

STUDIES ON ORIENTAL GOMPHIDAE (ODON.),
with descriptions of new or interesting larvae

by

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This small contribution to our knowledge of the adults and nymphs of the oriental Gomphidae owes its origin to an attempt to determine several hundreds of Odonate larvae collected by the writer in the course of a ten years' stay in Java, and during an expedition undertaken by Mr M. W. F. TWEEDIE to the Plus and Yum Rivers in Perak, Malaya, early in 1933. At that time great difficulty was experienced in assigning names to the various forms, the larvae of many genera being still unknown. Early in 1940 an opportunity was found to collect also in South Sumatra, and on this latter expedition particular attention was paid to the immature stages of Odonata. As a result it became possible in several instances to rear the imagines and to assign a number of Mr TWEEDIE's larvae to their proper genera, if not to their species, many of which were apparently still unknown.

Since very little is on record regarding the life history and the habits of tropical Gomphidae, I have started with this family; the few descriptions and drawings of the ultimate larval instars here given are to be followed by those of other species of this family and of other families of the Odonata. The material in our collection is very rich, but of the Gomphidae only a fraction could be identified beyond any doubt.

The immature stages of Gomphidae in most cases are fairly easily obtained by sifting mud, silt, or sand from the bottom of streams and rivers; but the imagines, though evidently not rare, are, with very few exceptions, seldom or never encountered, and but few references are found in the literature to the rearing of the imagines from these larvae.

A detailed study of the relationships of the various genera of the Gomphidae will have to be postponed until the larvae of more genera are known. Dr NEEDHAM in his latest paper justly states: "It has long been apparent that some of the problems in the systematic arrangement of adult dragonflies might be helped toward a solution if more were known about their immature stages. This statement especially applies to Gomphine dragonflies, in the classification of which no one's proposals have as yet been very convincing". (*Trans. Amer. Ent. Soc.* 65, 1940, p. 363).

Some of the drawings of the entire larvae were made from living individuals by a Sundanese draftsman; all other illustrations were drawn by the writer with the aid of a camera lucida.

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Merogomphus parvus (KRÜGER) (pl. 9, fig. 1 - 6, pl. 13, fig. 3 - 5).

1899. KRÜGER, Stett. Entom. Ztg. 59, p. 308 - 311. — ♂ ♀ N.E. Sumatra (*Leptogomphus*).
1934. SCHMIDT, Arch. Hydrob. Suppl. 13, p. 365 - 366, fig. 68 - 70. — Types re-described).
1935. LIEFTINCK, Misc. Zool. Sum. 92 - 93, p. 20.

Material studied: — 1 ♂ (bred from penult larva), South Sumatra, Lam-poeng residency, Giesting near Talang Padang, ca 400 m alt., Wai Teboe river, 29.iii.1940, Mrs M. LIEFTINCK leg. — 1 ♂ (juv., holotype), N.E. Sumatra, Soekaranda, H. DOHRN, labelled by E. SCHMIDT: "*Merogomphus parvus* (Krüg.) Typus"; ex Museum Stettin.

The single reared individual in our collection fits closely KRÜGER's description of the type, which I have been able to examine in 1937. The colour-scheme of the thorax of the male is quite identical with that shown in SCHMIDT's sketch of the female.

The head is small and broad, coloured similarly to the female described by KRÜGER. The two transverse yellow spots on top of frons are narrow, rather linear, and distinctly separated mesially. The occipital plate is slightly concave posteriorly, and devoid of spines or teeth.

Legs black, posterior pair long and slender, femora very long (6.0 mm excl. troch.), each armed with 5 - 6 very robust spines between which a row of ca 30 minute spinules is inserted.

Wings hyaline. Pterostigma rather long, with a brace-vein to all four of them. Nodal index $\frac{9.13.13.9}{9. 9. 8.9}$. Distal side of all triangles fractured, especially those of fore wings; *t* normal in all hind wings. Cross-veins between sectors of arculus to the bifurcation of $M_{1-2}-M_3$ $\frac{3.3}{1.1}$. Discoidal field of fore wing with two rows of cells up to the nodus, thence with three and more cells. Anal loop made up of a single hexagonal cell.

Abdomen largely black, marked with yellow as described by KRÜGER. Segments 8 and 9 very long, 8 longer than 9, this two times as long as 10; all black.

Genitalia: pl. 13, fig. 3.

Anal appendages small, shaped as shown in pl. 13, fig. 4 - 5 ¹⁾. Superior pair pale yellow, black-tipped, inferior black.

Abd. + app. 27.5, hw. 23, pt. $\frac{20}{25}$ mm.

Description of the larval exuvia.

Total length 19.3; length of abdomen 12.3, greatest width of same 3.7; length of head 2.7, width over the eyes 3.7; length of posterior femur 4.0, of antenna 1.7 mm.

A small, slender, long-legged larva with a narrow pointed abdomen. Head, sides of pro- and synthorax sparsely fringed with tufts of short soft hair. Body bare, covered with microscopical, adpressed, spine-like hairs, those on head and thorax less inconspicuous than those on the dorsum of abdomen. Head with some hairless spots in the region of the antennae and upon the occipital lobes. Wing-sheaths covered with scale-like hairs, lying parallel on the back in the living larva (divergent in the exuvia, fig. 1 on pl. 9 slightly restored). Legs moderately hairy along the carinae, their surface smooth but with definite broad longitudinal stripes made up of short, closely set, adpressed hairs.

Head rather large, upper surface slightly convex. Mouth-parts projecting forward, labrum short and narrow, porrect, its anterior border rounded and fringed with darkly coloured stiff hairs. Antennae inserted in front of the eyes; first two joints short. Third joint much longer, cylindrical, strongly curved, covered with microscopical scale-like hairs; its basal third, the inner margin along full length and outer margin basally, fringed with very long, soft, pencil-hairs. Fourth antennal joint rudimentary, a small spherical knob on the apex of the third (pl. 9, fig. 5).

Postero-lateral angles of head rounded, covered with wart-like scales.

Labium extending back to slightly over the middle of procoxae, shaped as shown in pl. 9, fig. 3 - 4. Median lobe narrow, straight on anterior border, with a very slight median concavity, margin simple, slightly thickened and darkly pigmented, furnished with long bristles. Lateral lobe stout, very broad at base, thence suddenly narrowed and tapering gradually toward the incurved pointed apex; inner margin gently curved, toothless. Movable hook robust and curved.

Prothorax distinctly narrower than head, simple, about two times wider than long; lateral lobes rounded.

Wing-sheaths parallel (v.a.), extending back to the end of 3rd abdominal segment.

Legs long; femora, especially the two anterior pairs, flattened and somewhat curved, posterior pair slender, reaching the apex of 4th segment; tibiae thin and slender, also slightly curved. Burrowing hooks on fore and middle tibiae vestigial.

¹⁾ The sketches of genitalia and appendages were made from the freshly killed specimen, which had been kept alive in a cage for 3 days to reach maturity.

Abdomen much flattened (more inflated and hence narrower and less strongly pointed in the exuvia than in the living larva), widest across end of segm. 4, thence tapering. Dorsal spines present on segments (6) 7-9, broad basally, depressed, directed almost straight backward, increasing in size to rearward; a vestige of a spine on 6. Lateral spines on segments 6-9, directed backwards, increasing in length to rearward, distinctly sharp pointed on 6-8, those on 9 longest, fitting close against lateral border of 10 and reaching half the length of that segment. Segm. 9 almost as long as it is broad at base, its posterior border in dorsal view concave on either side of the dorsal spine. Segm. 10 much shorter than 9, distinctly wider than long, and about as long as the anal pyramid. Epiproct (superior appendage) abruptly pointed apicad, as long as the cerci (lateral appendages); paraprocts (inferior appendages) a trifle longer (pl. 9, fig. 6).

The small, slender nymph of *Merogomphus* resembles that of *Burmagomphus* somewhat closely, but it is at once distinguished by its very long and thin legs, which lack the burrowing hooks entirely, and by its large head. The elongate ninth abdominal segment corresponds with the shape of the same segment in the adult *Merogomphus*, a feature that may possibly serve to identify the nymphs of other species of the genus as well.

Like *Burmagomphus*, the larva of *Merogomphus* is a sluggish and clumsy creature which is very difficult to feed. It is a shallow burrower in small clear streams with a sandy or somewhat gravelly bottom.

Only a single nymph in the penultimate instar and a few younger ones were sifted from sand, together with those of several other Gomphid larvae. The young nymphs were not kept apart from the others until the next day and as a result fell a victim to the rapacious larvae of *Acrogomphus* with which they had been placed in the same dish for a while.

The ultimate larval instar of the reared specimen lasted from 6th April to 25th May, 1941 (49 days).

Megalogomphus icterops (MARTIN) (pl. 10, fig. 1-7).

1935. LIEFTINCK, Treubia, 15, p. 206-207 (references, descr., notes). — Sumatra, Java, Borneo.

Material studied (larvae): — Numerous larvae (all stages) and exuviae, W. Java, Buitenzorg residency, Djasinga, Tjibarangbang, 180-200 m, all the year round, 1937-1941, AUTHOR. — 1 ♂ larva (ult., dried), W. Borneo, Melawi River, near Nanga Kroeab (?), 9.ii.1924, H. WINKLER (ex Mus. Hamburg).

Since reporting on this species in a previous paper (loc. cit. 1935), I have been able to collect a small series of males and two females, all on the Tjibarangbang river (near Djasinga), in West Java. I have also come across *M. icterops* at Tjigoegoer, Penandjoeng Bay, in the coastal districts of Banjoemas, South Java.

The known range of *M. icterops* includes the islands of Sumatra, Billiton, Java and Borneo. Examples of all these localities are in the Buitenzorg Museum.

The nymph associated with this species is not, as I first thought, found in the leafy trash which collects in the pools and eddies of the stream, where Epigomphine larvae (e.g. *Microgomphus* and *Leptogomphus*) abound, but it lives hidden in the sandy and muddy bottom under the river bank. The eggs are laid in the shallow water along the edges of the stream where the current is swift and flows over ripples and gravel bars. It was here that the youngest nymphal stages were most frequently found. During the latter part of their life, however, they live in the muddier bottom of the quieter water where the fat larvae lie buried in the sand several inches below the bed of the stream, and from such places nymphs in the penultimate and ultimate instars were dredged.

The burrowing powers of the *Megalogomphus* nymph are only rivalled by those of *Acrogomphus*. This very strong burrowing tendency and the agility with which the insect, on being disturbed, disappears in the sand, permits the larva to live in fast running water and to withstand the current when the river is in spate, at which time the Tjibarangbang is a rushing mud-stream that rises high enough to uproot and carry trees.

