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Autor: Lieftinck, M. A.
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Ergebnisse der Bhutan-Expedition 1972 des Naturhistorischen Museums in Basel

Odonata

By M. A. Lieftinck

Abstract: The author deals with a small collection of Odonata from Bhutan. Six species are listed, two of which new, which represent the first records of Odonata from this country. The two new species *(Davidius baronii* and *Cephalaeschna triadica)* and other interesting records are dealt with in detail and discussed in comparison with other related taxa from the Himalaya.

Introduction

The present report deals with a small collection of dragonflies (Odonata), made by members of the "Zoologische Expedition des Naturhistorischen Museums Basel in das Königreich Bhutan", 1972. As far as I am aware, it is the first time that dragonflies were obtained, and can now be recorded, from this remote and practically unexplored country. Though only nine individuals pertaining to six species were brought home from this journey, the collection deserves special attention as it includes, quite unexpectedly, two novelties, viz. the gomphid *Davidius baronii* spec. nov., and the aeshnid *Cephalaeschna triadica* spec. nov., both belonging to genera well known from the Himalayan range. The discovery of a third species of interest, i.e. the zygopteron *Calicnemia mortoni* (Laidlaw), decided me to deal with these three species in somewhat greater detail. In order to establish the affinities with representative species occurring in adjacent countries, it was thought advantageous to analyse the status of some rare and insufficiently characterized relatives as well. The type-specimens of these are often unique and found scattered in various museum collections. Pending more elaborate revisions, most of these types could already be compared with allied congeners obtained by the Bhutan expedition. When possible or thought expedient, I have attempted to re-define at least some of the former, supplying illustrations of their salient specific characters. As the majority also came from the high mountains of the Himalayan region, the fuller treatment of them may, I trust, enhance the quality of this article.

All specimens collected in Bhutan are deposited in the Naturhistorisches Museum, Basle. Details concerning the topography, vegetation and collecting localities are to be found in the interesting account written by members of the party (see BARONI URBANI et al., 1973).

Acknowledgements

I wish to express my best thanks to all colleagues abroad whose invaluable assistance during the preparation of this report is gratefully acknowledged. First of all to Dr. C. Baroni Urbani, who gave me the opportunity to study the Odonata assembled by the zoologists of the expedition, and who made the manuscript of this paper ready for the press. My indebtedness goes in particular to Dr. K. K. Günther, Museum für Naturkunde an der Humboldt Universität, Berlin-DDR, who promptly sent me on loan the type of *Cephalaeschna sikkima* Karsch; and also to Prof. E. Tortonese and Miss Dott. Delfa Guiglia, Museo Civico di Storia Naturale, Genova, who kindly enabled me to settle the status of "*Calicnemis atkinsoni*" Selys. Through the courtesy of Dr. G. Demoulin, Institut royal des Sciences Naturelles, Brussels, and Mr. Peter Ward, British Museum (Nat. Hist.), London, and their assistants, I was given again free access to the important collections under their care, which has greatly facilitated my studies and answered the purpose of this paper.

Zygoptera
Calopterygidae
Caliphaeinae

Caliphaea confusa Hagen, 1859

Material. — Bhutan: 1 ♀ (adult), Changra, 18 km S of Tongsa, 1900 m, 21.–23.6.1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

C. confusa was originally described from Nepal but has a much wider distribution, ranging from Nepal through Sikkim, Assam and North Burma, Yunnan, the Mekong in Laos and, perhaps, into SW China and Szechuan. Besides *confusa*, two other species have been described, viz. *consimilis* MacLachlan, from Ta-chen-lu, and *nitens* Navas, from Chekiang. As has been pointed out by ASAHINA (1956:

205–206, figs.), at least the former, which he described and figured from South Shensi, is a distinct species. The specific status of *nitens* still remains to be settled.

The supposed larva of *Caliphaea confusa* was described and figured by FRASER (1943: 87, figs.), but in his 'Reclassification' (1957) the same author states that "... its larva is unknown", an opinion with which I agree.

The subfamily Caliphaeinae is regarded as an early off-shoot of the main calopterygid stem which has undergone specialization along lines of its own.

Synlestidae

Megalestes major Selys, 1862

Material. — Bhutan: 1 ♂ (immature), Gidaphu, 2300 m, 2.6.1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

A typical example of this Himalayan mountain species.

The structural characters of the larva of *major*, reported by LAIDLAW (1920), from Pashok (Darjeeling), were illustrated in greater detail by LIEFTINCK (1956: 120–121, figs.).

Lestidae

Lestes (Indolestes) cyaneus Selys, 1862

Material. — Bhutan: 1 ♂ (adult), Tak Sang, 2300–2700 m, 2.5. 1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

An incomplete and discoloured specimen lacking the last four segments of abdomen. Widely distributed in the Himalayan region.

S. SINGH (1955: 172–174, figs. 8–13) described and illustrated a *Lestes manaliensis* Singh, from Manali in the Pir Panjal Himalayas. This species, which is not a *Lestes* s. str., is quite evidently conspecific with *cyaneus* Selys: — *Syn. nov.*

Platycnemididae

Calicnemia mortoni (Laidlaw) (figs. 1–5)

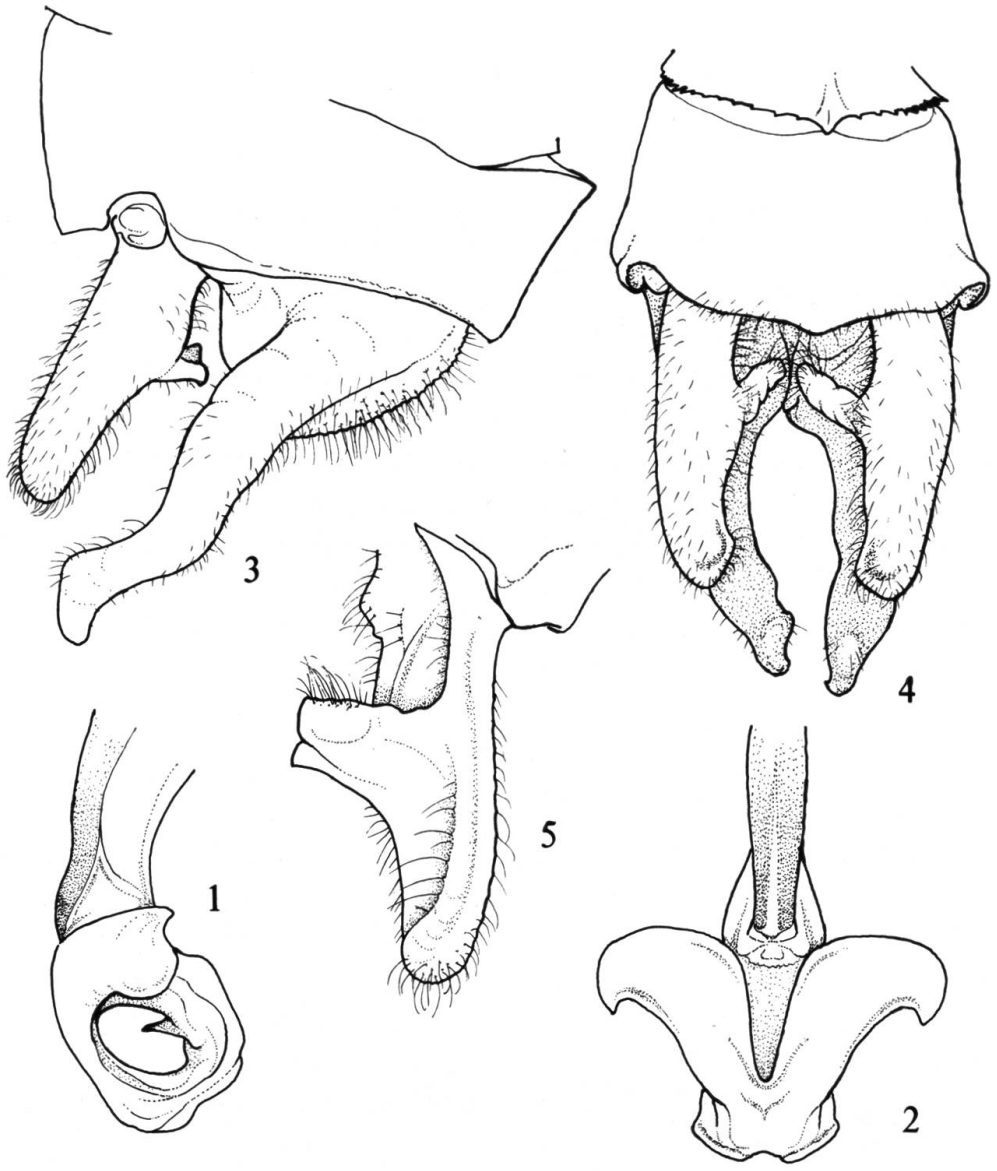
Calicnemis mortoni LAIDLAW, 1917: 326–327, 331 (♂ Pashok, Darjeeling). FRASER, 1932: 142 (key), 150–151, fig. 3[3] (♂♀ Sikkim).

