 ♀ (adult), N.E.-side, Pouébo, ca. 250 m, near mountain stream, 23.I.1964, R. Straatman (1 ex. BISH).

Very near *S. montaguei* Campion and of the same slender build.

Male (holotype). — Labrum ochraceous-orange, broadly bordered with black; low median longitudinal ridge also blackish anteriorly. Clypeus olivaceous-brown, the post-clypeus with oval pale greenish-yellow spot on either side. Frons anteriorly and round-about the prominent tubercles blackish brown, marked each side with a squarish pale greenish-yellow spot towards margin of compound eye; anterior surface of tubercles red-brown. Vertex brownish-black. (In *S. montaguei* the light areas of labrum, post-

clypeus as well as those upon summit and sides of frons are definitely larger, more sharply delimited and bright greenish-yellow in colour; the roundish spots on top of frontal tubercles are well marked off posteriorly from a thick bluish-black band at the base of frons).

Pro- and synthorax metallic brown, less obscured than in *S. montaguei* and with metallic green reflections less evident on mesepisternum and posterior to first lateral suture. No yellow markings at spiracle and first lateral suture (*S. montaguei*: an undulated yellowish stripe dividing mesepimerum and metepisternum, separated from a yellow spot placed a little more ventrad at the spiracle).

Legs lighter brown than in *S. montaguei*, femora less obscured apically. Tibial keels as in that species, extending along distal one-half on fore and middle pair and a little more than distal three-fourths on hind tibia.

Wings hyaline with rusty brown spots, ill-defined distally, in *c-sc* as far as the basal postcostal nervure, and traces of similarly coloured spots in *m* and *cu*. Shape of wings very similar to *S. montaguei*; neurulation dense. Fore wings with 22 *Ax* of first series and 13—15 *Px*, hind wings with 15—16 *Ax* and 17 *Px*. Triangle with 2 cross-veins in fore wing, only 1 (or *t* 3-celled!) in hind wing; *ti* 3-celled in fore wing; *bt* with 3 cross-veins in fore wings, 2 in hinder pair; *m* with 5 in fore wings, 4 in hind wings; *cu* with 8—9 in fore wings, 7—8 in hinder pair. Bridge cross-veins 7—8 in fore as well as in hind wings. Discoidal field of fore wings commencing with 4 cells, then expanded and followed by double cells up to a point one cell distal to the separation of *M*₁₋₂; 15—18 marginal cells. Primary (distal) anal loop consisting of 6—7 cells without central cell, the secondary (proximal) enclosure with 4—5 cells. Pterostigma a little longer than in *S. montaguei*, without brace vein; colour dark brown. Membranula white (smoky grey to black in adult *S. montaguei*), extending as far as the cross-vein in anal triangle.

Shape and markings of abdomen much as in *S. montaguei* but all light spots a little smaller, less sharply defined and of a darker yellow tint. Bases of segm. 2—5 unmarked, lacking the paired transverse yellow streaks, interrupted in the median line, of *S. montaguei*; paired middorsal subcircular spot at the jugal sutures of 2—8 present and similar to that species, except that they are more roundish anteriorly, projecting markedly beyond the suture; middorsal spots on 8 subtriangular and a little smaller. Segm. 9—10 blackish brown. Genitalia (Fig. 33) prominent; basal two-thirds of hamulus straighter and more inflated at extreme base than in *S. montaguei*, undulated in profile view, the apical portion weakly S-shaped with curled, outbent tips; shiny dark brown, the slender distal part reddish brown. Posterior division of vesicle in caudal view circular and hollowed out deeply so as to form a tiny yellowish brown crater-like pit (similar to that of *S. montaguei*). Anal appendages very long, superior pair distinctly longer than segm. 9 + 10 (ratio ca. 36 : 26) and also longer than in *S. montaguei* (ratio ca. 32 : 27); in dorsal view the superiors are shaped similarly in the two species but in profile those of *S. campioni* are straighter, neither upcurved nor flattened, and depressed in distal half, but rather sinuous and swollen towards apex; colour uniform brown (not yellow in distal two-thirds!) with slight darkening at extreme base and a blackish obscuration all along inner border from a point slightly beyond half-way their length to apex; bristles black. Appendix inferior less upcurved than in *S. montaguei*; colour brown (Fig. 34).

Female (adult). — Very similar to the male but differing from it in the following respects. Pale areas of labrum ochraceous-orange, the free margin less broadly black; clypeus and base of frons brown, the lateral pale spots dirty ochreous; swollen tubercles

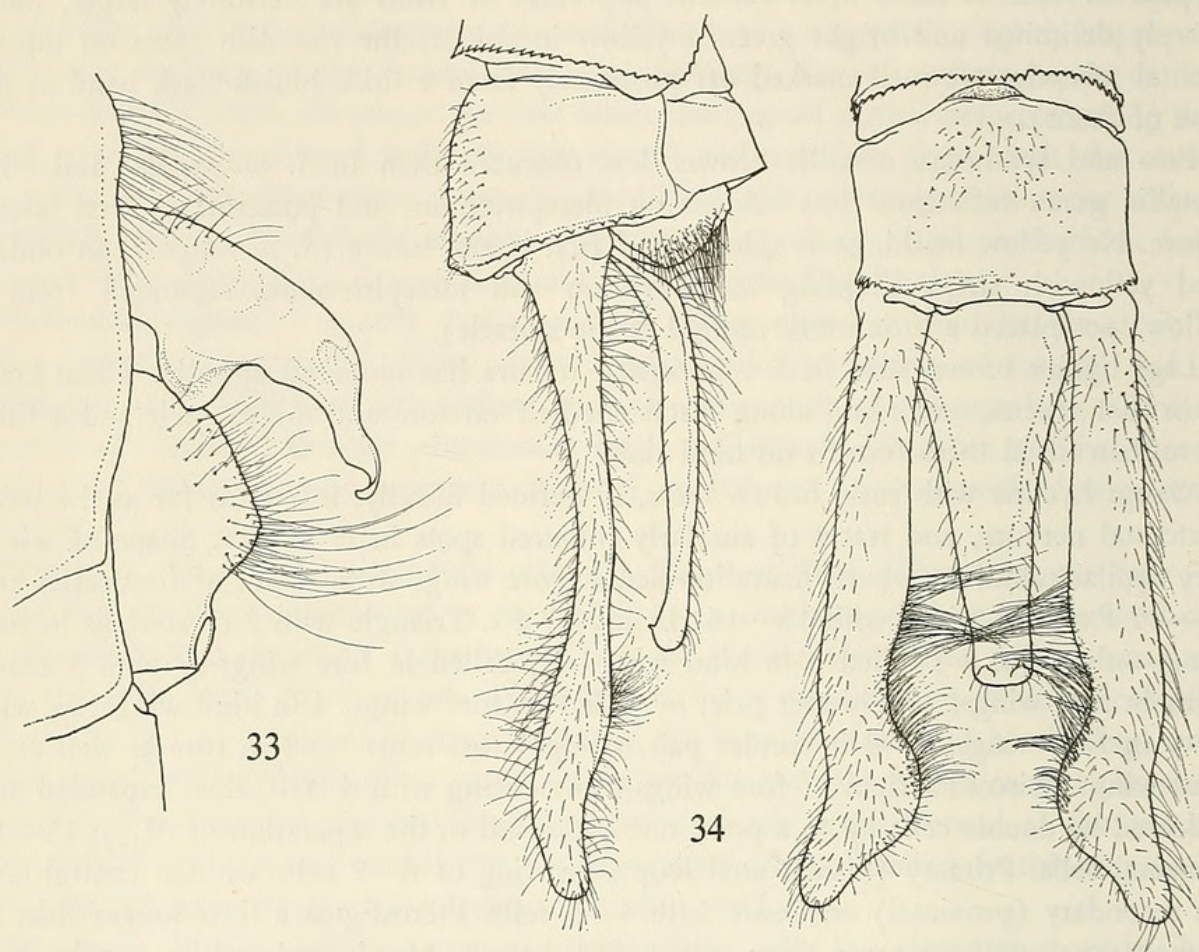


Fig. 33—34. *Synthemis campioni* spec. nov., ♂ from New Caledonia. 33, genitalia, right side; 34, anal appendages, right side and dorsal view

