SOME GOMPHIDAE AND THEIR LARVAE, CHIEFLY FROM THE MALAY PENINSULA (ODONATA)

by

M. A. LIEFTINCK
Rijksmuseum van Natuurlijke Historie, Leiden

During a nine week's sojourn in the Malay Peninsula, from February 12 until April 22, 1963, I have been able to acquaint myself with the insect fauna of that country and to make a special study of the Odonata and their larvae. The present account is the first of a series dealing with the results of this collecting expedition. It merely contains descriptions and illustrations of a few new and insufficiently known species of Gomphidae; more of these pertaining to the same family will, it is hoped, soon follow. The rich and varied supply of material accumulated during the Malayan trip forms the basis of this study, but specimens from other sources are incorporated wherever this was found appropriate or necessary. Thus it includes re-descriptions of types in the British Museum collection (BM) and the University Museum of Michigan, Ann Arbor (UMMZ), as well as notes on some valuable larval forms collected in the Plus River area (Perak) given to me long ago by Mr. M. W. F. Tweedie, at one time director of the Raffles Museum, Singapore. More recently, interesting samples of larvae from Johore and Pahang, collected for the Department of Zoology, University of Singapore, were sent to me for study by Dr. D. S. Johnson and his assistants.

In this paper only passing mention is made of the habits, local distribution and larval development of the Odonata. Several more will be reared and information on the life-history obtained under natural conditions in the field, will be supplied by my companion, Mr. J. I. Furtado, of the Zoology Department, University of Malaya in Kuala Lumpur. Attention will be paid by him in particular to various aspects of the natural history of Malayan dragonflies in connexion with ecological factors.

The following species are discussed in this paper:
Phaenandrogomphus asthenes gen. et sp.n. — Malay Peninsula; adult and larva.
Burmagomphus Williamson. — Key to SE. Asiatic species, adults and larvae.
—— *arboreus* Lieftinck. — Burma; lectotype re-defined.
—— *williamsoni* Förster. — Malaya to Sumba; a polytypic species.

Burmagomphus w. williamsoni Förster. — Malaya: new status, types etc. re-described (*B. siamensis* Fraser, Thailand, new synonym).
—— *w. javicus* Schmidt. —— Java; new status. Larva described.
—— *w. austrosundanus* subsp.n. — Sumba I.
—— *divaricatus* sp.n. — Malay Peninsula; adult and larva.
—— *plagiatus* sp.n. — Malaya (terr. typ.), Sumatra and Borneo; adult and supposed larva.
—— *arthuri* Lieftinck. — Borneo; further notes.
—— *insularis* Laidlaw. — Borneo; holotype re-defined.
Merogomphus parvus (Krüger). — Malay Peninsula; adult and larva.

Phaenandrogomphus gen. nov.

Stature of a slender *Onychogomphus*. Integument weakly sclerotized, wing venation more open and terminal segments of abdomen more drawn out. Differs from allied genera (*Acrogomphus, Onychogomphus*) by a combination of characters which are enumerated in the following characterization.

Anterior portion of head short and broad, face not protuberant and scarcely convex. Horizontal and vertical parts of frons rectangulate, fold sharply demarcated by an acute transverse ridge, only the extreme lateral edges rounded. Synthorax narrow and of small size, with shoulder-area less protuberant than in allied genera. Legs short, femora almost straight; femur III reaching caudad to apex of first abdominal segment; armature similar to *Acrogomphus*, but femur II, in addition to the irregularly arranged short spicules, with outer row of 12-14 longer, equidistant, curved spines, which are directed caudad and increasingly longer from base to apex. Outer and inner rows of tibial bristles also longer, 6-7 in number on all tibiae, decreasing in length from base to apex, basal ones almost three times longer than interspaces. Basal part of both fore and hind wings narrow. Venation open; main longitudinal veins slightly curved, marginal cells reduced in number. Basal postcostal nervure wanting. Separated sectors of *Arc* approximated immediately after origin, then diverging. At least 3 (3-4) antefurcal crossveins between M_{1-3} and M_4 in fore wing, 2 (2-3) in hind wing; fork M_{1-2}-M_3 slightly asymmetrical in fore wing, distinctly so in hind wing; one row of cells M_1-M_{1a}, M_{1a} extending inward 2-4 cells proximal to pterostigma. Discoidal field of fore wing narrow, almost parallel-sided, with single row of cells up to level of nodus (fore wing) or to about half-way distance between apex of *t* and *Nod* (hind wing). All intercalaries bounded by M_{1a}-M_2, Rs-M_3, M_4-Cu_1 as well as transverse secondaries in anal area of hind wing obsolete and/or fractured. Area posterior to Cu_2 in fore wing with maximum of two, in hind wing with three cell-rows. Anal area of fore wing with one cell-row proximal to *t* (female occasionally with few cells divided). Proximal side of *ti* very oblique. Male with single row of three

cells between anal triangle and anal loop, the latter one-celled (male) or irregularly two-celled (female). Anal triangle of male four-celled as in the majority of *Onychogomphus*. Pterostigma braced. Membranula vestigial.

Abdomen very slender, segments more protracted than in related genera, 8 only little shorter than 7. Auriculae present in both sexes, those of male conspicuous, transverse, subcircular in outline. Male with apical segments somewhat expanded, but foliaceous expansions of 8 and 9 narrow. Male genitalia strongly projecting; hamuli well developed, long and slender. Vesicle large and of complex structure, projecting ventrad perpendicular to long axis of body, its apex bifurcate. Median and distal segments of penis unusually drawn out, distal segment slender, dorsoventrally flattened, bilobed and cornuate. Subgenital plate of female of large size. Male anal appendages well developed, superior pair forcipate, inferior appendage deeply cleft, both subequal in length to segm. 9 and 10 united.

Habitat, Malay Peninsula.

Genotype, *P. asthenes* sp.n.

Phaenandrogomphus occupies an isolated position between the 'epigomphine' and 'gomphine' series. Superficially recalling a slender *Onychogomphus*, it comes much nearer *Acrogomphus* Laidlaw, a genus treated by me in some detail recently (1964, Zool. Meded. Leiden **39**: 93-102). The two genera have the following important features in common: (1) sectors of *Arc* approximated for a short distance immediately after origin; (2) fork M_{1-2}-M_3 asymmetrical; (3) cross-veins M_{1-3} and M_4 incompletely spaced out; (4) tendency to a narrowing of the basal portion of the wings; (5) short, robust legs. In other respects there is no approach toward *Acrogomphus*. Features not shared by *Acrogomphus* are the flatly curved main veins of the wings, the strongly aslant proximal side of the fore wing triangle, the marked parallelism and apical convergence of the veins M_2 and *Rs*, and the bizarre form of the male sexual organs. *Phaenandrogomphus* is, in fact, readily distinguished from all Asiatic gomphines including the small-sized members of the *Nepogomphus* section of *Onychogomphus*, by its feeble build and excessive slenderness of the body segments. The narrow wings and curiously open venation, together with the long and vividly orange coloured abdomen give the insect a facies of its own.

The new dragonfly is notable and somewhat enigmatic also for another reason. Its morphological characters are closely paralleled in *Onychogomphus maculivertex* (Selys), previously known as *O. aureus* Laidlaw [1]), from

1) As I have shown elsewhere (1960, Mem. Soc. ent. Ital. **38**: 244-245, fig.), *Onychogomphus aureus* Laidlaw, 1922, male from the Garo Hills, Assam, can not be maintained as specifically distinct from *Leptogomphus? maculivertex* Selys, 1891, female from

Burma. Superficially, these two insects do not only resemble each other in colour and markings, but even the structure of the male accessory genitalia and anal appendages are built according to the same ground-plan. The curiously shaped anterior hamulus with its long recurved branches (fig. 2) conforms with that of *O. maculivertex*; the spout-like vesicle of the penis bears two finger-shaped processes at the end also recalling those of the same species; lastly, the apical segment (glans) is dorsoventrally flattened, bifurcate at apex, each part carrying a curved flagellum, the whole organ thus becoming an almost exact replica of that of *O. maculivertex*. On these grounds one would be inclined to classify these two gomphids as nearly related species. There can be no doubt, however, that they are not even congeneric. This is quite obvious from a comparative study of the wing venation, the general build and texture of the body segments and armature of the legs. Important differences between the two reveal themselves also when comparing the larval characters and studying the habitat and behaviour of this stage. In fact, the present new species may be considered as one of the most striking examples of an isolated gomphid disguised as a species of *Onychogomphus* which itself has deviated from the normal type and acquired a number of extravagant features [2]). It is evident that the characters of the male genitalia and appendages of *Onychogomphus, Acrogomphus* and *Phaenandrogomphus* in practice break down as criteria for generic distinction and that in all three genera they have to be supported by others. The problem of the natural relationships of the Old World gomphine genera and their subdivision can probably be best approached on the lines laid down by Walker in his fine paper on the affinities of the North American species of *Gomphus* (1957, Contrib. R. Ontario Mus., Toronto **46**: 3-24, fig.).

Phaenandrogomphus asthenes sp.n. (fig. 1-13)

Material. — Malay Peninsula: 5 ♂ 5 ♀, 2 larvae (ultimate instar) and many exuviae, from the following localities: 1 ♂ (ad., holotype), Selangor, Templer Park, 12-13 miles from Kuala Lumpur, roadside stream, 26.iii.1963, M. A. Lieftinck (ML); 1 ♀ (ad., allotype), labelled "Wasserscheide zwischen Perak u. Pahang, Inner Malakka, Camp Jor, Albert Gru-

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Lower Burma. It will be seen from the redescription and figures of the latter that *maculivertex* is a true *Onychogomphus*.

2) Similar examples of parallel development of structure in the family Gomphidae were given by Fraser for a number of unrelated genera (1940, Trans. R. Ent. Soc. Lond. **90**: 541-550, 6 pl., 1 fig.), and more recently (1964, loc. cit.) also by Lieftinck for *Acrogomphus jubilaris* Lieft. from Borneo, a species also simulating *Onychogomphus*.

bauer 1901" (UMMZ); 1 ♂ (juv.), Central Perak, 41½ mi. N. of Ipoh, N. of Kuala Kangsar, nr. Bukit Gantang, roadside stream, 2. iii.1963, M. A. Lieftinck; 1 ♀ (juv., bred from larva), Id., 10 mi. N. of Ipoh, Sungai Chepor, 6.iii.1963, J. I. Furtado & M. A. Lieftinck; 2 ♂ (juv., one bred from larva), Selangor, Sungai Gombak, 16.iii.1963 and 22.v.1963 (emerged on same day), J. I. Furtado & M. A. Lieftinck; 1 ♂, 3 ♀ (juv., bred from larvae), Id., Ulu Gombak area, Sungai Tangli, 6.iv.1963 (em. 10.iv), 13.v.1963 (em. 17.v) and 22.vi.1963 (em. same day), J. I. Furtado. — Larvae and exuviae: 1 larva (ult), Perak, Sungai Yum, Sungai Plus area, 15.iii.1933, M. W. F. Tweedie; 1 larva (ult), Selangor, Templer Park, 12-13 mi. from Kuala Lumpur, 11.iv.1963, M. A. Lieftinck; 11 exuviae (all from Selangor), Sungai Gombak, 16-17.iii.1963 (1 ex.), Dusun Tua, Ulu Langat area, 22.iii.1963 (1 ex.), Ulu Gombak area, Sungai Tangli, 6.iv.1963 (8 ex.), Klang Gates, upstream, 2.iv.1963 (1 ex.), all J. I. Furtado & M. A. Lieftinck. — Colour notes taken from live immature ♂: "Head and thorax bright yellow and deep black; abd.-segm. 1-2 yellow, remainder of abdomen bright orange with deep black apical rings" (M.A.L.).

Male (adult, holotype). — Head 5.8 mm wide across eyes, frons 2.3 mm equal to diameter of eye, distance between eyes at closest point 0.6 mm. Labium, maxillae, mandibles (except apically), pleurostomae, and basal four-sevenths of labrum, bright greenish yellow. Genae, upper margin of mandibles and a thick straight band occupying anterior portion of labrum, deep black. Anteclypeus and a small roundish spot on either side of postclypeus, greenish yellow. Clypeus and frons not projecting, almost flat and in line with labrum. Frons green above in front with a thick straight black stripe bordering clypeal suture; this stripe occupies about two-fifths of the vertical portion, extending narrowly upward along margin of compound eye to become fused with a broad black band covering about the basal two-thirds of the horizontal surface of frons; anteriorly, this band extends at the middle in a broad low triangle which does not divide the pale area and widens a little on either side, giving the green area a slightly convex posterior border on each side of the median line. Antennae black, shaped as in *Onychogomphus,* first segment with pale apical ring. Vertex black, raised, with a pair of slightly oblique, low, blunt tubercles, one on each side behind lateral ocellus; surface of posterior portion evenly sloping down toward transverse sulcus separating it from the occiput. Occiput black, trapezoidal, hollowed out on either side of a low, finely sulcate, median longitudinal ridge, its posterior border also somewhat swollen, feebly concave in dorsal view. Rear of occiput black as are also the swollen postocular areas of the postgenae, which for the rest are bright yellow; mesally, the end of the dividing line

is accentuated on either side to form a low ridge ending in a small yellow tubercle.

