

Notes on some Chinese and Himalayan Cordulegastridae (Insecta: Odonata: Anisoptera)

G.J. van Pelt

G.J. van Pelt. Notes on some Chinese and Himalayan Cordulegastridae (Insecta: Odonata: Anisoptera)

Zool. Med. Leiden 67 (16), 30.vii.1993: 265-282, figs. 1-46. — ISSN 0024-0672.

Key words: Cordulegastridae; Anisoptera; Odonata; East Palaearctic; China; Himalaya; Lieftinck.

East Palaearctic Cordulegastridae from the former Lieftinck collection are identified. Two *Neallogaster* species are described and figured. *Neallogaster* is supposed to consist of two species-groups. *Cordulegaster lunifera* and *C. pekinensis* are redescribed and figured. A single female from Central China belongs to *C. jinensis*. It is assumed that these three *Cordulegaster* species belong to a separate supraspecific taxon. A single male *Cordulegaster* from "Tsingtau" is not conspecific with other cordulegastrids known from China; it resembles the European *C. boltonii* and will be described as a new species in a revision of the *C. boltonii* species-group. It is emphasized that the cordulegastrid fauna of the East Palaearctic is still insufficiently known.

G.J. van Pelt, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands.

Introduction

In the collection of the late Dr M.A. Lieftinck, former curator of the department of Odonata of the Rijksmuseum van Natuurlijke Historie (RMNH, now: Nationaal Natuurhistorisch Museum), six interesting East Palaearctic specimens of Cordulegastridae were found. All East Palaearctic cordulegastrids in the RMNH are *Anotogaster*, but none of Lieftinck's specimens belongs to this genus. The present author is revising the European *Cordulegaster boltonii* (Donovan, 1807) species-group and made an attempt to identify these specimens. Apart from *Anotogaster* spp., only *Neallogaster* spp., *Cordulegaster lunifera* Sélys, 1878, and *Cordulegaster pekinensis* Sélys, 1886, have been recorded from the East Palaearctic region (Fraser, 1929; Needham, 1930). A single female in the collection could not be associated with these species and is identified as the recently described *Cordulegaster jinensis* Zhu & Han, 1992, from Central China. Little, and only 19th century material is known of the other two *Cordulegaster* species; their type specimens are redescribed in this paper. Abbreviations: RMNH: Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands; ZMH: Zoologisches Museum Hamburg, Germany; BM(NH): British Museum (Natural History), London, England; MNHN: Muséum Nationale d'Histoire Naturelle, Paris, France; IRSN: Institute Royale des Sciences Naturelles, Brussel, Belgium.

Classification at generic level

The newly proposed classification of the Cordulegastridae by Lohmann (1992) is only partly followed. It is considered not useful to follow this revision as far as the

East Palaearctic fauna is concerned. For the time being, taking our restricted knowledge into account, this fauna should preferably be dealt with by establishing species-groups, i.e. monophyletic groups of vicarious species. When two cordulegastrid species occur largely sympatrically, they in principle belong to different species-groups, and are separable by structural differences (appendages) and habitat preferences.

Lohmann has placed both *Cordulegaster lunifera* and *Cordulegaster pekinensis* in *Neallogaster*, but in characters of the frons these species show more affinity with *Cordulegaster jinensis* than with *Neallogaster* species. Therefore it is assumed that these three *Cordulegaster* species belong to a separate, yet undescribed supraspecific taxon. Since the fauna of the East Palaearctic is unsufficiently known, it is preferred to be cautious with the introduction of new names. Therefore these three species are provisionally treated as *Cordulegaster* spp. The representatives of the various species-groups (including their distributions to determine vicariance patterns) should be sufficiently well-known before a revision at the generic level can be made (Tangelder, 1988: 3).

***Neallogaster* Sélys, 1878**

Allogaster Sélys, 1878: 684; Kirby, 1890:79; Fraser, 1927: 76; Fraser, 1929: 77-78; Fraser, 1936: 37-39.
Neallogaster Cowley, 1934: 201. [*Allogaster* Sélys, 1878, preoccupied by *Allogaster* Thompson, 1864, Coleoptera]

Sélys (1878: 684) characterized the genus *Neallogaster* mainly by the extraordinarily expansion of the frons. Asahina (1982: 154) tentatively defined both genera, but pointed out that "it seems rather difficult to separate the two genera without surveying whole the representatives of both the genera."