of frons orangish, turning darker with distinct metallic blue reflections posteriorly and in the sulcus. Vertex metallic blue-black. Occipital triangle brown, its side margins raised above level of compound eyes but dorsal surface and posterior division convex.

Pro- and synthorax as well as the legs as in male, except that there are no tibial keels. Wing membrane hyaline. In one specimen the extreme bases of both fore and hind wings are strongly spotted with dark rusty brown in *c-sc*, *m* and *cu*, these spots being ill-defined outwards and in *sc* extending from base as far as the first complete *Ax*, in the other spaces only about half-way into the basal cells. In the second female the basal spots are greatly enlarged, in *c-sc* reaching as far as *Ax*₇ in fore wing and *Ax*₆ in hind wing, in *m* as far as *Arc* and in *cu* to about *Cux*₃₋₄; there is, in addition, a cloudy post-nodal spot of brown extending from the nodus outwards for about 5—6 cells (fore wing) and 2 cells (hind wing) between *C* and *M*₁. Venation denser than in male (e.g. 23 *Ax* in fore and 15 *Ax* in hinder wings, 14—15 *Px* in fore and 15—17 *Px* in hinder pair). All *t* at least with 1 cross-vein and all *ti* of fore wing 3-celled. Anal loop consisting of three enclosures, the two proximal ones containing 4—7 cells, the distal (primary) loop made up of 11—13 cells with 2—3 central cells. Pterostigma light brown between black nervures. Membranula pure white, extending to the end of the two basal cells.

Abdomen (compressed) long, slender and cylindrical, the basal segments only slightly, the terminal ones not at all inflated. Colour uniform brown, only the dorsal parts of the intersegmental rings deep black. Pale spots on 2—7 yellowish, quite distinct, arranged

as in the male but considerably reduced in size and in the form of tiny transverse streaks placed at the jugal sutures on either side of the dorsal crest; 8—10 dark reddish-brown, mixed in places with cloudy brown areas.

Genital valve short, directed almost straight backward; much swollen basally and at some distance from base deeply divided to form a pair of slightly less inflated triangular processes; median processes of ovipositor arising from the 9th sternite short, black, finger-like and subparallel, directed obliquely ventrocaudad, concealed in ventral view by the genital valve. Anal appendages long, lanceolate, depressed, unicoloured light brown with black pubescence; tuberculum supra-anale subtriangular, not strongly protuberant in dorsal view, directed ventrad between the appendages almost at a right angle (Fig. 35).

Measurements: ♂ (holotype) abdomen + app. 50.5 mm, hind wing 40.5 mm, pt. fore wing 3.2 mm; ♂ paratype 50.3, 41.3, 3.5 mm, respectively; ♀ abdomen 44.8—47.5 + 4.0 mm, hind wing 40.5—44.0 mm, pt. fore wing 3.5—3.7 mm.

Synthemis montaguei Campion

Fig. 36

1921. Campion, Ann. Mag. Nat. Hist. (9) 8: 55—57, textfig. 9 (♂ app.), pl. 8 fig. 13 (♂ wings), ♂ Mt. Mou, New Caledonia.

Material. — New Caledonia: 2 ♂ (1 immature) 2 ♀, N.E.-side, 10 km S. of Pouébo, 400 m, 24.I.1964 (♂), 15 km S. of Pouébo, 480 m, 22.I.1964 (♂), Pouébo, 200—250 m, 19 & 21.I.1964 (2 ♀), all R. Straatman; ♂ (adult), Col d'Anuén, 550 m, 3.III.1960, J. L. Gressitt; ♂ (adult), St. Louis Valley, 24.III.1945, H. E. Milliron. (All in BISH and ML).

This is undoubtedly the same insect as the one characterized by Campion, the male only being known so far. All of our males are fully coloured but apparently slightly less mature than the holotype, with which Mr. Kimmins has been kind enough to compare a well preserved specimen from Pouébo. He tells me in a letter that owing, perhaps, to inferior optical apparatus, Campion erred a little in his description. The sides of the thorax of the type in a good light show obscure pale spots and stripes in the same places as in fresh examples, while the markings on the frons, though more obscure, are similar. In the type the pale area on the superior appendage is dull yellowish and does not extend so far basally; the pterostigma also is blacker, as is the dark ground of the abdomen. These are, however, evidently characters varying with the age of the individual, as is evident from the present specimens. The genital hamule is of the same shape in all individuals, not at all undulated as in *S. campioni*.

Female (hitherto undescribed). — Similar to male and differing but slightly, as follows.

Labrum still more broadly bordered with black, the ochreous spots subinterrupted by brown in the median line. Frons yellow only on summit of tubercles, which are otherwise reddish-brown anteriorly and dark metallic greenish-black posteriorly. Entire thorax dark brown with violet and bronze reflections; pale yellow stripe at first lateral suture in one specimen as in male, in the second broader and of even width but similarly leaving off