Prothorax bright chrome, the posterior lobe black except narrow yellow streaks on each side at base and a small isosceles triangle of the same colour placed between the swollen tubercles at hind margin.

Colour-pattern of synthorax sharply defined, bright greenish yellow and deep black, as in fig. 1; ventral surface unmarked.

Coxae and trochanters light greenish yellow; femora moderately inflated, likewise pale-coloured, but outer faces of first two pairs increasingly more obscured from base to apex, the posterior femur only with short extero-apical streak, and the knees narrowly, black. Tibiae and tarsi as well as all spines and bristles, black.

Wings hyaline; neuration black except costal vein, from near base to nodus, finely lined with yellow anteriorly. First and fifth (or fourth) antenodal thickened; 13 *Ax* and 8-10 *Px* of first series in fore wing, 10 and 8-10, respectively, in hind wings. Pterostigma black. Membranula white.

Abdomen long and very slender; basal and terminal segments moderately expanded; segments measuring in length about as follows: 1.0, 2.2, 4.6, 4.2, 3.9, 3.7, 2.7, 1.8, 1.4, app. sup. 3.3 mm. Ground-colour predominantly vivid orange, this colour intermingled with light green on first two and base of third segments, brightest orange on segm. 7, somewhat obscured and mixed with cloudy brown at the sides of 8-9 and on most of 10. A submedian elongate streak of canary yellow on middorsum of 3 and small triangular dorsal spots of the same colour at extreme base of 3, 4 and 5. Markings otherwise fairly well defined, brownish black or black, as follows: segm. 1 and 2 each with a pair of continuous dorso-lateral bands, subequal in width to the pale median area enclosed, the one on 1 widening out posteriorly, the one on 2 slightly diminishing in width toward apex; median pale band of 2 slightly twice constricted; sides unicoloured greenish orange, the auricles canary yellow, in the form of large subcircular lobes, posterior margin of each with 5-7 small incurved acute black denticles. Segm. 3-6 each with complete blackish apical annules, progressively wider from before backwards and including the intersegmental rings, the one on 3 very narrow, those on 4-6 occupying from one-eighth to one-sixth of the total length; each of these tergites moreover with traces of longitudinal dark streaks placed along the median crest (which itself is finely yellow) in front of the supplementary transverse carinae. Segm. 7 also with narrow dark apical ring, ill-defined and obliterated on dorsum on which two black subapical points stand out more clearly than the rest. Dorsum of 8 and 9 from base to apex for the greater part black, but the sides orangish mottled with brown, the posterior margins deep

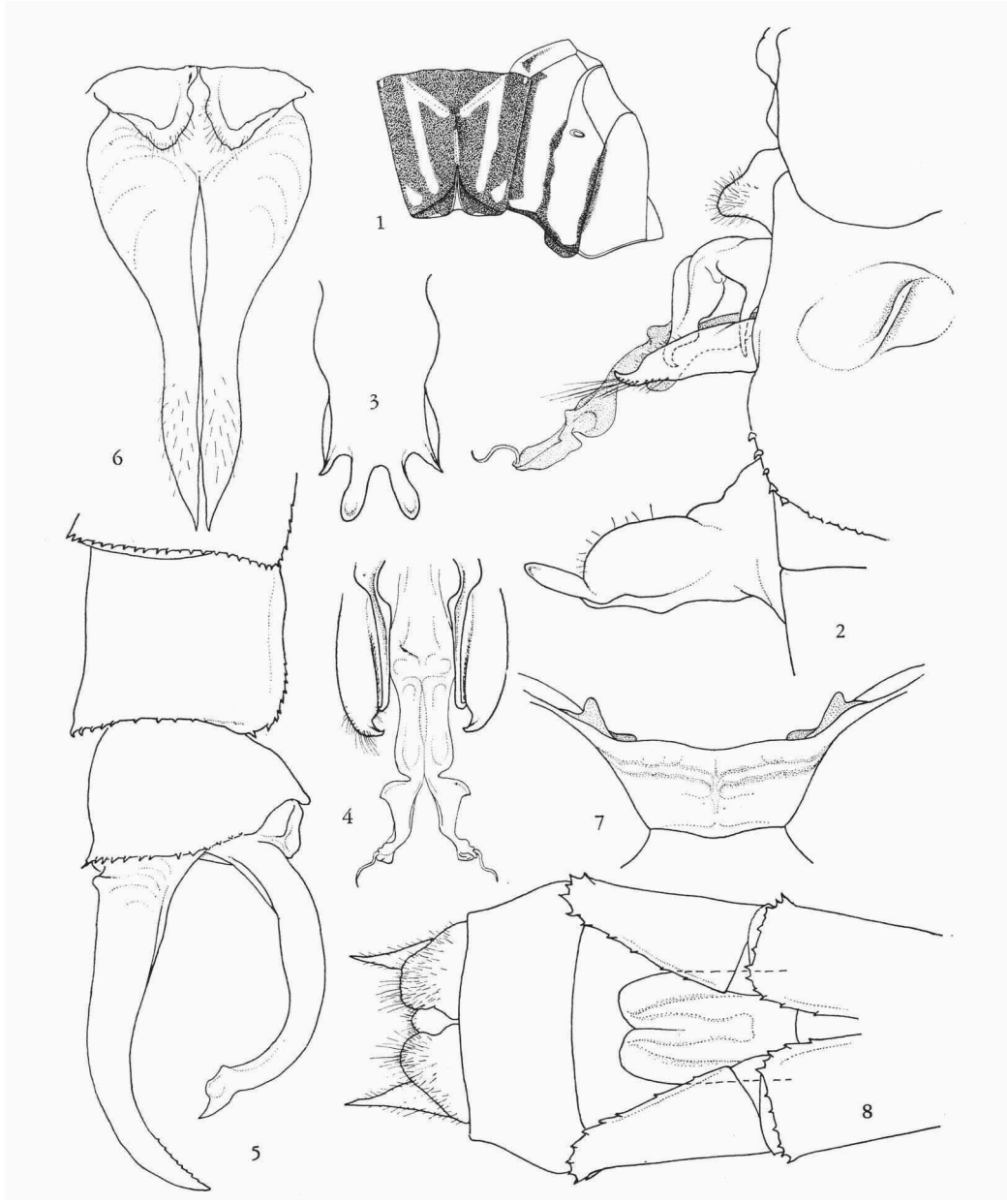

Fig. 1-8. *Phaenandrogomphus asthenes* gen. et sp.n., ♂ holotype and ♀ paratype from Selangor. 1, colour-pattern of ♂ synthorax; 2, left lateral view of genitalia; 3, penis vesicle, ventral view; 4, hamuli and apex of penis, ventral view; 5, apex of abdomen, right lateral view; 6, appendix inferior more enlarged, ventral view; 7, occipital region of ♀, antero-dorsal view; 8, apex of ♀ abdomen, ventral view.

black; 10 obscurely orange, save for a tiny dark mid-dorsal spot at base of segment and a narrow stripe extending along the entire posterior border.

Anterior lamina of genitalia subrectangular in outline with rounded edges, its surface convex, strongly hollowed out within, colour olive-brown, margin obscured. Anterior hamulus of large size, black, its lower margin obtuse-angulate about half-way whole length, the anterior process in the form of a laterally compressed strongly sclerotized elongate plate which tapers to an upcurved point; the posterior process pale-coloured, membranous and filiform. Posterior hamulus greenish tipped with black; size robust, subcylindrical, abruptly pointed at the end which carries a number of long strong exterior bristles, the tooth-like apex directed mesad. Vesicle black, swollen, its distal portion shaped like a deep trough with strongly raised, dorsally convex walls, the whole structure terminating in a robust forked process whose branches are finger-like and shiny (fig. 2-4).

Anal appendages throughout bright orange, only the minute ventro-apical tubercles of the superior pair being black (fig. 5-6).

Female (adult, allotype). — Very similar structurally to the male and differing only in the following respects. Colour of mouth-parts, face and frons olive-green marked with brown, all dark markings ill-defined. Light lateral spots on postclypeus enlarged, subtriangular; brown anterior stripe of frons not sharply delimited and horizontal surface almost wholly olive-brown. Vertex and occiput shaped as in the male, colour of both dark brown; yellowish interior tubercles at inner end of postgenal ridge, on each side below level of occipital rear, better developed and higher than in male (fig. 7).

Colour-pattern of pro- and synthorax as in the male, but all markings warm purplish brown instead of black, ground-colour probably light green in the living insect. Colour of legs dirty ochreous, only the tarsi and distal parts of tibiae dark brown. Outer row of spines present on both intermediate and posterior pair of femora and all spines a little longer than in the male.

Wing venation as described for the male, but cross-veins more numerous and somewhat variable (e.g., discoidal field in right fore wing and left hind wing with a single row of cells, in the remainder with several duplicated cells). Anal loop irregular, one- or (more frequently) two-celled (allotype and 2 other females). Allotype with 13-17 *Ax* and 10-12 *Px* in fore wings, 11 and 11, respectively, in hind wings. Pterostigma slightly larger than in male, brown.

Abdomen long and slender, with cylindrical segments. Markings similar in principle to those described for the male, but smaller and on a darker orange background. Dark dorso-lateral stripes on segm. 1-2 faintly indicated,

the apical rings of the succeeding segments reduced to tiny brown annules, only the one at apex of 6 and 7 a little wider especially at the sides of segments; segm. 8-9 predominantly black, 10 black at base and apex, the sides also obscured, orangish only on mid-dorsum. Anal appendages light orange. Vulvar lamina yellowish, of large size, directed straight backward, strongly longitudinally ridged ventrad on either side of a deep median furrow, each of the elongate lobes thus indicated rounded off apically and fused together for about three-fifths of the total length (fig. 8).

Measurements: ♂ (holotype), abd. + app. 33.0 mm, hind wing 25.0 mm, pt. fore wing 2.3 mm; ♀ (allotype), 33.0, 27.3, 2.6 mm. Some measurements taken from immature (reared) specimens are: ♂ abd. + app. 33.0, hw. 25.0 mm; ♀ 32.0-33.0, 27.2-28.0 mm.

Only two adults of this interesting new species were taken, one at a time, sitting perched high up on the leaves of trees overhanging the stream, the first one captured being not long emerged. All remaining specimens were reared from ultimate instar larvae taken to the laboratory. The identity of the only fully adult female, a somewhat discoloured example in the Förster collection (UMMZ), has remained unknown since I received it on loan from Mrs. K. G. Gloyd in 1935. It is here made the allotype of *P. asthenes*.

The larva of *Phaenandrogomphus asthenes* (fig. 9-13)

A smooth larva with a large head, narrow prothorax, short legs and a rather strongly arched, torpedo-shaped abdomen.

Total length 17.0 mm; length of abdomen 10.7, highest point 3.0, greatest width of same 5.5 mm; length of head 3.2, width across eyes 4.0 mm; greatest width of prothorax 3.0 mm; length of posterior femur 3.0, of antenna 1.7 mm.

Head moderately convex above, frons almost flat, postocular lobes strongly convex. Antenna with first segments short and cylindrical, third segment flattened and expanded, fourth segment vestigial, knob-like (fig. 10). Whole dorsal surface of head covered with microscopical circular warts, all smaller than the interspaces; smooth naked areas on various segments, as follows: parts of labrum, genae, clypeus and base of first antennal segments; a more or less tripartite V-shaped area in front of median ocellus, oval spots lateral to this as well as behind it and also to the outside of the lateral ocelli; five subcircular areas placed in a transverse row on postoccipital portion.

Labium of large size, extending back to the end of procoxae, shape and armature as in fig. 11-13; median lobe wide, slightly arched in front; palpus almost straight, gradually and but slightly narrowed towards apex, which is blunt, the inner margin feebly serrulate.

Neck bare, with its posterior angles a little projecting, rectangulate and acute. Prothorax much wider than long, but distinctly narrower than head; anterior pronotal angles protuberant, rounded, in line with a pair of smaller anterior tubercles, one on each side of the median line, the whole surface covered with warts similar to those on the head save for a subcircular naked depression on each side between the larger and smaller tubercles. Meso-metathorax short and broad, surface as described before but depressed areas smooth and naked. Wing-cases strongly divergent, tips of hind wing reaching slightly beyond apex of segm. 4.

Legs short, moderately strong, all femora rather curved and laterally compressed, the anterior two pairs moreover somewhat inflated; alternating smooth and wart-bearing longitudinal areas on outer faces of all legs, the warts most densely crowded together at the ridges. Distinct, though short, outcurved burrowing hooks carrying two teeth at apex of fore and middle tibiae, those on fore tibia largest; claws long and strongly curved apically.

Abdomen broadly lanceolate, ventral surface flat, dorsal surface rather strongly convex, widest across apex of segm. 5. Dorsal protuberances present on segm. 2-9, obtuse and tubercular, semi-erect, gradually decreasing in height from before backwards, the anterior ones more pinched and narrower than the succeeding ones, but from segm. 4 onwards increasingly more projecting beyond posterior margin of each segment, those of 8 and 9 bluntly triangular in outline when viewed from above. Warts rather evenly distributed, except for small naked areas that are clearly discernible on each side of the middle in front of the dorsal tubercles and also laterally about halfway the distance from middle. Lateral spines of small size and present only on segm. 8 and 9, both blunt and but little protuberant, smallest on 8. Anal pyramid slender, the separate parts pointed apicad, forming together an almost equilateral triangle nearly equal in length to segm. 9 + 10; epiproct and paraprocts subequal in length, the cerci sharply triquetral, slightly outwardly concave, a trifle shorter than the other appendages.