***Neallogaster hermoniae* (Fraser, 1927) (figs 19-20, 22)**

Allogaster hermoniae Fraser, 1927: 76-77; Fraser, 1929: 80-81; Fraser, 1936: 40-43.
Neallogaster hermoniae; Kimmins, 1966: 195; Asahina, 1982b: 162-164, figs 37-41; Lohmann, 1992: 11.

Material.— India. Simla. Baghi 4000 ft., 7.ix.1966, one male; Bhahi, 7.x.1966, one male. Both leg. Gupta, ex coll. Lieftinck (RMNH).

Description.— The specimens do agree well with the description and figures by Asahina (1982b: 162-164, figs 37-41). The abdominal markings of the "Baghi" specimen are somewhat different from those described by Asahina (1982b: fig. 37) (fig. 22). The "Bhahi" specimen has its abdominal markings on 3-6 connected at the dorsal carina, and small basal yellow streaks at 9. The "Baghi" specimen has a black thoracal ground colour with yellow markings as shown in fig. 19. The incision in the hind margin of the stripe on the mesepimeron is remarkable (a character not mentioned by Asahina). The dorsal marking on the metepisternum is variable: it is undivided in the left side of the "Baghi" specimen and extended into a small downwards stroke, as with the upper spot in the "Bhahi" specimen (fig. 20).

Dimensions (in mm).— "Baghi" specimen: total length including appendages 68.5; length abdomen including appendages 51.5; length fore wing 38.5; length hind

wing 39.0. "Bhahi" specimen: total length including appendages 66.0; length abdomen including appendages 50.0; length fore wing 38.0; length hind wing 38.5.

Distribution.— According to Asahina (1982b: 164), known from NW India, Nepal, the Darjeeling District, Bhutan and Assam.

Remarks.— The two specimens were labelled as *Neallogaster luniferus* by Lieftinck, but they do not agree with the original description of that species (labrum yellow, frons excavated etc.).

N. hermionae was described by Fraser (1927: 76-77) on the basis of two males. He separated his specimens from *Allogaster latifrons* Sélys, 1878, by: (1) the much smaller size, (2) the greater extent of the thoracal markings and (3) the different character of those on the abdomen. According to Asahina (1982b: 164), *N. hermionae* is separable from *N. latifrons* by: (1) the vertical wrinkles on the anterior side of the frons, running more or less laterad in *hermionae*, (2) the superior appendages which are slightly narrower than those of *latifrons*, (3) the more blackish thoracal ground colour of *N. hermionae* and (4) the larger antehumeral stripe in *N. latifrons*. The dates of capture suggest that *N. latifrons* might be involved, because it is the only *Neallogaster* species that has been collected and observed in September and October (Asahina, 1982b), but reasons for not treating our specimens as that species are: (1) the larger size of their abdominal markings, (2) the black ground colour of the thorax and (3) the distributional data (*N. latifrons* has only been reported from the E Himalaya).

Despite the data on morphology, distribution, altitudes and flight periods of *N. latifrons* and *N. hermionae* in the literature (Fraser, 1929; Asahina, 1982b; Vick, 1989), it remains unclear whether these nominal taxa apply to separate species and not to e.g. seasonal or local forms of *N. latifrons*, since the two taxa occur largely sympatrically (cf. Asahina, 1982b).

Neallogaster ornata Asahina, 1982 (figs 21-23)

Allogaster parvistigma (nec Sélys); Fraser, 1929: 81-83, fig. 5.

Neallogaster aff. *hermionae*; Kiauta & Kiauta, 1976: 352-353.

Neallogaster ornatus Asahina, 1982b: 158-162, figs 42-49.

Neallogaster ornata; Lohmann, 1992: 11.

Material.— Nepal. "Syabru-Mangsen, 2670 m", 6.v.1976, leg. B. Kiauta, one male (ex coll. Lieftinck, now in RMNH). India. "Himalaya, Molta, 3000 m", 4.v.1956, D. Indien Exp., leg. G.A. von Meydell, one female (ZMH).

Description.— The specimens do agree well with the description and figures by Asahina (1982b: 164-167, figs 42-49). The abdominal markings of the male are shown in fig. 23. The abdominal markings of the female are similar to those figured by Asahina (1982b: 165, fig. 46); the thoracal pattern is shown in fig. 21.