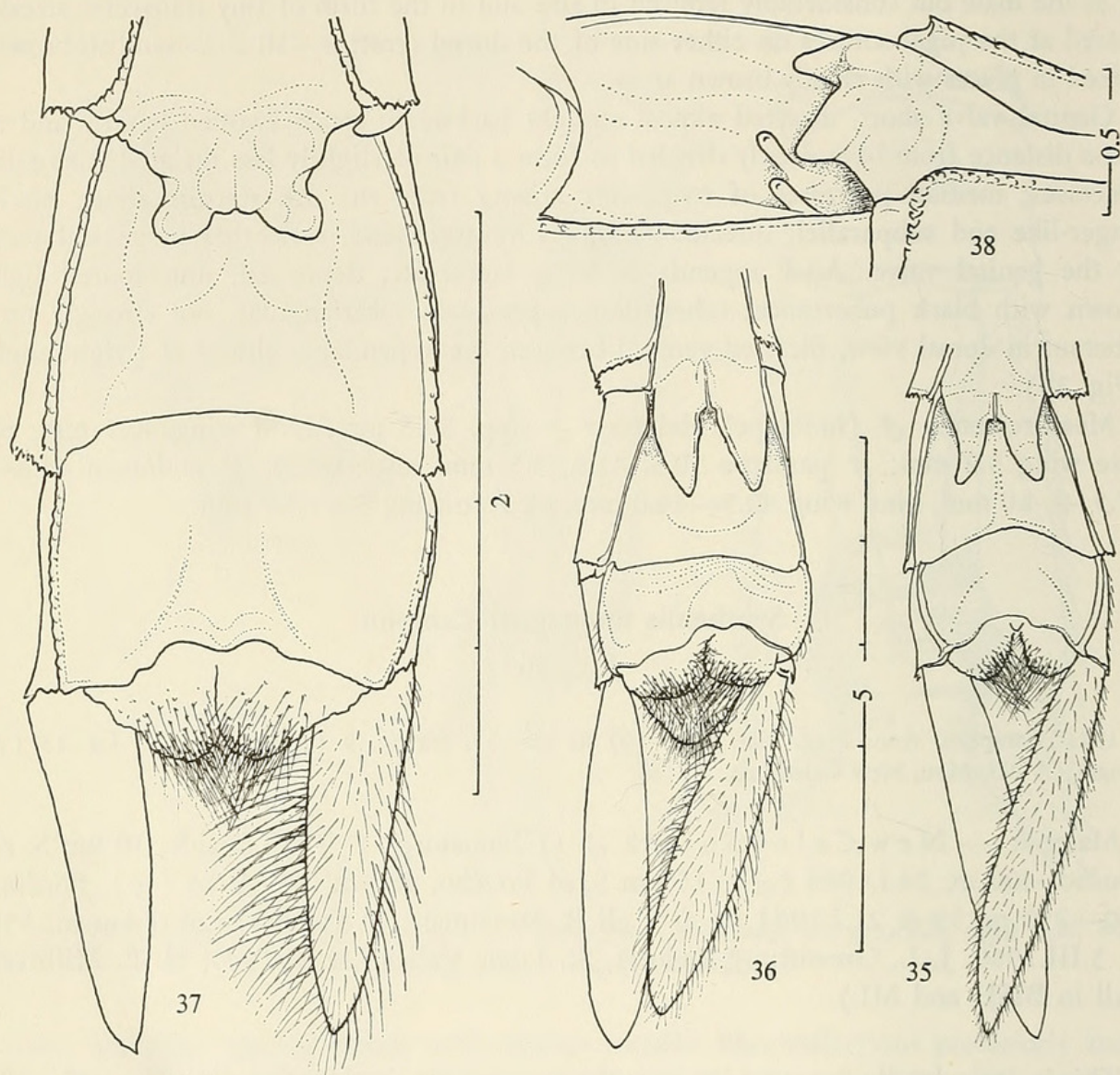


Fig. 35—38. Ventral view of ♀ terminal abdominal segments of New Caledonian species. 35, *Synthemis campioni* spec. nov.; 36, *S. montaguei* Campion; 37—38, *S. fenella* Campion

ventrad almost 1 mm above the spiracle, which also carries a tiny yellow spot. Membrane of wings in adult female subhyaline, distal portion gradually acquiring a pale yellowish-brown tint from nodus as far as the apex. Anal area of hind wing posterior to triangle with three loop enclosures, the two secondary (basal) ones made up of 4—5 cells, the largest (distal) enclosure consisting of 7—9 cells with or without central cell. Pterostigma brown. Membranula dark grey-brown.

Transverse yellow lines at extreme bases of abdominal segments 2—5 or 2—6 distinct though linear; central spots also narrower and placed more transversely than in male. Sexual organs as in Fig. 36; branches of genital valve similar to those of *campioni* but not outcurved. Anal appendages a little longer than segm. 9—10, depressed, lanceolate, slightly broader and more swollen than in *campioni*; colour light yellow, with the bases for about 0.5 mm dark brown and the extremities also finely obscured; pubescence black.

Measurements: ♂ abdomen + app. 51.0—53.0 mm, hind wing 42.0—42.6 mm, pt. fore wing 3.0 mm; ♀ abdomen 45.0—45.5 + 3.8 mm, hind wing 44.0—44.5 mm, pt. fore wing 3.0—3.2 mm.

Synthemis fenella Campion

Fig. 31, 37—38, 44—50

1921. Campion, Ann. Mag. Nat. Hist. (9) 8: 61—62, textfig. 11 (♂ app.), pl. 9 fig. 16 (♂ wings), ♂ Mt. Mou, New Caledonia.

Material. — New Caledonia: 2 ♂ (adult, 1 imperfect) 2 ♀ (adult), Forêt de Thi, 100—300 m, 9.III.1961 (♂) and 28—29.III.1961, J. Sedlacek; 2 ♂ 1 ♀, N.E.-side, Pouébo, 500 m, 12.I.1964 (♂), 10 and 15 km S. of Pouébo, 400—480 m, 22—24.I.1964 (♂ ♀), R. Straatman (1 ♂ 1 ♀ BISH).

Much smaller than the other four New Caledonian species. Only a single male has been described. Our specimens correspond with the existing description so far as it goes; the following emendations can now be supplied.

Coxae of legs blackish anteriorly, yellowish posteriorly; for the rest the legs are black except that the inner faces of the fore femora are light green as far as about 0.7 mm before the apex. Tibial keels also yellow, extending along distal one-half on fore tibia, almost three-fifths on mid tibia, and from near base as far as the apex on hind tibia.

Wings either entirely colourless or slightly tinged yellowish all over, the proximal area to the arculus in one male more deeply so, especially at the bases. Neuration open. All triangles and *ti* free (left hind wing *t* with transverse cross-vein in one male); *bt* with a single cross-vein. *Ax* coincident in *c-sc* but basal subcostal cross-vein present on all wings. Cross-veins in *m*, *cu* and bridge space slightly variable though not appreciably differing in number from those of the type as shown in Campion's photograph.

Abdomen deep black marked with bright yellow as described for the type. Genital organs not very prominent, vesicle of penis shaped as in the other species; hamulus shiny black, thick at base, evenly downcurved, and carrying a triangular inferior off-shoot at the basal portion, which is very similar to that seen in the allied species. Anal appendages deep black, shaped as described and figured by Campion, except that in one specimen the appendix superior after the subapical constriction is a little shorter, more swollen and distinctly rounded apically, the internal prominence being best visible in lateral view.

Female (adult; hitherto undescribed). — Resembles the male in almost every respect. Clear yellow reniform patches on either side on top of frons a little larger and more approximated. Yellow band crossing the spiracle at the thoracic sides broader, widest dorsally but similarly curving back along upper margin of metepisternum, only little narrower than the blue-black area separating it from the metepimeral band. Wing membrane more strongly flavescent, especially at the bases, which are deeply stained with golden yellow about as far as level of triangles. Neuration as described for the male, save that in one specimen the internal triangle in one fore wing possesses a single cross-vein. Basal portion of hind wing broader and more densely veined: primary (distal) loop of large size, comprising 11—12 cells with 1—2 central cells; the much smaller basal loop 6-celled.

Abdomen subcylindrical, basal and terminal segments 8—9 a little inflated. Deep black, yellow markings sharply outlined, slightly larger than in male, the transverse basal streaks broader and all paired central spots subcircular, surpassing the jugal sutures anteriorly. Genital organs black, shaped as in Fig. 37—38. Anal appendages only 1.3

mm long, subequal in length to segm. 9, straight and cylindrical, gradually tapered, tips acuminate.

Measurements: ♂ abdomen + app. 28.5—29.0 mm, hind wing 25.5—26.5 mm, pt. fore wing 1.2—1.3 mm; ♀ abdomen (incl. app.) 29.0—31.2, hind wing 28.0—30.0 mm, pt. fore wing 1.3—1.6 mm.

