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TWO NEW SPECIES AND ONE NEW SUBSPECIES OF GOMPHIDAE FROM SOUTHWESTERN CHINA, WITH DESCRIPTIONS OF LARVAE AND DISTRIBUTION RECORDS (ANISOPTERA)

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Anisogomphus resortus sp.n. (holotype ♂: Omeishan, Sichuan, 10-VI-1993), *Davidius davidi yunnanensis* ssp.n. (holotype ♂: Lijiang, Yunnan, 19-VII-1993) and *Stylogomphus lawrenceae* sp.n. (holotype ♂, allotype ♀: Jiangcheng Co., Yunnan, 24/31-V-1993) are described and illustrated. Holotypes are deposited at IZAS, paratypes were shared between IZAS and CUMZ. – The hitherto unknown larvae are described (mainly from exuviae) for *Burmagomphus divaricatus* Lieft., *Sinogomphus scissus* Needham and *Merogomphus chaoi* Yang & Davies. – *Phaenandrogomphus tonkinicus* Fraser is for the first time reported from China, and records are given for 6 spp. from new areas of SW China.

INTRODUCTION

CHAO (1990) has published an excellent, extensive and up-to-date monograph on the Gomphidae of China. There are about 170-180 species on the Chinese list of 1990 but already the number has increased considerably. West and South-West China have not been much explored odonatologically, having had (recorded) only about 20 of the species on the list. In addition to adding several of the known Chinese species to the list for Yunnan, we have added 6 previously undescribed taxa from just a small amount of field work carried out since 1991 (cf. YANG & DAVIES, 1993). No doubt, many more await discovery.

The dragonfly fauna, excluding Gomphidae, will also have surprises; we have about 15 particularly interesting new species awaiting description, excluding Coenagrionidae and Libellulidae, and not

mentioning *Chlorogomphus papilio* Ris, perhaps the most spectacular of the World's dragonflies, rarely seen and almost never caught!

NEW TAXA

ANISOGOMPHUS RESORTUS SP.N.
Figures 1-7

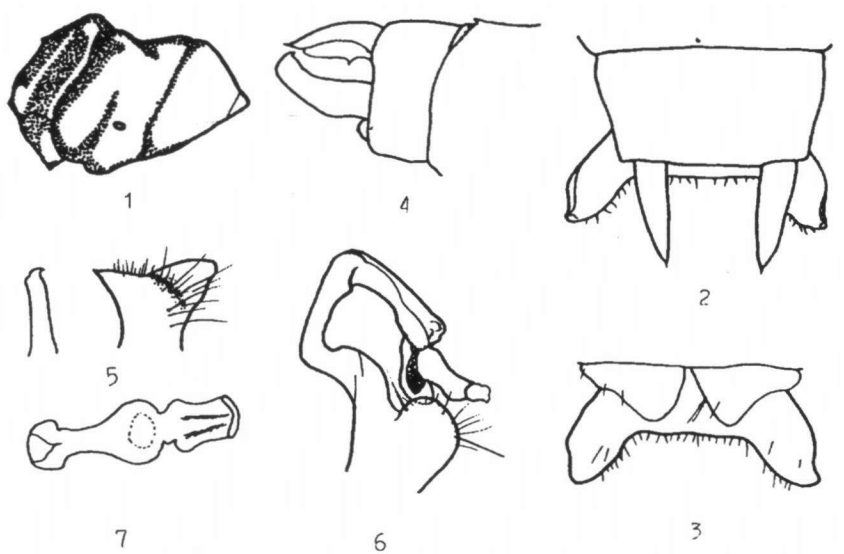
M a t e r i a l. – **Holotype** ♂: Omeishan, Sichuan, 10-VI-1993; – **paratypes**: ♂, same locality, 10--VII-1992, 10-VI-1993. All B. Yang leg.

E t y m o l o g y. – French "*sortir*", to go; "resort(us)", come and go, chance sightings.

MALE. – Abd. + app. 34.6 mm; hindwing 28.0 mm.

H e a d. – Labium with median lobe black, lateral lobes yellow; labrum bright yellow with anterior border black; base of mandible yellow anteclypeus and postclypeus black, the latter with a very small yellow spot on each side adjacent to the eye; one paratype without this spot. Frons black with a transverse yellow streak on its crest and tapering at each end; vertex and occiput black, the former with an oval tubercle behind each of the lateral ocelli; rear of the occiput having a central yellow spot.