The adult larva takes its prey beneath the surface of the bottom sand; it is extremely rapacious and will eat almost any living animals, including its own kind, small enough to be held by its powerful labium.

Young nymphs of *H. icterops* do not show the conspicuous black marks of the full-grown larva; they are of a uniform pale sandy-yellow colour, except the eyes which stand out as black points.

The exact length of larval life under natural circumstances is yet to be determined. Nymphs of various sizes are always found together in all seasons of the year. The last instar of two specimens bred in captivity lasted 85 days for the ♂ and 98 for the ♀.

It is my hope to publish elsewhere a fairly complete account of the life-history of this species.

Description of the full grown larva.

Total length ♂ 37.0 - 37.5, ♀ 39.0 (♂ exuvia 37.5, ♀ 40.4 mm); length of abdomen ♂ ♀ 26.0 - 26.5 (♂ exuvia 25.7, ♀ 28.2 mm), greatest width of same ♂ ♀ 12.0 (♂ exuvia 10.3); length of head 5.8, width over the eyes 6.6; length of posterior femur 5.9, of antenna 1.5 mm.

A huge, naked larva, very hairy on all lateral margins of head, thorax and abdomen, with a small head, rather slender but powerful and very hairy legs, and a broad, tumid, strongly keeled abdomen (pl. 10, fig. 1 - 2).

Clypeus and frons in front with a row of microscopical wart-like scales which are also scatteringly distributed on the dorsal surface of the head. The ocelli, two roundish spots on either side of the epicranium and a crescent-shaped area on each side upon the occipital lobes, smooth. Frons keeled anteriorly, antennae inserted just in front of and below the ridge, before which the anterior

surface of the head strongly slopes downward. Labrum wider than long, broadly rounded anteriorly and densely fringed with long, soft, silvery-white hairs.

Prothorax, pronotum covered with microscopical spinules; two low blunt latero-dorsal median protuberances; two pairs of smaller knob-like tubercles, placed two in a longitudinal row on each side of the median line; hairless areas two on each side, one lateral and one between the latero-dorsal and dorsal tubercles; side-angles broadly rounded. Meso-metathorax for the greater part covered with microscopical warts; tubercles and margins fringed with long tufts of silvery-white hair.

Legs very hairy, their surface smooth, those of femora alternated with definite, double longitudinal bands made up of short scale-like warts.

Head small, upper zone much wider than long, almost rectangular in dorsal view but with the side-angles rounded, in frontal view concave with strongly upward projecting eyes. Abdomen finely rugosely scaled, especially so around the dorsal spines; laterally with smooth areas along side-margins and round-about the black dots.

Antennae with the two basal joints short, annular, each with an apical ring of blackish scale-like warts. Third joint amply two times as long as the two basal joints combined, oval, its ventral surface convex, densely covered with blackish warts, as is the swollen margin, and fringed with long soft pencil-hairs; upper surface smooth, distinctly concave and slightly upcurved at tip, its raised margin rounded and beset with pear-shaped dark scales. Fourth antennal joint vestigial, knob-like, densely covered with rod-like scales (pl. 10, fig. 6).

Labium moderate, extending back to anterior margin of middle coxae, shaped as shown in pl. 10, fig. 3 - 5. Median lobe broad, its blackened front margin straight or even slightly concave, densely fringed with ochreous, scale-like hairs. Lateral lobe stout, very broad at base and strongly narrowed outward to the hooks; inner margin of each armed with a row of eight strong recurved teeth which decrease in size from apex to base; end hook strongly curved. Movable hook very long, robust and strongly arched.

Prothorax almost as broad as head, pronotum shield-shaped, strongly arched.

Wing-sheaths strongly divergent, pressed closely and obliquely against the abdominal segments, their tips reaching end of segm. 4 in the living larva.

Legs moderate, robust and fossorial. All femora rather more swollen and distinctly more curved in side view than when viewed from above. Position of first two pairs of legs as in *Acrogomphus*; fore and middle tibiae with very long, spine-like burrowing hooks, which are fringed ventrally with a tuft of blackish bristle-like hairs. All claws slender and pointed.

Abdomen broad, depressed, tergum arched, apical segments strongly keeled, venter flattened laterally, slightly concave on middle, widest across end of segm. 5. Dorsal spines present on segm. 1 - 9, all exposed in the living larva; that on 1 minute, knob-like, those on 2 - 4 small, but steadily increasing in size and length, convex dorsally and increasingly imbricated backwards; those

on 5-9 increasingly carinated longitudinally and overlapping posterior border of segments, gradually lengthening to a robust spine that is longest on 9. Lateral spines on segments 7-9, short, acute, pointed a little outwards on 7, slightly curved backwards on 8, again a little outwards on 9. Postero-dorsal borders of proximal segments sparsely, of all lateral borders densely fringed with long soft hairs. Segm. 9 much wider than long; 10 much shorter than 9, annular. Anal pyramid about as long as segm. 9 laterally; epiproct (superior appendage) slightly shorter than the paraprocts (inferior appendages), its dorsal surface provided in the ♂ with two low tubercles slightly beyond half-way its length ¹⁾; cerci (lateral appendages) again a little shorter than the epiproct (pl. 10, fig. 7).

Colours of the living larva.—General colour throughout light orange-yellow, only slightly intermingled with pale green on the middle of the prothorax, on dorsum of meso-metathorax, and about the dark patches on the abdomen. Antennae bright orange. Prothorax on mid-dorsum, wings and abdominal segments 6-9 with prominent blackish-brown flecks, as shown in pl. 10, fig. 1-2.

The genus *Megalogomphus* CAMPION (*Heterogomphus* SELYS, nom. preocc.) contains a considerable number of large and handsomely coloured Gomphidae. It has apparently no near allies and it is not easy to give a really satisfactory definition of *Megalogomphus*, apart from sexual characters which are very distinctive; but I am convinced that LAIDLAW ²⁾ was right in placing it in a tribe or 'alliance' of its own. None the less there seems no reason to doubt that *Megalogomphus* most nearly approaches the *Onychogomphus*-alliance and that the two tribes have had a common ancestor. As SCHMIDT ³⁾ has pointed out, *Megalogomphus* suggests affinities with the *Onychogomphini* by reason of the projecting shoulder-angles, to which I may add the short legs and the structure of the head.

Structurally the known species of *Megalogomphus* are all very similar. The long, straight, and armed anal appendages of the ♂ are decidedly characteristic and quite unlike those of any other genus of the Gomphinae. The genus is also characterized by the long and pointed wings, dense venation, the position of the areculus, &c. Venationally it differs also from *Onychogomphus* in the marked divergency of M_4 and Cu_1 of the fore wing.

The larva differs very markedly from that of *Onychogomphus* and other members of the tribe in almost all important characters. It is unique in the shape of the head, in the enormous burrowing hooks on the first two pairs of

¹⁾ As the projecting piece overlying the base of the epiproct is the developing inferior appendage of the male imago, these two tubercles may be the intero-apical projections, or the tips themselves, of the two branches of the appendix inferior of the male imago.

²⁾ *Rec. Ind. Mus.* 24, 1922, p. 412; *Trans. Ent. Soc. London*, 78, (1930) 1931, p. 196.

³⁾ *Arch. Hydrob. Suppl.* 13, 1934, p. 374-375.

tibiae, and in the structure of the labium ¹). The hairy legs and bright yellow and blackish-brown colours of the body give it an appearance strikingly unlike that of other tropical gomphid larvae.

The larva of *M. hanningtoni* FRAS. has been described and figured by FRASER ²) whilst a short note and a drawing of that of *M. ceylonicus* (LAID.) was published by the same author ³). The nymphs of *hanningtoni* and *icterops* appear to be closely similar; according to FRASER, that of *ceylonicus* differs from both in that the lateral lobe of the labium is deeply bifid at the end and has two robust teeth preceding the two long and equal terminal ones. In both *hanningtoni* and *icterops* this lobe ends in a single robust tooth which is dentate on its inner border.

Acrogomphus walshae LIEFT. (pl. 13, fig. 1 - 2, pl. 11, fig. 1 - 5).

1935. LIEFTINCK, Treubia 15, p. 203 - 205, fig. 13 - 15. — ♂ Benkoelen, S.W. Sumatra (*walshii*).

1937. LIEFTINCK, Ibid. 16, p. 118 (footnote).

Additional material studied: — 1 ♂ (bred from penult larva), and one larva, South Sumatra, Lampoeng residency, Giesting, near Talang Padang, ca 400 m alt., Wai Teboe river, 29.iii.1940, Mrs. M. LIEFTINCK leg. — 1 ♂, 1 ♀ (*in cōp.*, ♀ allotype), W. Java, Buitenzorg residency, Djampang Tengah (Bodjonglopang), Tjitalahab estate, 650 m alt., 30.iv.1940, Mrs. C. ROSIER leg.; 1 ♀ (ad., discoloured), W. Java, Buitenzorg residency, Djampang Koelon, 4 - 500 m alt., Goenoeng Goeha, xii.1939, native coll., Mrs. M. E. WALSH ded.

Male (Sumatra).—The reared specimen does not differ from the type except of course for its colours.

Wings very slightly washed with yellow. Pterostigma braced except in right hind wing. The discoidal field of fore wings begins with two rows of cells, followed by 5 single cells, and finally again by two rows of cells to much beyond the nodus. In the hind wing the discoidal field also has a few divided cells basally, followed by 3 - 4 cross-veins running directly from M_4 to Cu_1 , then two rows up to the level of the nodus, and finally three and more rows. Nodal index $\frac{10\ 19\ 20.12}{12.13\ 13.11}$. Cross-nerves between M_{1-3} and M_4 $\frac{56}{4.4}$. Anal loop two-celled. Anal triangle made up of 4 (3+1) cells.

Abdomen coloured similarly to the type.

Length: abd. + app. 36, hw. 31.4, pt. $\frac{30}{37}$ mm.

Male (ad., Java).—Almost identical with the Sumatran specimens, but for the following differences:

Ground-colour of thorax and abdomen deep velvet brownish-black. Markings soft olive-green. Antehumeral thoracic bands straight, decidedly narrower, and

¹) The shape and armature of the lateral lobe of the labium strongly recall *Macrogomphus* amongst the Epigomphinae; as a matter of fact the two genera are not at all related, but show a remarkable convergent similarity in this respect only.

²) *Mem. Dept. Agric. India*, Ent. Ser. 8, 1924, p. 79 - 81, fig. 1 - 3.