Despite the fact that no fresh examples of *S. flexicauda* have come to our knowledge, the five New Caledonian species at present known can be easily held apart by the following

KEY TO THE NEW CALEDONIAN SPECIES OF *Synthemis*

1. Large insects, ♂ and ♀ abdomen (incl. apps.) measuring 42—55 mm, hind wing 37—47.5 mm 2
- Smaller species, ♂ and ♀ abdomen (incl. apps.) 28.5—31 mm, hind wing 25.5—30 mm. A pair of clear yellow mesepisternal (antehumeral) stripes present on thoracic dorsum. Frons anteriorly with pair of large, curved chrome yellow patches. Both sexes with anal appendages black, superior pair of ♂ not exceeding 2 mm in length. Triangles and internal triangles normally without cross-veins and hypertriangle once traversed. Pterostigma small, black, about 1.5 mm long. Terminal segments and ovipositor valve of ♀ as in Fig. 37—38 **fenella**
2. No yellow mesepisternal (antehumeral) stripes present on dorsum of thorax. Wings more densely reticulated: triangles and internal triangles traversed by cross-veins, at least so in fore wings, and hypertriangles with more than one cross-vein in fore wing. Pterostigma much longer and not quite black. Anal appendages in both sexes brown, or partly yellow, the superior pair in ♂ about 3 mm long or more . . . 3
3. Male abdomen with large, erect, pointed black spine on dorsum of segm. 10. Sup. anal apps. 4 mm long; in dorsal view broad, almost straight, with acute internal black spine at about mid-length, followed first by an emargination, then by a dilatation; colour black as far as the emargination, pale yellow beyond. Genital hamule in profile view evenly downcurved, with strongly convex outer margin. Body dark, almost black, including the legs. Yellow lateral thoracic band present at level of spiracle as well as paired basal yellow spots on abdominal tergites 3—4 or 3—5. Wings at least with the extreme bases spotted with golden yellow, in ♀ more extensively so and often with brown rays also extending as far as the arculus. Genital valve of ♀ short, but outer and inner ovipositor valves, though fused together, still discernible by a longitudinal furrow. Female appendages short, upcurved, mainly yellow **miranda**
- No robust black spine on dorsum of ♂ abdominal segm. 10. Combined characters not as above 4
4. Male sup. anal apps. and ♀ appendages at least partly yellow or whitish. Segm. 3—4 of abdomen with pair of yellow spots forming more or less part of a ring at extreme base. Sides of thorax at least with traces of a yellow stripe and/or spot at level of first suture and the spiracle 5
- Male sup. anal apps. and ♀ appendages unicoloured brown, shaped as in Fig. 33—34 and 35. Segm. 2—4 or 2—5 lacking pale-coloured spots at extreme base. Sides

of thorax without any trace of yellow colour at first suture and spiracle. Male genital hamule distinctly sinuous apically (Fig. 33). Genital valve of ♀ as in fig. 35

- *campioni*
5. Male sup. anal apps. about 4 mm long, subequal in length and shaped similarly to those of *S. campioni* in dorsal view, though slightly dilated internally before the middle (not at middle), then emarginate, and dilated just before the rather obtuse apex. Appendix inferior about $\frac{2}{3}$ as long as the superior pair. Thoracic sides with narrow yellowish line at the first suture separated from a pale spot at the spiracle. Genital valve of ♀ as in Fig. 36 *montaguei*
- Male sup. anal apps. over 5 mm long, in dorsal view slightly divergent in basal half, then more sharply convergent, and ending by the tips becoming dilated, parallel, and almost in contact with one another; in lateral view depressed and dilated ventrally in the middle. Appendix inferior about half as long as superior pair, almost straight, abruptly reduced in breadth at some distance from apex, which is pointed. Thoracic sides with two broad uninterrupted creamy stripes or bands, one at the first suture enclosing spiracle, and a second crossing the metepimeron. Shape of ♀ genital valve not known *flexicauda*

Discussion and illustrations of the immature stages of some New Caledonian *Synthemis*

Synthemis miranda Selys (supposition)

Fig. 32, 39—43

Material. — ♂ larva (ult), New Caledonia: Bondé region, coastal area, middle course of Diahot river, near village Ouénia (chapelle de Saint-Joseph), 70 m, 16.IX.1965, F. Starmühlner et al., coll. no. FNK 105/1. The specimen is unique and in good condition.

Principal features.

Measurements: total length 22.5 mm; greatest width of head across eyes 5.7 mm; posterior femur 5.2 mm; length of abdomen 13.7 mm, its breadth at apex of segm. 4 6.5 mm, highest point 4.0 mm.

Facies of *S. macrostigma* Selys (Watson, 1962, pl. 9 fig. 49). Body moderately hairy.

Labium with postmentum reaching backwards to about midway between meso- and metacoxae. Prementum broad, gradually widened anterad, deeply concave dorsally; median lobe low, not prominent but projecting markedly ventrad, its thickened margin minutely and bluntly serrulate, lacking setae; ligula subtriangular, abruptly projecting anterad; premental setae clearly differentiated into major and minor sets, i.e. 4 + 8—7 + 4, the former rather short, the latter minute. Labial palpus strongly, deeply cupped, its borders strengthened and transversely wrinkled, outer border with row of rounded tubercles bearing longish fine setae; apical border with 4 large crenations, the last (outermost) divided, distal margin of each microscopically serrulate, lacking setae; palpal setae 4—4, lacking basal spiniform setulae; movable hook short and strong. Frontal plate between antennae porrect, transverse, only about one-fourth as broad as greatest width of head across eyes and twice broader than long, its borders rounded; surface flat, wholly and densely covered with minute swollen papillae, the marginal ones longest and inter-

mixed with few long setae. Antenna setiferous, 6-segmented, the second segment longest (Fig. 43). Head widest across anterior part of eyes, the latter moderately prominent, sides behind the eyes only slightly converging, postorbital lobes broadly rounded, covered rather densely with microscopical setiferous warts.

Prothorax transverse, upper pronotal lobes well marked off from the lower parts, their surface flat with evenly rounded, slightly raised, almost acute, side margins, which are beset with numerous minute setiferous warts. Wing sheaths strongly divergent, reaching caudad as far as end of segment 5. Legs relatively short, unmodified and hairy.

Abdomen elongate-oval, moderately flattened, pubescence especially long and dense at side margins, still longer and tufty at posterolateral angles of segments. Middorsal hooks conspicuous and in the form of raised bluntly rounded tubercles, those on 2—3 minute and knob-like, the next ones progressively higher and longest on 6 and 7, the terminal ones directed slightly caudad. Lateral spines wanting, replaced by dense tufts of longish hair. Anal pyramid pointed; processes sharply acute, subequal in length, but cerci shortest and epiproct a little shorter than the slender paraprocts.