Material. — Bhutan: 2 ♂ and 1 ♀ (1 ♂ and 1 ♀ semi-adult, abdominal segments 7–10 missing; 1 ♂, immature, complete), Phuntsholing–Thimphu, 87 km from Phuntsholing, 1700 m, 21.–23. 5. 1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

Male (immature). — Labium yellow, movable hook of lateral lobe deep black; squamae of mentum brown, maxillary palpus black; mandibles pale ochreous, the teeth brownish black. Labrum greenish yellow with oval, central spot of black extending forward for about half-way length from base. Clypeus yellow-brown, anteclypeus with black streak on either side, postclypeus with pair of transverse, almost confluent black spots. Genae and anterior surface of frons yellow-green; rest of head anteriorly mat black, but vertex on each side of the black ocellar area with irregular band of ochreous traversing the vertex from eye to eye just behind level of antennae, the inner portions of this band twice as broad as the outer, which are rather undulated; epicranium, occiput and rear of the head bronze-black, rather shiny; no postoccipital yellow stripes, but outer halves of ventral surfaces of head with ill-defined patch of brownish yellow, most conspicuous inward. Antennae obscured, except first segment yellowish anteriorly.

Prothorax with pronotal tubercles low, evenly convex, upper part of pleurae somewhat projecting and ridged laterally; colour bronze-black including anterior and posterior lobes, but propleuron almost entirely chrome; posterior lobe evenly rounded, border hardly elevated but side-angles in caudal view prominent and subacute basally.

Synthorax velvety black as far down as the first lateral suture and including most of the mesinfraepisternum; sides beyond this greenish ochreous, marked with a sharply defined, parallel-sided, black metepisternal stripe that runs along upper portion of second suture, stopping short abruptly a little before reaching level of metaspiracle; this stripe extends upward roundabout the dorsal crest so as to become connected with the dark colour of the mesepimerum, taking up a black area at base of hind wing above it, and also a shiny black speck at the extreme upper (anterior) and lower (posterior) edges of the metepimeral crest. Dorsum of thorax with pair of complete, moderately broad, yellow antehumeral stripes, widest ventrally and slightly outbent at their upper extremities; besides, there is a minute yellow spot placed just behind upper end of the humeral suture. Ante-alar triangles black, lacking a light spot. Ventral surface of thorax throughout pale-coloured.



Figs. 1–5. *Calicnemia mortoni* (Laidlaw), ♂ from Bhutan; right lateral and ventral view of ligula (1–2), right lateral and dorsal view of terminalia (3–4), and interior view of right superior appendage (5).

Legs with coxae and trochanters yellow, the femora brownish black, except about the basal three-fourths of their inner faces, which are yellow, and the trochanteral articulations, which are jet-black; tibiae, tarsi and all bristles, black.

Wings hyaline, neuration black; postnodal cross-veins 19 on fore wings, 16 on hinder pair; three postquadrangular antenodal cells;

medio-anal link fractured; three cells between M_2 and M_{1a}; pterostigma oblique, a little inflated, markedly longer than high, covering one and a half cell; proximal and distal sides subparallel, the latter slightly convex outwardly; colour light brown finely surrounded by yellow.

Abdomen more slender than in species such as *eximia* and *miniata*. Segm. 1 yellow, 2–5 light red, but sides of 2 also largely yellow and 3–6 each with fairly distinct basal yellow annules, which are narrowly interrupted by the black middorsal carina. A transverse marginal black streak alongside lower portion of 1; black intersegmental membranes between 2–3 linear, those between next segments broader, all restricted to the dorsum and upper portion at the sides. From the end of tergite 4 posteriorly, the red colour becomes less vivid and gradually turns to brown, the distal half of 6 becoming dark brown, while 7–10 are black. Anal appendages likewise black, only the tips of the superior pair being a little lighter, shaped as in figs. 3–5. Genital organs with the laminae, squarish hamuli anteriores, and vesica spermalis, brown, the latter more or less pear-shaped in ventral view, longitudinally grooved basally, its apex tapering to a blunt point; ligula (penis) membranous, pale yellow, shaped as in figs. 1–2; no shaft spines.

The second male is incomplete; it seems almost mature and is much darker than the type. Head: labium and other mouth-parts obscurated, the labrum and postclypeus almost wholly dark brown; anteclypeus and genae yellow-green; frons anteriorly, on either side of the middle, also light coloured, forming an incomplete greenish band from eye to eye; a narrow, transverse, undulated orange-yellow band touching anterior ocellus is situated just behind level of antennae, which are black; the limits of this band are effaced owing to a thin layer of bluish pruinescence upon the whole area; no yellow postoccipital streaks; ventral surface with pair of large, subcircular yellow dots. Colour-pattern of pro- and synthorax almost exactly as in the juvenile male, all light markings bright greenish ochreous, only antehumeral stripes (broadest ventrally) more distinctly tapered upward, their outbent tips slightly swollen. Sides and venter of thorax as in the first specimen, except that the anterior and posterior edges of the dorsal carina of the metepimeron are deep black. Legs with some obscuration on coxae and trochanters, for the rest entirely black. Wing venation as in the other male, except that in one hind wing there are two cells only between M_2 and M_{1a}; postnodal cross-veins 18–19 on fore wing, only 15 on hinder pair; pterostigma dark grey-brown.

Abdomen with the first two segments only light-coloured, 1 bright yellow, 2 light red; from just after a fairly broad yellow basal annule of 3 onward, the segments become darker, passing gradually from dark reddish brown to black, with the light basal rings of 4–6 reduced to lateral hair-lines, the rest of the abdomen in all probability being completely black. Accessory genital organs, except distal part of the ligula, deep black.

Female (subadult, incomplete). — Closely similar to the immature male, differing only in the following respects. A perfectly straight, transverse yellow bar on either side of the occipital crest, extending from the crest outward and leaving off at some distance from the eye-margin; rear of head with rhomboidal yellow patch occupying about the anterior four-fifths of the surface. Shape and colour of pro- and synthorax, as well as the legs, exactly as described for the first male. Wings as in male; postnodal cross-veins 17. 19 on fore wings, 16 on hinder pair; three cells between M_2 and M_{1a}.

Abdomen coloured and marked as described for the first male: 1–2 light greenish ochre, 2 without the apical admixture of light red as seen in the other sex, but with the deep black median line transversely extended before apex of segment, and with a black stripe bordering latero-ventral margin; 3–6 light red with the black line at the median carina expanded apically so as to form a more or less spear-shaped mark; latero-ventral stripes also becoming broader posteriorly, passing gradually into brownish black to black on 6, this tergite having the red colour much obscured distally.

Measurements: ♂ (immature) abd. + app. 32.0 mm, hind wing 24.5 mm; length of hind wing (♂ incomplete) 25.0 mm, and 26.0 mm (♀ incomplete).

This species was originally thought to be unnamed, hence the above elaborate descriptions. Yet I am almost sure that it is conspecific with the one described as *mortoni* by Laidlaw, after a single male from Darjeeling (Sikkim). The author stresses the slenderness of the body when compared with that of *C. eximia* and *miniata,* the present examples being indeed somewhat less robustly built than these. The type and only authentic specimen of *mortoni* should still be kept in the Indian Museum at Calcutta. FRASER claims the latter to be a discoloured and mouldy specimen that has lost most of its markings. The same author (1932) gave a better description of both sexes after a series from

Gangtok (also in Sikkim), and also a sketch of the head marks of the adult male. I have recently examined the specimens of *mortoni*, named by Fraser, in the British Museum (Nat. Hist.) collection and noticed that all have retained the original colours and markings which are so characteristic for full-coloured specimens of this insect.

It leaves no doubt that both sexes of several species of *Calicnemia* show striking age variations. As they become mature their colouring becomes rapidly darker, even the pattern changing considerably with age. *C. mortoni* presents a good example of this. It follows from the above descriptions that young males may have the first five segments of the abdomen at least partly light red, the face-marks, antehumeral stripes and thoracic pleurae still being yellow; they show no pruinescence yet on any part of the body. The much darker and older male agrees better with the aged ones described by Fraser, albeit that only the head above and the femora are overlaid thinly with a bluish bloom. The (incomplete and not fully coloured) female from Bhutan tallies Fraser's description of that sex, except that the nodal index is lower (*mortoni* of Fraser: 19–21 in fore wing, 18–19 in hinder pair), and that there is only a single row of cells between C and R_1 beyond the pterostigma.