Body pubescence scanty; moderately long (though not dense) hair-fringes along ventro-lateral margin of antennae, on the roundish frontal tubercles between compound eyes and antennal bases, behind postoccipital lobes and occiput, and at exterior ridges of abdominal segments; hair much longer, dense, very thin and silky, on outer faces of legs.

Colours of living larva. — Sandy yellow with a touch of light green all over; pattern fairly distinct, as shown in fig. 9, brownish yellow or brown markings most conspicuous on the proximal portion of the wing-sheaths, at middle of femora, and on tergite 9 of abdomen; dark patches often also on each side of the middle on segm. 6.

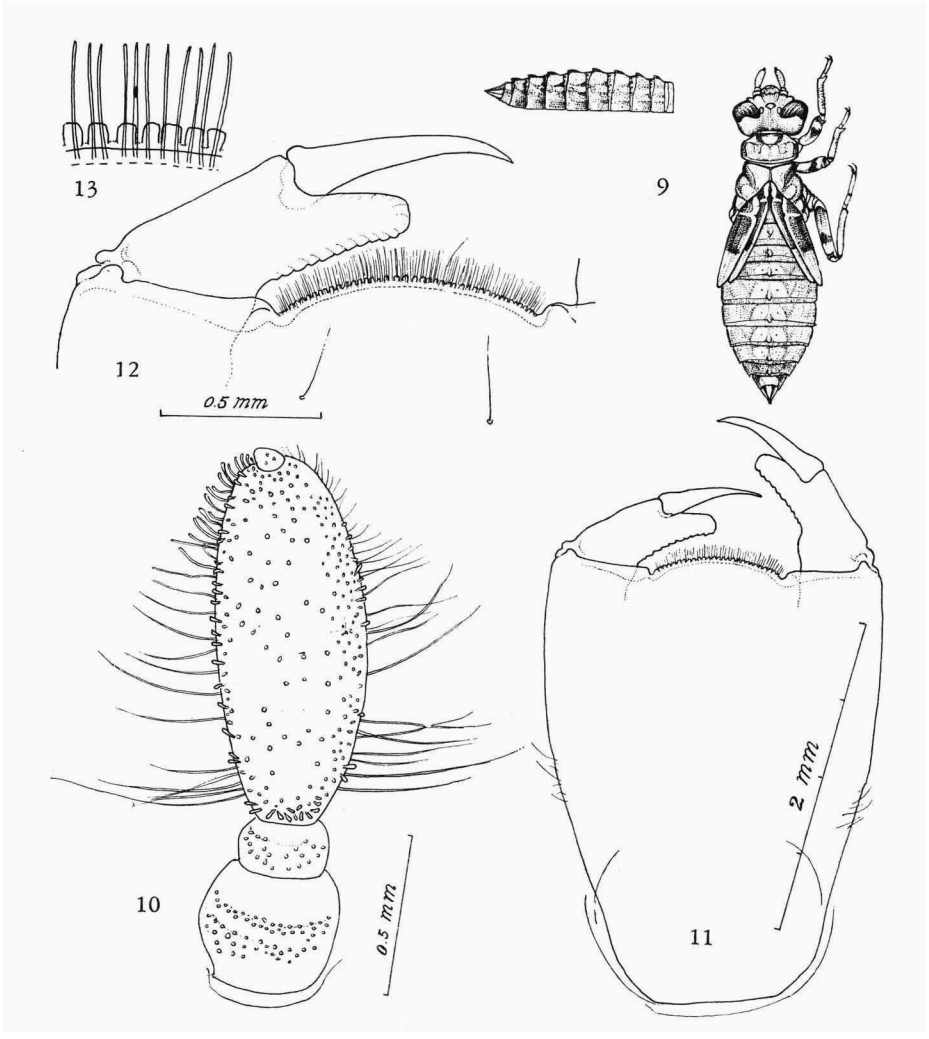

Fig. 9-13. *Phaenandrogomphus asthenes* gen. et sp.n., ultimate instar larva from Sungai Yum, Perak. 9, right lateral view of abdomen; 10, right antenna, dorsal view; 11, 12, labium with median lobe and left palpus more enlarged, interior view; 13, fragment of anterior margin of median lobe, highly magnified. Total length of larva 17 mm.

In general appearance and structure this larva differs markedly from that of *Onychogomphus* and *Acrogomphus*. Already in 1933, when first examining the unique specimen taken by Mr. Tweedie in Perak, I had removed and stretched its wings so that the venation could be studied. The neural characters revealed some striking features in addition to those already noted,

but as the perfect insect was still unknown this example was set apart for future study. Now, thirty years after, we found it fairly commonly in most clear running hill streams.

There is great similarity in habits between *Phaenandrogomphus, Acrogomphus* and *Megalogomphus,* and representatives of each may sometimes inhabit the same stream. All are smooth and very active creatures burrowing deeply in clean sand. The larval behaviour of *Acrogomphus walshae* Lieft. and *Megalogomphus icterops* (Martin) was described by me in 1941 (loc. cit.). The morphological differences between these three genera are best understood by comparing the illustrations of the present article with those given in the publication just mentioned. They agree in having the wing-cases widely divergent, but here the similarity ends. *Megalogomphus* is easily recognized by its large size, the sickle-shaped and strongly toothed labial palpus, and the straight border of the midlobe. The labial structure of *Acrogomphus* resembles that of *Phaenandrogomphus* fairly closely, but the former is easily known by its much smaller head, the enormously developed disk-shaped pronotum, and the differently shaped antennae.

Burmagomphus Williamson, 1907

This genus comprises some twenty species distributed all over the tropical parts of Asia, ranging from India into China and southward to Borneo and Sumba. No members are yet known from the Philippine Islands. Several, mostly Chinese, species previously referred to the closely allied genus *Gomphus* (s. lat.) have since been transferred to *Burmagomphus.* Though by no means homogeneous, the genus does not lend itself well to subdivision, because most of the differences found between species are merely of degree, and not of kind. Moreover, several members are known from one sex only and of the great majority the larvae are still unknown. At least one rare species, *B. inscriptus* (Selys) from Java, has a distinctive appearance very different from the rest. It is unmistakable by the broad expansion of the terminal segments of the abdomen and the strong tendency to develop a basal postcostal nervure in one or more of its wings is also unusual. Both features indicate relationship with *Anisogomphus.* Having carefully re-examined the characters of both sexes of *inscriptus* and seen other aberrant members, I agree with Ris and later authors that there is much to be said in favour of enlarging the scope of the genus to include it.

Adults are easily overlooked insects with arboricolous habits, usually found resting on bright green foliage beside a stream. So far known all species breed in running water, but the larvae seem capable only to burrow in silt or fine sand and avoid the tracts of streams with fast flowing water.

They are extremely inert, slow-moving creatures, young stages being very difficult to breed when held in captivity.

Key to the southeast Asiatic species of *Burmagomphus*

1. Head black, mouth-parts and face with well-defined yellow or green markings . 2
— Head greenish- to dark brown, lacking clearly defined light markings, or, if at all marked, crescentic spots present only on top of frons 6
2. Antehumeral thoracic bands abruptly sinuous and tapered dorsally to a point, the broader lower portion running down across episternal suture onto mesinfraepisternum and coxa to reach base of middle leg (fig. 24). A conspicuous transverse yellow band along hind margin of abd.-segm. 9. Anterior margin of posterior hamulus lacking a fringe of long hairs. Male anal appendages strongly divaricate . . . 3
— Antehumeral thoracic bands narrower, straight or somewhat undulated, gradually tapered on both ends, not confluent below with spot on mesinfraepisternum . . 4
3. Apex of male sup. app. very oblique, tapering inwardly to a fine point, extero-lateral projection obtuse-angulate, situated about half-way length of appendage; branches of inf. app. with tips visibly exposed in dorsal view and with fringe of long backwardly directed hairs along posterior margin of each. Posterior hamulus more elongate, distinctly longer than wide when viewed laterally. Occipital plate of male black, not protuberant in the middle, hind margin almost straight; occiput of female very narrow, ridge-like, slightly concave in dorsal view, carrying a vestigial tubercle at either end close to inner angle of compound eye. Both sexes with hind margin of abd.-segm. 9 slightly triangularly produced backward and spined in the middle, the marginal teeth black. Abdomen relatively longer (♂ abd. + app. 33-33.5, hw. 24-25 mm). Hab.: Indochina . . . . . *vermicularis* (Martin)
— Apex of male sup. app. more squarely cut off, pointed inwardly, but extero-lateral angular projections removed caudad and situated well beyond half-way length of appendage (fig. 19); branches of inf. app. almost or entirely covered by superior pair and concealed from view in dorsal aspect, posterior margin of each not or sparsely fringed with black hairs. Posterior hamulus more globular in lateral view, only little longer than wide (fig. 18). Occipital plate of male shaped similarly to *vermicularis*, either black or both occiput and postoccipital area with yellow central spot; female at least with the swollen median portion of occipital area bright green or yellow, this part produced caudad to form a conical or triangular tubercle, the plate provided at its base with an upwardly directed spike-like, bi- to tri-spinose process placed at either end close to inner angle of compound eye (fig. 20-23). Hind margin of abd.-segm. 9 straight, studded with black denticles. Abdomen relatively shorter . . . . . *williamsoni* Förster
4. Antehumeral thoracic bands narrow, almost straight, not nearly reaching lower suture; mesothoracic half-collar interrupted by black in the middle line, tapering laterally (fig. 42-43). Male anal app. thick, with rounded apices and poorly developed extero-lateral prominency; inf. app. divaricate (fig. 44). Female unknown. Length of abd. + app. 28, hw. 23 (?) mm. Hab.: Borneo . . . . . *insularis* Laidl.
— Antehumeral thoracic bands longer. Male anal app. not as above. Branches of inf. app. with fringe of longish hairs along posterior margin 5
5. Hind margin of abd.-segm. 9 straight in both sexes, lacking a spine- or tooth-like median projection, marginal teeth black. Posterior genital hamule of male with one or two small marginal teeth at outer apical angle, but lacking fringe of long hairs along its anterior margin (fig. 15). Sup. app. barely as long as segm. 10; branches of inf. app. projecting beyond apices of superior pair (fig. 16). Mesothoracic half-collar wide, entire or subinterrupted in the middle line; dorsal thoracic bands some-

what angulate about mid-way their length (fig. 14). Female unknown. Length of abd. + app. 28, hw. 23 mm. Hab.: Burma . . . . . *arboreus* Lieft.

— Hind margin of abd.-segm. 9 (and to a lesser extent also 8) produced backward in the middle above and carrying one or two spines, the short marginal teeth black. Posterior genital hamule of male lacking marginal teeth at outer apical angle but anterior border fringed with long hair (fig. 31). Sup. app. slightly longer than segm. 10; branches of inf. app. very slender, strongly projecting laterad, not attaining length of superior pair (fig. 32-33). Mesothoracic half-collar narrower, interrupted by black in the middle line; dorsal thoracic bands long and slender, almost straight (fig. 29). Occipital plate of female very short, feebly convex in the middle, unarmed; vertex with two pairs of erect, flattened teeth, one pair on each side behind posterior ocelli (fig. 34). Vulvar lamina very short, bituberculate (fig. 35). Very slender species: ♂ abd. + app. 27, hw. 22 mm. Hab.: Malaya. . *divaricatus* sp.n.

6. Antehumeral thoracic bands yellow-green, short, straight and completely isolated; sides with broad greenish yellow meso- and metepimeral bands. Neuration open; basal postcostal nervure often present in both pairs of wings, more rarely absent; anal triangle of male hind wing uncrossed or two-celled; tornal angle obtuse-angulate; pterostigma large, yellow. Abdomen slender, strongly expanded from base of segm. 7 to apex of 8, then again narrowed, 10 little broader than 7 at its middle; lateral foliations present on segm. 8 and 9 (♂) or 8 (♀). Male anal app. widely divaricate, each sup. app. a little expanded towards apex, which is abruptly and squarely cut off, both lateral angles acute. Posterior genital hamule slender, tapered, with acuminate tip; penis vesicle large. Occipital plate of female unarmed; abd.-segm. 9 subequal in length to 8; vulvar lamina vestigial. Large species, ♂ abd. + app. 33.0-35.0, hw. 27.0-29.0, pt. fw. 2.3-3.0 mm; ♀ 37.0, 31.0, 3.0 mm. Hab.: Java . . *inscriptus* (Selys)

— Antehumeral thoracic bands green, wedge-shaped, widest below. Basal postcostal nervure invariably absent; pterostigma cinnamon to yellow brown. Segm. 8 and 9 of abdomen lacking foliaceous expansions. Smaller species 7

7. Male, top of frons with a pair of glaucous spots. Thorax in both sexes dark brown with sharply defined green markings (fig. 36). Tornus of male hind wing incurved, rectangulate. Genitalia and appendages, see fig. 37-38. Occipital plate of female normal, swollen in the middle posteriorly; vulvar lamina short, not projecting, shortly bilobed (fig. 41). ♂ abd. + app. 28, hw. 22.5, pt. fw. 2.0 mm; ♀ 26.5-28.5, 23.0-24.0, 2.0-2.2 mm. Hab.: Malaya, Sumatra, Borneo . . . . . *plagiatus* sp.n.