T h o r a x. – Prothorax black, marked with bright yellow as follows: anterior lobe, a wedge shaped spot on each side and a geminate spot at the centre of the middle lobe. Thorax black, marked with yellow as follows: – an interrupted



Figs 1-7. *Anisogomphus resortus* sp.n., male holotype: (1) thoracic pattern; – (2-4) anal appendages; – (5-7) accessory genitalia.

mesothoracic collar confluent with the outer end of the antehumeral stripe on each side, with inverted '7'-shaped marks; long sinuous humeral stripes, slightly expanded at the upper ends and continuous with the yellow at the base of the middle pair of legs below; sides marked with a narrow, complete black stripe on the postero--lateral suture and an incomplete one on the anterior suture. – W i n g s hyaline, saffron at base to well beyond the distal side of the discoidal cells, basal incomplete antenodal nervure present in all wings, stigma brown, braced, covering 3-4 cells, nodal index 9-12:11-9/13-10:9-9. Legs black, fore femur with a yellow streak on the inner surface.

A b d o m e n. – Black, marked with bright yellow as follows: a mid-dorsal stripe on segments 1-7, broad and triangular on 1, broad and trilobed on 2, then narrow and fine to end of 7; baso-lateral triangular spot on 3; a very small and obscure baso-lateral spot on 4 and 5 (but in one of the paratypes segs 4 to 7 unmarked laterally; in the other paratype a very small baso-lateral spot on 4 and a very obscure baso-lateral spot and mid-lateral spot on 7), sutures between last 4 segments; large ventro-lateral spot on 8, ventro-lateral margin of seg. 9 but in one of the paratypes, instead, a large spot like that of seg. 8. Anal appendages as shown in Figures 2-4, the superiors (0.8 mm) slightly shorter than the length of seg. 10 (1.1. mm), blackish but paler at the apex; seen from above, parallel, tapering from the base to the pointed apex; in profile, gently and convexly curved on the dorsal side to the slightly upturned apex, on the ventral side the almost straight margin at the basal third interrupted by a short broad tooth. Inferior appendage black, equally long, very broad, bifid, the 2 branches splayed out to be in a straight line, concave above and slightly upturned at the apex. Genitalia as shown in Figures 5-7.

The 2 paratypes have hindwings 27.8 and 29.8 mm long and nodal indices 12--13:11-11/14-12:11-11 and 11-13:11-9/12-11:9-11 respectively.

FEMALE unknown.

AFFINITIES. – The genitalia and appendages of the male suggest a relationship to *A. bivittatus* (Sel.) and *A. b. flavifacies* Klots; but also to *A. maacki* (Sel.) and *A. forresti* (Morton), (superior appendages of male seen to be bifid from above and the inferior appendages deeply cleft in an inverted 'V' shape). The new species is distinguished from the others by the shape of the anal appendages and the smaller build.

DAVIDIUS DAVIDI YUNNANENSIS SSP.N.

Figures 8-15

M a t e r i a l. – **Holotype** ♂: Lijiang, Yunnan, 19-VII-1993; – **paratypes**: 3 ♂, same locality and date. All B. Yang leg.

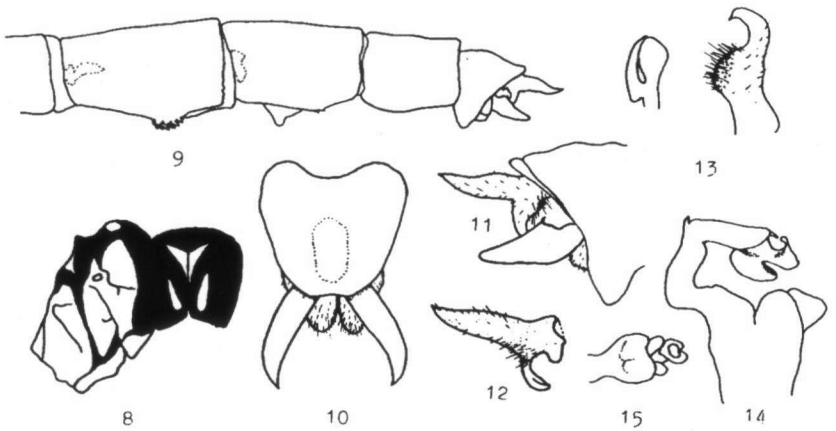
MALE. – Abd. + app. 35.0 mm, hindwing 29.0 mm.

H e a d. – Labium entirely black, moderately beset with dark brown hairs; labrum and base of mandible black, the latter with its anterior border brownish yellow;

anteclypeus brown; postclypeus black; frons greenish yellow with its base broadly black above; vertex black with a long transverse carina behind the lateral ocelli, the carina interrupted at the centre and beset with black hairs; occiput black, notched at the middle posterior margin and fringed with long hairs; rear of the occiput with a large greenish yellow spot extending forwards to the notched centre.