³) *Ceylon Journal Sci.* B. 18, 1933, p. 24 fig. 1.

more abruptly widened ventrally. Wings hyaline, veins all black; pterostigma dark blackish-brown, without distinct brace-vein. Discoidal field in fore and hind wings with two rows of cells to beyond the nodus, or to slightly before that level, respectively. Neuration otherwise as in the Sumatran examples.

Nodal index $\frac{12.20.20.11}{13.14.13.11}$. Cross-nerves between M_{1-3} and M_4 $\frac{5.6}{3.4}$.

Female (ad., Java). — Colouring in general very similar to that of the male.

Occipital plate shaped as shown in pl. 13, fig. 1; posterior margin thickened, slightly raised and corrugated on middle, very slightly concave posteriorly in dorsal view, and produced on either side into a blunt triangular tubercle, placed a little beneath the upper margin of compound eyes.

Differs further from the male in the reduction of the antehumeral stripes on the back of the mesothorax; these stripes, though sharply defined, are still narrower than in the opposite sex and come to consist of two fine, bright green lines, each of them being attached ventrally with an almost equally narrow cross-bar with which it forms a slender T-shaped mark, the transverse portion of the T being very short.

Wings entirely hyaline, veins black. Pterostigma dark brown, longer than in male, covering 6-7 cells, without brace-vein. Discoidal field of fore wing with two rows of cells to slightly beyond level of nodus. Nodal index $\frac{13.21.22.12}{12.16.15.13}$. Cross-nerves between M_{1-3} and M_4 $\frac{6.5}{4.4}$. Anal loop irregular, made up of two cells.

Abdomen stout, cylindrical, slightly decreasing in depth posteriorly. Segm. 1 ochreous, with a basal dorsal diffuse mark of brown and with the lateral margin blackish. Segm. 2 bright ochreous; dorsum with two very diffuse pale brown basal patches, one on either side of the middle, and a squarish black subapical spot, finely and longitudinally divided by yellow; laterally, with a thick black stripe along full length of lower margin of tergite. Intersegmental ring black. Segm. 3-4 black, each with very large ochreous dorsal patches, occupying nearly the basal three-fourths of each, but very finely divided into four spots by the brown longitudinal and transverse carinae, the hindermost pair of spots concave posteriorly. On segm. 5 and 6 the posterior spots are progressively narrower, smaller, and more widely separated by black dorsally, tapering to a point apically, so that on 6 almost the distal half remains black. Segm. 7 is coloured much as in the male, the basal ochreous ring occupying almost one-half of the length of segment. Segm. 8, 9 and 10 are black, but 8 and 9 have each of them an ochreous spot on either side at base, and 8 in addition a diffuse lateral spot of that colour near the apex.

Anal appendages black, conical, pointed, very slightly shorter than segm. 10. Valvula vulvae pale brown, shaped as shown in pl. 13, fig. 2.

Female (ad., in fragments and discoloured). — Resembling the allotype in all respects. Nodal index $\frac{13.22.24.12}{13.17.16.13}$. Cross-nerves between M_{1-3} and M_4 $\frac{5.5}{3.3}$.

Length: ♂ abd. + app. 36.7, hw. 32.2, pt. $\frac{3.0}{3.3}$; ♀ (allotype) 37.8, 37, $\frac{3.8}{4.2}$; ♀ (paratype) —, 37, $\frac{3.5}{3.9}$ mm.

Evidently a very scarce species. It should be looked for in deep ravines and on streams in dense jungle where the males rest on leaves of trees overhanging the stream, a habit which renders them very inconspicuous.

A. walshae is here recorded from Java for the first time.

Description of the larval exuvia.

Total length (♂) 26.7 (25.2 mm in the living larva); length of abdomen 16.8, greatest width of same 6.0; length of head 4.5, width over the occipital lobes 5.0; length of posterior femur 3.6, of antenna 3.0 mm.

A rather smooth larva of the ideal torpedo-shape, with a small head, very wide pronotum, short but very powerful legs, and a pointed abdomen (pl. 11 fig. 1 - 2).

Head in front covered with adpressed spine-like hairs which are dark brown on the labrum; dorsal surface covered with microscopical warts except the ocelli, two roundish pale hairless areas, one on each side, on the occipital lobes, two smaller, oval brown spots on each side of the middle line, and a dark median twin-spot between.

Prothorax, notum covered with microscopical warts except six more or less definite hairless areas on the middle, which together form a roughly x-shaped marking, hyaline and colourless in the exuvia; lateral portions with adpressed spine-like hairs growing longer towards the side-margins, which, in addition, are fringed with long and soft, golden yellow hairs. Meso-metathorax for the greater part covered with microscopical warts; hairless areas arranged as shown in pl. 11, fig. 1; side-margins fringed with soft longish hair.

Legs hairy along the carinae, their surface smooth alternated with definite, broad, longitudinal bands made up of short, closely set, adpressed hairs.

Head rather small, upper surface evenly convex, roughly triangular in outline, only little wider than long and widest across the occipital lobes which are rounded and fringed on their convex angles with short stiff spinules. Mouth-parts sloping anteriorly, labrum short and small, semicircularly rounded and fringed with dark-coloured stiff hairs anteriorly. Antennae inserted into cylindrical elevations on the front, separated from the eye-margin by much larger, broadly rounded elevations; two basal joints short and cylindrical, each with two rings of strong spine-like hairs. Third joint roughly one and one half times as long as the two basal combined, broadly finger-shaped, slightly flattened and a little upcurved at the tip, fringed with very long pencil-hairs; scales wanting. Fourth antennal joint a diminution of the third, slender, slightly curved, finger-shaped, about one-fifth as long as the third (pl. 11, fig. 5).

Labium of moderate size, extending back to the middle of procoxae, shaped as shown in pl. 11, fig. 3 - 4. Median lobe narrow, rounded on anterior border; margin simple, with a double row of fringing scales. Lateral lobe stout, very

broad at base, curved, its apex gradually tapered and rounded, inner margin bearing about 20 very low inconspicuous teeth. Movable hook stout, incurved.

Prothorax of unusual dimensions on the dorsal side, distinctly broader than the head, its hind margin on line with the bases of the posterior legs, shield-shaped, strongly convex, the hind angles rounded.

Wing-sheaths strongly divergent, pressed closely and obliquely against the abdominal segments, their tips reaching the end of segm. 4 (half-way segm. 4 in the living larva).

Legs short, very strong and fossorial; anterior legs approximate to the sides of the head, bearing shields of stiff hairs between which the middle legs may be brought forward; no definite burrowing hooks present. Middle legs approximated on the venter, rotated downward and extended horizontally close under the fore legs. Posterior legs longer, more nearly normal, directed posteriorly. Anterior tarsi with soles facing mesially; middle tarsi rotated on tibiae so as to point backward (not shown in the figure); hind tarsi elongate, with sharp and long claws; claws of anterior and middle tarsi blunt and shorter. Each femur with a distal anterior process which rests against and supports the tibia when moved backward. ¹⁾

Abdomen broadly and regularly lanceolate, subtriangular in cross-section but convex dorsally, widest across end of segm. 4. Dorsal spines present on segm. 1-9, all exposed; that on 1 narrow and high, nipple-shaped, those on 2-4 increasing in height and width and decreasing in length (very short and triangular in dorsal view on 4); those on 5-9 again increasing in size, triangular and successively more pointed to rearward in dorsal view, more closely appressed and flatter in lateral view. Lateral spines on segments 6-9 short, acute, very small on 6, directed a little outwards on 7 and 8 where they are distinctly sharp pointed, that on 8 longest; lateral spine on 9 directed a little inwards. Segm. 9 about twice wider than long; 10 shorter than 9, more than twice wider than long. Anal pyramid about as long as segm. 10 is wide at the tip; epiproct (superior appendage) a trifle shorter than the paraprocts (inferior appendages), the cerci (lateral appendages) distinctly shorter than both.

Colours of the living larva. — Head, thorax and wings light yellow intermingled with olive-green. Antennae, all legs, wing-borders, and dorsal spines of abdomen pale yellow. Eyes black, their mesial prolongations on both sides of the ocelli, and the vertex, chestnut-brown. Ocelli silvery white. Pronotum with the x-shaped marking on mid-dorsum dark brown. Abdomen olive-green, lateral portions of segm. 2-6 turning to grass-green. Segm. 9 and 10 and anal appendages more darkly coloured, ochreous-brown. Markings on abdomen scattered, as shown in pl. 11 fig. 1-2, black.

¹⁾ As follows from this description, the legs of *Acrogomphus* are rather similar to those of *Progomphus* (see NEEDHAM & HART, *Bull. Ill. State Lab. Nat. Hist.* 6, 1901, p. 55-56), except that the separate joints are less strongly twisted, less curved, and not so angular.

Of this species we had two larvae, both males, collected in the Wai Teboe, near Talang Padang, on March 29th, 1940. Both were in the penultimate instar and these were the only *Acrogomphus* nymphs that we found. One of the larvae died just at the point of transformation on 5th August, 1940. The second specimen emerged at Buitenzorg on 8th July, 1940. The larvae were obtained by sifting sand ripples and fine gravel in turbulent water under the river bank. Associated with them were the larvae of *Chlorogomphus magnificus* SELYS, *Merogomphus parvus* (KRÜGER), *Onychogomphus pollux*, sp. n., and two unidentified species of Gomphid larvae, possibly *Onychogomphus thienemanni* SCHMIDT, and a *Burmagomphus*.

The nymphs were transported to Buitenzorg on 30th March and kept alive until emergence (see also p. 251). In captivity, the larva of *Acrogomphus* burrows deep in the sand so that the body disappears completely. Whenever the nymph is disturbed and exposed to the surface it will always instantly start digging itself in, burrowing spasmodically forward through the sand, perhaps even more rapidly than the average Gomphid larva can walk. It is quite likely that only such vigour and speed could save an insect of this size from being swept away during freshets of the swift current.

The larvae were fed with earthworms and small burrowing Gomphine larvae, which were devoured in the sand.

***Acrogomphus malayanus* LAIDLAW** (pl. 12, fig.1 - 5).

1925. LAIDLAW, Proc. Zool. Soc. London, p. 443 - 444, tfig. 1 (wings). — ♂ Pulau Aor, off E.-coast of Johore.

1931. LAIDLAW, J. Fed. Mal. States Mus. 16, p. 214. — Note.

1935. LIEFTINCK, Treubia, 15, p. 205.

1937. LIEFTINCK, l.c. 16, p. 118 - 119. — Notes on venation.

Material studied: — 1 larva (ult. instar), Malaya, Perak, Plus River, near Legap, 10.iii.1933, M. W. F. TWEEDIE leg. (ex Raffles Museum).