— Male unknown. Thorax of female paler, reddish brown above, fading to green laterally, markings indistinct. Occipital plate very short, reduced to a ridge-like crescent, open to behind, its crest finely spinulose on each side of the middle; vulvar lamina of large size, gutter-shaped, projecting ventrad almost at a right angle. ♀ abd. 27.4, hw. 23.0, pt.fw. 2.0 mm. Hab.: Borneo . . . . . *arthuri* Lieft.

The larva of *Burmagomphus* was first described and figured by Lieftinck (loc. cit. postea, 1940) for the Ceylonese *B. pyramidalis sinuatus* Fraser. A description and some figures of a Chinese species, *B. intinctus* (Needham), were published by Chao (loc. cit. postea, 1954). It can be distinguished from allied genera by the depressed and elongate form of the body, the parallel wing-cases, and the exceptional small size of the median lobe of the labium, which is but little protuberant and narrower than each of the side portions of the prementum (measured along anterior border of the latter); also, by the rather slender third and minute fourth antennal segments, and

the well-developed squarish teeth bordering the inner margin of the palpus, whose end-hook is curved and sharply acute.

The Malaysian species described below resemble each other closely and are similar to *pyramidalis* with respect to their labial structure, except that the median lobe carries a blunt median tubercle, which is absent in *pyramidalis, intinctus* and maybe several others in the genus. The presence or absence of dorsal hooks and lateral spines as well as the colour-pattern of the abdomen seem to afford useful specific characters.

We have larvae and/or exuviae of *B. williamsoni javicus* and *divaricatus* correctly associated with the adult insects, but the one of *plagiatus* is only tentatively referred to that species. They may be distinguished thus:

1. Dorsal hooks only on segm. 8 and 9, broadly triangular in dorsal view and but little produced caudad, smallest on 8; hind margin of these segments including the hooks finely and acutely spinulose. Lateral spines on segm. 7-9, acute, strongest on 9, reaching ¾ length of 10; side-margin of 8 and 9 finely serrulate, the serrations shorter than the interspaces. Median lobe of labium a very low triangle, the sides straight and meeting in the median line to form a minute blunt denticle or knob (fig. 28) 2

— Dorsal hooks present on segm. 4-9, acute and laterally compressed, regularly increasing in size to rearward, those on 8 and 9 continued basad as strong median ridges, but hind margins and dorsal hooks not or scarcely themselves spinulose. Lateral spines on segm. 6-9, acute, strongest on 9; side-margins of 7-9 with minute, more widely spaced serrulations. Abdominal pattern strongly pronounced, on 4-9 consisting of a double row of irregular brown marks on each side of the middle forming together an almost continuous band that deepens in colour from before backwards. Proportional lengths of segm. 8 and 9 measured alongside as 10 : 13.3 . . *plagiatus* (supposition)

2. Abdomen with a cluster of four brown spots on each side upon middle of segm. 3-8 as well as a pair of brown patches placed more inwardly and forming a pair of interrupted bands on 4-9, these spots most conspicuous on 9 and placed in the long axis of the body. Proportional lengths of segm. 8 and 9 measured alongside as 10 : 12.7 . . . . . *divaricatus*

— Abdominal pattern as described and figured (fig. 25). Proportional lengths of segm. 8 and 9 measured alongside as 10 : 14 . . . . . *williamsoni javicus*

Burmagomphus arboreus Lieftinck, 1940 (fig. 14-17)

Selected references:

1907. Williamson, Proc. U.S. Nat. Mus. **33**: 298-303, fig. 28 (♂ struct.), 29[10] (♂ thorax). — ♂ Burma (*B. vermiculatus* Martin).
1926. Fraser, J. Bombay Nat. Hist. Soc. **31**: 410-411, pl. 1 fig. 2 (insect, loc.?). — ♂ Burma (*B. williamsoni* nom. nov.).
1940. Lieftinck, Ceylon J. Sci. (B) **22** (1): 111-112 (nom. nov. pro *B. williamsoni* Fraser, 1926, nec Förster, 1914).
1954. Chao, Acta Ent. Sinica, Fukien Coll. Agric. **4** (1): 67-69, notes.
1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 88 (genotype *B. arboreus* Lieft. fixed).

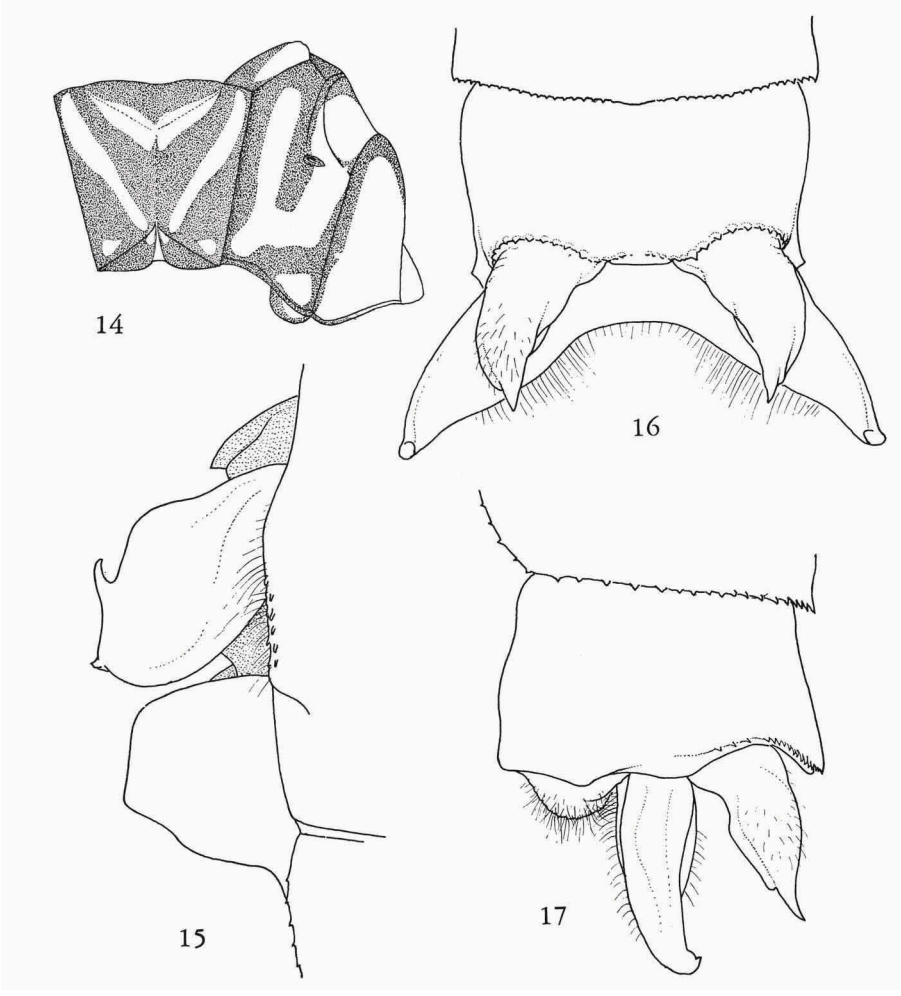

Fig. 14-17. *Burmagomphus arboreus* Lieftinck, ♂ holotype from Burma. 14, colour-pattern of synthorax; 15, left lateral view of genitalia; 16, 17, apex of abdomen, dorsal and left lateral view.

Material. — Burma: 1 ♂ (ad., lectotype), labelled: "Burma, R.A. Earnshaw" and "Burmagomphus williamsoni Fraser TYPE — pp. 4-5 Jour. Bombay Nat. Hist. Soc. 1926" (both written), "Burmagomphus williamsoni Fraser TYPE ♂ Burma R. A. Earnshaw coll. E. B. Williamson" (written), and "Holotype ♂ Burmagomphus williamsoni (Williamson) nom. nov. See Catalog Types UMMZ Odonata, Kormondy 1958" (red, printed & written) (UMMZ).

This is one of three males on which Williamson based the diagnosis of *Burmagomphus*; one other was sent to R. Martin whose comments Williamson quoted in the original description.

The principal characters of the type given in the key as well as the accompanying drawings may serve to its easy recognition. The female still remains unknown.

Burmagomphus williamsoni Förster, 1914 (fig. 18-28)

The name of this species was originally intended to denote a Malayan subspecies (called "Rasse" by Förster) of the Indochinese *B. vermicularis* R. Martin, 1904. This is, however, specifically distinct and easily separated from the present one, as explained by me in an earlier paper on the genus (loc. cit., 1953). Laidlaw (1931), when describing *B. seimundi* from the Malay Peninsula, was well aware of Förster having already reported the occurrence of a closely similar species in that country, of which he even states that it is "... almost certainly the same form as that described here". However, Laidlaw overlooked the fact that Förster, incidentally, had already given it a name. *B. seimundi* thus becomes a synonym of *williamsoni*. In 1907, Williamson defined the new genus *Burmagomphus*, with a Burmese species in his collection as the genotype. This was described and figured in great detail but left unnamed, because Williamson mistook his species for the poorly described *vermicularis* Martin (misspelled by him "*vermiculatus*" Martin). The Burmese insect was first recognized as a distinct species by Laidlaw and subsequently renamed *williamsoni* by Fraser, who overlooked Förster's earlier use of that name for a species from Malaya. Therefore, Williamson's genotype from Burma had to be renamed again and ultimately became known as *B. arboreus* Lieftinck (1940). It will be understood that *vermicularis* Martin and *arboreus* Lieft. are independent species quite distinct from their allies. However, the Malayan species *williamsoni* Förster, although bearing a validly proposed name, has never been properly described. It is here characterized and synonymized for the first time, two species described by later authors having been found to belong to it. Schmidt (1934), also overlooking Förster's insect, described *B. javicus* as a new species from Java. It was compared with *vermicularis* Martin and the Burmese "*williamsoni* Fraser" (= *arboreus*), not with the true *williamsoni*. I am deliberately of the opinion that *javicus* can no longer be maintained as a full species and am therefore giving it subspecific rank. At the same time a similar status has been assigned to a smaller and darker race from Sumba, already dealt with earlier but left unnamed by me. The distinguishing features of these subspecies are given below; they are slight, not easily paraphrased, and based

on average characters of size and extent of body markings. It is worthy of note that the females are more easily held apart than the males.

Burmagomphus w. williamsoni Förster, 1914 (fig. 18-24) status nov.

1914. Förster, Archiv Naturgesch. **80**: 75-77. — ♂ ♀ Perak, Malaya (*B. vermicularis* Rasse *Williamsoni* nov.).
1930. Laidlaw, Trans. Ent. Soc. London **78**: 189 (*B.* spec.).
1931. Laidlaw, J. Fed. Mal. States Mus. **16**: 212-214. — ♂ ♀ Pahang, Malaya (*B. seimundi* sp.n.)
1934. Schmidt, Archiv Hydrobiol. Suppl. **13**, Trop. Binnengew. **5**: 368 (key ♂ ♀ Borneo, err. pro Malaya, not seen) (*B. Seimondi* Laidlaw).
1940. Lieftinck, Ceylon J. Sci. (B) **22**: 111-112 (synonymy) (*B. williamsoni* Förster).
1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 89-90 (references & synonymy) (*B. williamsoni* Förster).

Material. — Malay Peninsula: 1 ♂ 1 ♀ (both adult, lectotype and lectoallotype), labelled: "Camp Jor, Wasserscheide zwischen Perak und Pahang (Inner Malakka) Albert Grubauer 1901" and "Burmagomphus vermiculatus R.M. ♂" (both in Förster's writing), with additional printed labels "Lectotype ♂ and lectallotype ♀ Burmagomphus vermicularis williamsoni Forster, selected types, see Cat. Types UMMZ Odon. Kormondy 1958" (UMMZ). 1 ♂ (juv.) 4 ♀ (2 ad.), Central Perak, 9½ mi. N. of Ipoh, Sungai Chemor, 2.iii (2 ♀) and 3.iii.1963 (1 ♂ 2 ♀), M. A. Lieftinck (ML).

Male. —A tripartite, ill-defined, greenish mark placed transversely in the centre of the occipital plate (type) or this spot a little larger and less constricted (S. Chemor). Baso-dorsal yellow ring of segm. 7 of abdomen reaching transverse suture, finely indented by black from behind at the dorsal crest; a fine yellow streak on either side at base of 8. Transverse yellow band covering dorsum of 9 widest on each side of the middle, where it occupies about the apical one-fourth, but narrowing towards the middle and attaining only one-fifth of the segment's length. Otherwise as in *w. javicus*. Genitalia and appendages exactly as in that subspecies.