T h o r a x. – Prothorax black, its anterior and posterior lobes brownish yellow. Thorax black, marked with greenish yellow as follows: a short unbroken mesothoracic collar; the lower part of the mid-dorsal carina is confluent with the collar and has an upper isolated cuneiform humeral spot and laterally 2 very broad yellow stripes separated by a narrow black stripe on the postero-lateral suture. Interalar space also yellow. Legs black, rather long, the posterior femur 8.0 mm long. – W i n g s hyaline, slightly enfumed, costa black, stigma brown, stout, 2.7 mm long in forewing, 3.1 mm in hindwing, covering 5-6 cells, nodal index 10--14:10-10/13-10:9-10.

A b d o m e n. – Black, marked with greenish yellow as follows: dorsum and sides of seg. 1, a dorsal stripe and sides of 2, a baso-lateral and mid-lateral spot on 3, baso-lateral spots on 4 to 8, diminishing posteriorly, a dorso-apical spot on seg. 10; sutures between last four segments brownish yellow, 9 unmarked; seg. 7 at apical two-thirds with the ventral margin expanding to a tubercle covered with backwardly directed spines, seg. 8 with a central-like process on its ventral tergite. Appendages black, superiors bifid nearly to base, upper branches divaricate, 1.1. mm long, shorter than seg. 10 (1.6 mm long), the apices pointed and turning a little inward; inner branch nearly at right angles to the upper, which is inclined downward, its end curved back slightly towards the base and resting on the inferior appendages. Inferior appendages black, almost the same length as the upper side of the superiors, triangular, excavate above and with a transverse tooth on each side



Figs 8-15. *Davidius davidi yunnanensis* sp.n., male holotype: (8) thoracic pattern; – (9) last abdominal segments; – (10-12) anal appendages; – (13-15) accessory genitalia.

near the base, apex blunt and bifid to half its length. Genitalia as shown in Figures 13-15.

FEMALE unknown.

AFFINITIES. – This new subspecies is close to *D. d. shaanxiensis* Zhu, Yan & Li, but differs in the male as follows: (1) abdominal seg. 10 with a dorso-apical greenish-yellow spot, (2) upper branches of the superior appendages with apex pointed and directed inward, and (3) significant differences in the hamulus of the genitalia.

STYLOGOMPHUS LAWRENCEAE SP.N.
Figures 16-27

Material. – **Holotype** ♂, **allotype** ♀: Jiangcheng Co., Yunnan, 31-V-1992; – **paratypes**: 2 ♂, 12 ♀, 6 exuviae: same area, 24/31-V-1993. All B. Yang leg.

Etymology. – Named in honour of Patricia Lawrence Davies, our expedition colleague.

MALE. – Abd. + app. 27.0 mm, hindwing 22.8 mm.

Head. – Labium yellowish; labrum black, marked with a pair of transversely oval yellow spots; bases of mandibles yellow; anteclypeus greenish yellow; postclypeus black with a yellow spot on each side; frons black, its crest traversed with yellow; occiput black, simple.

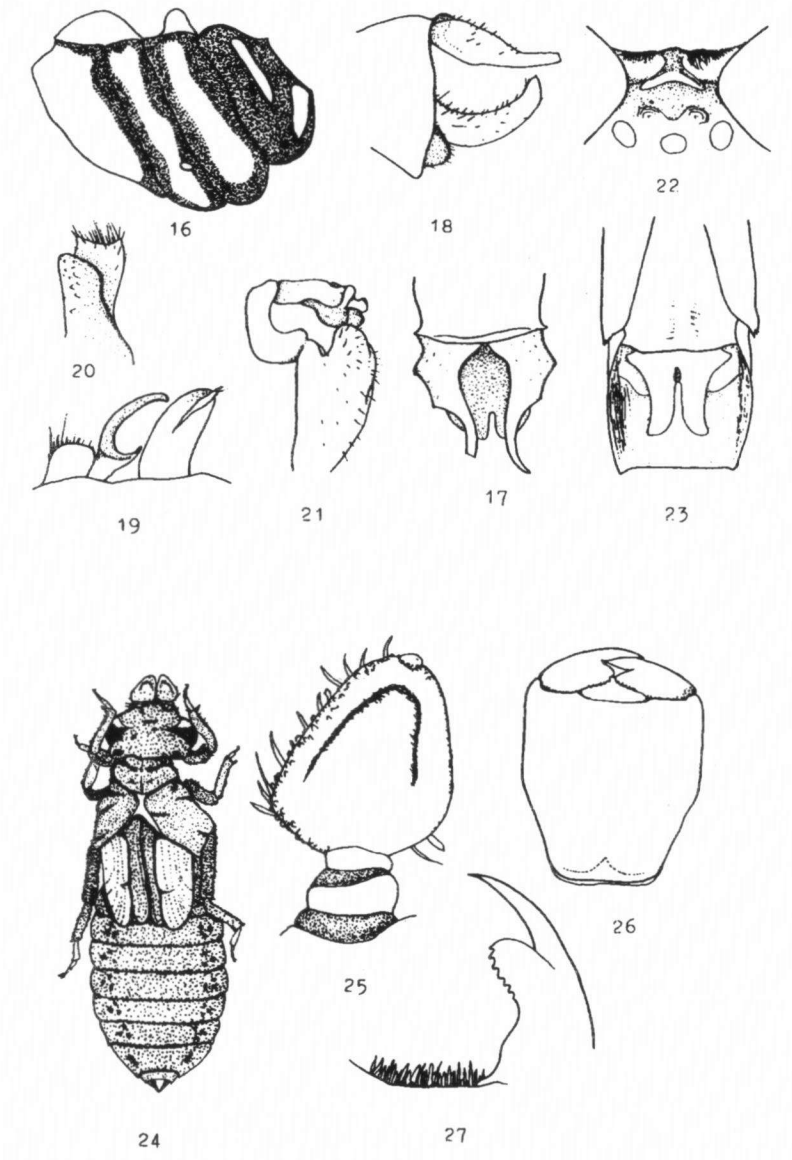
Thorax. – Prothorax black. Thorax black, marked with bright yellow as follows: mesothoracic collar narrowly interrupted in the midline; dorsal stripes with their lower ends pointed and divergent, well separated from the alar sinus above and mesothoracic collar below. Laterally yellow, divided by the two fine stripes on the lateral sutures. Legs black, coxae yellow and the first femur yellow internally. – Wings hyaline, pale saffron at base; stigma brownish-black covering 2-4 cells, strongly braced; nodal index 9-10:10-9/10-8:8-10.