In addition to the Sumatran and Javan material of *Acrogomphus* nymphs, I have received from Mr TWEEDIE a single alcoholic larva from Malaya. The drawings of it reproduced on pl. 12 had been made long before the nymph of *A. walshae* was discovered and it remained unidentified for many years. This larva conforms so closely to the reared nymph of *walshae* that I do not hesitate in referring it to *A. malayanus* LAIDLAW, the only species found in the Malay Peninsula ¹⁾.

Description of the larva (alcoholic).

Total length (♂) 21.0; length of abdomen 13.3, greatest width of same 5.5; length of head 3.6, width over the occipital lobes 3.4; length of posterior femur 2.8, of antenna 2.5 mm.

¹⁾ *Acrogomphus* (?) *minor*, LAIDLAW (J. Fed. Mal. States Mus. 16, 1931, p. 215 - 217) is from Selangor and peninsular Siam; but, according to LAIDLAW, this is probably only a subspecies of *Onychogomphus circularis* SELYS.

Very similar to the nymph of *A. walshae*, but distinguished by its smaller size, by having the head relatively longer (slightly longer than wide instead of a little wider than long), and by having a better development of dorsal hooks and lateral spines (the latter on 6 to 9). These lateral spines are slender, straight and very acute, slightly and increasingly projecting laterad from 8 to 6, that on 7, 8 and 9 subequal in length, that on 6 a little shorter. Dorsal spines slender and also very acute, successively and increasingly imbricated backwards in lateral view (pl. 12, fig. 2).

The third and fourth antennal joints are relatively a little longer; also the labium is less expanded and somewhat longer than in *walshae*; and lastly, the teeth along the inner margin of the lateral lobe of the labium are very unapparent, its distal half being entirely toothless (pl. 12, fig. 4).

The dorso-lateral abdominal blackish dots on segments 3 - 9 are invisible in opaque view, but clearly turn up in transmitted light and appear to be composed of 4 - 5 small spots that form together a roundish dot, shaped quite similarly in fact to those of *walshae*.

The discovery of the *Acrogomphus* nymph not only means a welcome addition to our knowledge of tropical Gomphid larvae, but also throws more light upon the relationship of genera.

In 1925, LAIDLAW ¹⁾ established the genus *Acrogomphus* for two species of peculiar oriental dragonflies. At the same time he discussed its affinities and placed *Acrogomphus* in the subfamily *Gomphinae*, admitting, however, that the genus agreed severally in many characters with the known Epigomphine genera from tropical Asia, especially with *Perissogomphus*. In 1930, LAIDLAW ²⁾ placed *Acrogomphus* at the foot of the "*Onychogomphus* alliance" in his "Series *Gomphus*"; but FRASER, in 1934 ³⁾, did not follow him and transferred it to the *Epigomphinae*, chiefly on account of the presence of more than two transverse nervures between the sectors of the arculus. Meanwhile the distinctness of the genus was further evidenced by the discovery of another representative of *Acrogomphus*, viz, *A. walshae* LIEFTINCK ⁴⁾ from Sumatra and Java. In 1937 ⁵⁾ I published a paper in which I pointed out that the venation of *A. walshae* would indicate in sufficient detail that *Acrogomphus* is an Epigomphine. As a matter of fact, the venational characters of *A. walshae*, and *malayanus* and *fraseri* as well, are strongly in favour of this view; on the other hand the general facies and the shape of the ♂ anal appendages of all species of *Acrogomphus* suggest affinities with the *circularis*-section of the genus *Onychogomphus*, i.e. the least specialized members of that genus ⁶⁾. It is extremely unfortunate that

¹⁾ *Proc. Zool. Soc. London*, 1925, p. 439 - 444, 2 textfigs.

²⁾ *Trans. Ent. Soc. London*, 78, 1930 (Dec. 1931), p. 191.

³⁾ *Fauna Brit. India*, Odon. II, London 1934, p. 316, 335 - 337.

⁴⁾ *Treubia*, 15, 1935, p. 203 - 205, 3 textfigs.

⁵⁾ *Treubia*, 16, 1937, p. 118 - 119.

⁶⁾ For a discussion of *O. circularis* SELYS and allied species see *Treubia*, 16, 1937, p. 118 - 118.

no nymphs are known of species of that section of *Onychogomphus*, nor yet of *Perissogomphus*. With respect to the latter, we may expect a type of larva similar to that of *Acrogomphus* or at least intermediate between this and the more typical members of the subfamily *Epigomphinae*.

The distinguishing features of nymphs of *Acrogomphus* are the great development of the prothorax with its enormous disc-like pronotum and the peculiar shape and size of the head, which is unlike any other Gomphine or Epigomphine larva known to me, and unique in being widest across the occipital lobes instead of between the eyes. It is also characterized by the wide mentum, the little produced median lobe of the labium and by having well-developed dorsal spines on the abdominal segments, all characters that may serve to distinguish it from the nymph of *Paragomphus*, which it approaches in the shape of the abdomen, legs and antennae.

The *Acrogomphus* nymph does not resemble any of the known Epigomphine larvae and at the same time differs from those of the *Gomphinae* to a degree that does not correspond very well with the differences between the adults of the oriental genera of that subfamily.

***Onychogomphus castor*, sp. n.** (pl. 13, fig. 6, pl. 14, fig. 1-3).

Material studied: — 1 ♂ (ad., holotype), Malay Peninsula, Kelantan, HEYNE vdt. 1903, ex coll. FÖRSTER (Michigan Museum, Ann Arbor).

Closely allied to *O. pollux*, sp. n., from South Sumatra, but differing from that species in a number of characters enumerated in the key.

Wings slightly tinged all over the membrane. Nodal index $\frac{11.17.17.11}{11.12.12.12}$.

Length: abd. + app. 42, hw. 34, pt. fw. 3.4 mm.

This new species has the following characters in common with its nearest ally *O. pollux*: —

Labrum black with a pair of transverse, green spots. Anteclypeus and base of mandibles greenish-yellow. Epicranium, vertex and occiput entirely black.

Prothorax entirely black.

Synthorax preponderantly black, dorsal bands green, confluent with the mesothoracic collar, so as to form a pair of complete 7-shaped spots, interrupted by black in the middle line. No trace of antehumeral band. Sides of synthorax black with two light green bands, one mesepimeral and one metepimeral band. A vestige of a green metepisternal spot just beneath the wing-bases between first and second lateral sutures (pl. 13, fig. 6).

Wings hyaline. Neuration as for the section *biforceps* SELYS of the genus. Pterostigma dark brown, covering 4 - 4½ underlying cells. Cross-veins between sectors of arculus to the bifurcation of $M_{1-3} \frac{2.2}{1.1}$. Anal triangle made up of 3 + 1 (small) cells. Anal loop two-celled.

Abdomen shaped as in the other species of the section *biforceps* SELYS (*Lamelligomphus*, FRASER 1922). Segm. 1 - 2 black, each with a narrow, mid-dorsal longitudinal green stripe, that on 2 widest on middle and tapered posteriorly; sides of 1 with an oval green spot, of 2 with two such spots, the anterior spot rather triangular, covering the auricles, the posterior one rather rounded. Segm. 3 - 6 each with a pair of dull orange baso-dorsal subtriangular spots, largest on base of 3, occupying the basal one-fourth of segment; those on 4 - 6 much smaller, progressively smaller from before backwards; 7 with almost the entire basal half orange, this colour divided partly into two by the black stripe over the dorsal carina; 8 - 10 black, 8 with a small lateral spot near its base. Dorsal surface of segments 8, 9 and 10 smooth, entirely devoid of wrinkled tubercles, notches or concavities.

Anal appendages and genitalia black, shaped as shown in pl. 14, fig. 1 - 3.

Onychogomphus pollux, sp. n. (pl. 13, fig. 7, pl. 14, fig. 4 - 6, pl. 15, fig. 1 - 4).

Material studied: — 2 ♂ (ad.), 1 ♂ (bred from larva), South Sumatra, Lampoeng residency, Giesting, near Talang Padang, ca 400 m alt., Wai Teboe river, 27 & 29.iii.1940, AUTHOR et al. leg. Holotype: 29.iii.1940.

Wings entirely hyaline. Nodal indices: $\frac{9\ 17.15.11}{10.10.10.11}$ (holotype), $\frac{10\ 15.14.10}{10.\ 9.\ 9.11}$ (one paratype).

Length: abd. + app. 36, hw. 30, pt. fw. 3.3 mm.

To the brief descriptions given above of both species, some particulars may be added. *O. castor* and *pollux* may be differentiated as follows:

O. castor

Labium greenish-yellow, the anterior margin of median and lateral lobes narrowly black, and fringed with dark brown hair.

Labrum with green transverse spots equal in width to the black interspace.

No lateral green spots on postclypeus.

Transverse green mark on top of frons completely divided into two oval spots on each side of the sulcus.

Seven-marks on dorsum of thorax narrower. Green mesepimeral fascia about equal in width to the black humeral band.

O. pollux

Basal two-thirds of labium dirty green, the lobes broadly bordered with black and fringed with golden-brown hair.

Labrum with green transverse spots almost twice as wide as the black interspace.

Small lateral green spots on postclypeus conspicuous.

Transverse green mark on top of frons entire, only slightly and triangularly indented by black posteriorly.

Seven-marks on dorsum of thorax wider. Green mesepimeral fascia only one-half as wide as the black humeral band.

Lamina anterior of genitalia rounded, prominent in profile view. Posterior hamulus in side view evenly narrowed towards the pointed apex and about twice as long as it is wide at base.

Sup. anal app. in dorsal view with a low marginal intero-dorsal tubercle about half-way its length.

Branches of inf. anal app. in dorsal view separated at their origin by almost a circular space, thence parallel, perfectly straight and closely approximated towards the apices, which curve straight upwards; in side view the branches are more abruptly upcurved, the tips reaching hardly as far as the ventral margin of the superior pair.

Lamina anterior smaller and more flattened, barely visible in profile view. Posterior hamulus in side view rather triangular, more abruptly narrowed apically and only little longer than it is wide at base.

Sup. anal appendages without such a tubercle.

Branches of inf. anal app. in dorsal view separated at their origin by an oval space, thence converging a little and finally again divergent with slightly incurved apices; in side view the branches are evenly curved upwards, the tips reaching as far as the dorsal margin of the superior pair.