Dimensions (in mm).— Male: total length including appendages 62.0; length abdomen including appendages 46.5; length fore wing 36.5; length hind wing 35.0. Female: total length including ovipositor 67.0; length abdomen including ovipositor 50.0; length fore wing 40.0; length hind wing 39.5.

Distribution.— According to Asahina (1982b:167), *N. ornata* occurs in the W Himalaya from Central Nepal to Kumaon and Simla.

Remarks.— The two specimens cited under material were identified by Asahina as *Neallogaster ornatus* in 1982.

As pointed out by Asahina (1982b: 164-167), this species has been incorrectly indicated as *Allogaster parvistigma* Sélys, 1873 (since Fraser, 1929: 81-83). The type of *A. parvistigma* is now considered lost (Asahina, 1982b: 166). Sélys described *Thecagaster parvistigma* on the basis of a single female from the Himalayas (Sélys, 1873: 64-65). I cannot draw any conclusions on the basis of the original description, so it remains uncertain to which species this specimen belonged. It might have been conspecific with *Thecagaster brevistigma*, since Sélys placed it in the same "subgenus".

Lieftinck already noted that the position of the teeth on the superior appendages in this species differs from that in the preceding species and in *N. latifrons*. *N. ornata* is characterised by: (1) the posterior teeth of the superior appendages that are hardly visible in both dorsal and lateral view and (2) situated rather more anteriorly (cf Asahina, 1982b, figs 47-48), (3) the anterior crest of the frons being concave in frontal view (straight in *latifrons* and *hermionae*) and (4) the greater extent of the markings on the abdomen.

The termination 'gaster' in *Neallogaster* is feminine and, therefore, the epithet should be *ornata*.

Discussion.— *N. ornata* occurs largely sympatrically with *Neallogaster hermionae*. It is therefore assumed that *Neallogaster* consists of more than one species-group. Asahina (1982a: 313) described the larval habitat of *N. hermionae*: "The stream has a fine, sandy bottom, in the dry season (when the dragonflies emerge) it is hardly more than 20 cm deep and some 60-80 cm wide." The larval habitats of the other *Neallogaster* species have yet to be established. It can be expected, that there is a difference in habitat preference between *N. hermionae* and *N. ornata*. Before the habitat preferences and distributions of the various *Neallogaster* species are known, it is considered not useful to subdivide *Neallogaster* into species-groups.

The character state of a "raised frons" occurs in more than one species-group (e.g. also in *Thecagaster brevistigma* Sélys, 1858). It might be related to the position of the eyes (van Tol, pers. comm.), possibly being an adaptation to life at higher altitudes. If this is true, the occurrence of this character state in Himalayan Cordulegastridae might be due to a parallel development in different species-groups.

Cordulegaster Leach, 1815

Cordulegaster Leach, 1815: 136; Sélys, 1858: 327.

Thecagaster Sélys, 1858: 327; Lohmann, 1992: 10.

Lohmann (1992) has made an attempt to separate this (presumably paraphyletic) genus into monophyletic genera, but *Thecagaster* is probably still paraphyletic when the genera Lohmann described are recognized. If the three *Cordulegaster* species here described indeed belong to a separate taxon, it might prove useful to redescribe *Cordulegaster* and *Thecagaster*, and the differences with other genera.

***Cordulegaster lunifera* Sélys, 1878**
(figs 1-12, 24-33, 35-37, 39-40)

Cordulegaster lunifera Sélys, 1878: 691-692; McLachlan, 1896: 368; Fraser, 1929: 121-123, pl. x, fig. 14.
Cordulegaster lunifera pekinensis; McLachlan, 1896: 368 [partim]; Fraser, 1929: 121-123 [partim].
Cordulegaster luniferous; Needham, 1930: 106.
Neallogaster lunifera; Asahina, 1988: 32-33.
Neallogaster lunifera; Lohmann, 1992: 11.

Material.— **China.** "Thibet, Mon-Pin". 1870. Leg. A. David (MNHN). One male and one female. Male (designated lectotype by Fraser in 1929) labelled: "*Cordulegaster lunifera* Sélys 1 det F. C. Fraser 26"; "Type" (pink label, in Fraser's hand); "Museum Paris"; "MouPin Thibet A. David 1870" (small round label); "*Neallogaster* (?) *lunifera* Sélys rév. M.A. Lieftinck 1977 Lectotype selected by Fraser". Female with labels: "C. *lunifera* Type" (large yellow label with black cadre); "allotype" (pink label, written in Fraser's hand); "Museum Paris"; "MouPin Thibet A. David, 1870" (small round label); "*Neallogaster* (?) *lunifera* Sélys rév. M.A. Lieftinck 1977". Szechwan. Five McLachlan specimens, all with label "McLachlan Coll. B.M. 1938-674", now in BM(NH): "Siao-Lou", one male, one female (female labelled "var. *pekinensis*"); "Mo-si-mien", one male; "Ta-chien-lu", one male, one female (both labelled "*Cordulegaster pekinensis*").