Integument brown, darkest on head and pronotum; lighter brown are the coxae,

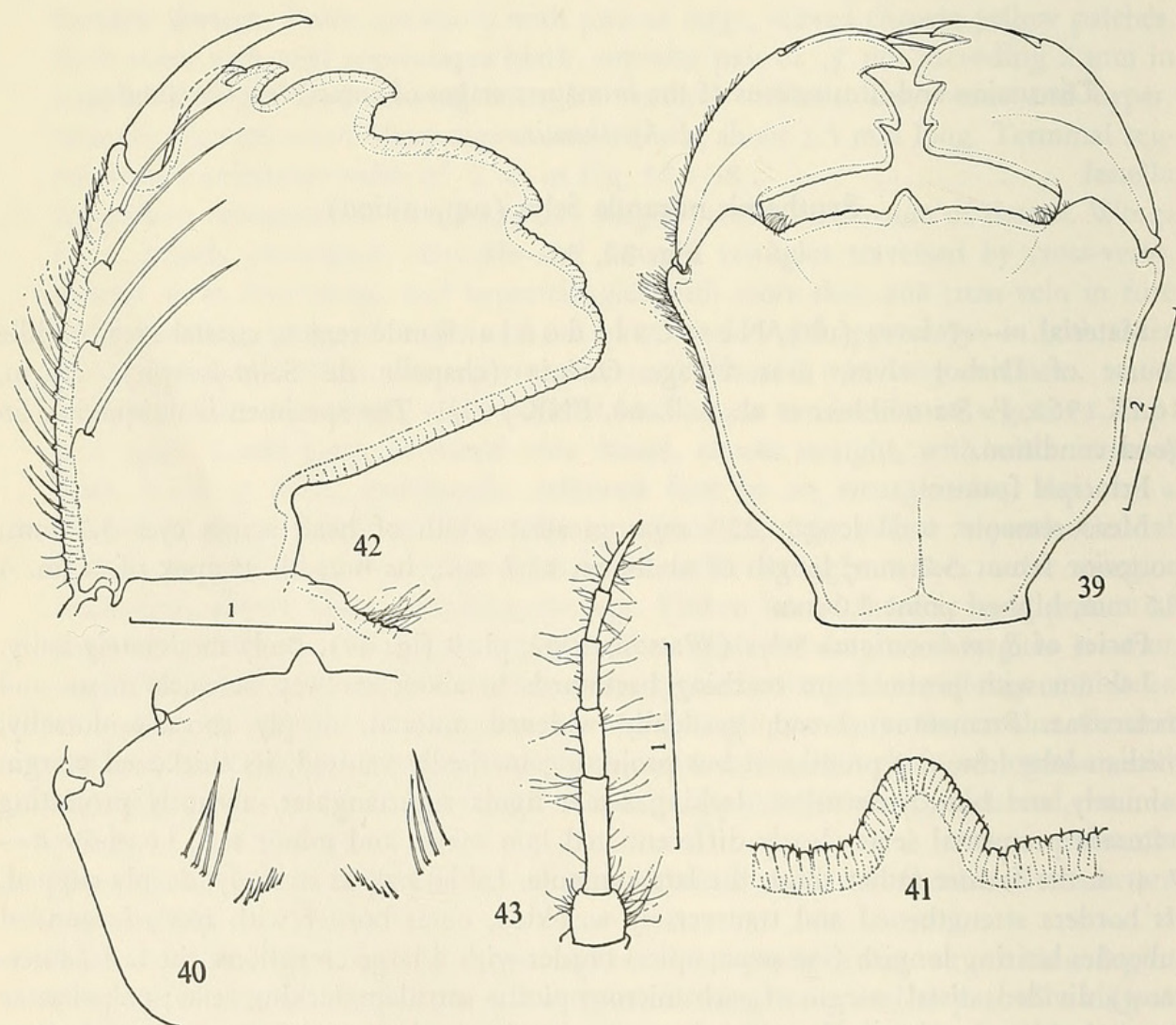


Fig. 39—43. Larval structures (ult instar) of *Synthemis miranda* Selys (supposition) from New Caledonia; 39, external view of labium; 40, partial internal view of prementum, showing setae; 41, ligula of same, more enlarged; 42, internal view of left labial palpus; 43, antenna

trochanters, tibiae towards the end, tarsi, and basal segments of abdomen. Thoracic pleurae and terminal segments of abdomen mottled with blackish-brown forming a distinct pattern on the abdomen, the dark areas centred with, or surrounded by, light brown of the ground colour.

The present larva exhibits some unusual features by which it differs markedly from other species including the two other New Caledonian forms. It is placed in this species by supposition only, based on the evidence of the fully developed venation, the body size being also in agreement with this assumption. On that basis it might be, however, one of the other large-sized species quite as well. It differs from Champion's larva in many respects and is unique in that the penultimate abdominal segments are furnished with conspicuous, almost finger-shaped "nodding" tubercles middorsally. Champion's example agrees with Australian species like *S. eustalacta* or *leachi* by having the two basal joints of the 7-segmented antennae short and rather rounded, those of the supposed *miranda* have 6 segments, only the basal one being short and rounded (Fig. 43). Also, Champion's *Synthemis* is less hairy, has distinct postero-lateral spines at segments 2—9 and no dorsal abdominal hooks; lastly, it is said to have more palpal teeth and a greater number of submental setae.

Synthemis fenella Champion (supposition)

Fig. 31, 44—49

Material. — Many larvae, all stages, New Caledonia: 4 larvae (ult) and one specimen (probably 4th instar) more closely investigated, dissected and measured. Localities: W.-coast, Poya-Nekliai region, right tributary of river Nekliai, 2 km above Catholic Mission, 36 m, 10.VIII.1965, coll. no. FNK 63 (1 very young larva); S.W.-coast, right tributary of river Dumbéa, 117 m, 15.VII.1965, coll. no. FNK 9 (1 ♀); S.-part, Mont des Sources, near Ouénarou, tributary of river Bleue, primeval forest, 250 m, 17.VII.1965, coll. no. FNK 15 (1 ex.); same area, streamlet at tributary of river Blanche, near forest bridge, 160 m, 21.VII.1965, coll. no. FNK 26 (1 ex.); E-coast, Hienghène area, 8 km N., 3 km S. of Ouaième Bay, waterfall stream, ca. 130 m, 7.IX.1965, coll. no. FNK 97 (1 ♀); all F. Starmühlner et al.

Principal features of mature larva.

Resembles the preceding species but can be easily distinguished by much smaller size, almost hairless and lighter coloured body, 5-segmented antennae, absence of dorsal abdominal protuberances and details of labial structure.

Measurements: total length 15.0—16.0 mm; greatest width of head across eyes 3.8—4.0 mm; posterior femur 3.4—3.5 mm; length of abdomen 9.4—10.0 mm, its breadth at apex of segm. 4 4.2—4.6 mm, highest point 4.5 mm.

Postmentum of labium reaching backwards to the base of metacoxae. Prementum distinctly narrower, still more deeply cupped with abruptly downbent midlobe, and more heavily sclerotized, than in the former species; asetose margins similar but apical border on either side at base of palpus prolonged to form a broadly tongue-shaped lobe whose free margin is entire; premental setae reduced to a pair of inconspicuous short setae (occasionally only one!) on either side, the placement of these indicated in Fig. 45 by two dots. Labial palpus strongly hollowed out, solid and hard, subtriangular in outline,

outer border with row of rounded tubercles bearing short spinulose setae; apical border entire with strengthened margin and lacking setulae; palpal setae relatively short, 2—2 only; movable hook long and markedly curved. Frontal plate between antennae projecting anterad but distinctly sloping down, longer than in the previous species and about one-third (34 : 100) as wide as the greatest breadth of head across eyes; surface somewhat hollowed out with upturned rounded margins, densely covered with minute swollen papillae but lacking setae. Antenna short, almost bare, only 5-segmented, the second segment longest (Fig. 49). Prothorax (Fig. 44) shaped much as described for the previous species, anterolateral angles of pronotum almost pointed. Integument of all thoracic segments and legs covered with minute warts. Wing-sheaths strongly divergent, reaching caudad as far as a little beyond apical margin of segment 4 (fore wing) or midway between 4 and 5 (hind wing). Legs relatively short, unmodified, lacking long setae or hairs but all tibiae with outer row of minute spinulose setae.