As appears from the above descriptions, *O. castor* and *pollux* are closely allied species. Both are characterized by the peculiar, sharply hooked upper appendages of the male, which lie upon the dorsal surface of the branches of the lower appendage. I have described rather a similar species, *O. banteng* LIEFT. ¹⁾, from Java; this is also remarkable for the specialization of the anal appendages, but differs from the other two in details of colouring and in the much less curled anal appendages of the male.

Along with a fair number of other species of similar appearance, from India, Indo-China and China, these three Malaysian species clearly fall in LAIDLAW'S section IV of *O. biforceps* SELYS.

Both *O. castor* and *pollux* come nearest to *nilgiriensis* FRASER (originally considered a subspecies of *biforceps*), but differ in the shorter hamuli and the more strongly curled branches of the inferior appendage; also in not having the superior pair of appendages partly yellow, and in details of colouring.

(Besides some undescribed species from China, the following species of this section in my own collection were available for comparison: — *O. acinaces* LAID. (India), *ardens* NEEDHAM (China), *camelus* MARTIN (Tonkin), *micans* NEEDHAM (China), *nilgiriensis* FRASER (India), and *viridicosta* OGUMA (Japan).)

In 1922, a number of oriental species of the large and difficult genus *Onychogomphus* were grouped by LAIDLAW ²⁾ in several sections, which arrangement has facilitated considerably their identification. Two of the four sections recognized by LAIDLAW have since been given full generic rank, viz.

¹⁾ *Tijdschr. v. Entom.* 72, 1929, p. 133 - 136, fig. 25 (thor.), 26 (genit.), 27 (apps.). — ♂ W. Java.

²⁾ *Rec. Ind. Mus.* 24, 1922, p. 403 - 412.

section II of *O. lineatus* SELYS, now transferred to genus *Paragomphus* COWLEY (*Mesogomphus* FÖRST. nec DAVIS), and section IV of *O. biforceps* SELYS, for which FRASER proposed *Lamelligomphus*. I have discussed elsewhere another section of the genus, viz. that of *circularis* SELYS ¹⁾, but at the same time I have emphasized the point that neither in *Lamelligomphus* nor in the section *circularis* characters were found that would, in my opinion, justify generic separation. I have also been able to examine a few other species of *Onychogomphus* from China, which could be placed in yet another section of the genus; these are of small size and have the reduced venation of *O. modestus* SELYS (for the reception of which FRASER proposed the new generic name *Nepogomphus*), but not the swollen genital lobe of that species.

In 1922, when FRASER ²⁾ proposed to remove the group *biforceps* from *Onychogomphus* and erect a new genus for it with the name of *Lamelligomphus*, it was on account of the very great difference of the supposed larva from all other species of *Onychogomphus* (vide postea). FRASER in 1924 ³⁾ gave as generic characters of the adult insect only the relative length and shape of the inferior appendage, whilst in 1934 ⁴⁾ the two genera were separated thus:

Lamelligomphus

"Ground-colour preponderatingly black; superior anal appendages enormous curled hooks, which enclose a broad cordate or oval space by meeting the similarly curled branches of the inferior appendages, which slightly overlap the superiors."

Onychogomphus

"Ground-colour preponderatingly yellow; superior anal appendages much straighter and curled only at apices; branches of inferior appendage slightly shorter than superiors, between which they may project."

It has since been found that the different species of *Onychogomphus* show extreme variability in the colour of the body as well as in the shape of the male anal appendages and genital organs. This great variability makes the characters for several sections, including *Lamelligomphus*, quite inadequate and therefore, until a great deal more study has been devoted to them, I agree with WILLIAMSON in including them all in the same genus.

Description of the larval exuvia. ⁵⁾

Total length 24 - 25; length of abdomen 15.8 - 16.3, greatest width of same 6.6; length of head 3.7, width over the eyes 5.0; length of posterior femur 3.5, of antenna 2.5 mm.

¹⁾ *Treubia* 16, 1937, p. 117 - 119.

²⁾ *Rec. Ind. Mus.* 24, 1922, p. 425 - 426, figs.; see also: *Fauna of Brit. India*, Odon. II, 1934, p. 270.

³⁾ *Indian Dragonflies*, pt. 16, *J. Bombay N.H. Soc.* 29, p. 332 (sub *Lamelligomphus*).

⁴⁾ *Fauna of Brit. India*, Odon. II, p. 160.

⁵⁾ The following description is based upon eight exuviae, apparently all males, and all from the Wai Teboe river, Lampongs, South Sumatra.

Larva of the usual Gomphine shape. Head, sides of pro- and synthorax, and of abdomen fringed with tufts of long thin hair. Body for the greater part densely covered with microscopical scale-like warts. Head and thorax adorned with conspicuous hairless spots forming a distinct pattern. Wing sheaths bare, the ridges covered with minute, coarse, scale-like hairs. Legs very hairy along the carinae, their surface smooth but with definite stripes made up of closely set, minute scaly hairs, which form distinct longitudinal bands on the posterior femora.

Head moderately large, sloping downwards from a point just behind posterior ocelli, slightly convex in profile view; vertex almost flat.

Mouth-parts projecting, labrum broad, projecting well beyond lateral lobes of labium, its anterior border rounded and densely fringed with longish hair. Antennae (pl. 15, fig. 4) inserted in front of the eyes and separated from these by a rounded marginal tubercle; first two joints of antennae short. Third joint large, flattened, greatly expanded, with its dorsal surface slightly concave and covered with microscopical scale-like hairs alternated with irregular hairless areas; inner margin very densely fringed with long, soft, curled hairs, outer margin more sparsely and stiffly hairy, the hairs themselves are microscopically plumose. Fourth antennal joint rudimentary, a small spherical knob on the apex of the third. The antennae are strongly convergent in natural position, covering most of the labrum, and projecting well beyond it. ¹⁾

Postero-lateral angles of head somewhat projecting backward, rounded, covered with wart-like scales.

Labium extending back to posterior border of procoxae, shaped as shown in pl. 15, fig. 2-3. Median lobe distinctly convex on anterior margin and furnished with about 24 short, square teeth between which the long hair-like brissae are inserted. Lateral lobe stout, slightly incurved, widest basally, thence strongly diminishing in width to slightly beyond the movable hook, from where the lobe is suddenly narrowed with the end-hook blunt; inner margin slightly curved and beset with 15-17 low, backwardly directed, irregular denticles up to the apex of the hook, these denticles becoming indistinct toward the base. Movable hook long and curved.

Prothorax much narrower than head, simple, two times wider than long; lateral lobes rounded, not projecting.

Wing-sheaths divergent ²⁾, extending back to half-way the length of 4th abdominal segment.

Legs rather short, femora somewhat flattened and slightly curved. Burrowing hooks on fore and middle legs well developed.

Abdomen torpedo-shaped, rather flattened, almost twice broader than high in normally inflated exuviae (flatter in the living larva), roughly triangular in cross-section, widest across segm. 5. Dorsal hooks present on 2th to 9th

¹⁾ The ventral aspect of the head is quite similar to that of the larva of *O. forcipatus* (L.), figured by SCHMIDT (*Senckenbergiana*, 18, 1936, p. 279 fig. 10a).

²⁾ The position of the wing-sheaths in 'gaping' exuviae is similar to that of the living larva.

segments, erect and knob-like on 2 (but not projecting beyond posterior border), lower and progressively more rudimentary on 3-5, thence becoming sharper, half-erect and gradually more projecting beyond posterior margin of each of the segments 6 to 9. Lateral spines on segments 7, 8 and 9, directed backwards, those on 9 longest. Segm. 10 annular, in dorsal view broader than the anal pyramid is long and shorter than the epiproct (superior appendage) is wide at its base.

Body-colour sandy-brown, scales on antennae and on dorsal surface of head and prothorax somewhat darker. Side-margins of all abdominal segments as well as the dorsal tubercles and spines posteriorly (especially those of 7-9th segments), more darkly scaled. Pattern on abdomen very simple: 4-6 minute dark brown specks placed alternately in a row before and after the middle of each segment.

Habits and environment.—Seven exuviae were picked up from boulders ashore and in mid-stream of the river Wai Teboe, whilst on March 23th two larvae in the penultimate instar were sifted from sand under the river bank, in water less than knee-deep. The nymphs are burrowers and were less abundant than those of *Chlorogomphus magnificus*, which were found in all stages. No imagines were seen over this large stream, which is about 100 feet wide and flows through heavy jungle. The young larvae were transported in tins filled with wet moss, and in the resthouse were put separately in bigger jars for more than six days. On our return to Java these larvae along with many others were kept in the washing-bowls on board steamer for about 14 hours, thence again transferred to tins during the whole morning of Jan. 1st, and on our arrival in Buitenzorg the same day released in large petri-dishes, partly filled with sand, in which the nymphs soon disappeared; they remained in the dishes until emergence. The larvae were fed with pieces of living earth-worms and small fry, offered to them every two days. One of the larvae died before last ecdysis, whilst the other emerged June 16th, 1940.

The adult insects apparently frequent small, shady streams as the two males captured were found settled on the gravelly beach of a tributary of the Wai Teboe, at some distance of the main stream.

Notes on the genus "*Lamelligomphus*" and its larva.

In his 1922 paper (loc. cit.), FRASER described as *nilgiriensis* a new subspecies of *O. biforceps*, which came from Gudalur, Nilgiris. At the end of the diagnosis this author gave a description and sketches of a peculiar larva of which four specimens were found in a deep pool of a mountain stream, lurking amongst débris consisting mainly of rotting leaves, twigs, etc., above Gudalur, 26.ii.1922. These larvae had curiously flattened, short, lamellate antennae, coupled with a very short labium and a greatly depressed abdomen; they were dark brown in colour and closely resembled the decaying leaves amongst which they lived. FRASER added that five adult insects of *O. b. nilgiriensis* were taken within 10 yards of this pool and 3 others seen. As no other species had been

seen or taken over this stream and no other kinds of larvae were found, FRASER thought them to belong to *nilgiriensis*; and the aberrant characters of the larva suggested the new generic name of *Lamelligomphus*.

As may appear from the above description and sketches of the larva of *O. pollux*, it is quite evident that FRASER's larva from Gudalur was erroneously associated with "*Lamelligomphus*". On comparing our positively identified exuviae of *O. pollux* with SCHMIDT's ¹⁾ descriptions and drawings of some palaearctic species of *Onychogomphus*, the close agreement in general shape and structural characters is quite striking. The labium resembles closely that of the genotype, *O. forcipatus* (L.), whilst the antennae are almost exactly like those of *O. uncatatus* (CHARP.). I have been able to compare our skins of *pollux* with one of *O. costae* SELYS, from Algiers, and with one of *O. forcipatus* (L.), from Switzerland. The differences found are slight and of not more than specific value.