Abdomen. – Black marked with yellow as follows: seg. 1 with sides broadly yellow and a mid-dorsal spot; 2 with a trilobed mid-dorsal stripe extending the whole length of the segment and the sides broadly yellow, including the oreillets; 3-7 with a basal small mid-dorsal triangular spot and a baso-lateral triangular spot, diminishing posteriorly from 4 to 7. Anal appendages shaped as in Figures 17, 18: superiors pale yellow, inferior black. Genitalia as shown in Figures 19-21.

The 2 male paratypes have an antehumeral spot on the thorax.

FEMALE. – Abd. + app. 27.4 mm; hindwing 24.6 mm.

Coloration very similar to that of the male, differing as follows: segs 1-2 completely yellow on sides; seg 3 with a dorsal line running the whole length of the segment and a lateral stripe interrupted on the jugal suture; 4-5 with an additional elongate mid-dorsal spot, the basal spots of 4-7 confluent with the basal ring. Occiput broad, slightly swollen, the posterior margin armed with a protuberance shaped like a 'whale's tail'. Nodal index 9-12:9-9/12-8:8-9. Anal appendages pale yellow, shortly conical; vulvar scale 0.9 mm long, a little over half the length of seg. 9 sternite (1.4 mm) and deeply cleft.



Figs 16-27. *Stylogomphus lawrenceae* sp.n., male h o l o t y p e: (16) thoracic pattern; – (17-18) anal appendages; – (19-21) accessory genitalia; – female a l l o t y p e: (22) head, vertex and occiput; – (23) vulvar scale; – e x u v i a e: (24) intact; – (25) antenna; – (26) labium; – (27) part of labium.

EXUVIAE. – Total length 17 mm; abd. 9.5 mm; greatest width of abdomen 5.4, length of head 2.8, width over eyes 3.8, length of posterior femur 2.5 and of antenna 1.5 mm.

Rather naked, brownish. Body densely covered with brown microscopical wart--like scales.

Head small, widest across the eyes, upper surface almost flattened in profile, the postero-lateral angles projecting somewhat backwards. First 2 joints of antennae short. Third joint flattened, greatly expanded, with its dorsal surface slightly concave and margins a little raised, the outer margin densely fringed with microscopical scale-like hairs. Fourth antennal joint rudimentary, the antennae covering nearly all the mouthparts in profile and projecting well beyond the labrum. Mouthparts projecting, labrum with its border rounded and densely fringed with longish hairs. Labium shaped as shown in Figure 26, median lobe straight or even slightly convex on anterior border, margin simple, furnished with long hairlike bristle. Lateral lobe stout, very broad at base, curved; inner margin bearing about 7 low, backwardly directed denticles up to the apex of the hook, these denticles becoming indistinct toward the base. Movable hook long and curved. Prothorax distinctly narrower than head, simple, about twice as wide as long; lateral lobes rounded. Wing sheaths parallel, extending back to the middle of the third abdominal segment. Legs moderate sized. All femora more swollen and distinctly more curved in side view than when viewed from above. Fore and middle tibiae with well developed burrowing hooks. Abdomen broad, convex dorsally with no dorsal hooks and venter flattened laterally, slightly convex over centre, widest across seg. 6. Seg. 9 with anterior margin twice the width of the posterior. Very short lateral spines on segs 8 and 9; seg. 10 about a fifth as wide as long. Anal pyramid about twice the length of seg. 10

AFFINITIES. – The male of this species differs from that of *S. tantulus* Chao by the differently shaped posterior anal appendages. The female differs from all known species of the genus by having the occiput armed with a 'whale's tail'-shaped protuberance.