Description of male (lectotype).— Head (figs 1-2) with labium ochreous; labrum yellow, largely bordered with dark reddish brown, dark virgule practically dividing yellow markings into two isolated spots; anteclypeus blackish brown; postclypeus with posterior margin narrowly black, impressions and lateral portions yellowish brown, rest and anterior part of frons reddish brown with long brownish hairs, upper part of frons yellow on anteriormost central part and at anterolateral edges, rest black (fig. 2); vertex black; occipital triangle black, the crest with long brownish black hairs, rearside yellow with the normal obscured impression; rear of head yellow (not visible in dorsal view) except for dorsalmost part near upper edge of compound eyes which is black.

Thorax (fig. 3) normally marked, right side damaged by scavengers, upper spot on metepisternum therefore not visible (in fig. 3 this spot has been drawn on the analogy of this spot on the left side of this specimen).

Wings suffused with yellow only near extreme base, damaged at all apices, right fore wing also at antenodal part of costal area; costae reddish brown; right fore wing with at least 16 Ax and 14 Px; left fore wing 18 Ax (first and seventh primaries) and 15 Px; left hind wing with 12 Ax (first and seventh primaries) and 16 Px; right hind wing with 12 Ax (first and sixth primaries) and 15 Px; pterostigma brown, length in fore wing 3.5 mm, in hind wing 4.0 mm; anal triangle with 4 cells.

Abdomen (figs 24-25) with 1 black; small dorsal markings and apical lunules on 2-7; 9 with basal streaks; 10 with apical spots; anteroventral marking present only on 7.

Appendages brownish; superiors (figs 32, 36) long and slender, basally close up to 2/3 of their lengths, apically diverging, in dorsal view teeth invisible; in lateral view basal tooth well-visible, posterior tooth situated more internally, just before half of appendage length; inferior (fig. 35) ca 2/3 of superior's length, narrowed towards apex.

Dimensions (in mm).— Total length including appendages 68.5; length abdomen including appendages 52.0; length fore wing >41.0; length hind wing >39.0; span of hind wings ca 83.0.

Description of female (allotype).— All markings dark reddish yellow, probably due to poor preservation. Not all of these markings (especially the ventral markings) are necessarily yellow in life.

Head (figs 4-5) with labium light reddish yellow; labrum yellow with darkbrown median virgule, largely bordered with black at all margins, dark reddish brown interiorly; anteclypeus dark reddish brown, with yellow at posterior and anterior margins; postclypeus reddish brown with yellowish brown at dorsolateral portions; frons brownish, with light reddish yellow at lower margin below lower crest only, hairs on lateral parts of anteclypeus and frontal part of frons shorter and less dense than on upper part of frons, which is black with long dark hairs, two yellow patches near upper crest and yellowish at lateral margins (in dorsal and frontal view, cf. figs 4-5); vertex black; occipital triangle reddish brown, with a fringe of long black hairs; rear of head yellow, except for upper part near compound eyes which is black with a reddish brown margin; rear of occipital triangle yellow with somewhat obscured median virgule.

Thorax (fig. 6) with spots on metepisternum only near base of wings, one tiny spot (hardly visible) just above the spiracle, and one spot just below it.

Wings hyaline, with yellow basal suffusion extending to nodus, especially in space between subcosta and radius; apices missing except in right fore wing; costae brown; membranula greyish white; right fore wing with 19 Ax (first and seventh primaries) and 14 Px; left fore wing 17 Ax (first and seventh primaries) and 15 Px; left hind wing with 13 Ax (first and seventh primaries) and 15 Px; right hind wing with 13 Ax (first and seventh primaries) and 15 Px; pterostigma light reddish brown, length in fore wing 3.5, in hind wing 4.0 mm.