In 1933 ²⁾ I published figures and descriptions of the exuvia of *Heliogomphus kelantanensis* (LAIDLAW) from Kedah, Malay Peninsula, a nymph showing unmistakably close affinity with FRASER's supposed "*Lamelligomphus*." Later, I received from Mr M. W. F. TWEEDIE, curator of the Raffles Museum, Singapore, a great many nymphs of the same species, from the Plus river in Perak, Malaya, and in the meantime had succeeded myself to rear several individuals of *H. drescheri* LIEFT., from larvae secured from leaf- and mud-bottomed stream pools in Java and South Sumatra. Lastly, the larva of *H. bakeri* LAIDLAW, has been described and figured by NEEDHAM & GYGER ³⁾. These nymphs differ widely from those of the true *Gomphinae* in their flattened body, depressed antennae, bare-backed abdomen, short and broad labium and segmentally serrated abdomen. Other Epigomphine larvae (e.g. *Epigomphus* ⁴⁾, *Microgomphus* ⁵⁾ and *Leptogomphus*) agree in many respects with that of *Heliogomphus*.

Mr FRASER had no acquaintance of the larva of *Heliogomphus* at the time of establishing "*Lamelligomphus*", and no one at that time suspected that all *Heliogomphus* larvae are easily distinguished from other nymphs by the curiously flattened antennae and the depressed body. Our alcoholic larvae of *H. kelantanensis* and *drescheri* compare very well with FRASER's sketch of "*Lamelligomphus*" so that I am strongly inclined to identify this larva with that of the Indian *Heliogomphus promelas* (SELYS), the adult of which is of the same size as *Onychogomphus nilgiriensis* FRASER, both species being reported by FRASER from the Nilgiris. It is here referred to this species by supposition for many reasons: (1) General shape of body, especially of antennae and

¹⁾ *Senckenbergiana*, 18, 1936, p. 276, 281, figs. (larval structures).

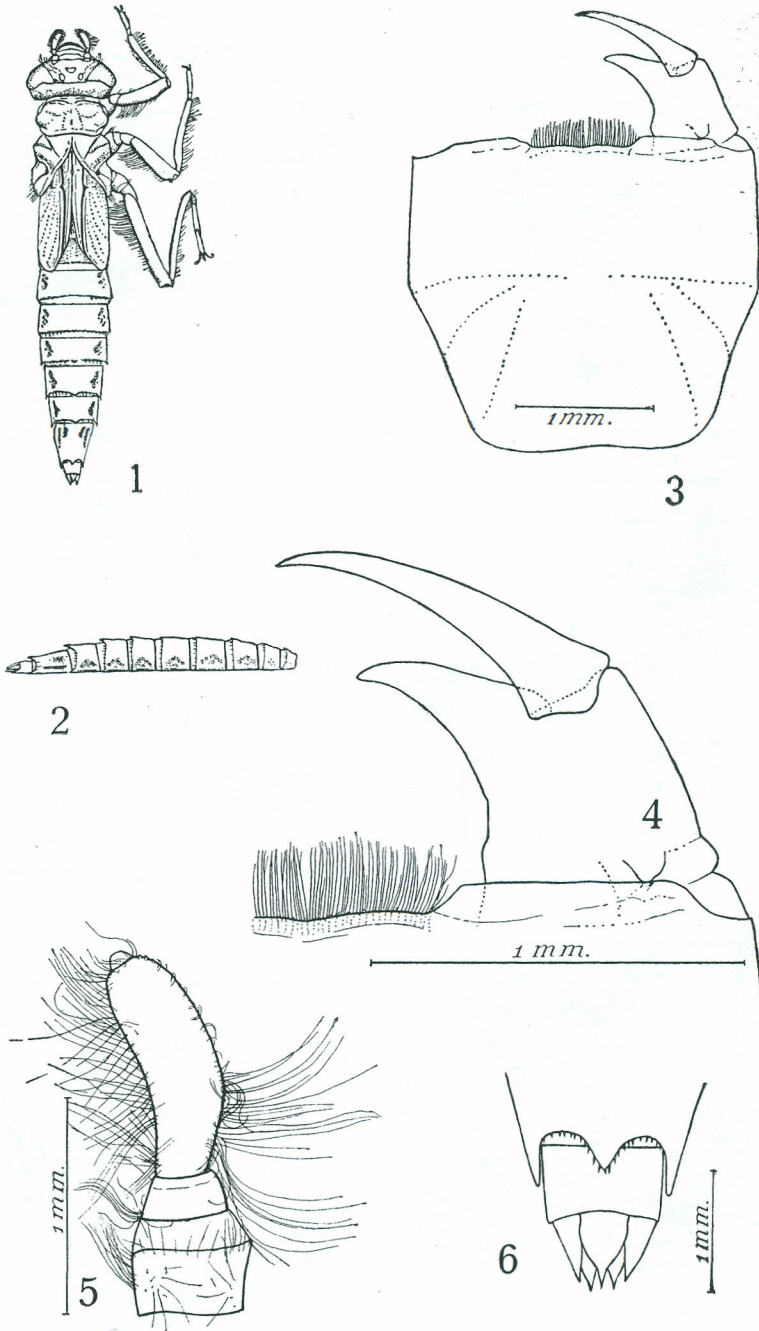
²⁾ *Bull. Raffles Mus.* 7 (1932), 1933, p. 109-113, tfig. 2, pl. 2 fig. 6, pl. 4 fig. 1-4 (idem).

³⁾ *Philipp. J. Sci.*, 63, 1937, p. 38-39, pl. 10 fig. 121-122 (larval structures).

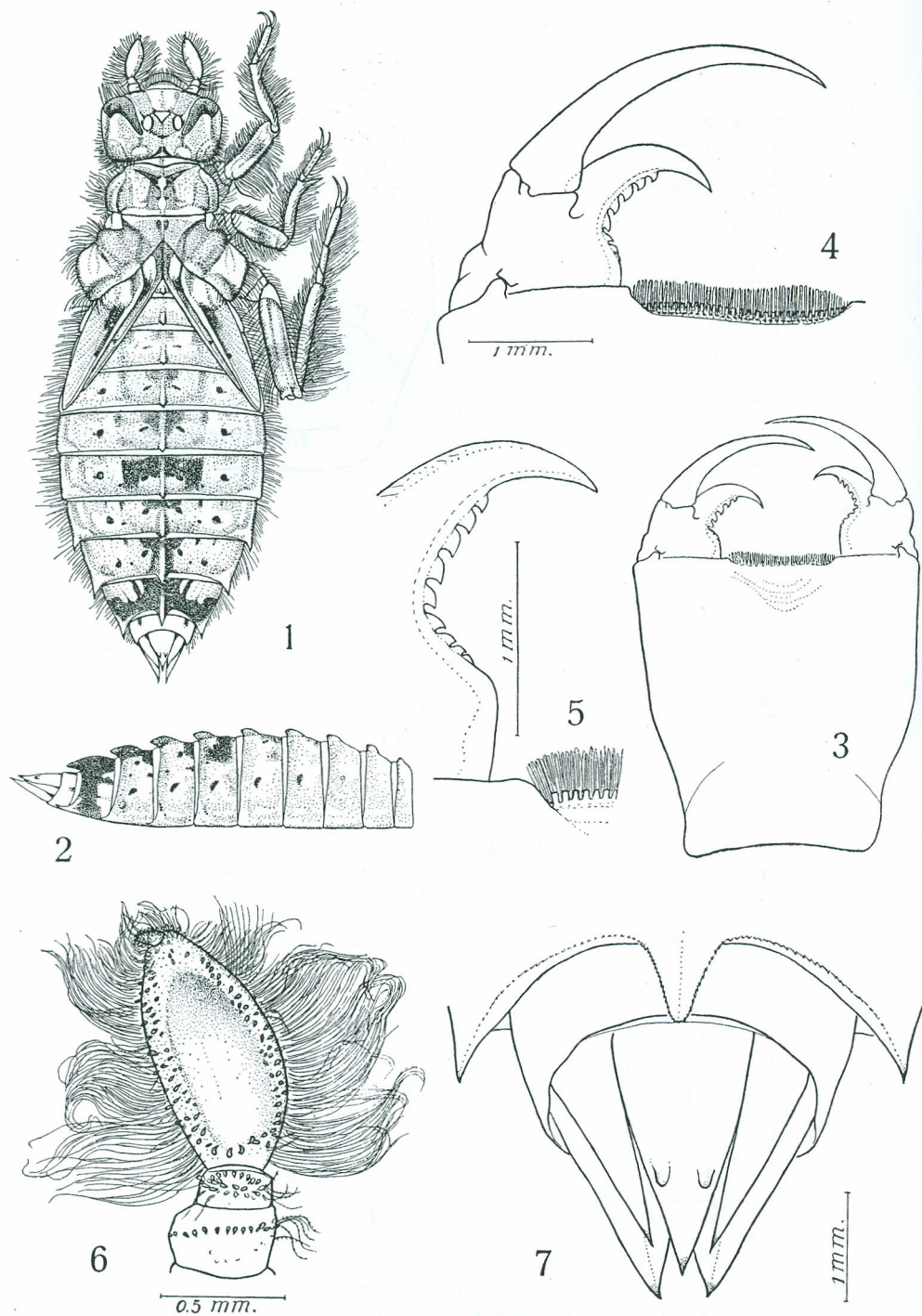
⁴⁾ See NEEDHAM, *Trans. Amer. Ent. Soc.* 65, 1940, p. 385, fig. 30-31 (idem).

⁵⁾ See LIEFTINCK, *Ceylon J. Sci.* B, 22, 1940, p. 101-104, fig. 6 & pl. 1 fig. 4 (idem).