HABITAT. – Six exuviae were found on boulders ashore and in mid-stream of a small river flowing through heavy jungle. It was fortunate to find a mature larva (24-V-1992) at the same site, from which a female adult promptly emerged. All the adults captured had settled on trees by the river-side, were very shy and rose swiftly to the tree tops when disturbed.

SPECIES NEW TO CHINA

PHAENANDROGOMPHUS TONKINICUS (FRASER)

Material. – 1 ♂ & tandem pair: Jiangcheng Co., Yunnan, 30-V-1992, B. Yang leg.

MALE. – Abd. + app. 37.4-40.3 mm; hindwing 29.3-32.0 mm.
FEMALE. – Abd. + app. 40.0 mm; hindwing 35.4 mm.

Our male specimens matched well with the description by ASAHINA (1986) and specially with the redescription by LIEFTINCK (1969); the female specimen also coincides with the description in the latter reference.

DESCRIPTION OF EXUVIAE

BURMAGOMPHUS DIVARICATUS LIEFTINCK
Figures 28-31

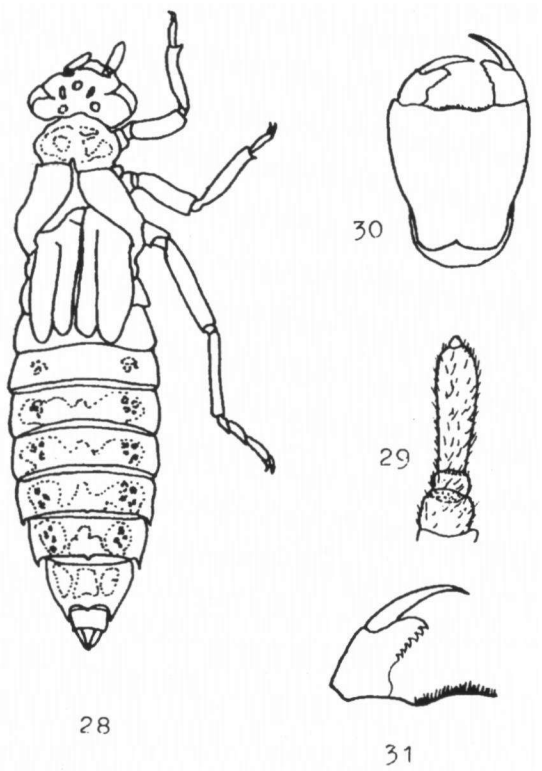
M a t e r i a l. – 7 exuviae: Jiangcheng Co., Yunnan, 24-V-1992, B. Yang leg.

M e a s u r e m e n t s (in mm). – Total length 21.3; length of abdomen 14.0; greatest width of the latter 5.3; length of head 2.7; width over the eyes 3.8; length of posterior femur 4.3 and of antennae 1.6.

A small, slender, long-legged larva with a narrow, pointed abdomen. Body covered with short, soft hairs, those on the head and thorax more conspicuous than those on the dorsum of the abdomen; long hairs on the lateral margins of thorax, abdomen, inner and outer margins of legs. Abdominal segments 5-9 with a pale grey mid-dorsal triangular spot and a lateral oval spot on each side.

Head small, sloping downwards from a point just behind the lateral ocelli, slightly convex in profile; the postero-lateral angles rounded in dorsal view; the ocelli smooth.

Mouthparts projecting, labium with its anterior border rounded and densely fringed with longish hairs. Antennae inserted in front of the eyes; first two joints short, third joint much longer, cylindrical, its apex turned slightly upward and covered with short soft hairs but its margin densely fringed with rather long soft hair; the fourth joint rudimentary being a small spherical



Figs 28-31. *Burmagomphus divaricatus* Lieftinck: (28) exuviae; – (29) antenna; – (30) labium; – (31) part of labium.

knob on the apex of the third. Labrum extending back to the posterior end of the procoxae, shaped as shown in Figures 30-31, median lobe narrow, convex on anterior border, margin simple with a tooth at the centre and two rows of long bristles. Lateral lobes stout with apex incurved and pointed; inner margin gently curved with about 7 teeth directed backwards. Movable hook long, curved and with apex pointed.