Reliable specific characters for the recognition of males are found in the shape of the ligula (penile organ) and to some extent also in the finer structure of the anal appendages. *C. mortoni* differs from *eximia* Selys, *erythromelas* Selys, and *imitans* Lieftinck, by the much broader apical flaps of the ligula (figs. 1–2). In the three last-mentioned species, the recurved apex of the organ is deeply divided into a pair of ribbon-like, curling branches of variable length, these filaments in some species being so long as to curve round to embrace the stem of the ligula. In *C. mortoni* the end of the organ is shaped differently, approaching most closely the form it has in *C. chaseni* (Laidlaw), *miles* (Laidlaw), *miniata* (Selys), *pulverulenta* (Selys), and *rectangulata* Laidlaw. From these five species *mortoni* can be readily distinguished, however, on the basis of other characters.

Taken on the whole the genus *Calicnemia* stands in need of a thorough revision. In the course of restudying some species from other sources and a consultation of their types, I availed myself of the present opportunity to include a few notes on the following three species, with illustrations of their structure. In a future paper I hope to supply better characters for some other imperfectly known and apparently new species, and to clear up some difficulties in the nomenclature.

Calicnemia miniata (Selys) (figs. 6–9)

Calicnemis miniata SELYS, 1886: 132 (♂ Darjeeling). LAIDLAW, 1917: 328–329, 331 (♂♀ Darjeeling). FRASER, 1932: 142–143 (key), 146–147, fig. 3^5 (♂♀ Himalayan locs.).

Material. — North India: 3 ♂ (one subadult and one with incomplete abdomen), all with printed labels "Darj." and "Atkinson", and two with "Cal. miniata ♂" (yellow) and "miniata S. ♂" (white), in de Selys handwriting. Lectotype ♂: the one with yellow identification label; the two others are paratypes (IRSN, Brussels). – Nepal: 1 ♂ (adult), Nepal–Tibetan frontier, Kodari, ca. 1700 m, 4. VI. 1973 (collected at the same locality and on the same day with another, possibly undescribed, red-bodied species), B. Kiauta and M. Brink leg. (Coll. Kiauta, Utrecht).

In general appearance and colour, the male of *miniata* bears a surprisingly close resemblance to at least three other red-bodied species, some of which have a more eastern distribution. One of them is *miles* Laidlaw, the other two being apparently still undescribed. As stated already by DE SELYS (1891: 504), the supposed male of "*atkinsoni*" from Burma is "excessivement voisin de ... *miniata*". These two species are, indeed, very similar, but the males can be held apart fairly easily by comparing the amended diagnoses which follow and which are based on a confrontation of the types. This became necessary, seeing that the existing specific keys in the literature are misleading.

The head markings of *miniata* and *miles* are well shown in FRASER's sketches (loc. cit.), but I have not yet been able to verify the identity of all males in the British Museum (Nat. Hist.) collection named by Fraser as *miniata*, and I am unacquainted with the females; the latter were, however, described by Fraser in the same paper.

The Nepalese male agrees well with de Selys's typical examples from Darjeeling. It is of interest to observe that the form of the projection at the superior appendage of *miniata* varies individually, as it does in several other members of the genus; it is often shaped differently on the left and right appendage. For example, in one of de Selys's males the short tooth-like tubercle at this process is well visible at the left appendage but greatly reduced on the right.

Diagnosis. — Mouth-parts, face, frons and vertex as far back as a line drawn through the lateral ocelli, red; between frons and vertex an

irregular (though complete) black stripe connecting the eyes, this stripe varying in width, but not or little broadened between antennal bases, the dorsal surface of frons for the greater part remaining red; the much broader transverse band behind the black frontal stripe narrowed at level of ocelli, but just includes the median ocellus. Rear of the head black save a small yellow spot (occasionally wanting) on either side at the eye-margin. Antehumeral red band straight, almost complete, variable in width but comparatively narrow and always tapering gradually upwards. Legs mainly black, only the coxae, anterior faces of trochanters and extreme bases of femora usually somewhat yellowish. Neuration rather dense, but variable; fore wing with 17–21, hind wing with 15–18 postnodals. Quadrilateral relatively long, e.g. costal side in hind wing almost or fully twice as long as distal side; 3–4 postquadrangular antenodal cells; M_2 arises at Px_{6-8} in fore wing, at Px_{5-6} in hinder pair; M_{1a} 2–3 or even 4 cells further distad. Pterostigma relatively short, brownish black or black (fig. 6). Apical portion of ligula deeply cleft into a pair of broad membranous flaps (figs. 7–8). Segm. 2–6 of abdomen red, the apex of 6 narrowly and 7 except dorsally at base, black; 8–10 black, as are also most of the anal appendages and intersegmental membranes. Sup. anal app. distinctly shorter than lower pair, shaped as in fig. 9. Slightly larger in size and more stoutly built than *miles*.

Measurements: abd. + app. 32.3 mm, hind wing 25.0 mm (lectotype); 30.5 and 24.0–26.0 mm, respectively (paratypes); 32.7 and 25.4 mm (Nepal specimen).

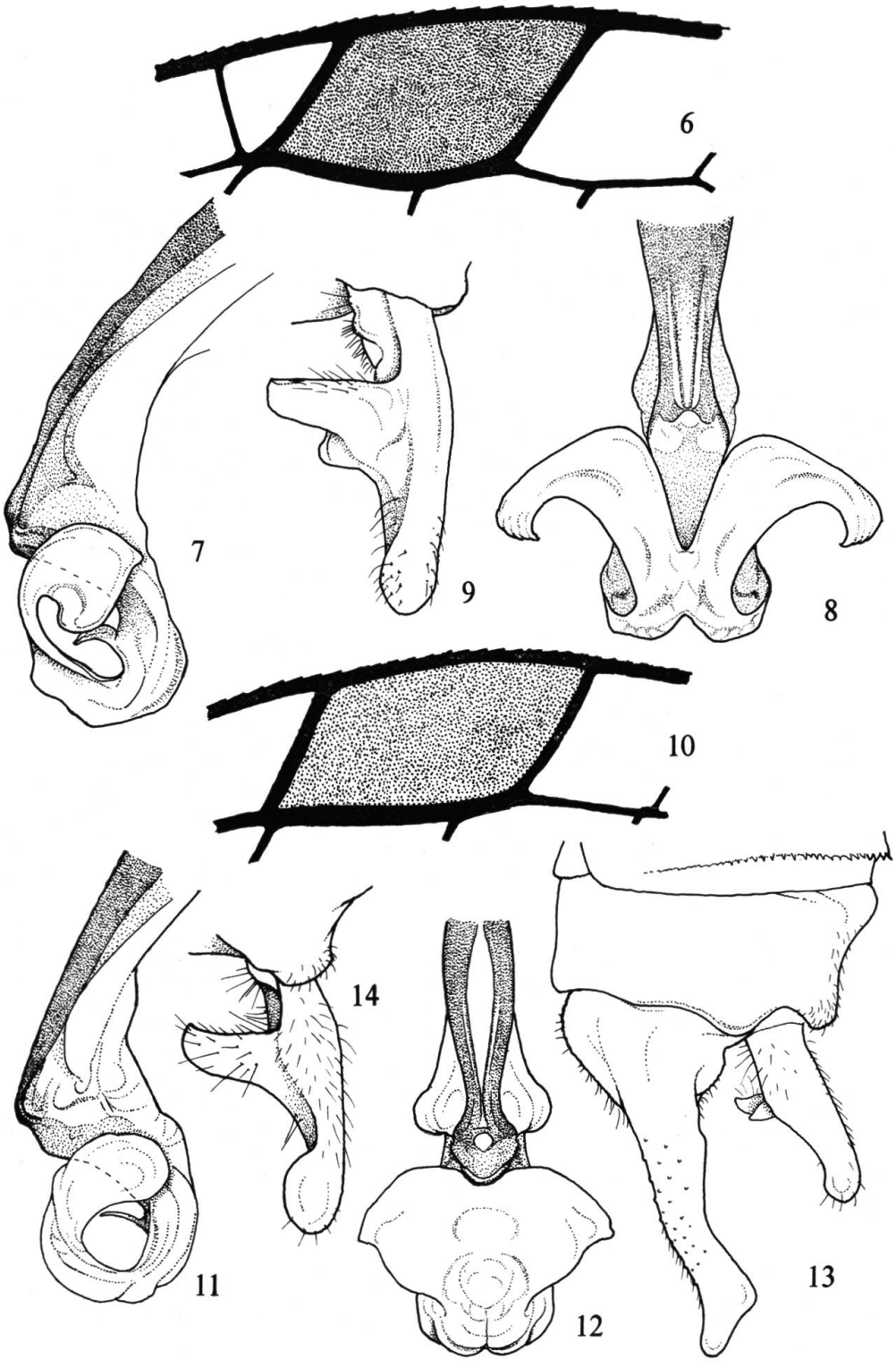
It will be seen from our drawings that, structurally, *miniata* also nearly approaches the above described *mortoni*, a species with a very different facies and colour pattern.