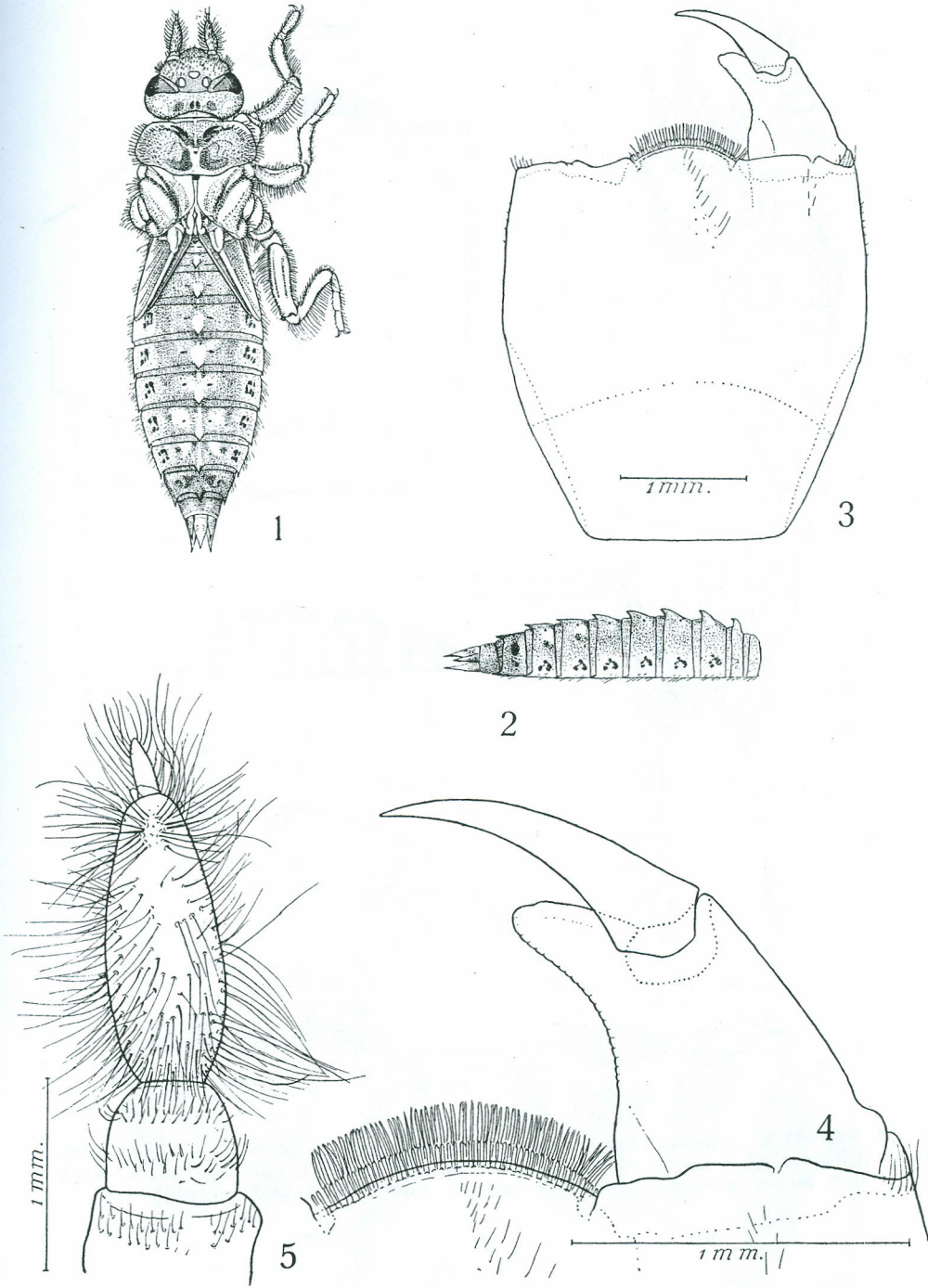
abdomen; (2) the presence of a squarish, flat projection in front of frons, between the insertion-point of antennae; (3) the slender bare legs, together with the absence of strong burrowing hooks to the anterior two pairs of tibiae; (4) the presence of dorsal tubercles on the prothorax; (5) the projecting lateral angles to segm. 6 or 7-9 of abdomen; (6) the short and quadrate labium; &c. It may be added that *H. promelas* in its larval characters approaches most closely *H. kelantanensis* LAID., from Malaya.



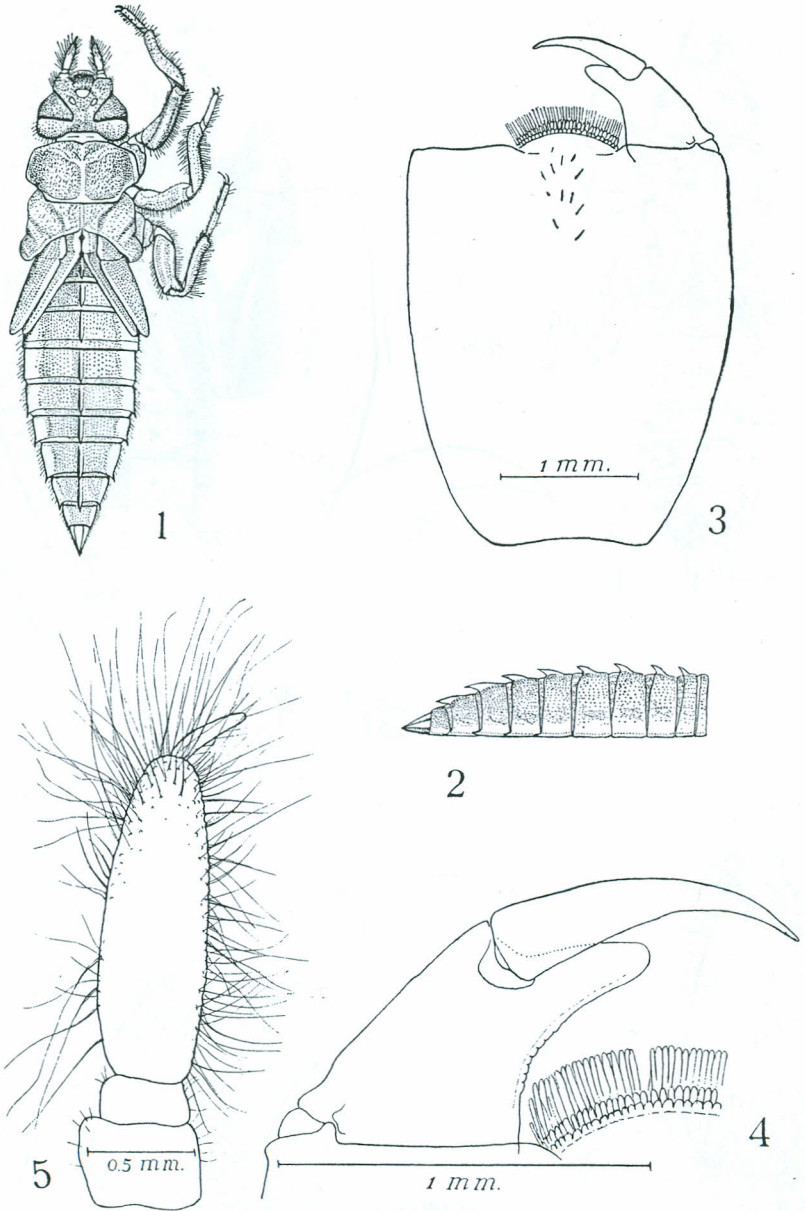
Pl. 9. Fig. 1-6. *Merogomphus parvus* (KRÜG.), larval structures. — 1. Exuvia (longitudinal slit of head and thorax closed); 2. Abdomen, lateral view; 3. Labium, interior view; 4. Right lateral lobe and part of median lobe of labium; 5. Right antenna, dorsal view; 6. Apical segments of abdomen.



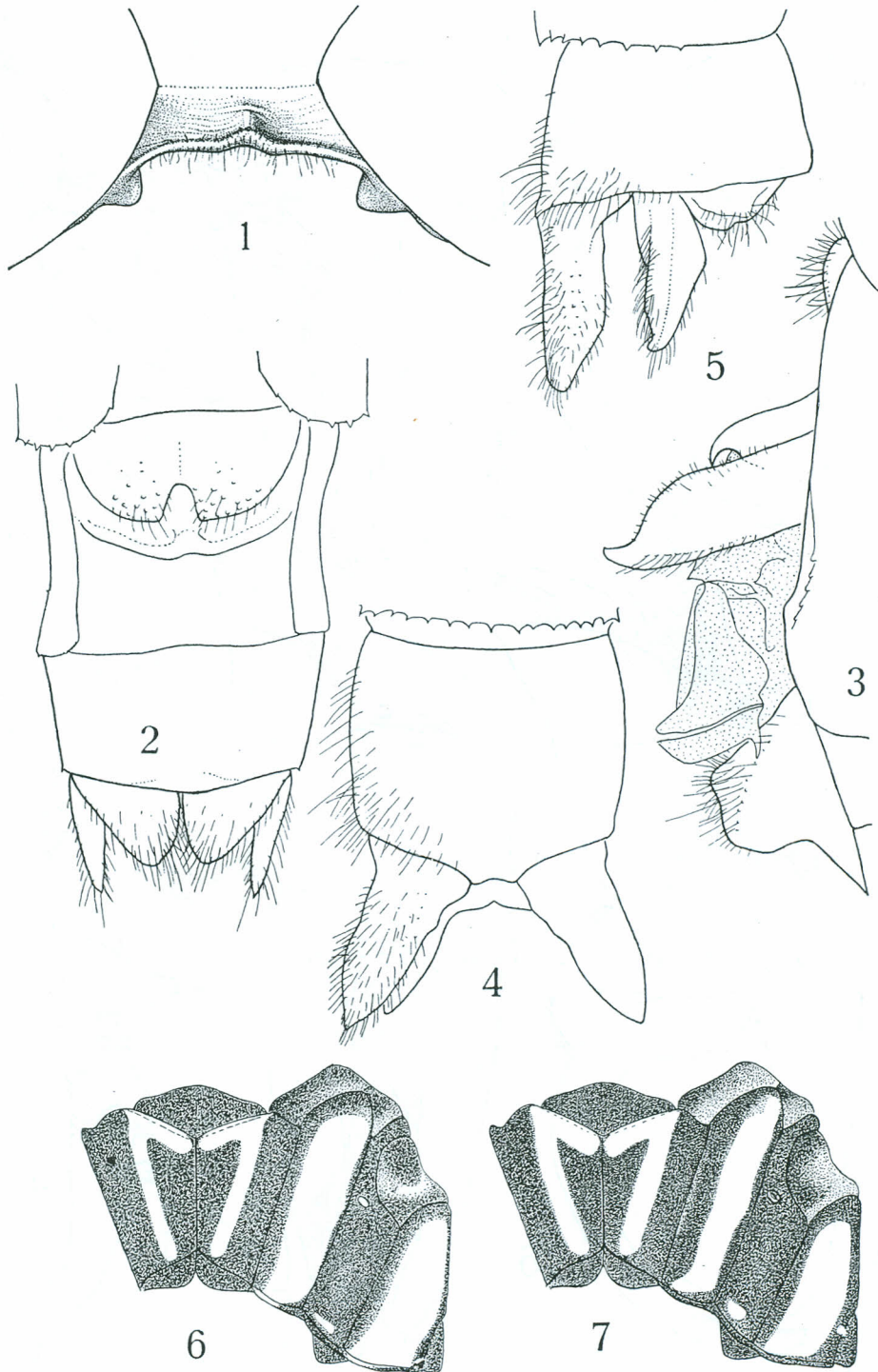
Pl. 10. Fig. 1-7. *Megalogomphus icterops* (MARTIN), larval structures (♂). — 1. Ultimate larval instar (drawn from living specimen); 2. Abdomen, lateral view; 3. Labium, interior view; 4. Left lateral lobe and median lobe of labium; 5. Part of left lateral lobe, more highly magnified; 6. Right antenna, dorsal view; 7. Apex of abdomen (♂).