Abdomen elongate-oval, narrower and also higher than in the former species, practically hairless. Middorsal hooks wanting, replaced by very low and faintly indicated apical tuberculae. Lateral spines likewise absent, though indicated by a vestigial tooth-like projection at posterior angle of segment 9, which is devoid of hairs. Anal pyramid pointed; processes sharply acute, cerci only half as long as epiproct, which is broadly triangular in outline and only little shorter than the paraprocts.

Integument light brown, darkest on the wing-buds and femora, the latter being decidedly lighter apically; the pale yellowish-brown tibiae ringed with dark brown at their bases. Abdominal segments 4—9 with a row of rather closely approximated dark brown dots placed lengthwise on either side of the dorsal line slightly in advance of the middle of segments.

This is by far the most aberrant *Synthemis* larva so far known. By its almost naked body and elongate, rather flattened forms, it bears a 'prima facie' resemblance to certain gomphid larvae. Its most outstanding characters are best understood from the outline drawings (Fig. 44—49). Head, thoracic segments and divergent wing buds are almost exactly similar in shape to the other two regional species. It also resembles the latter in the shape of the frontal plate and advanced median lobe of the labium. The strongly spoon-shaped labium with its extraordinary hook-like palpus lacking crenations at its distal border is, however, surprisingly different from anything so far observed in *Synthemis*. Another peculiarity is the reduced 5-segmented antenna with its single short basal joint, present in all individuals examined. Both specimens whose fully developed wing venation could be studied in detail, proved to be females. On comparing the neural characters with those of the adult dragonfly, I found full agreement in all essential respects. There are 12 or 13 cells in the anal loop of the hind wings and the nodal indices are those typical of *S. fenella*. The only discrepancies are (1) all triangles with 1 cross-vein; (2) discoidal field of both fore and hind wings commencing with 2 cell-rows; (3) 2 rows of cells also at the beginning of the field Cu_1 - Cu_2 of hind wing. These irregularities in the venation may be due either to a certain amount of variation existing in the female wings — so much in evidence throughout the *Synthemis* group — or else, may point to some undescribed species closely allied to *fenella*, the last possibility being unlikely considering the great number of larvae collected. This is out of proportion to the few adult dragonflies captured and may be due to the diminutive size and dark colours of the latter, causing it to be an insect much less conspicuous than its larger congeners in the island.

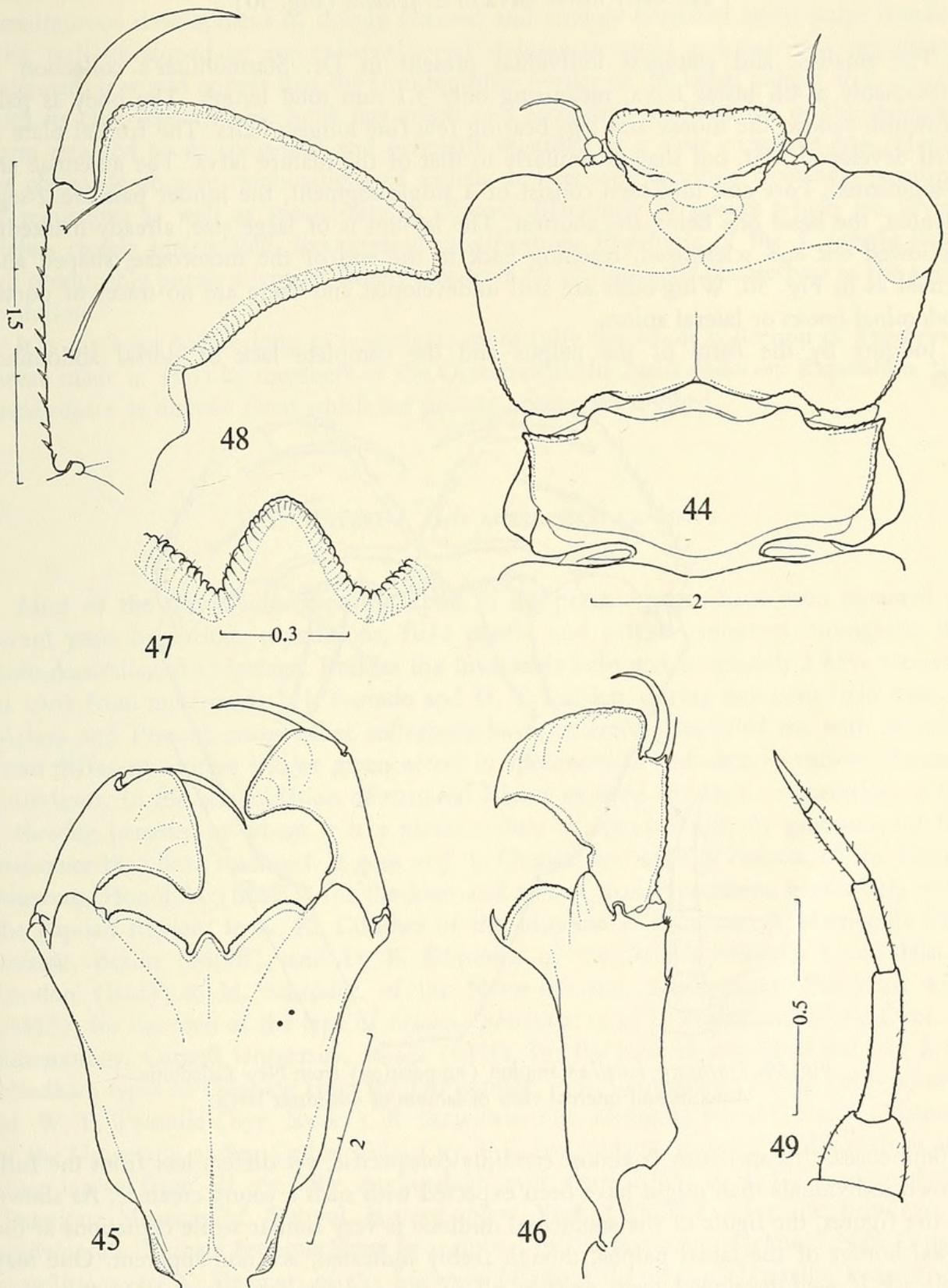


Fig. 44—49. Larval structures (ult instar) of *Synthemis fenella* Campion (supposition) from New Caledonia. 44, dorsal view of head and prothorax; 45, external view of labium; 46, left side view of same; 47, ligula of submentum, more enlarged; 48, internal view of left labial palpus; 49, antenna

The early instar larva of *S. fenella* (Fig. 50)

The smallest and youngest individual present in Dr. Starmühlner's collection is presumably a 4th instar larva, measuring only 3.1 mm total length. The body is pale brownish-yellow, the thorax and legs bearing few fine longish hairs. The frontal plate is well developed, flat, but shaped similarly to that of the mature larva. The antennae are 5-segmented. Fore and mid tarsi consist of a single segment, the hinder pair are 2-segmented, the basal one being the shortest. The labium is of large size, already markedly hollowed out and sclerotized, reaching back to the end of the mesocoxae, shaped and armed as in Fig. 50. Wing-buds are still undeveloped and there are no traces of dorsal abdominal hooks or lateral spines.