Prothorax narrower than head, simple, about twice as wide as long; lateral lobes rounded; two spots on smooth dorsum.

Wing-sheaths parallel, extending back to the end of the third abdominal segment.

Legs moderately long; femora flattened and curved; posterior pair reaching the end of seg. 3. Burrowing hooks slightly developed on fore and middle tibiae.

Abdomen flattened, widest across the end of seg. 4 but segs 4 and 5 almost the same width then tapering. Dorsal spines present on segs 8-9, broad basally, depressed and increasing in size rearward; lateral spines on segs 7-9, pale gray, those on seg. 9 longest, reaching half the length of seg. 10; seg. 10 distinctly wider than long and about as long as the anal pyramid.

SINOGOMPHUS SCISSUS (McLACHLAN)
Figures 32-35

Material. – 6 ♂ larvae, 7 ♀ larvae, 2 exuviae: Omeishan, Szechuan, 10-VI-1993, B. Yang leg.; – 1 ♂ larva: Guan Co., 12-VIII-1993; – 1 ♂ larva: Luding Co., Szechuan, 27-VIII-1993, L. Su leg.

Measurements (in mm). – Total length 24.7; length of abdomen 15.1 and its greatest width 7.3; length of head 4.7; width over the eyes 5.8; length of posterior femur 5.7; of antennae 2.4.

Body for the greater part densely covered with black and grey microscopical scale-like warts; moderately hairy on lateral margins of thorax, abdomen and inner and outer edges of legs.

Head moderately large, dorsal surface almost flat. Antennae inserted in front of the eyes and separated from these by a rounded marginal tubercle. First 2 joints of antennae short, the third large, flattened, elliptical, length one and a half times the width, margin beset with scale-like hairs, dorsal surface flat and densely covered with scale-like warts. Fourth joint rudimentary, being a small spherical knob on the apex of the third joint. The antennae are strongly convergent in their natural position, covering most of the labrum. Mouth parts projecting, labrum broad, its anterior border rounded and densely fringed with longish hairs. Postero-lateral angles of head projecting backwards.

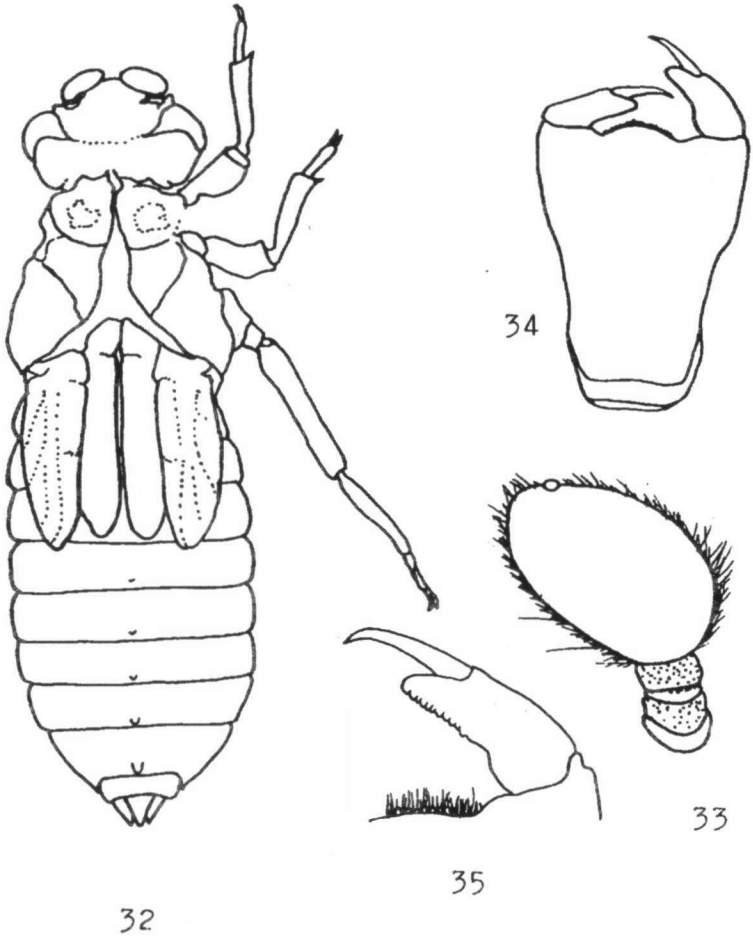
Labium extending back to anterior border of mesocoxae, shaped as shown in the Figures 34-35; median lobe distinctly convex on its anterior margin and furnished with about 18 short blunt teeth and a row of long hair-like brissae. Lateral lobe with about 11 low, backwardly directed, irregular denticles up to the apex of the hook on the inner margin. Movable hook long and curved.