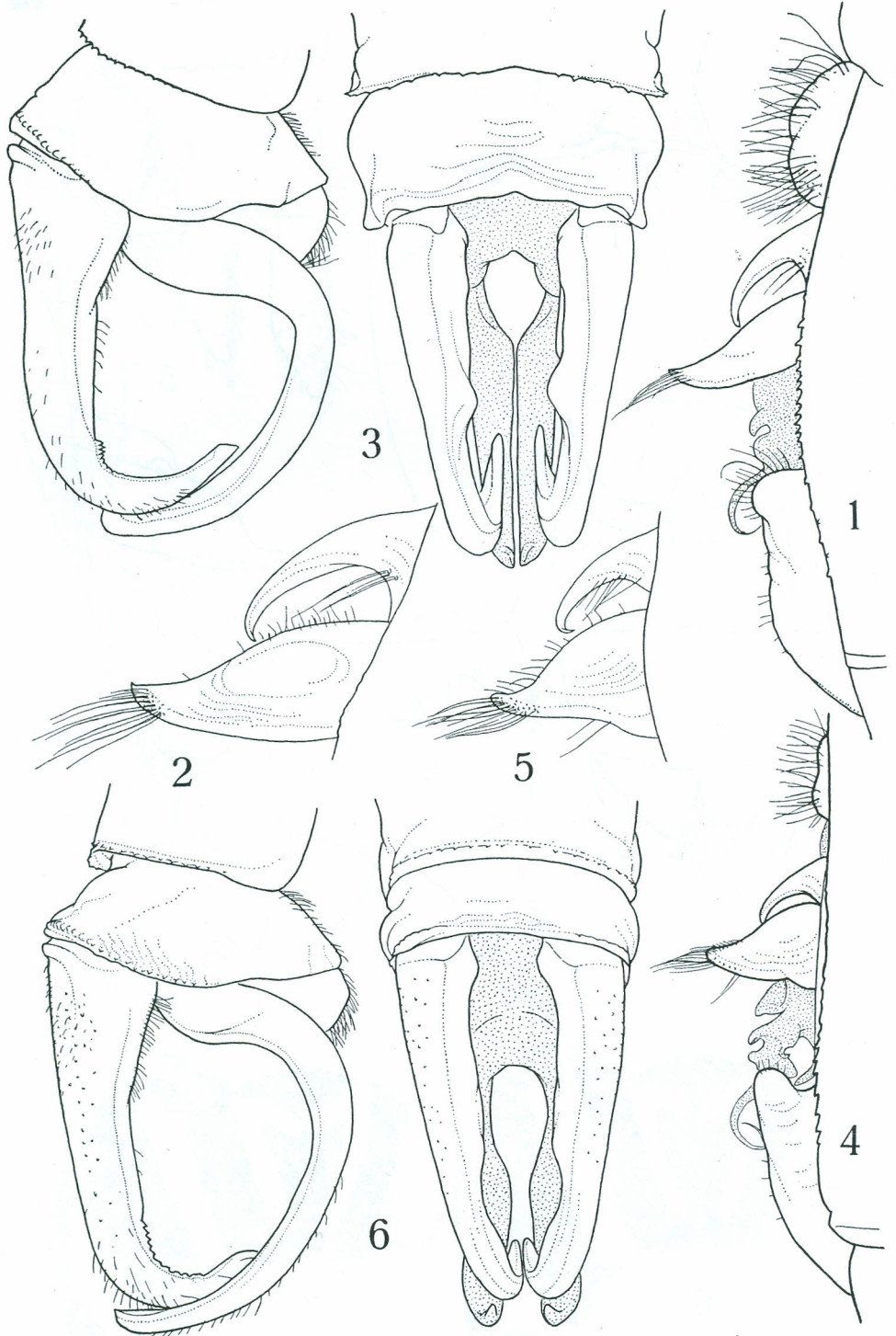
Pl. 11. Fig. 1-5. *Acrogomphus walshae* LIEFT., larval structures. — 1. Ultimate larval instar (drawn from living specimen); 2. Abdomen, lateral view; 3. Labium, interior view; 4. Right lateral and median lobe of labium; 5. Right antenna, dorsal view.



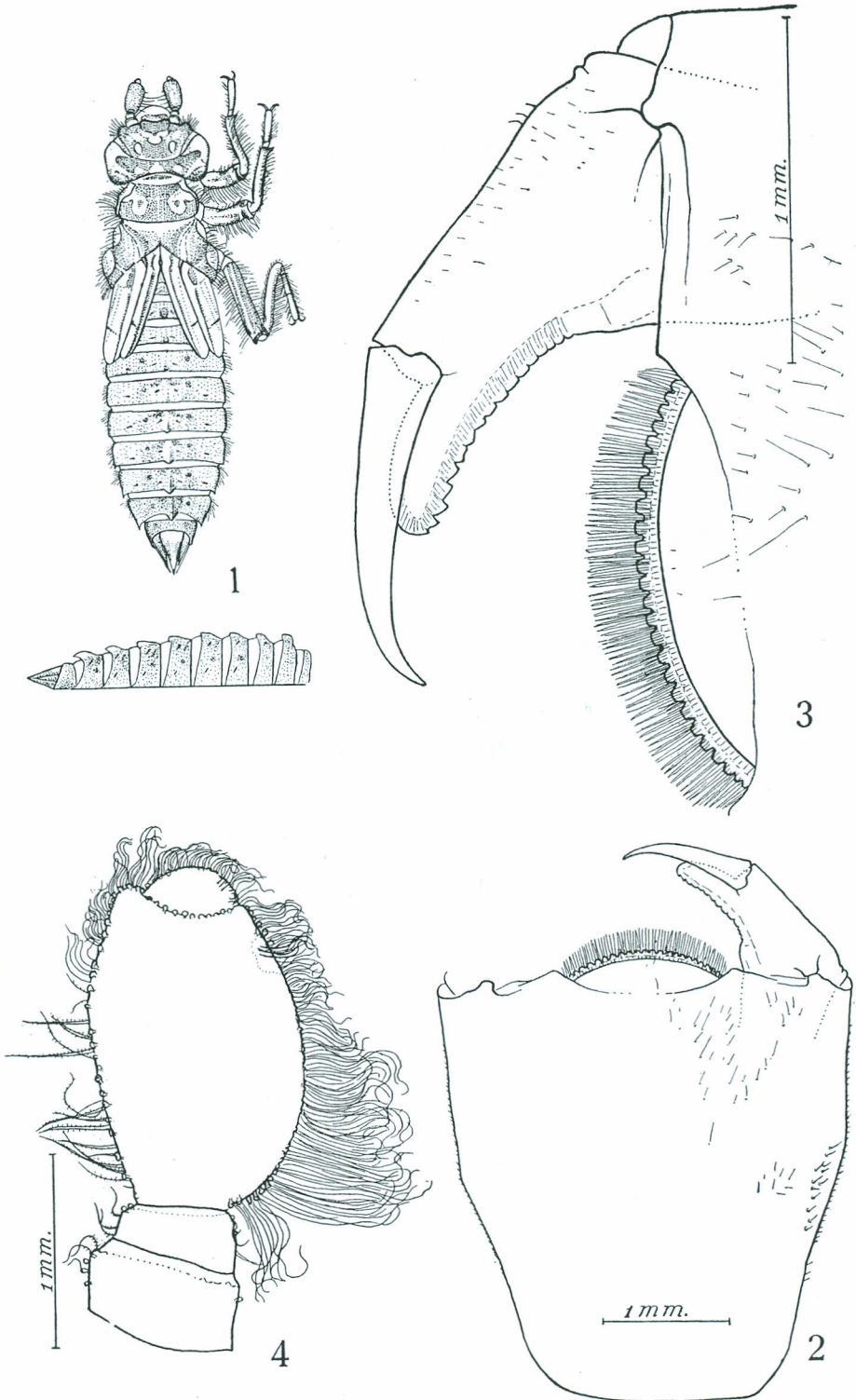
Pl. 12. Fig. 1-5. *Acrogomphus malayanus* LAID., larval structures. — 1. Ultimate larval instar (alcohol specimen); 2. Abdomen, lateral view; 3. Labium, interior view; 4. Left lateral and part of median lobe of labium; 5. Antenna, dorsal view.



Pl. 13. Fig. 1-2. *Acrogomphus walshae* (LIEFT.), structures. — 1. Occipital plate of ♀ from Java, dorsal view; 2. Terminal segments of ♀ abdomen, ventral view, showing vulvar scale. — Fig. 3-5. *Merogomphus parvus* (KRÜG.), ♂ structures. — 3. Genitalia, left lateral view; 4-5. Anal appendages, dorsal view and right side. — Fig. 6. *Onychogomphus castor*, sp. n., ♂ Malaya, diagram of synthorax; 7. The same of *O. pollux*, sp. n., ♂ S. Sumatra.



Pl. 14. Fig. 1-3. *Onychogomphus castor*, sp. n., Malaya, ♂ structures. — 1. Genitalia, left side-view; 2. Hamuli of same, more highly magnified; 3. Anal appendages, right side and dorsal view. — Fig. 4-6. *O. pollux*, sp. n., S. Sumatra, ♂ structures. 4. Genitalia, left side-view; 5. Hamuli of same, more highly magnified; 6. Anal appendages, right side and dorsal view.



Pl. 15. Fig. 1-4. *Onychogomphus pollux*, sp. n., S. Sumatra, larval structures (δ). — 1. Exuvia (longitudinal slit of head and thorax closed) and right side-view of abdomen; 2. Labium, interior view; 3. Right lateral and median lobe of labium; 4. Right antenna, dorsal view (scale-like hair on dorsal surface omitted).