Calicnemia miles (Laidlaw) (figs. 10–14)

Calicnemis miles LAIDLAW, 1917: 330–331, nom. nov. pro *C. atkinsoni* SELYS, 1891: 503–504 (♂ Puepoli, Burma; nec *C. eximia* Selys, race *atkinsoni* SELYS, 1886: 131–132, ♀ Sikkim!). FRASER, 1932: 142, 147–148, fig. 3[1] (♂♀ Burma).

Calicnemis atkinsoni SELYS, 1891: 503–505 (♂ Puepoli, Burma).

Figs. 6–9. *Calicnemia miniata* (Selys), ♂ lectotype and paratype from Darjeeling; fore wing pterostigma of lectotype (6), right lateral and ventral view of ligula, paratype (7–8), and interior view of right superior appendage, paratype (9). – Figs. 10–14. *C. miles* (Laidlaw), ♂ holotype from Puepoli; fore wing pterostigma (10), right lateral and ventral view of ligula (11–12), left lateral view of terminalia (13), and interior view of right superior appendage (14). Corresponding structures on the same scale.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Material. — Central S. Burma (Karen or Karenni Hills, alt.?): 1 ♂ (adult, holotype), with two yellow labels "Puepoli 22. VI. 88" and "Calicnemis Atkinsoni Selys ♂ Puepoli", both in de Selys's handwriting (MCG, Genova).

Here follows a comparative redescription of the holotype.

Diagnosis. — Head anteriorly coloured as in *miniata,* but black band between frons and vertex considerably broadened in front of the antennal bases, the dorsal surface of frons being black with the exception of a hair-line anteriorly, which remains red; posteriorly, this black coalesces in front of the median ocellus with the entirely black ocellar triangle, hence the transverse red band connecting the eyes is broadest laterally, abruptly narrowed and finely interrupted medially. Rear of the head with conspicuous yellow patch on either side, broadly attached to the eye-margin and occupying almost the outer half of the ventral surface. Antehumeral red stripe complete, broader than in *miniata,* perfectly straight and parallel-sided. Legs light red, only the femora exteriorly with a black stripe, incomplete distally, and the last tarsal segment at its apex also obscured, claws reddish. Neuration more open than in *miniata,* fore wing with 15, hind wing with 14–15 postnodals. Quadrilateral slightly shorter, e.g. costal side in hind wing less than twice as long as distal side; 3–3½ postquadrangular antenodal cells; M_2 arises at Px_6 in fore wing, at Px_5 in hinder pair; M_{1a} two cells further distad. Pterostigma longer, dark sepia-coloured (fig. 10). Apical portion of ligula gradually broadening toward apex, undivided, with shallow crescentic median emargination (figs. 11–12). Segm. 2–10 of abdomen red, lacking sharply defined black markings, basal and apical portions of 9 and 10 obscured, almost black dorsally, for the rest reddish, these markings all ill-defined; anal appendages likewise reddish, but distal half of inferior pair gradually becoming black; intersegmental membranes very finely black dorsally. Anal appendages shaped much as in *miniata,* though more slender, especially the superior pair, the tips of which are definitely swollen apically (figs. 13–14).

Measurements: abd. + app. 28.8 mm, hind wing 22.2 mm.

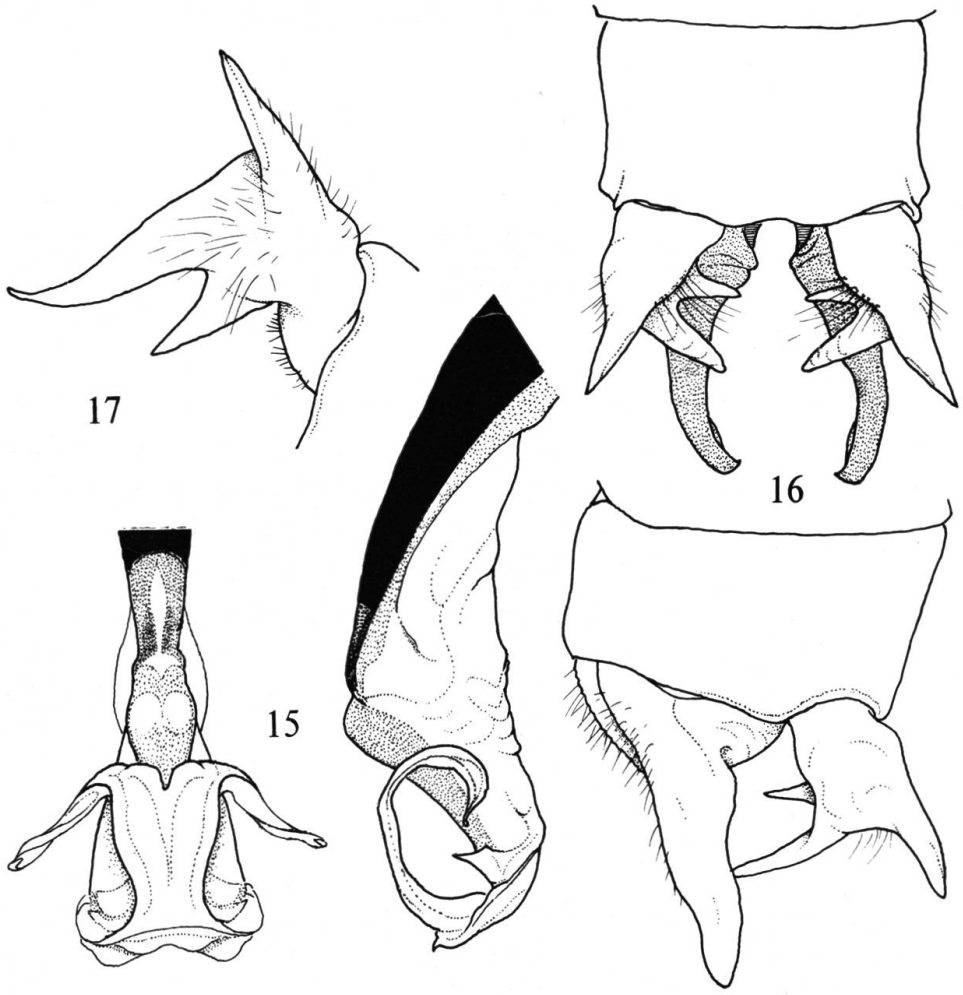
The holotype of *C. miles* is distinctly smaller in size and also more slenderly formed than the original series of *miniata,* discussed above. It should be noted that Fraser's male of *miles,* described from Gokteik (Upper Burma), measured 33 mm for the abdomen, 25 for the hind wing, hence a decidedly larger-sized specimen than the type.

Calicnemia erythromelas (Selys) (figs. 15–17)

Calicnemis erythromelas SELYS, 1891: 505–506 (♂♀ Burma). LAIDLAW, 1917: 322, 331 (key, not seen). FRASER, 1932: 142–143 (key), 149–150, fig. 3^2 (♂♀ Burma).

Material. — Burma: 1 ♂ 1 ♀ (adult), respectively with written labels "Puepoli 22. VI. 88", "erythromelas S. ♂" and "Leito 25. V. 88", "erythromelas Selys ♀ Leito", in de Selys' writing. I have selected the only male from Puepoli as lectotype of *erythromelas*. Both examples are still in good condition (IRSN, Brussels).

This is, indeed, a smaller and much more slenderly built species than most other described members of the genus. The narrow wings, and the anal appendages and ligula of the male as well, are quite



Figs. 15–17. *Calicnemia erythromelas* (Selys), ♂ from Puepoli; ventral and right lateral view of ligula, paratype (15), dorsal and left lateral view of terminalia, lectotype (16), and interior view of left superior appendage of same, more enlarged (17).

characteristic; these structures are here figured for the first time. The superior appendages are described as "pointus, dilatés en dessous vers leur milieu en une large dent", but after the specimen had been relaxed and its appendages unfolded, the enormous inferior spur proved to be again deeply cleft (figs. 16–17).