Judging by the form of the palpus and the complete lack of dorsal abdominal

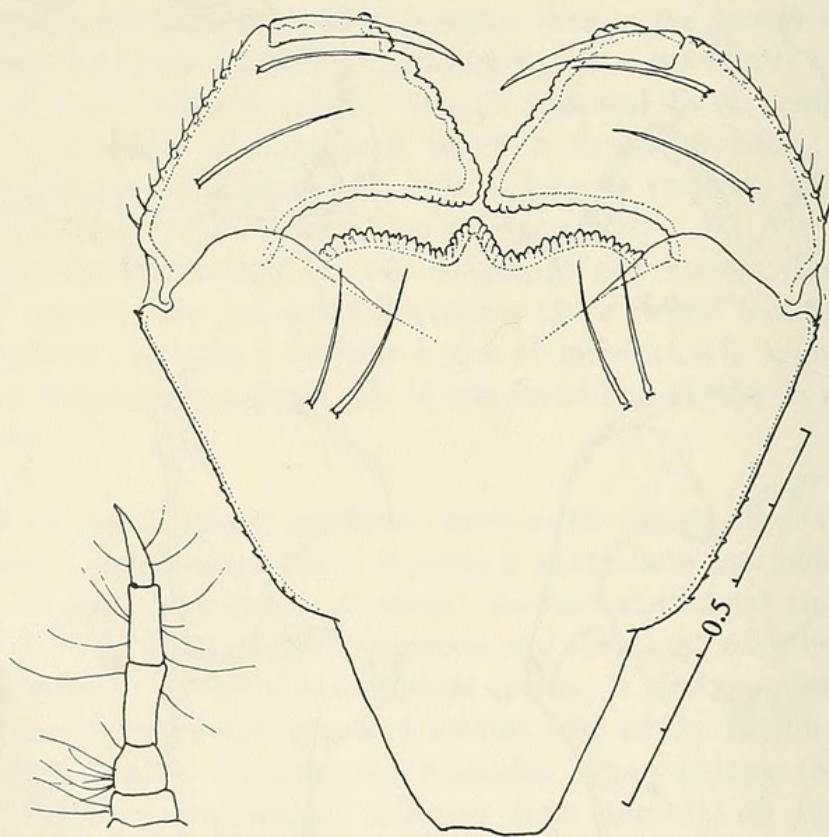


Fig. 50. *Synthemis fenella* Campion (supposition) from New Caledonia.
Antenna and internal view of labium of 4th instar larva

prominences, this specimen is almost certainly conspecific, yet differs less from the full-grown individuals than might have been expected with such a young creature. As shown in the figures, the ligula of the submental midlobe is very similar while crenations at the distal border of the labial palpus, though feebly indicated, are non-apparent. One may well ask if well-developed teeth exist at all in the earliest instar larva? On the other hand, the two premental and two palpal setae are relatively longer than in the mature larva, and the antenna — though already 5-segmented — has two instead of only one small basal segments.

In Oriental larvae of *Macromia* we have met with a variety of characters developed independently in species living under different circumstances, habitat and behaviour varying correspondingly from species to species. In our *Synthemis* larvae the specific

differences are even more striking and less easy to explain. Here we meet with the simultaneous development of deeply fissured and straight-bordered labial palpi coupled with well developed or non-existent dorsal abdominal hooks and variously segmented antennae. It would appear that the firm toothless border of the labial palpus of *S. fenella* with its claw-like movable hook has arisen as a secondary modification of the indented form retained by its congeners and generally regarded as a more primitive type. Hence we obviously observe combinations of archaic and recently acquired characters resulting in reductions as well as specializations allotted differently in species which are nevertheless closely interrelated. Exaggerated modifications like those of the *S. fenella* larva are presumably purely adaptive, in any case have no phylogenetic counterpart in the adult evolution.

It is my hope before long to investigate more fully the whole collection of *Synthemis* larvae made in 1965 by members of the Oesterreichische Neukaledonien Expedition, the same source as the one from which the present notes were derived.

VII. MATERIAL AND ACKNOWLEDGEMENTS

Most of the Corduliidae reported upon in the present paper have been obtained in recent years by various expeditions, field parties and private collectors throughout the Indo-Australian Archipelago. Besides the invaluable help and hospitality I have received in 1963 from my friends J. I. Furtado and H. T. Pagden, during our joint field trips in Malaya and Penang, many other colleagues have generously supplied me with material from different sources and/or given access to specimens of Odonata in various museum collections. In the accumulation of material I have enjoyed the kind co-operation of the following persons, to whom it is a pleasant duty to acknowledge my gratitude for the assistance they have rendered. It goes to J. L. Gressitt and Miss S. Nakata, of the Bishop Museum, Honolulu (BISH), for the loan and gift of many specimens particularly from the Papuan Region; to K. K. Günther of the Museum f. Naturkunde, Humboldt Universität, Berlin (MNB), and D. E. Kimmins of the British Museum (Nat. Hist.), London (BM); to H. Schröder, of the Natur-Museum Senckenberg, Frankfurt a.M. (SMF), for the loan of the type of *Idionyx philippa*; to L. L. Pechuman, of the Dept. of Entomology, Cornell University, Ithaca (CUI), for the loan of several of the late J. G. Needham types of Odonata from the Philippines; to L. Coomans de Ruiter (Hilversum), M. W. F. Tweedie (Rye, Sussex), R. Straatman (Pt. Moresby, Papua), and C. Plateros, of the University of San Carlos, Cebu City, P.I., for valuable material of dragonflies and their larvae from all over the Archipelago ever since 1933; to J. G. Rozen, of the American Museum of Natural History, New York (AMNH), for the privilege of studying all Odonata brought home by members of the successive Archbold New Guinea expeditions; to A. Heymer, of the Museum National d'Histoire Naturelle, Brunoy, for the partial gift of Odonata collected recently in the Lesser Sunda Islands; to Børge Petersen, of the Universitetets Zoologiske Museum, Kopenhagen (MC), for specimens obtained during 1962 by the Danish Noona Dan expedition in the Bismarcks; and lastly, to D. St. Quentin and F. Starmühlner (Vienna), for arranging the loan of an important collection of larvae made in 1965 by the Oesterreichische Neukaledonien Expedition.

Unless indicated otherwise, i.e. by means of the above symbols denoting institutions

and museums abroad, the specimens dealt with in this paper are lodged in the Rijksmuseum van Natuurlijke Historie, Leiden (ML).