Prothorax narrower than head, twice as wide as long; lateral lobes with antero--lateral angles projecting.

Legs moderately long, robust; femora slightly curved, posterior femur reaching anterior border of the fourth abdominal segment. Burrowing hooks on fore and middle legs somewhat developed.

Wing-sheaths parallel, extending back to basal ring of fifth abdominal segment.

Abdomen: segs 3-7 about the same width; seg. 9 with posterior ring half the width of the anterior; seg. 10 much shorter than 9, more than 3 times wider than

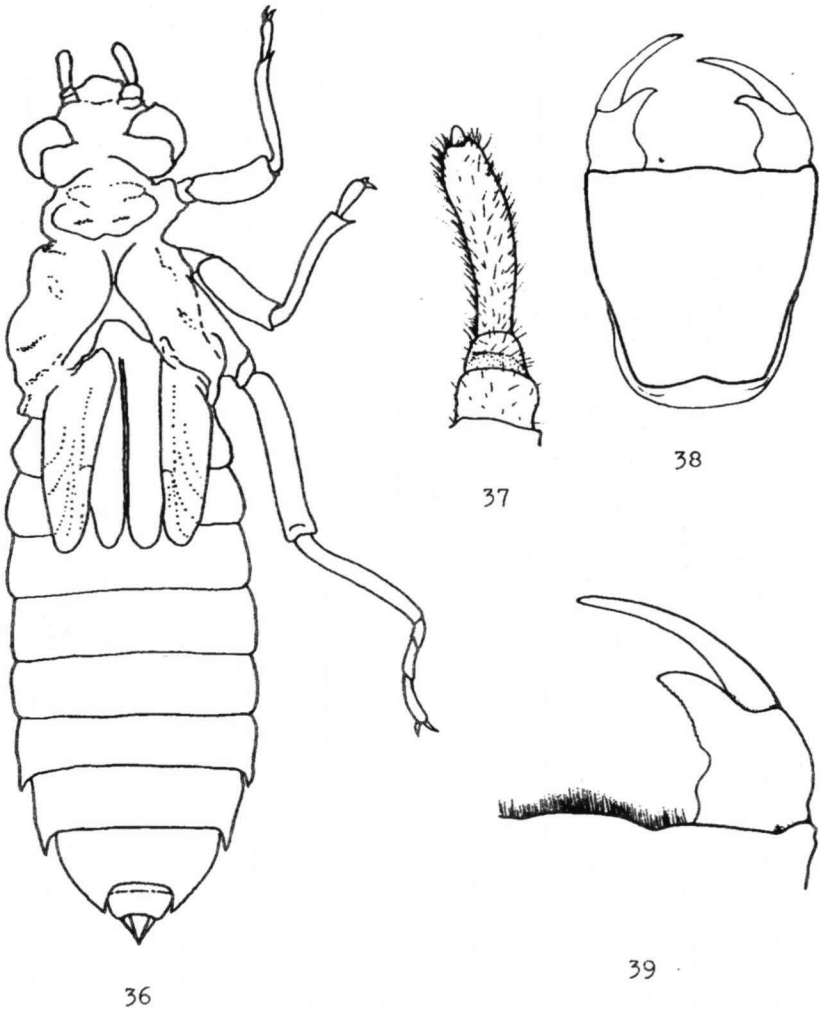


Figs 32-25. *Sinogomphus scissus* McLachlan, exuviae: (32) intact; – (33) antenna; – (34) labium; – (35) part of labium.

long. Dorsal spines present as small tubercles on segs 3-9. Seg. 9 with lateral spines. Anal pyramid about 3 times the length of seg. 10.

MEROGOMPHUS CHAOI YANG & DAVIES
Figures 36-39

Material [additional to that listed by YANG & DAVIES, 1993]. – 15 ♂ larvae, 7 ♀ larvae, 3 exuviae, 16/30-V-1992; 1 ♂ larva, 2 ♀ larvae, 26-V-1993, all from the type locality: Jiangcheng Co.,



Figs 36-39. *Merogomphus chaoi* Yang & Davies, exuviae: (36) intact; – (37) antenna; – (38) labium; – (39) part of labium.

B. Yang leg. – The 1992 material was collected among 3 mountain streams, including the type site. On 22-V-1992, a very fresh exuviae was found on a mid-stream boulder, with a newly emerged ♀ nearby; 2 more exuviae were found near the same site.

Measurements (in mm). – Total length (♀) 31.8; length of abdomen 18.8; greatest width of same 9.0; length of head 3.9; width over the eyes 5.6; length of posterior femur 6.5; of the antennae 2.7.