C. erythromelas does not seem to have any near allies. The known range extends from Burma to Laos and Tonkin.

Anisoptera
Gomphidae

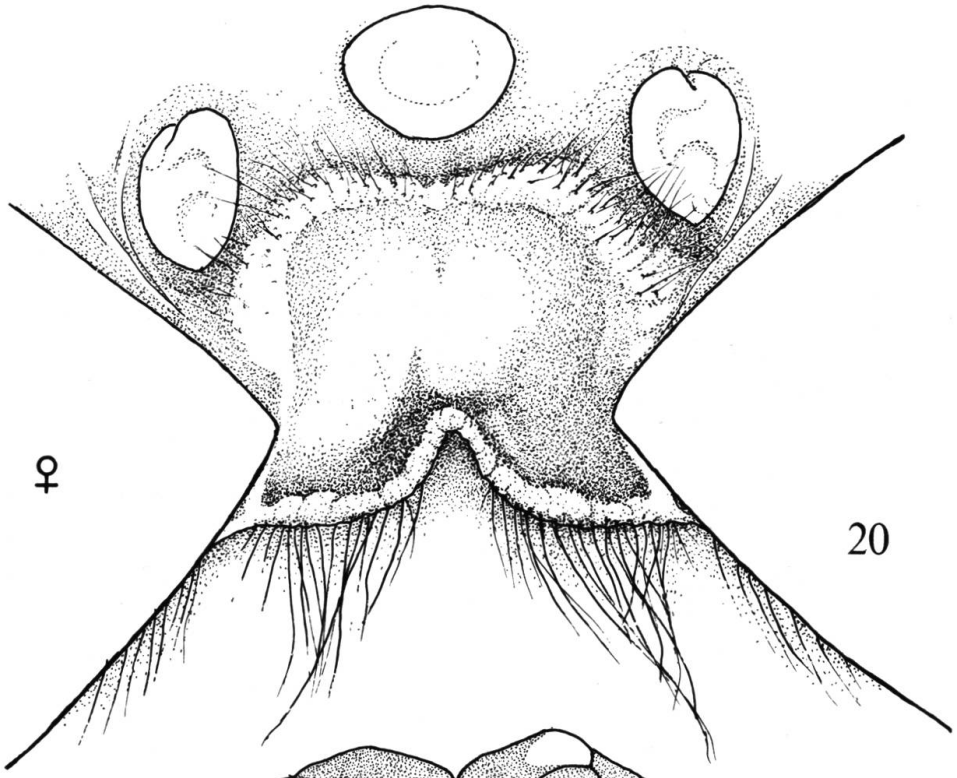
Davidius baronii spec. nov. (figs. 18–20)

Material. — Bhutan: 1 ♂ (ad., holotype) and 1 ♀ (immature), Changra, 18 km S of Tongsa, 1900 m, 21.–23. 6. 1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

Male (holotype). — Labium jet-black; mandible-bases, the small sclerite immediately beside it, and an isolated transverse streak upon middle of labrum, placed a little beyond half-way its length from base and slightly indented by black at its base, bright chrome; face and frons otherwise deep black, but upper surface of frons marked with a thick transverse greenish yellow band, slightly narrowed at either end and not touching the eye-margin, the base of frons being striped with black. Head, including antennae, otherwise deep black, unmarked; vertex with a raised, rounded crest connecting lateral ocelli behind which the surface is flat and slopes down, a deep sulcus separating it from the occiput; dorsally, the latter bears a pair of minute pits, one on either side of the middle, the posterior ridge being somewhat impressed medially, rounded off posteriorly, and carrying long fringes of black hairs; lower portion of postocciput with a pair of closely approximated, knob-like, shining black tubercles.

Pro- and synthorax deep black; cervical process, anterior lobe and a crescentic dorsolateral spot of propleuron, bright chrome; posterior prothoracic lobe short, simply rounded, black. Colour-pattern of synthorax as in fig. 18; ventral surface mainly black, only middle of metasternum with a longitudinal yellow stripe.

Figs. 18–20. *Davidius baronii* spec. nov., holotype ♂ and ♀ from Bhutan; colour-pattern of synthorax (18), dorsal and left lateral view of ♂ terminalia (19), and dorsal view of occipital plate (20).



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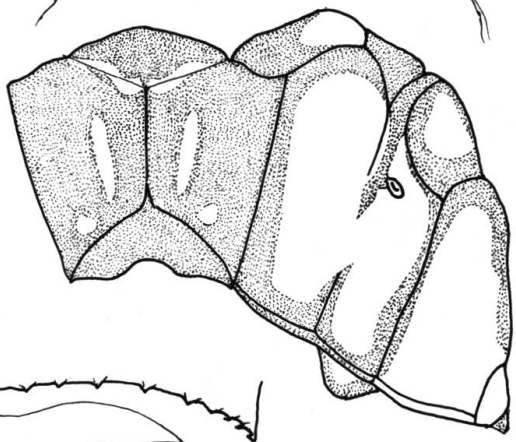

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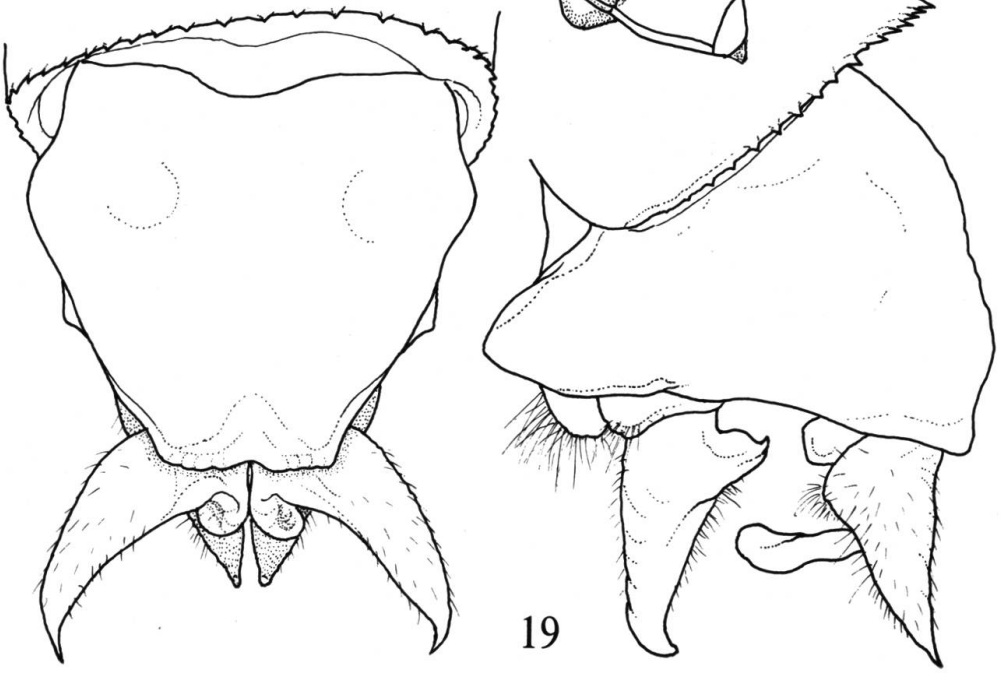

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Legs long, shaped as for genus, coxae yellowish posteriorly, for the rest all black.

Wings clear, neuration black; nodal index of first series $\frac{12.14.14.13}{12.11.10.11}$. A basal subcostal cross-vein present only in left fore wing; proximal and distal primary antenodal nervures separated by five cells. Fore wing with 2, hind wing with only 1 antefurcal cross-veins between sectors of arculus, the fork symmetrical. All triangles, internal triangles and supra-triangles free, but triangle of hind wings once (obliquely) traversed; distal side of triangles not noticeably fractured. Discoidal field of fore wing with two rows of cells up to a little before level of subnodus. Anal triangle four-celled, including one small intercalated marginal cell. Anal angle long, prominent, rectangulate, but apex rounded off. Pterostigma short, rather swollen, braced, covering two and a half to four cells; colour sepia brown, framed in thick black nervures.