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VIII. SELECTED REFERENCES

- Asahina, S., 1968. Records and notes on Philippine Odonata. — Jap. Jour. Zool. 15: 349—376, pls. 1—2.
- , 1970. Burmese Odonata collected by Dr. Arthur Svihla with supplementary notes on Asiatic *Ceriagrion* species. — Jap. Jour. Zool. 16: 99—126, 68 figs., 1 pl.
- Campion, H., 1921. Odonata collected in New Caledonia by the late Mr. Paul D. Montague. — Ann. Mag. Nat. Hist. (9) 8: 33—67, pls. 8—9, figs. 12—17.
- Cowley, J., 1942. Descriptions of some genera of fossil Odonata. — Proc. R. ent. Soc. Lond. (B) 11: 63—78.
- Foerster, F., 1900. Odonaten aus Neu-Guinea. — Termész. Füzetek 23: 81—108, figs.
- Fraser, F. C., 1918. Two new Indian dragonflies. — J. Bombay Nat. Hist. Soc. 25: 383—385.
- , 1924. A survey of the Odonate (Dragonfly) fauna of Western India, etc. — Rec. Ind. Mus. 26: 423—522, 8 figs., pls. 25—27.
- , 1934. Indian dragonflies 42. Revision of genus *Idionyx*. — J. Bombay Nat. Hist. Soc. 37: 553—572, 3 figs., 2 pls.
- , 1936a. New Oriental dragonflies. — J. Bombay Nat. Hist. Soc. 38: 700—701, 1 phot.
- , 1936b. Odonata III in The Fauna of British India &c. London, 461 pp., 125 figs., 2 pls., map.
- , 1957. A reclassification of the Order Odonata. — Roy. Zool. Soc. N.S. Wales, Sydney. 133 pp., 62 figs.
- , 1960. A handbook of the dragonflies of Australasia. With keys for the identification of all species. — Roy. Zool. Soc. N.S. Wales, Sydney. 67 pp., 27 pls.
- Furtado, Jose I., 1969. Ecology of Malaysian odonates: Biotope and association of species. — Verh. Internat. Verein. Limnol. Stuttgart 17: 863—887, map & tables.
- Gloyd, L. K., 1959. Elevation of the *Macromia* group to family status. — Ent. News 70: 197—205, 4 figs.
- Laidlaw, F. F., 1912. On a new genus and species of Odonata from Sarawak. — Sar. Mus. Journ. 2: 67—68, pl. 1.
- , 1922. Some notes on Oriental dragonflies: the genus *Macromia*. — J. Str. Br. Roy. As. Soc. 85: 218—228, figs.
- , 1923. On a new and interesting dragonfly from Gunong Tahan. — J. Mal. Br. Roy. As. Soc. 1: 231—232, pl. 5.
- Lieftinck, M. A., 1933. The life-history of *Procordulia artemis* Lieft., with comparative notes on the biology of *P. sumbawana* (Förster). — Int. Revue ges. Hydrogr. u. Hydrob. Leipzig 28: 399—435, 14 figs., 1 pl.
- , 1935a. New and little known Odonata of the Oriental and Australian regions. — Treubia 15: 175—207, 15 figs.
- , 1935b. The dragonflies (Odonata) of New Guinea and neighbouring islands. Part III. — Nova Guinea 17, Zool.: 203—300, 50 figs.
- , 1939. Critical notes on the Malaysian species of *Idionyx* Hagen. — Treubia 17: 199—204, 2 figs.
- , 1942. The dragonflies (Odonata) of New Guinea and neighbouring islands. Part VI. — Treubia 18: 441—608, 2 figs., 19 pls.
- , 1948. Descriptions and records of South-east Asiatic Odonata. — Treubia 19: 221—278, 19 figs.

- Lieftinck, M. A., 1950. 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* 20: 657—716, 61 figs.
- , 1952. On the Papuan representatives of the genus *Macromia* Rambur, with descriptions of five new species and some larval forms. — *Treubia* 21: 437—468, 22 figs.
- , 1953a. Revision of the Australasian species of *Synthemis* Selys. With descriptions of four new species and a key to their identification. (O.S.R. publ. 38). — *Idea* (Bogor) 9: 70—88, 14 figs.
- , 1953b. The Odonata of the island Sumba, with a survey of the dragonfly fauna of the Lesser Sunda Islands. — *Verh. Naturf. Ges. Basel* 64: 118—228, map & 72 figs.
- , 1954. Handlist of Malaysian Odonata; etc. — *Treubia* 22 Suppl. xiii + 202 pp., map.
- , 1955. Further inquiries into the Old World species of *Macromia* Rambur. — *Zool. Meded. Leiden* 33: 251—277, 28 figs.
- Martin, R., 1907. *Cordulines in Cat. Coll. Selys Longchamps* 17, 89 pp., 3 col. pls.
- Needham, J. G., 1932. *Coenagrion interruptum*, new species, from the Marquesas, and nymph of *Hemicordulia assimilis* Hagen. — *Bull. B. P. Bishop Mus.* 98: 111—114, figs. 33—34.
- Needham, J. G. & M. K. Gyger, 1937. The Odonata of the Philippines. — *Philipp. J. Sci.* 63: 21—101, 2 figs., 10 pls.
- Ris, F., 1912. Neue Libellen von Formosa, Südchina, Tonkin und den Philippinen. — *Suppl. Ent.* 1: 44—84, 19 figs., pls. 3—5.
- , 1913. Die Odonata von Dr. H. A. Lorentz' Expedition nach Südwest-Neu-Guinea 1909 und einige Odonata von Waigöu. — *Nova Guinea* 9 *Zool.* 3: 471—512, 28 figs.
- Selys Longchamps, E. de, 1878. Secondes additions au Synopsis des Cordulines. — *Bull. Acad. Belg.* (2) 45: 183—222.
- St. Quentin, D., 1939. Die systematische Stellung der Unterfamilie der Corduliinae Selys. — *Proc. VII. Intern. Kongr. Entom. Berlin*, I. Sekt. Syst. u. Tiergeogr.: 345—360, 25 figs.
- Starmühlner, F., 1968. Etudes hydrobiologiques en Nouvelle-Calédonie (Mission 1965 du Premier Institut de Zoologie de l'Université de Vienne). I. Généralités et description des Stations. — *Cah. O.R.S.T.O.M., sér. Hydrobiol.* 2: 3—27, 18 figs.
- Tillyard, R. J., 1910. Monograph of the genus *Synthemis*. — *Proc. Linn. Soc. N.S. Wales* 35: 312—377, fig. 1 & pls. 4—9.
- , 1911. Further notes on some rare Australian Corduliinae, with descriptions of new species. — *Proc. Linn. Soc. N.S. Wales* 36: 366—387, pl. 10.
- Tillyard, R. J. & F. C. Fraser, 1938—1940. A reclassification of the order Odonata. Based on some new interpretations of the venation of the dragonfly wing. — *Austr. Zool.* 9: 125—169, 27 figs. (1938), 195—221, 11 figs. (1939), 359—396, 15 figs. (1940).
- Watson, J. A. L., 1962. The dragonflies (Odonata) of South-Western Australia, etc. — *Handbook* 7, W. Austr. Natur. Club, Perth, 72 pp., 1 col. pl., 21 pls., 3 tab.
- , 1967. The larva of *Synthemis leachi* Selys, with a key to the larvae of Western Australian Synthemidae. — *The West Austr. Naturalist* 10: 86—91, 9 figs.



Lieftinck, M. A. 1971. "Studies in Oriental Corduliidae (Odonata) I." *Tijdschrift voor entomologie* 114, 1-63.

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