Female. — Erect spine-like process on each side at base of occipital plate usually placed transversely and ending in two or three (rarely four) fine spines; plate black, usually only the middle portion green, whether or not including the spines. The colour-pattern of the abdomen varies somewhat in the five females before me, but in all of them (except the allotype, which is marked exactly as in *javicus*!), the following slight differences are apparent: mid-dorsal green mark of segm. 1 separated, or almost so, from the light colour on the sides (confluent or anastomosing in *javicus*), while the longitudinal median stripe on 2 is a little narrower at its base than in *javicus*. The basal rings of 3-6 are somewhat broader and triangularly indented by black from behind instead of being angularly excised (more ⌐¬ - or M-shaped)

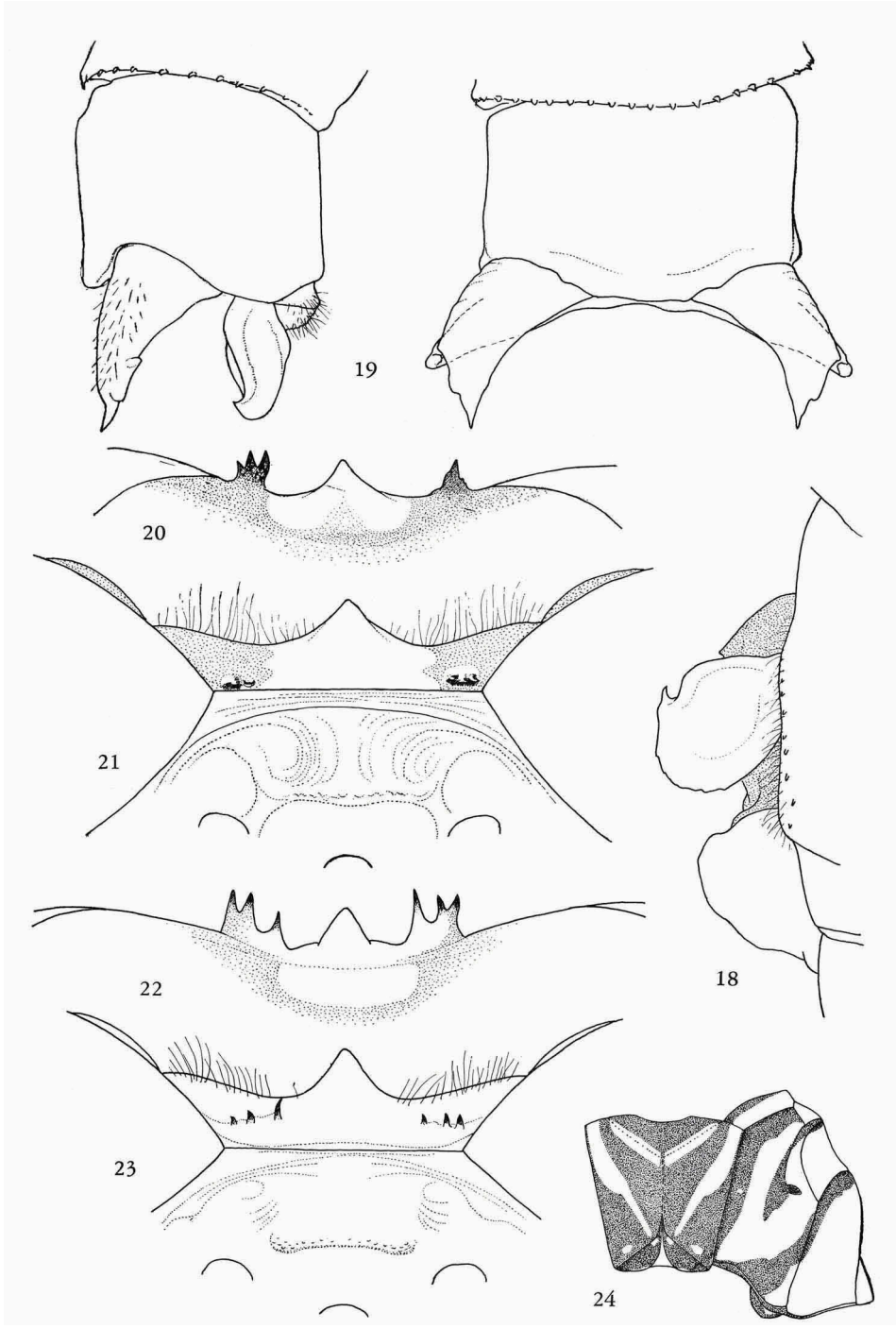

Fig. 18-24. *Burmagomphus w. williamsoni* Förster. 18, 19, ♂ lectotype from Camp Jor; 18, left lateral view of genitalia; 19, apex of abdomen, right lateral and dorsal view; 20, 21, ♀ lectallotype from Camp Jor; 20, caudal view of occiput; 21, vertex and occiput, antero-dorsal view; 22-24, ♀ from Sungai Chemor; 22, caudal view of occiput; 23, vertex and occiput, antero-dorsal view; 24, colour-pattern of synthorax.

in *javicus*; the lateral stripes on the middle segments are smaller, there being no trace of them on 5 and 6 (usually present in *javicus*); lastly, the apical ring of segm. 9 is narrowest on mid-dorsum, as in the male, whereas in *javicus* the reverse condition prevails. The vulvar lamina is short and varies a little in shape, but on the whole the triangular lobes are a trifle longer, more approximated, with the emargination more triangular in outline, than in *javicus* (figured by Schmidt, loc. cit.).

Length: ♂ abd. + app. 27.3, hw. 21.8, pt. fw. 2.3 mm; ♀ 27.0-28.0, 23.3-24.0, 2.3-2.7 mm.

This species was found by us only at the banks of a slow-flowing stream in open country. A few were seen rising from their emergence supports in or beside the stream, flying straight toward the nearest bushes some twenty metres away and settling on the foliage of shrubs. Other more mature and wary ones had probably emerged earlier in the morning or the day before; these were resting at variable heights but on the slightest disturbance left their positions on the leaves only to select higher sites, mostly far out of reach of a net. We did not come across any exuviae which could belong to this species, but the larva of its subspecies, *javicus*, is described hereafter.

B. siamensis Fraser, 1926 (J. Bombay Nat. Hist. Soc. **31**: 411-412, pl. 1 fig. 1, ♀ insect and head), described from a single female taken at Bangkok (Thailand), is probably this species. From Fraser's sketch it would appear that the occiput of this specimen is shaped similarly to that of *williamsoni*; the type of *siamensis* is in the British Museum collection (see p. 37).

Burmagomphus williamsoni javicus Schmidt, 1934 (fig. 25-28)
status nov.

1934. Schmidt, Archiv Hydrobiol. Suppl. **13**, Trop. Binnengew. **5**: 368-369 (incl. key ♂ ♀), 388, fig. 72-75 (♂ genit., ♀ occiput, ♂ thorax and ♀ genit., Java). — ♂ ♀ W. Java (*B. javicus* n.sp.).

1934. Lieftinck, Treubia **14**: 440, 461, notes. — ♀ W. Java (*B. javicus* Schmidt in litt.).

1950. Lieftinck, Ibid. **20**: 664-665 (ethology) (*B. javicus* Schmidt).

1953. Lieftinck, Verh. Naturf. Ges. Basel **64**: 128, 131, 167-171 (♂ ♀ W. Java, notes imago & larva, variation etc.), fig. 32-33 (♂ ♀ thorax, Java) (*B. javicus* Schmidt).

1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 89 (references, notes). — ♂ ♀ W. Java (*B. javicus* Schmidt).

Material re-examined. — W. Java: 4 ♂ 12 ♀ (ad.), W. Java, Djampang Tengah, Mt. Tjisuru, 600 m, iv.1933, native coll. (1 ♀), Djasinga, Tjibarangbang, 150 m, 1, 6 & 8.iii.1935 (2 ♂ 10 ♀), 1 & 15.xi.1936 (2 ♂ 2 ♀), all M. A. Lieftinck. — A total of 10 young larvae (various stages), all from W. Java, Djasinga, Tjibarangbang, 150 m: 18.vii.1937 (2 ex., reared to ult instar, killed 28.x.1937), 27.x and 8.xii.1940 (2 ex., died in confinement),

9.I.1941 (5 ex., one reared to ult instar, killed 5.iii.1941), all M. A. Lieftinck.

Male. —Occipital plate either entirely black, or with a transverse central patch of yellow. Baso-dorsal yellow ring of segm. 7 of abdomen as described for the nominotype; vestiges of yellow lateral streaks and a small mid-dorsal triangle at base of 8, or these spots united to form a complete basal mark pointing caudad in the middle. Transverse yellow band covering dorsum of 9 widest in the middle, where it is triangularly produced basad, occupying about one-third or a little less of the segment's length.

Female. — Erect spine-like process on each side at base of occipital plate less broad at base, uni- or bispinose, rarely tridentate, in some specimens not at all differing in shape and length from typical *williamsoni*, but occiput with few exceptions much more broadly green, only the side-edges remaining black. Further differences between the two subspecies as described before.

Size larger. Length: ♂ abd. + app. 28.5-29.0, hw. 23.0-23.5, pt. fw. 2.5 mm; ♀ 29.0-32.0, 25.0-26.0, 3.0 mm.

The larva of *Burmagomphus williamsoni javicus* Schmidt

A flattened, elongate larva with the facies of *Gomphus pulchellus* Selys, but much smaller, more compactly built and with a larger head.

Total length 20.0-21.5 mm; length of abdomen 12.8-14.2, greatest width of same 5.3-5.8 mm; length of head 3.0, width across eyes 4.0 mm; greatest width of prothorax 3.2 mm; length of posterior femur 3.8, of antenna 2.2 mm.

Head rather broad and flat, widest across eyes, which are comparatively small; postocular lobes not very protuberant behind, evenly rounded; antenna with first segments short and cylindrical, third segment slender, slightly flattened dorso-ventrally and a little upcurved, not widened, fourth segment vestigial, knob-like (fig. 26). Integument of body covered with microscopical warts much as described for *Phaenandrogomphus*, though still smaller and more closely set; smooth naked areas on various parts, as follows: most of the labrum, genae, clypeus, horizontal portion of frons and first antennal segments; also on the ocellar areas, three dots in a transverse row on occiput with an additional oblique scar on either side on middle of lobes. Lateral frontal tubercles poorly developed, but margin behind antennae slightly raised and ridge-like, acute-angulate.

Labium of moderate size, extending back to the end of procoxae, shape and armature as in fig. 27-28; median lobe narrow, little protuberant, sides almost straight, the whole structure in the form of a very low triangle, apex shortly but distinctly toothed; palpus broad at base, apex evenly narrowed and curved, inner margin distinctly denticulate with short robust end-hook.

Neck bare, broad and trapezoidal, widest posteriorly, hind angles not projecting, acute-angulate. Prothorax wider than long, but narrower than head; pronotal angles low, rounded, the whole anterior lobe raised, rather swollen, its front margin evenly rounded; middle portion wider, trituberculate, with a pair of depressed, rather U-shaped naked areas, one on each side of the median tubercle; posterior lobe not developed. Meso-metathorax short and broad, surface covered with microscopical warts, with two transverse, deeply impressed, smooth and naked areas, on either side. Wing-cases lying parallel on the back, tips of fore wings reaching from half-way length of segm. 4 almost to posterior margin of same.

Legs rather slender, fore and middle femora a little curved and swollen but scarcely compressed, outer faces of all femora with two longitudinal, linear and naked stripes that run parallel to each other. Fore and middle tibiae with well-developed, narrowly triangular, moderately curved, extero-apical burrowing hooks; claws long, evenly curved.

Abdomen broadly lanceolate, evenly tapered and much flattened, highest point only 2 mm; greatest width across apex of segm. 4 or at middle of 5. Dorsal hooks present on segm. 8 and 9 only, both directed caudad, acutely pointed with finely denticulate margins, the one on 9 about two times the size of 8, about twice as wide basally and also a little longer. All tergites covered with fine warts, except a smooth mid-dorsal pale line extending as far as the end of segm. 8 and a cluster of four oval naked areas on either side upon the middle of 3-8; 9 with a naked lateral scar placed in the long axis of the body. Lateral spines well-developed, present only at segm. 7-9, those on 7-8 directed almost straight back, slender and acute, those on 9 longest and a little convergent, tips almost reaching apex of 10. Segm. 9 distinctly longer than 8, its posterior border when viewed from above concave and finely denticulate between the dorsal and lateral hooks; segm. 10 very short and annular with straight hind margin. Anal pyramid only little longer than segm. 10, all appendages triangular, rather swollen basally and abruptly pointed; epiprocts and paraprocts of equal length, bluntly pointed, the cerci a little shorter, apices acute.

Body pubescence rather long, consisting of extremely fine, white silky hairs, which are longest and densest at the flat lower lateral parts of frons, at the legs and at the exterior ridges of abdominal segments; hair covering dorsal surface of body short and scanty.