Abdomen very slender, strongly spindle-shaped, broadest at segment 8, which is almost parallel-sided; 8th sternite with a cone-shaped median tubercle clearly visible in lateral view; sternite 6 and 7 sparsely clothed with erect light brown hairs, longest on 7. Colour black, marked with sharply defined green spots and streaks, as follows: a subtriangular middorsal spot and most of the sides of 1; a thick longitudinal stripe from end to end on middorsum and a curved spot at sides of 2, including the auricles; followed by a more definitely hooked spot of about the same size just before posterior margin above seminal vesicle; a subinterrupted, elongate, antejugal mark at sides of 3, extending from base to apex, and a tiny elongate streak upon middle of sides on postjugal part of segment; 4–8 each with pair of well defined, though small, subcircular spots, one on either side, upon middle of sides at extreme base, largest on segment 4. Accessory genital organs distorted; vesicle considerably larger and more prominent than in species like *fruhstorferi,* longer than broad, rather urn-shaped, its apical rim swollen but not notched. Anal appendages black, shaped as in fig. 19; appendix inferior triangular in outline, divided into a pair of closely approximated branches almost as far as its base, the branches themselves also triangular, strongly tapered, each rather convex in ventral view.

Female. — The specimen is immature, with a badly shrivelled abdomen. Markings on head and thorax very similar to those of the male, only the winged ante-apical spot of the labrum being a little

larger. Occipital region of characteristic shape, the area posterior to the lateral ocelli being trapezoidal in outline, rather deeply and smoothly hollowed out and bounded on all sides by an elevated rim, the posterior one bearing a triangular emargination fringed with very long black hairs (fig. 20); postero-ventral tubercles not visible in caudal view. Antehumeral stripes and upper mesepisternal spots a little longer and larger, respectively, than in male, the lateral design identical. Wing-bases, as far out as the region of triangles, strongly tinged with yellow; nodal index $\frac{12.16.15.12}{12.10.11.11}$;
two postfurcal cross-veins in fore wings, only one in hinder pair; neuration otherwise much as in male; distal side of all triangles slightly fractured; pterostigma yellowish brown, braced, covering three cells.

Abdomen (deformed) with all yellow marks enlarged, postjugal spots elongate or diabolo-shaped, present on 3–7, those on 3 and 4 almost confluent with the prejugal ones. Vulvar lamina broad, distal half divided into a pair of approximated, oval, tapering blades with bluntly rounded apices. Appendages about as long as segment 10, triangular, pointed.

Measurements: ♂ abd. + app. 28.0 mm, hind wing 26.7 mm, pterostigma fore wing 1.7 mm; ♀ —, hind wing 26.0 mm, pt. fore wing 2.0 mm.

This new little gomphid is, I think, nearly related to *D. delineatus* FRASER (1926: 166, figs. 3, 5 and 8 and pl. fig. 4), both sexes from Gangtok, Darjeeling Distr. These two dragonflies by their stature and colour-pattern, resemble each other more closely than any other of the genus. I have confronted *baronii* with the type and female of *delineatus* in the British Museum (Nat. Hist.) collection and found well-marked structural differences between them.

I do not know why *delineatus* was described by Fraser as a subspecies of *zallorensis* Hagen and Selys, the type species of *Davidius*. According to the description, which is very full, this is a much lighter-coloured insect with very different body markings and a longer abdomen. *D. zallorensis* is known only from a single immature male, measuring 31 mm for the abdomen, 27 mm for the hind wing. The type is not in the Hagen collection and may have become lost[1]. The male of

[1] I am indebted to Miss Janice C. White, who kindly informed me that the type is not to be found in the collections of the Museum of Comparative Zoology at Harvard University, Cambridge, Mass.

delineatus is marked similarly to *baronii,* but differs in the shape of the inferior branch of the upper anal appendages, which appears shorter and distinctly more swollen apically than in the Bhutan insect; *delineatus* also has the upper branch of the same organ shorter and less pointed, while the vesica seminis of the genitalia is smaller, with a notched apical rim. The female of *delineatus* can be immediately distinguished from that of *baronii* by having a completely flattened and poorly defined supra-occipital plate, the posterior border of which is scarcely bilobed, not at all excised as it is in *baronii* (fig. 20), the lobes being evenly rounded. The two sexes of *delineatus* examined and compared by me with the new species, are from the same locality and date (Gangtok, 17.5.1925 and other dates, C. M. Inglis leg.). The measurements of the male are given as 26 mm for the abdomen, 25 mm for the hind wing, those of the female being 27 mm for both abdomen and hind wing.

I have much pleasure in naming this new species after its discoverer, Dr. Cesare Baroni Urbani, of the Basle Museum.

Aeshnidae
Brachytroninae

Some general remarks on the Asiatic Brachytroninae

As has been pointed out recently by ASAHINA (1974), the systematics of the Eurasian representatives of F. C. FRASER's "group 2" in his subfamily Brachytrinae (rect. Brachytroninae), treated by him in the "Reclassification" (1957), are still in a very confused state, all taxa urgently requiring a thorough revision. In fact, little has been added to our knowledge since LAIDLAW (1923) gave his interesting comments on the group. On the contrary, the mere proposal of poorly defined monotypic "genera" to accommodate solitary specimens of rather doubtful identity, has aggravated the existing difficulties to unravel the status, synonymy and affinities of the various taxa involved.

Leaving *Caliaeschna microstigma* (Schneider), from the drier areas in the west, out of account, the fifteen described species from the Himalaya and more eastern mountainous regions of the Indo-Chinese continent, are characterized by the following combination of venational characters. Median space traversed by a number of cross-veinlets;

radial sector (Rs, or IR_3) forked, but rarely more than two cell-rows between its branches; radial and median supplements (Rspl and Mspl) almost straight, with a single row of cells separating them from the lower sector of Rs and M_4, respectively; and – with the exception of the aberrant *Petaliaeschna fletcheri* Fraser – the possession of a well-braced pterostigma.

Cephalaeschna Selys, 1883 (type species *orbifrons* Selys, 1883), *Periaeschna* Martin, 1908 (type species *magdalena* Martin, 1908), *Gynacanthaeschna* Fraser 1922 (type species *Cephalaeschna sikkima* Karsch, 1891), *Petaliaeschna* Fraser, 1927 (type species *fletcheri* Fraser, 1927), and *Indophlebia* Fraser, 1935 (type species *asiatica* Fraser, 1935), are currently differentiated on the basis of the form of the 10th abdominal segment of the female, in combination with the shape of the frons and details of the wing venation.

A re-examination of the types (or paratypes) of 9 species and of 4 additional "*Cephalaeschna*" from S.E. China (all of these possibly undescribed), has led to the conclusion that even the earliest proposed genera are not clearly definable and that several species were erroneously interpreted by subsequent authors; also, that in some cases the sexes were wrongly associated.

Of a good few species only one of the sexes has been described. Species so far known with certainty only from the unique type, either male or female, are the following: — *acutifrons* Martin (♀, "Ind. or."), *asiatica* Fraser (♀, Sikkim), *biguttata* Fraser (♂, Assam), *magdalena* Martin (♀, Tonkin), *masoni* Martin (♂, Assam), *obversa* Needham (♀, Szechuen), and *viridifrons* Fraser (♂, Burma).

It will be clear that under the present circumstances it is still quite impossible to deal in a satisfactory manner with the group as a whole and with all species concerned. As a consequence it seems best for the time being to keep all described species together by allotting them to *Cephalaeschna* Selys, i.e. the earliest defined and best known genus of the group, the type of which (*orbifrons* Selys) having recently been re-characterized and fully illustrated by ASAHINA (1974).

The specific synonymy, so far established, is unimportant save in the case of *Caliaeschna lugubris* Martin, which was erroneously classified as a species synonymous with *Cephalaeschna sikkima* Karsch, the two being in fact quite different; and in the case of the

Chinese female of "*Caliaeschna* (?) *acutifrons* Martin", discussed in great detail and photographed by Ris (1916), which is neither identical with that species nor with *Indophlebia asiatica* Fraser, as will be explained below.