Abdomen (figs 26-27) with all markings dark reddish brown, probably due to poor preservation; in figs 17-18 the ventral markings on all segments are indicated as reddish brown, the remaining as yellow; when the lateral and ventral markings are confluent (as on 2, 3 and 8) the assumed separation is indicated with a questionmark; 1 with lateral marking; dorsal markings larger than in male, apical lunules present on 2-5, vestigial on 6; 8 with streaks on distal carina; 9 black; 10 with lateral streaks; anteroventral spots on 2-8; 9-10 with basolateral reddish brown markings.

Ovipositor reddish brown.

Dimensions (in mm).— Total length including ovipositor 70.5; length abdomen including ovipositor 53.0; length fore wing 43.5; length hind wing 43.0.

Description of McLachlan specimens.— The "Mo-si-mien" male agrees well with the male type; differences are: labrum with virgule light reddish brown; postclypeus with lateral portions only slightly lighter than frons; abdomen with posteroventral spot on 1 (fig. 29), with generally slightly larger markings, especially the apical lunules larger; anteroventral spots on 7-10; apical lunule vestigial on 7, absent on 8. The "Siao-Lou" male differs by the reddish brown virgule on the labrum; postclypeus and frons dark reddish brown; abdomen with posteroventral spot on 1; 7 with anteroventral spot, apical lunule vestigial; 9 with basal streak not connected with dark reddish brown ventral portion; 10 with vestigial dorsal spot. The "Siao-Lou" female differs from the allotype in (1) yellow on labrum divided by dark reddish brown virgule, (2) postclypeus only somewhat lighter than frons, but not yellowish, (3) thorax (fig. 12) with narrow stripe on mesepimeron and only dorsal and ventral spot on metepisternum and (4) smaller abdominal markings (fig. 28). The "Ta-chien-lu" pair

differs from the type specimens in the larger yellow markings on postclypeus, frons and abdomen, while the costae are yellowish brown. The male has its postclypeus largely greenish yellow instead of yellowish brown (figs 7-8), larger thoracal markings (fig. 9), all dorsal abdominal markings larger in size, anteroventral spots present on 5-8 (figs 30-31), and the superior appendages (figs 33, 37) basally more separated, the apex rather blunt and the posterior teeth more caudally situated than in the type. The female has a larger yellow marking on its dorsal part of the frons of which the base is yellow laterally of the vertex (figs 10-11), abdominal segment 1 a large more or less heart-shaped dorsal spot which is connected with the marking on 2, larger dorsal markings on all segments, on 9 basal streaks and the anteroventral markings smaller on 2-5 and 8, but larger on 6 and 7 (figs 39-40).

Dimensions (in mm).— "Mo-si-mien" male: Total length including appendages 70.5; length abdomen including appendages 53.0; length fore wing 41.5; length hind wing 41.0. "Siao-Lou" male: total length including appendages 71.0; length abdomen including appendages 54.0; length fore wing 40.5; length hind wing 40.0. "Siao-Lou" female: total length including ovipositor 76.0; length abdomen including ovipositor 58.5; length fore wing 46.0; length hind wing 44.5. "Ta-chien-lu" male: total length including appendages 67.5; length abdomen including appendages 50.0; length fore wing 40.5; length hind wing 40.0. "Ta-chien-lu" female: total length including ovipositor 72.0; length abdomen including ovipositor 58.0; length fore wing 43.5; length hind wing 42.0.

Distribution.— According to Asahina (1988: 33), the type locality "Mon-Pin" is "now believed to be Moupin in western Szechwan near Tachenlu, northwest of Mt. Omei, Szechwan." According to Wagener (1959), "Tatsienlu (Ta-chien-lu, now officially Kangting)" is located at ca 2600 m asl at the Ta river (Ta-ho = Lu-Ho), 102°2'E, 30°2'N; "Siaolu (Hsiao-lu)" is a location between Tientsuen and the Maan Shan pass (3000 m asl) at the shortest road from Yaan to Tatsienlu (50 - 100 km SE of Tatsienlu; "Muping (Mu-p'ing)" was the missionary post of Armand David between 1869 and 1872, some 80 km NE of Tatsienlu (Wagener, 1959: 86-98). I have not been able to find any references to the position of the locality "Mo-si-mien" (Mo-si-nuen in Fraser). If Wagener and Asahina are right in the establishment of the localities, this species is only known from the surroundings of Ta-chien-lu in W Szechwan, some 450 km W of Tchong-King in the Red Basin.