Colours of living larva. — Generally sandy yellowish grey, lacking definite markings on head, thorax and legs, except that the deeply sulcate meso-metapleural sutures are clearly indicated by oblique brown streaks; abdo-

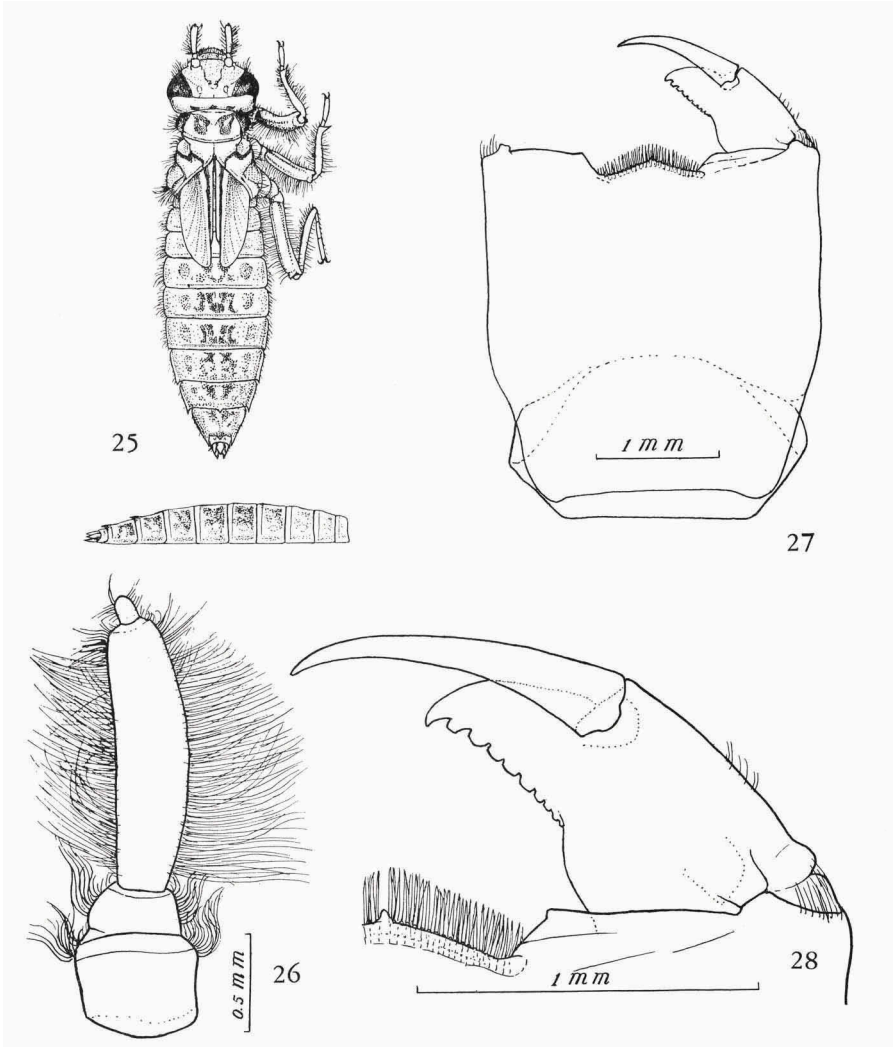

Fig. 25-28. *Burmagomphus w. javicus* Schmidt, ultimate instar larva from Djasinga, W. Java. 25, right lateral view of abdomen; 26, right antenna, dorsal view; 27, 28, labium with median lobe and right palpus more enlarged, interior view. Total length of larva 20.5 mm.

minal pattern distinct, consisting of partly anastomosing brown median spots on segm. 4-9 (rather diffuse also on 2-3), as shown in fig. 25.

Burmagomphus williamsoni austrosundanus subsp.n.

1953. Lieftinck, Verh. Naturf. Ges. Basel **64**: 167-171, fig. 34 (♂ ♀ thorax, Sumba), 35-40 (♂ ♀, structures, Sumba). — ♂ ♀ Sumba (*B. javicus* Schmidt).

Material re-examined. — Sumba I.: 1 ♂ 1 ♀ (ad., holo- and allotype),

E. Sumba, Laluku, 4.vii.1949 (♂) and Wai Lekabe, 28.vi.1949 (♀), A. M. R. Wegner et al., Sumba Exped. (ML); 1 ♂ 1 ♀ (ad.), W. Sumba, Wai Tombo, 7.viii.1949 and E. Sumba, Wai Lekabe, 27.vi.1949 (paratypes, ZMB).

Male. — All black markings of synthorax a little more extensive than in *javicus*, the black band along second lateral suture equal in width to the green mesepimeral band. Antehumeral band abruptly angulate outwardly at about half-way its length, the lower portion twice as broad as the upper. Yellow apical ring of segm. 9 with straight anterior border. Sup. anal app. each with a greenish dorsal patch.

Female. — Conical tubercle in middle of occiput slightly less prominent than in *javicus*, the erect processes near eye-margin either bidentate or undivided, in the form of slender conical spikes. Plate for the most part green, the spines tipped with black. Vulvar lamina trapezoidal, even shorter than in *javicus*, the apical emargination and lobes scarcely indicated.

Size smaller. Length: ♂ abd. + app. 25.5-26.0, hw. 22.0, pt.fw. 2.2 mm; ♀ 27.0-28.0, 23.5-25.5, 2.2-2.6 mm.

Burmagomphus divaricatus sp.n. (fig. 29-35)

Material. — Malay Peninsula: 6 ♂ 4 ♀, one larva (penult) and many exuviae, from the following localities: 1 ♂ (ad., holotype), Kelantan, Ulu Kelantan, Sungai Nengiri, Fort Brooke, 700 m, 31.vii.1963, J. I. Furtado (ML); 5 ♂ 4 ♀ (including allotype, all teneral, with exuviae, bred from larvae), Selangor, 11½ mi. Kuala Lumpur-Bentong Rd., Sungai Gombak, 16.iii.1963 (4 ♂ 2 ♀, em. 24.iii, 10.iv. and 31.v), 22.v.1963 (♀, em. 24.v), and 22.vi.1963 (♂, em. vii), J. I. Furtado & M. A. Lieftinck; 1 ♀ (juv., bred from larva), Pahang, Sungai Tangli, 6.iv.1963 (em. 17.iv), J. I. Furtado; 1 ♂ (juv.), Selangor, Dusun Tua, Ulu Langat, 9.iii.1963, M. A. Lieftinck. Larvae and exuviae (all from Selangor): 1 ex., Sungai Gombak, 17.iii.1963; 2 ex., Dusun Tua, Ulu Langat, 22.iii.1963; 9 ex., Klang Gates, upstream, 2.iv.1963; all M. A. Lieftinck. 1 larva (penult), Johore, Sungai Seletar, at Nee Soon, tidal stream, 11.ix.1956, D. S. Johnson, with collector's note: "muddy stream in open country, occasionally very slightly saline; bottom muddy with leaves in places".

Male (adult, holotype). — Labium pale glaucous, apex of lateral lobes and a thick stripe bordering the median lobe, deep black. Face and frons deep black, marked with pale glaucous: a large patch occupying most of the mandible-bases; a vertical streak on the genal area immediately beside it; two large, isolated, elongate transverse bars on each side of the middle near base of labrum; a tiny transverse streak in the centre along anterior border and

a small circular dot on either side at base of postclypeus; and a pair of transverse, isolated, elongate spots on top of frons, each of these a trifle larger than the spots on labrum. Frons smooth, antero-dorsal margin obtuse-angulate and completely rounded. Vertex black, raised behind the ocelli to form a weakly bituberculate swollen ridge, convexly arched anteriorly, its posterior face hollowed out and sloping gradually down. Occiput black, its surface a little concave, posterior border straight, distinctly raised and densely fringed on top with long upwardly directed black hairs. Rear of the head black. Prothorax black, pronotum with a subtriangular green spot on either side.

Synthorax deep black, marked with green as in fig. 29; ventral surface also green, the metepimera bordered with black medially to form a joint band that extends right back to the end of the poststernum.

Legs wholly black except the outer faces of the trochanter and femur of the anterior pair, which are green. Posterior femur long and straight, 5 mm long, armature as for the genus.

Wings hyaline; neuration black. Antefurcal cross-veins 2.2 in fore wing, 1.1 in hind wing; fork symmetrical. Fore wing with 12 *Ax* and 9.10 *Px* of first series, hind wings 9 and 8.9, respectively. Anal loop one-celled. Anal triangle three-celled; tornus normal, obtuse-angulate. Pterostigma braced, colour yellow brown. Membranula very narrow, white.

Abdomen very slender, the basal and apical segments distinctly expanded; intermediate segments, from basal third of 3 to the end of 6, thin and parallel-sided, the widest point situated at the end of segm. 8. Posterior margin of segm. 9 produced backward in the middle, margin denticulate, one or two of the median teeth larger than the lateral ones. Colour predominantly black, marked with green, as follows. Most of segm. 1, the dorsal and lateral marks incompletely divided by brown on each side of the middle above; segm. 2, a complete mid-dorsal stripe, widest about half-way its length, all of the auricles including the surrounding area, and a large subquadrangular lateral patch occupying the apical two-fifths of the segment; segm. 3-6, a complete, fine mid-dorsal longitudinal line expanding a little at the base of each segment to form tiny lanceolate spots, and vestigial dots at extreme base in the middle of the sides, the one on 3 largest and triangular in outline; segm. 7, an incomplete basal ring placed in front of the transverse carina, squarely indented by black from behind on mid-dorsum and abruptly leaving off half-way down the sides; segm. 9, a still narrower stripe, restricted to the dorsum, bordering posterior margin. Intersegmental rings of segm. 7 to 10 clear yellow.

Genitalia (fig. 31) black, only the posterior hamulus slightly coloured;

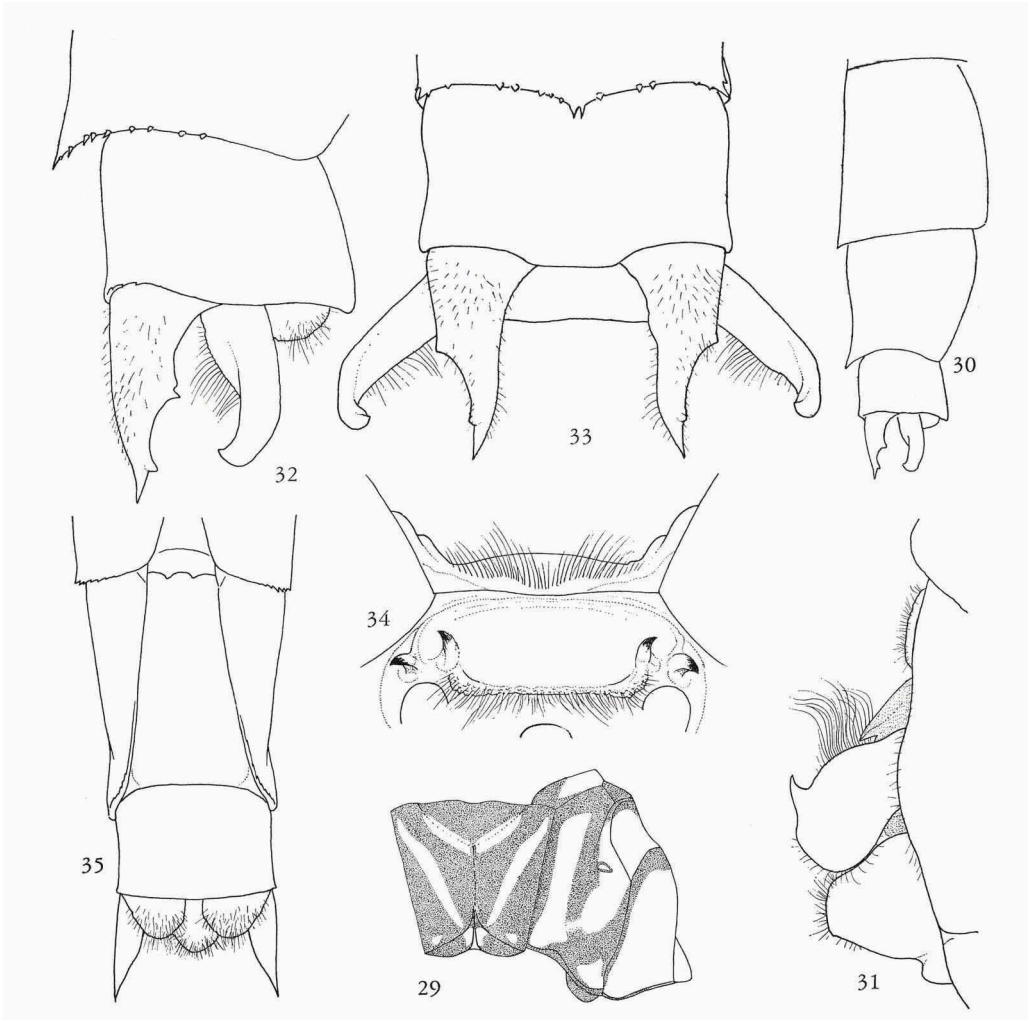

Fig. 29-35. *Burmagomphus divaricatus* sp.n., ♂ holotype and ♀ allotype from Ulu Gombak, Selangor. 29, Colour-pattern of ♂ synthorax; 30, apex of ♂ abdomen; 31, left lateral view of genitalia; 32, 33, apex of abdomen (32, right lateral; 33, dorsal view); 34, vertex and occiput of ♀, antero-dorsal view; 35, apex of ♀ abdomen, ventral view.

anterior hamulus lanceolate, very short and completely hidden from view in lateral aspect. Anal appendages deep black, shaped as shown in fig. 32-33.

Female. — Colour-pattern of head and thorax similar to the male, the transverse marks on top of frons larger, more closely approximated. All posterior parts of head black. Vertex with two pairs of robust, erect, slightly

outcurved, laterally compressed acuminate teeth, as shown in fig. 34; post-occipital area somewhat convex and but little protuberant.