As mentioned already before, a feature regarded as a primary generic character, is the shape of the female genital organs, c.q. the ovipositor valves and adjoining appendages, viz. the epiproct, cerci, rudiment of larval paraproct and, more especially, the 10th abdominal sternite, the so-called "dentigerous plate". In typical *Cephalaeschna,* these structures are not in any way modified, but in several others, like *sikkima, fletcheri, magdalena, nocturnalis* and allied forms, the dentigerous plate is either finely spinulose, shortly bidentate, or else, prolonged downward and ending into a pair of long, acuminate and often divaricate spines, varying considerably from species to species. A corresponding variability is displayed also by the ovipositor valves and other apical appendages. Now it is of particular interest to observe that these structural modifications are by no means correlated with other features also considered as of generic value, e.g. the form of the face, details of the venation, colour-pattern, etc. Therefore, with species known only from the male, it is absolutely impossible to foretell whether their females would exhibit a simply rounded 10th sternite, a bispinose plate (as in *sikkima*), or a *Gynacantha*-like structure. Good examples illustrating this phenomenon are two extremes, viz. *C. acutifrons* Martin and *laidlawi* Foerster, two very similarly-looking species. Both possess the relatively narrow face characteristic of the type species of *Periaeschna, magdalena* Martin, while the frons is rather long, somewhat elevated and cone-shaped in the middle. Nevertheless these species differ conspicuously from each other not only in the shape of the dentigerous plate, but in the form of the ovipositor valves as well. In *acutifrons,* the well-developed 10th segment is simply rounded ventrally while the valves are very long and slender, projecting straight back and surpassing the tip of abdomen, being in fact practically identical in shape to those figured by Fraser for his *Indophlebia asiatica* Fraser (1935: 324 fig. 2)[1]. In *laidlawi,* on the other hand, the 10th tergite, though small and annular, has a sternal projection which is prolonged ventrad and terminates in a pair of long, fine spines, the valves on the

[1] Although the unique type of *I. asiatica* is no more available for comparison, a direct confrontation will probably prove *Caliaeschna acutifrons* Martin and *Indophlebia asiatica* Fraser to be conspecific.

contrary being short, upcurved, convexly rounded below with the tip falling short of the apex of segment 10.

On account of the extremely varied character of the female genital apparatus I am strongly inclined to regard each set of corresponding structures merely as a specific device suitable for the purpose of oviposition. Adaptive modifications like the above can, of course, be used conveniently for the recognition of species but should not, in my opinion, be employed as criteria for generic division.

As to the sexual organs of the male (anal appendages), I have found these to be of rather uniform structure and not very helpful for the separation of species. Better characters are found in the colour-pattern of the synthorax and abdomen, which seems to differ little from that of the female, as witness some topotypical couples and pairs of other species whose sexes unquestionably belong together.

Now that the types are still before me, I have thought it advisable to supply some camera lucida sketches of the shapes and colour designs of the basal abdominal segments of 7 species, including the new taxon *triadica* sp. n. These patterns are drawn on the same scale and, save one paratype, all taken from the types. I hope that they may prove of some service to a future reviser who can deal with the group on a larger scale. In all these drawings (figs. 21, 24 and 26–30), the unbroken areas and lines enclosed within the body contour, represent sharply defined green or yellowish spots and stripes on a dark background, those rendered by dotted lines being less defined, or even diffuse, and placed on a lighter ground.

Cephalaeschna triadica spec. nov. (Fig. 21–23)

Material. — Bhutan: 1 ♂ (subadult, holotype), Gidaphu, 2300 m, 2.6.1972, Nat. Hist. Mus. Basel – Bhutan Expedition 1972.

Male (holotype). — Anterior portion of head broad; frons protuberant, with well defined, transverse, anterodorsal crest which fades away on either side but projects anterad so as to form a tiny, obtuse-angulate triangle; whole surface clothed with longish black erect hairs which are longest at frontal crest and sides of postclypeus. Greatest width at base of frons and its length to summit of anterior crest in the ratio of 100 : 34.2; frons slightly broader than transverse diameter of one compound eye; greatest breadth of frons and that of head across

eyes in the ratio of 100 : 184. Mouth-parts, face and frons uniform brown (possibly rather more greenish in life?), unmarked, except that the dorsal surface of frons is a little lighter brown with indication of a diffuse, elongate-oval median spot, which extends from base almost up to the crest. Median eye-line long, subequal to midlength of frons. Vertex and occipital triangle dark brown; rear of the head somewhat lighter.

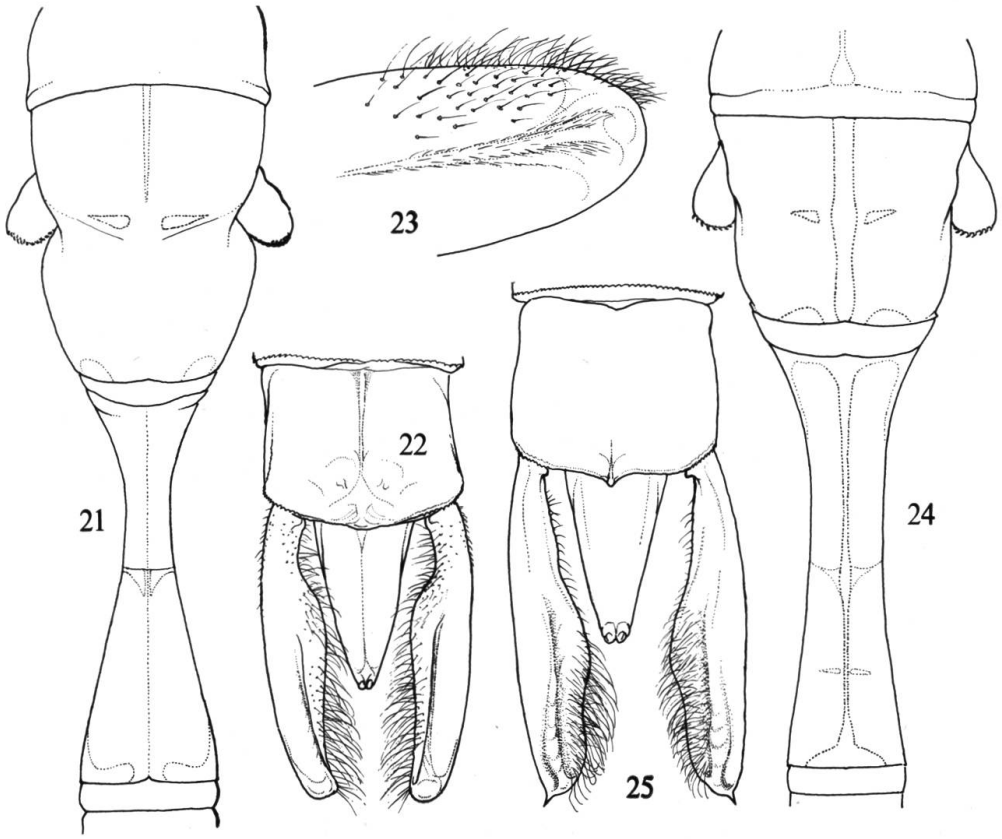
Pro- and synthorax throughout uniform dark brown, including ante-alar triangles, without any indication of light-coloured ante-humeral spots or stripes; sides likewise brown, except metepimeron, which carries a large, subrectangular, citron-yellow patch occupying the posterior three-fifths of the dorsal half of the space, the antero-dorsal angle of this spot giving off a short rounded projection along dorsal margin of metepimeron, but which does not reach the second suture. Ventral surface of thorax brown.

Legs slender; femora reddish brown with well defined deep black apical rings; tibiae and tarsi deep black.

Wings clear hyaline, but extreme bases faintly saffronated in subcostal and cubital spaces. Neuration dense, brown.

Nodal index $\frac{23.27.27.25}{26.20.20.27}$.

A basal subcostal nervure present in all wings. Proximal and distal primary antenodal nervures separated by four cells in all four wings. Arculus situated slightly distal to distal primary antenodal. Cross-veins in median space 5–6 in both fore and hind wings, those in cubital space (including ill-defined internal triangle) 8 in fore wings, 7 in hinder pair; hypertriangles with 5 cross-veins in all wings; triangles made up of 6 cells in fore wings, 5 in hinder pair, the basal cells being divided. Fork of Rs distinctly asymmetrical at a point about midway between nodus and pterostigma, Rsa strongly convex, the space enclosing Rsa and Rsb with 3 rows of cells. A single row of cells between Rs-Rspl, the latter well developed, straight. Supplementary nervure arising from distal side of triangles (Mspl) irregular and zigzagged at origin, then straight and well marked, with one cell-row M_4-Mspl, except a distal row of duplicated cells towards wing border. One cell-row Cu_1-Cu_2 in fore wings, two for a distance of 5–6 cells in hinder pair; Cu_2 of fore wing with three branches, the area posterior to it with a maximum of 6 cells. Anal loop rather broad, 16-celled with 3–5 central cells. Anal triangle 5-celled, sides perfectly straight; anal angle well pronounced, tornus



Figs. 21–23. *Cephalaeschna triadica* spec. nov., holotype from Bhutan; shape and colour-pattern of first three abdominal segments (21), dorsal view of terminalia (22), and apex of left superior appendage, interior view (23). – Figs. 24–25. *C. nocturnalis* (Fraser), paratype from Shillong; shape and abdominal colour-pattern as before (24), and dorsal view of terminalia (25). Drawn on the same scale.

right-angled. Pterostigma of moderate size, well-braced, covering 4–5 cells, colour light yellow. Membranula well developed, only little narrower than base of cubital space, pure white.