The exuviae is elongate with a rather small head and very broad, parallel-sided strongly depressed abdomen. The body is scurfy and pubescent with long, soft, silvery yellow hair fringed on all lateral margins of head, thorax, abdomen and inner and outer edges of the rather slender legs. Head with the upper surface almost flat in profile. Antennae with 2 short, cylindrical basal joints, the third twice as long as these together, flattened and a little upcurved at the tip, the fourth rudimentary as a small spherical knob on the apex of the third.

Labium extending back to the anterior margin of the middle coxae. Median lobe (4.2 mm long) a little longer than wide, contracted in its basal half, straight or even slightly convex on its anterior border, margin simple, slightly thickened and darkly pigmented, furnished with long bristles. Lateral lobes stout, very broad at base, then narrowed and tapering toward the incurved pointed apex; inner margin gently curved and beset with about 11 low, backwardly directed denticles up to the apex of the hook. Movable hook very long (1.8 mm), a little longer than the entire lateral lobe, strongly incurved at tip.

Prothorax distinctly narrower than head, simple, lateral lobes rounded.

Wing-sheaths parallel, extending back nearly to the centre of the fourth abdominal segment.

Legs long; the femora, especially the two anterior pairs, lined on the upper surface by curved, parallel linear scars, flattened and somewhat curved; posterior pair slender, tibiae thin and slender, also slightly curved. Burrowing hooks on fore and middle legs well developed.

Abdomen very broad and parallel sided from segs 4-8. No dorsal hooks, but a faint mid-dorsal groove on segs 4-7. Lateral spines on segs 7-9, directed backwards, increasing in size rearward. Spines on seg. 9 three-fourths as long as seg. 10, serrate in lateral margins. Appendages longer than seg. 10.

NEW DISTRIBUTIONAL RECORDS

Anisogomphus forresti (Morton). – Jiangcheng Co., Yunnan, 1 ♂ (31-V-1992), 1 ♂ (26-V--1993), B. Yang leg.

MALE. – Abd + app. 38.0-38.4 mm; hindwing 31.8-32.0 mm.

Our specimens differ slightly from the original description and figures of MORTON (1928) in colouration as follows: fore femora with a broad pale stripe on the inner side; abdominal seg. 7 with an obscure mid-lateral spot. This anomaly may well be due to the poorer condition of preservation of the original material

when described.

A. yunanensis, Zhou & Wu. – Menglun, Mengla Co. (21.4°N, 101.5°E), Yunnan, 1 ♂ (8-VI--1992), L. Su leg.

MALE. – Abd + app. 35.0 mm; hindwing 27.7 mm.

The material agrees exactly with the original description by ZHOU et al. (1992).

Davidius frustorferi junior (Navas). – Omeishan, Szechuan, 1 ♂, 2 ♀, 13 exuviae (10-VI--1993), B. Yang leg.

Lamelligomphus ringens (Needham). – Laifeng Co. (29.4°E, 109.3°N), Hubei, 1 ♂ (21--VII-1989), D. Dong leg.

L. tutulus Liu & Chao. – Funjingshan (27.9°N, 108.6°E), Guizhou type location, 1 ♂ (6-VIII--1988), Y. Li leg.; – Omeishan, Szechuan, 1 ♂ (8-VI-1993), B. Yang leg.

Melligomphus ardens (Needham). – Qiangjiang Co. (29.5°N, 108.7°E), Szechuan, 1 ♂ (16--VII-1989), X. Liang leg.

DISCUSSION

There are about 800 species of Gomphidae recorded so far in the World. The family is particularly well represented in the geographical area from Japan to India, but a large part of the centre of this region has been inaccessible for half a century for political reasons; Burma, Assam, Cambodia, Vietnam and Laos are only just beginning to allow safe entry. Thus, the post-World-War-II surge in odonatology, as a popular and important area for study (for example as predators of insect vectors of disease and in biogeography), has yet to extend the regional species lists as provided in the first 40 years of the century by LAIDLAW (e.g. 1930) and FRASER (e.g. 1933-1936). Adjacent to the 'centre', air travel and 4WD have extended our knowledge substantially, e.g. in Thailand.

Burma and SW China, with the mountainous North to South ridges of the Eastern Himalaya, compose a likely area from which the early Gomphidae may have radiated. China, as a whole, has a generous share of the Gomphidae, with perhaps 25% of the family. But West and Southwest have not been much explored odonatologically and following our paper describing new species from Yunnan (YANG & DAVIES, 1993), we add more descriptions in this present sequel. Japan to India has on record about 28 gomphine genera (DAVIES & TOBIN, 1985); by contrast, the circa 30 species in Australia are taxonomically quite homogeneous in 4 genera and the circa 85 Gomphinae of N. America can be accommodated in about 8 genera.

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