Abdomen with complete mid-dorsal longitudinal stripe from base of segm. 1 as far as the end of 7; on 1 it is squarish, on 2 shaped like an arrow-head with transverse off-shoots lying in front of the transverse carinae; on 3-7 they are linear, expanding a little at extreme base of each; sides of 1 and 2 entirely greenish yellow save for a narrow basal ring on 2; 3 with broad lateral stripe widest basally, interrupted by the transverse carina and tapering away apicad; 4-6 with large squarish marks extending as far back as the transverse carinae, each narrowly continued ventrad at right angles along base of segments, 4 and 6 moreover with small mid-lateral elongate spot; 7 with complete basal ring stopping short at the transverse carina, 8 with very fine basal yellow ring, and 9 with well-defined transverse yellow bar bordering posterior margin dorsally; 10 and anal appendages brown. Vulvar lamina very short, not projecting, apex bituberculate, the tiny lobes separated from each other by a shallow emargination; sunken membranous part of 9th sternite a little shorter than the vulvar lamina and entirely covered by it (fig. 35).

Measurements: ♂ abd. + app. 27.0, hw. 22.0-22.3, pt. fw. 2.5 mm; ♀ 26.0-27.0, 23.5-24.5, 2.0-2.5 mm.

The lateral thoracic black bands are variable in shape and width in the male as well as in the female: the mesepimeral stripe is invariably incomplete dorsally and often only half as broad as the light-coloured band anterior to it; the dorsal portion of the stripe is frequently much smaller than shown in fig. 29 and detached from the band along second suture, which itself may be reduced to a narrow stripe tapering to a point upward.

A darker and more slenderly built subspecies than *w. williamsoni*. All individuals except the type are immature, most of the latter being reared from larvae in the final instar. The exuviae measure 19 mm in length on the average and are, of course, narrower, less flattened, than the ultimate instar larvae.

Burmagomphus plagiatus sp.n. (fig. 36-41)

Material. — Malay Peninsula: 1 ♂ (ad., holotype), Johore Bahru, kp. Tinggi Mawai Rd., Sungai Mupor, 17.iv.1963, J. I. Furtado (ML); 1 ♀ (juv.), same locality and date, M. A. Lieftinck (ML). Larvae, doubtfully referred to this species: 1 larva (penult), Johore, Tankak, stream in rubber estate at foot of Mt. Ophir, close to Muar Res., 4.xi.1959, D. S. Johnson, with collector's note: "Stream of moderate speed, 0.15-0.30 ms/sec.; turbid water, bottom mainly silty with some coarse sand; depth 0.7 to 1 m, width

1 to 5 m; oxygen ca. 33 to 50 % saturation; alcalinity 16 and 19 pts/million; temp. 26° and 27.5° C; pH 5.8 and 6.8". 1 larva (ult), Johore, Nee Soon swamp forest, 11.xi.1956, D. S. Johnson. — Sumatra: 1 ♀ (ad.), NE. Sumatra, Deli, Laut Tador, 90 m, 15.viii.1948, R. Straatman (ML). — Borneo: 1 ♀ (juv.), S. Borneo, Sampit distr., Sungai Mentaja, near Pemantan, 30.vii.1953, with collector's note: "emerging on floating *Pistia stratiotes* at bank of large, slow-flowing, mud- and sand-bottomed stream; exuvia not found", M. A. Lieftinck (ML).

Male (adult, holotype). — Mouth-parts greenish ochreous, all margins lighter, more definitely yellow. Clypeus and frons unicoloured brownish olive turning to brown upwards, marked only with a pair of clearly defined crescent-shaped light blue spots bordering the crest on each side of the middle on top of frons. Frons obtuse-angulate, antero-dorsal margin subacute. Vertex, occiput and rear of the head dark brown, the postgenae becoming paler, rather more ochreous, anteriorly; vertex slightly raised to a low blunt ridge immediately behind the ocelli, the tubercles lower and less sloping posteriorly than in *divaricatus*, the surface only slightly concave. Occiput likewise concave, its posterior border weakly undulated, neither thickened nor raised, with dense fringe of backwardly directed long brown hairs.

Prothorax dark velvet reddish black, dorsum unmarked, the sides dark ferruginous. Synthorax deep reddish black, slightly bronzy above, sides towards ventral surface gradually becoming more ferruginous mixed with green; all markings well defined, dark green, as shown in fig. 36.

Legs dark ferruginous, the coxae and inner faces of anterior femora more definitely geen and outer faces of femora obscurely brown. Posterior femur long and straight, 5.0 mm long, armature as for genus.

Wings hyaline; neuration brownish black. Antefurcal cross-veins 2.2 in fore wing, 1.1 in hind wing; fork symmetrical. Fore wing with 12.11 *Ax* and 8.9 *Px* of first series, hind wing 9.9 and 8.8, respectively. Anal loop consisting of a single cell. Anal triangle two-celled, with a single straight transverse cross-vein; tornus of hind wing distinctly incurved, rectangulate, subacute. Pterostigma braced, a little shorter and more expanded than in *divaricatus* and *arboreus*; colour cinnamon. Membranula vestigial, white.

Abdomen shaped much as in *divaricatus*, but longer, and intermediate segments wider as compared with the basal and apical segments, the latter attaining their greatest width at the end of segm. 8. Posterior margin of segm. 9 straight. Colour dark reddish brown, almost black, sparingly marked with dark green, as follows. Most of the sides of 1 and 2, the mark on 2 indented by dark brown from above just behind the auricles, the entire

dorsum of 2 remaining dark brown; small, transverse, more or less crescent-shaped dorsal spots at extreme base of segm. 3-7, all of about equal size and occupying one-third of the distance between base and supplementary carina, those on 4-6 finely indented or divided into two by brown from the rear at the median carina, the one on 7 somewhat larger and in the form of two closely approximated subcircular spots almost reaching the transverse carina; sides unmarked. Dorsum of segm. 8-10 blackish brown, including the intersegmental rings, unspotted; sides of 8 and 9 turning ferruginous, 10 entirely of that colour.

Genitalia (fig. 37) dark brown, outer faces of both anterior and posterior hamuli greenish and basal portion of vesicle castaneous; anterior hamulus well visible, lanceolate, placed transversely, apex fringed with long pale bristles.

Anal appendages, superior pair blackish brown, the inferior dark ferruginous (fig. 38).

Female (adult, Sumatra). — Very similar to the type male and differing only in the following respects. The ridge behind posterior ocelli is situated further caudad and differentiated into a pair of semicircular low crests, each of which carries two minute blunt tubercles; the occiput is somewhat swollen and protuberant in the middle, carrying a minute tubercle at the eye-margin and rudiments of marginal teeth in the middle (fig. 39-40).

Colour-pattern of thorax as in the male, except that each of the ante-alar triangles bears a small green spot placed in line with the antehumeral bands. Wing-membrane slightly tinged with yellowish; neuration without peculiarities; anal loop one-celled. Pterostigma ochreous between black nervures.

Abdomen stout, segments cylindrical; colour predominantly dark brown, markings at basal segments not clearly discernible and discoloured; sides of segm. 4-10 unmarked. Baso-dorsal spots of 3-7 all larger than in male, extending black almost to the transverse carinae but restricted to the dorsum and upper part of the sides, those on 5-7 distinctly angularly indented by brown from behind; intersegmental rings 6-10 yellowish; dorsum of 9 with thick yellow transverse bar bordering posterior margin; 10 and anal appendages black. Vulvar lamina plate-shaped, bilobed, extending straight back for about two-third the length of the membranous part of the 9th sternite; colour brown tipped with black (fig. 41, Malayan ♀).

Female (juvenile, Johore and S. Borneo). — These two individuals are undoubtedly conspecific with the preceding adult female. The markings — though still incompletely developed and all of a much paler tint — are quite similar, except that there are no pale spots on the ante-alar triangles. Structural differences between these females are quite unapparent, only the

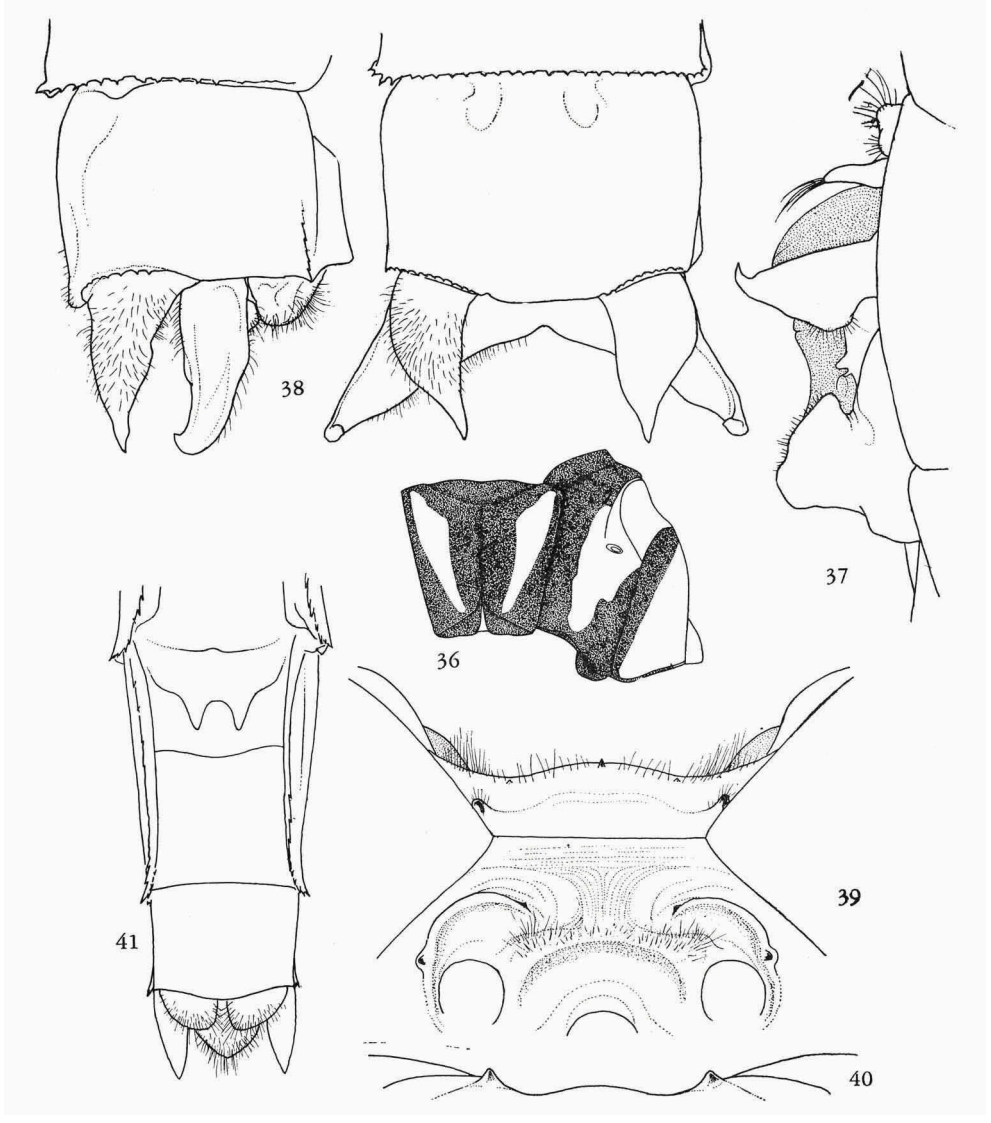

Fig. 36-41. *Burmagomphus plagiatus* sp.n. 36-38, ♂ holotype from Johore; 36, colour-pattern of synthorax; 37, left lateral view of genitalia; 38, apex of abdomen, right lateral and dorsal view; 39, 40, ♀ from NE. Sumatra; 39, vertex and occiput, antero-dorsal view; 40, transverse ridge of occiput, caudal view; 41, ♀ from Johore, apex of abdomen, ventral view.

vestigial median denticle along the hind margin of the occiput is wanting in the two immature specimens, and in the Bornean example there appears to

exist an additional spine-like process (on one side only!) emerging from a point just in front of the suture between vertex and occiput. The genital valves are identical in shape in all females.

Measurements: ♂ (holotype), abd. + app. 28.0, hw. 22.5, pt. fw. 2.0 mm; ♀ (ad., Sumatra), 27.7, 24.0, 2.0 mm; ♀ (juv., S. Borneo), 27.2, 23.5, 2.0 mm.

Burmagomphus arthuri Lieftinck, 1953

1953. Lieftinck, Treubia **22**: 251-252, fig. 7 (♀ occiput, apex of abdomen & genit.). — SE. Borneo (*B. arthuri* sp.n.).
1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 88, 183 (cat.; for ♂ read ♀).

Additional material. — Borneo: 3 ♀ (ad.), E. Borneo, Kutai, Samarinda dist., about 100 km upstream, Tabang River, kali Bengen, 2, 6 and 9.ix.1956, A. M. R. Wegner et al. (ML).

The unique type of this aberrant species was collected six years previously in the same area, at the Mentawir River, also in low country. The present examples are true to the type and all are of the same size. The thoracic antehumeral bands in one of them are definitely green and somewhat better outlined, but the ground-colour of the sides gradually turns paler and there are no dark bands or lines. In a second specimen there is only a single prefurcal cross-vein between the sectors or *Arc* in both fore wings.

One of the females was captured the same day as the type male of *Heliogomphus borneensis* Lieftinck, 1964, which it resembles closely in size and sombre coloration. The male of *B. arthuri* has unfortunately remained unknown.