Abdomen slender, broadest across basal segments, 2 somewhat constricted at base of auricles, which are large and prominent, carrying up to three rows of 20–26 short, recurved black teeth. Segment 3 with strong prejugal constriction beyond which it retakes its basal breadth (fig. 21); succeeding segments gradually a little expanded, the apical ones slightly depressed. Colour brown, darkest beyond segment 3; 2 marked with pair of transverse yellowish jugal spots and traces of yellow also laterally; 3–8 each with transverse, paired, triangular yellow spots immediately behind jugal sutures and finely interrupted by

the dorsal carina, which remains black; these segments in addition with broad, ill-defined, lateral postjugal bands of the same colour running alongside segments; 9 and 10 each only with traces of ill-limited basodorsal pale spots. Middorsal area of tergites 8–9 covered with microscopical warts and basal two-thirds of 10 with a middorsal longitudinal carina.

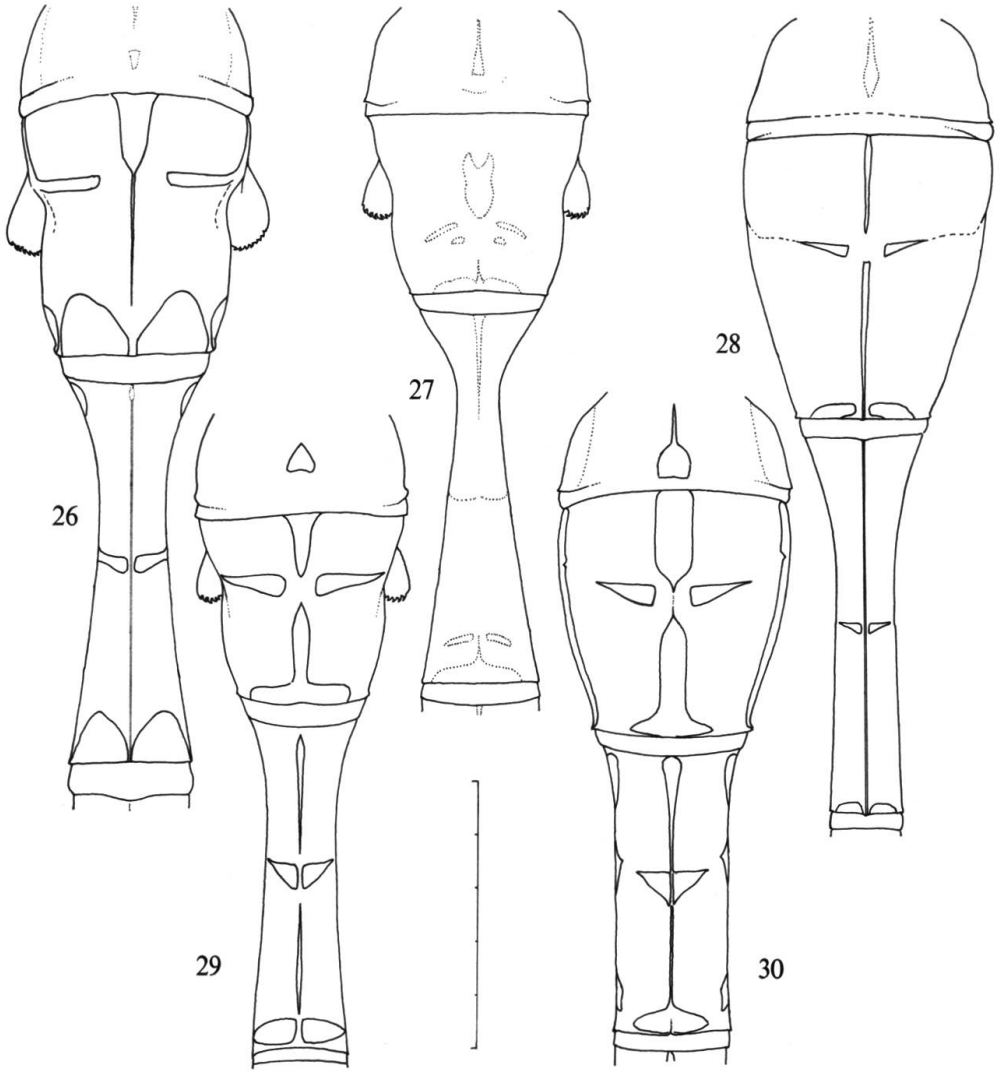
Anal appendages (figs. 22–23), superior pair brown, less than twice as long as segment 10 (ratio 75 : 45), in lateral view almost of even width from base to apex, at first a little downbent, then gradually but distinctly upcurved; no intero-basal projection. Seen obliquely from within, the apical portion of the appendage is twisted and placed more or less transversely, the distal half of each with distinct, blunt middorsal ridge, which is slightly swollen and upturned apically, the apices themselves being completely rounded (fig. 23). Appendix inferior brownish yellow, gradually upcurved, following the bend of the superior pair. All bristles black.

Measurements: abd. + app. 51.0 mm, hind wing 42.0 mm, pterostigma fore wing 2.5 mm.

Female unknown.

This new species is easily distinguished from all other members of the group that I have been able to examine. It is chiefly characterized by its wings, which are much more densely reticulated than in any of the others, there being no less than 16 cells in the anal loop of the hind wing, while the nodal index is noticeably higher than in the remaining species of the same sex. Of particular interest is the presence of three instead of two cell-rows in the space enclosed between the sectors of Rs, which itself is forked asymmetrically, the upper branch (Rs_a) being distinctly convex, while the lower (Rs_b) is straight. Venational peculiarities not mentioned in the above description are (1), the presence of two cell-rows between M_1 and M_2 almost as far proximad as the nodus (three rows under the pterostigma!) and (2), the unusual number of three instead of only one or two cells between the arculus sectors (M_3 and M_4).

Another interesting feature of *triadica* is found in the facial part of the head, which is rather intermediate in shape between that of typical *Cephalaeschna* and *Periaeschna:* the frons is broad, but longer and more prominent at the middle than in *C. orbifrons* and species like *sikkima* and *masoni,* though distinctly less pointed than the narrower-faced *acutifrons, laidlawi, nocturnalis,* and others.



Figs. 26–30. Shape and colour-pattern of first three abdominal segments of *Cephalaeschna masoni* (Martin), holotype from Assam (26), *C. laidlawi* (Foerster), lectotype from Camp Jor, Malaya (27), *C. acutifrons* (Martin), holotype from "Ind. or." (28), *C. lugubris* (Martin), lectotype from Khasia Hills, Sikkim (29), and *C. sikkima* Karsch, from Darjeeling, agreeing with discoloured holotype from Sikkim (30). Scale-line = 5 mm.

Superficially, *C. triadica* is very similar in size, wing form and 'facies' to *nocturnalis* Fraser. The latter is thought by Asahina (in litt.) to be conspecific with *Periaeschna magdalena* Martin, one of the few species of which I have not seen the type. This is a female from Tonkin in the Paris museum, its male being not definitely known. Both *magdalena* and *nocturnalis* have a more open venation than *triadica*.

As to the colour-pattern, *C. triadica* somewhat resembles *acutifrons* (fig. 28), *laidlawi* (fig. 27) and *nocturnalis* (fig. 24), except that in the new species green or yellow antehumeral and mesepimeral bands are apparently lacking, and the abdominal markings are less distinct and shaped differently. *C. unifasciata* Fraser also has somewhat similar abdominal markings but is a larger, more robust and darker insect, with green antehumeral and mesepimeral stripes; its male appendages are more slender and the superiors are minutely pointed. The terminalia of *triadica* are, indeed, quite characteristic in shape (figs. 22–23), the superior ones being entirely devoid of the apical tooth or acuminate spine of *nocturnalis* (fig. 25) and most other species of the group.

Postscript: Since the completion of the present article, in which I called attention to the existence of several more species of *Calicnemia* still to be described (huj. op.: 199), a characterization of one of these was published in September 1976 by A R. LAHIRI in a paper entitled: *Calicnemia mukherjeei spec. nov. from Khasi Hills, India.* Odonatologica 5: 273–276, figs.

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Author's address:
Dr. M.A. Lieftinck
"Kalliste", Rhenen 2780, Netherlands