Burmagomphus insularis Laidlaw, 1914 (fig. 42-44)

1914. Laidlaw, Proc. Zool. Soc. London: 55-57, pl. 1 fig. 2 (♂ thorax). — ♂ Borneo, sine loc., rect. Sarawak (*B. vermiculatus* Martin subspec. *insularis* nov.).
1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 89 (references).

An imperfectly understood species, known only from the type in the British Museum. Mr. D. E. Kimmins has kindly prepared the accompanying sketches of the thorax pattern and appendages. These structures were somewhat flattened and distorted by pressure of the paper triangle so that the anal segments had to be removed and cleared in KOH solution before they were drawn. From these figures it will be seen that *insularis* is quite distinct from any of its congeners.

The following points are taken from the original description.

Head black with rectangular yellow mark on either side of labrum, a yellow spot at each angle of postclypeus, a transverse yellow band along

crest of frons divided by a fine median line into two lateral halves. Fore wing with 13.12 *Ax* and 9.9 *Px* of first series, hind wing 9.8 and 8.10, respectively. Wing characters otherwise almost as in Williamson's photograph (loc. cit., fig. 27) of *B. arboreus* Lieft. from Burma, but anal triangle of hind wing only two- instead of three-celled and area included between

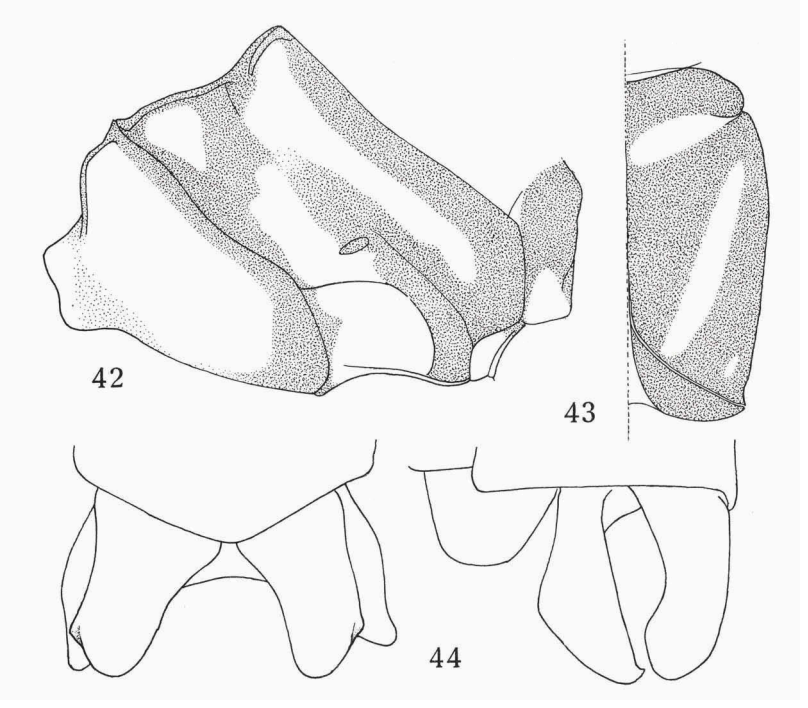

Fig. 42-44. *Burmagomphus insularis* Laidlaw, ♂ holotype from Borneo. 42, 43, colour-pattern of synthorax; 42, right lateral; 43, partial dorsal view; 44, anal appendages, dorsal and left lateral view. Drawn by Mr. D. E. Kimmins.

Cu_2 and A_1 a little longer and narrower than in that species; pterostigma also a shade longer and narrower, covering four cells in the fore wing.

Abdomen spotted with yellow; segm. 1 laterally; 2 with dorsal triangle having its apex directed caudad and covering basal two-thirds of segment, sides including auricles also yellow; dorsum of 3-7 with fine transverse marks coccupying the basal one-eighth of the length of each; 8 black; 9 with trace of yellow apical ring; 10 black. The genital organs on segm. 2 are said to be almost identical with those shown in Williamson's fig. 28c for *B. arboreus* (fig. 15 of the present paper), but the posterior hamulus not quite so prominent.

Length of abdomen 28 mm, that of hind wing also 28 mm (error for 23 mm?).

Merogomphus parvus (Krüger, 1899) (fig. 45-47)

1899. Krüger, Stett. ent. Ztg. **59**: 308-311. — ♂ ♀ NE. Sumatra (*Leptogomphus parvus* n.sp.).
1934. Schmidt, Archiv Hydrobiol. **13**, Trop. Binnengew. **5**: 365-366, fig. 68-70 (♀ thor., occiput & apex abd.). — ♂ ♀ NE. Sumatra, types redescr. & figured.
1941. Lieftinck, Treubia **18**: 234-235 (♂ type & ♂ S. Sumatra), 235-236 (♂ larva, descr. & ethol.), pl. 9 fig. 1-6 (larva & larval struct.), pl. 13 fig. 3-5 (♂ genit. & app.). — ♂ Sumatra.
1954. Lieftinck, Handlist Mal. Odon., Treubia **22** (suppl.): 88 (references & notes).

Additional material. — Malay Peninsula: 1 ♂ (juv., freshly emerged, with exuvia), Central Perak, Sungai Plus, near Lasah, 7.iii.1963, "bamboo grove at river bank", M. A. Lieftinck (ML); 1 ♀ (juv., exuvia not found), Selangor, Klang Gates, upstream, 2.iv.1963, M. A. Lieftinck (ML).

New to the fauna of Malaya.

After the colours had completely developed the present examples were preserved in alcohol and subsequently described, measured and drawn. Both specimens conform closely with Krüger's types and also with the reared male from South Sumatra commented upon in my 1941 paper.

Neural characters. Triangles normal, distal side of that of fore wing slightly fractured, of hind wing hardly noticeably so and neither unusually long nor separated from M_4 by a short stalk. No basal postcostal nervure. Three antefurcal cross-nerves in all fore wings, one in hind wings. Fork symmetrical. Male with 12 *Ax* and 9 *Px* of first series in fore wings, 9 and 8-9 in hind wings; female with 15, 11 and 10, 10-11, respectively. Anal triangle of male hind wing three-celled. Pterostigma braced.

Male. — Thoracic pattern, fig. 45. The very long posterior femora are armed with an outer row of 7-8 very robust spines and an inner row of 5-6 slightly shorter ones. Genitalia shaped as shown in fig. 3 on pl. 13 (loc. cit., 1941); branches of anterior hamulus subequal in length; penis shaped almost exactly as in *M. martini* (Fraser), figured by Fraser (loc. cit. antea, 1940), but the flagellae arising from the lower border of the glans are a little shorter and preceded basally by a small tooth; the apical border of the glans is straight cut off with rounded angles.

The superior appendage (fig. 46) bears an oblique, finely denticulate, black ridge at its apex; this is also present in the Sumatran specimens, but was not shown in my previous figures.

Female. — Similar to male. Upper juxtahumeral thoracic spot detached

from the antehumeral band and reduced to a smaller, more roundish spot, the specimen agreeing in this respect with Krüger's allotype. Erect spines at occipital crest placed further apart than in that specimen, one of them being divided (fig. 47). Femoral spines similar to those of the male. Vulvar lamina reaching half the length of 9th sternite, widest basally, evenly narrowed toward apex, which is triangularly (though not deeply) excised, with rounded lobes.

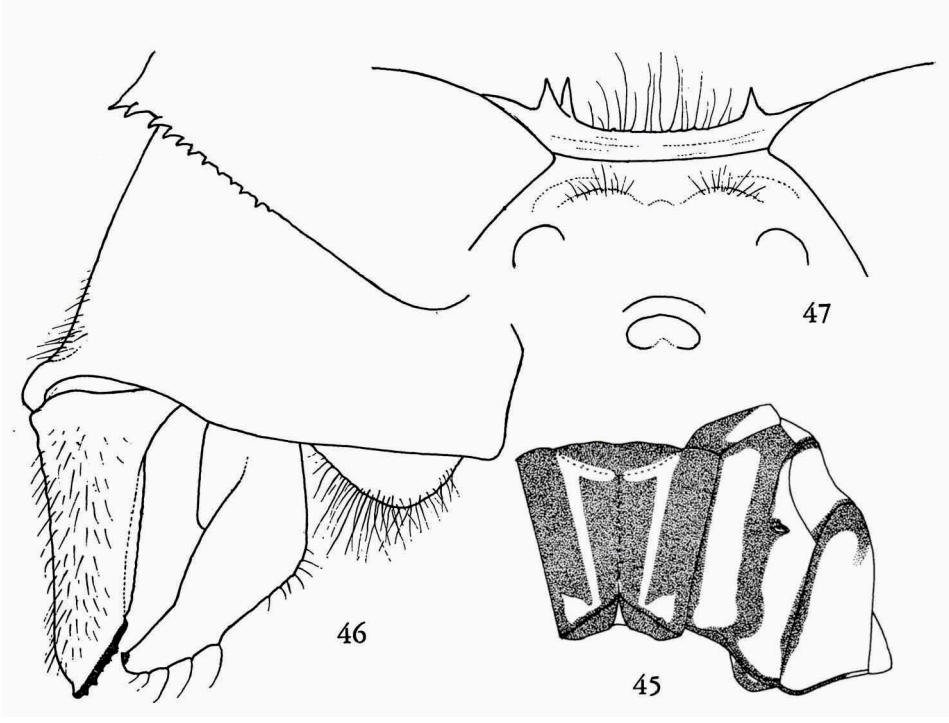

Fig. 45-47. *Merogomphus parvus* (Krüger), from Malaya. 45, colour-pattern of ♂ synthorax; 46, apex of ♂ abdomen, right lateral view; 47, ♀ vertex and occiput, anterior view.

Measurements: ♂ abd. + app. 27.3, hw. 22.4, pt.fw. 2.0, pt.hw. 2.4 mm; ♀ 29.0, 25.0, 2.2, 2.6 mm.

The larval exuvia differs in no way from the one described and figured by me after the Sumatran example.

The unique type male of *Merogomphus femoralis* Laidlaw, 1931, described from Kuala Lumpur (Selangor, Malaya), was not seen by me but should be a distinct species. The size is larger (abd. 32, hind wing 26.5 mm); the triangle of the hind wing is described as rather long and narrow, separated

from M_4 by a short stalk, and a basal postcostal nerve is present in three of its wings. No mention was made of *M. parvus* when Laidlaw described his *femoralis*, the former being still considered a *Leptogomphus* at that time.

ACKNOWLEDGEMENTS

My appreciation is due to Dr. J. R. Hendrickson (at present in Honolulu), then Professor of Zoology at the University of Malaya in Kuala Lumpur, for many facilities made available by him and his staff during my stay in the Zoology Department. I am equally grateful to Dr. C. H. Fernando (now with the Fisheries Research Station, Colombo), for much helpful guidance in the field and in the laboratory for hydrobiology at the University of Singapore. In particular I wish to thank my esteemed colleague H. T. Pagden in Penang, for his generous hospitality, wise advices and unflagging interest in my work. Thanks to him and my good odonatologist companion, J. I. Furtado, a highly efficient program outlined in the interest of our field work could be accomplished to our mutual benefit. It is a pleasure to express my thanks to all other persons who have been of assistance, either by providing for transport and accommodation or help in the field.

Finally, I wish to acknowledge my gratitude to the Uyttenboogaart-Eliasen Stichting, Amsterdam, for provision of the travel grant that made this journey possible. For financial assistance I am also grateful to the Netherlands Organisation for the Advancement of Pure Research (Z.W.O.) and the Maatschappij voor wetenschappelijk onderzoek in de tropen (Treub-Maatschappij).

ADDENDUM

Since writing the above, I have been able to examine the types of *Burmagomphus seimundi* Laidlaw, 1931 and *B. siamensis* Fraser, 1926 in the collection of the British Museum (Nat. Hist.), London.

As indicated earlier, *B. seimundi* (this paper: 20), from Kuala Tahan, Pahang, is the same species as *B. w. williamsoni* Förster, the type male agreeing with it in every detail.

B. siamensis (this paper: 22), female holotype, is labelled "Don Chai, Siam, 5.xi.1923, coll. S. Williamson". As anticipated, this is also conspecific with *B. williamsoni* and indistinguishable from Malayan specimens of that sex in our collection. The raised transverse processes, one on each side of the yellow central cone of the occiput, leave no room for doubt regarding the determination.

Recently, mag. scient. Palle Johnsen, of the Naturhistorisk Museum, Aar-

us, Denmark, kindly submitted to me for study a collection of Odonata from Thailand, made by members of the "Thai-Danish Prehistoric Expedition 1960-62". Most of the specimens were collected in the Kwae Noi area of western Thailand, close to the Burmese frontier. Amongst these I found another example of *B. w. williamsoni* that fits our description and figures of that insect in every respect. It is a male in excellent preservation (no. 1146), taken by Mr. Johnsen on November 19, 1961, at 9 km N. of Ban Kao, northwestern Thailand. Thus the occurrence of *B. williamsoni* so far north appears to be firmly established. Surprisingly, yet another *Burmagomphus* is contained in the same collection. This evidently belongs to a new species, represented by a single male in good condition, labelled as having been taken by Mr. Johnsen a few days earlier almost at the same locality. I hope to describe this at another occasion.