Asahina (1982b: 169) reported one female specimen (in alcohol) from Kashmir, which shows affinity to *N. lunifera* in its thoracal markings (mesepisternal) and its abdominal markings. It remains uncertain to which species this specimen belongs.

Remarks.— This taxon was described by Sélys after one male and one female from "Mon-Pin (Thibet)", sent to Sélys by "M. l'abbé David", and deposited in de MNHN, Paris. In 1886, Sélys described a single male from "Pekin" as "*pekinensis*", and associated it with *C. lunifera* (see below). More material from China became available with the description of material in the coll. McLachlan from several localities in the Chinese province of Szechuen (= Szechwan). McLachlan (1896: 368) associated his four males and two females, "irrespective of locality", with these two Chinese *Cordulegaster* species.

McLachlan's views were followed by Fraser (1929), who redescribed three specimens in the MNHN and material McLachlan associated with this taxon (three males). Fraser (1929: 121) mentions only one female (from the MNHN, designated

allotype), but his description of the female is probably also based on the so-called *pekinensis* females ("Abdomen 52-57 mm", "occiput definitely yellow").

Asahina (1988: 32-33) described a single male from the Paris Museum labelled: "Thibet", "Lacroix", and "luniferus?". He concluded that this specimen "coincides well with Sélys' description", although he noted the presence of a small yellow spot on the metepisternum above. This specimen does not belong to the original pair Sélys based his description on, but must be the second male already mentioned by Fraser.

Compared with the type of *Cordulegaster pekinensis*, all specimens are smaller and have notably small abdominal markings. Therefore, all "*C. luniferus* var. *pekinensis*" are considered specifically distinct from *C. pekinensis*. The superior appendages of the "Ta-chien-lu" male are more similar to those of *C. pekinensis* (figs 34, 38), but, unfortunately, in the only known specimen of that species these are broken off.

The "Ta-chien-lu" pair differs in several characters from the other specimens examined. Apart from the appendages, however, these characters vary in the other specimens as well. The locality "Ta-chien-lu" is, if Asahina is right, in the vicinity of the type locality of *lunifera*. It remains uncertain whether the two specimens are really conspecific with *lunifera*. If they are, this taxon appears to be remarkably variable in frontal and abdominal markings. If not, the ranges of the two taxa are expected to have separated somewhere between Ta-chien-lu and "Mou Pin".

The termination 'gaster' in *Neallogaster* is feminine and, therefore, the epithet should be *lunifera*.

***Cordulegaster pekinensis* Sélys, 1886**
(figs 13-15, 34, 38, 41-42, 45)

Cordulegaster pekinensis Sélys, 1886: clxxxii-clxxxiii.

Cordulegaster luniferus pekinensis; McLachlan, 1896: 368 [partim]; Fraser, 1929: 121-123 [partim]; Needham, 1930: 105-106 [partim].

Material.— China. Beijing, coll. Sélys (IRSN). One male (holotype) labelled: "N. China. Pékin." (written in Albarda's hand); "*Corduleg. Pekinensis*" (written in Sélys' hand); "K [underlined] *Cordulegaster Pekinensis* Sélys" and "K [underlined] 1 exempl. M. Tylliard (Tormais [?])" both large pink labels, written in Fraser's (?) hand.

Description of male (holotype).— Head (figs 13-14) with labium ochreous; labrum yellow, narrowly bordered with black, median virgule black at base, remaining reddish brown, posterior margin internally reddish brown; anteclypeus black-reddish brown with margin near base of labrum yellow; postclypeus yellow with black posterior margin, impressions light reddish brown, grey blackish laterally; frons dorsally not swollen, in frontal view yellow with black bar restricted to dorsal part of protruding area, black extending laterally along crest towards latero-ventral corners, not quite reaching these, in dorsal view upper part of frons excavated, yellow except for black base which is confluent with dark patches near anteriormost part of crest; black hairs on lateral regions of frons, post- and anteclypeus; vertex black; occipital triangle black with two vaguely yellowish spots, hairs on crest black, rear side yellow with median virgule somewhat obscured; back of head and compound eyes yellow, extending dorsally but not confluent with yellow of occipital triangle.

Synthorax (fig. 15) slightly damaged by scavengers; antehumeral stripe wedge-

shaped; tiny humeral spot; stripe on mesepimeron; metepisternum with round yellow dorsal spot, straight narrow medial spot and a comma-shaped spot just below spiracle; stripe on metepimeron with anterior margin slightly incurved.

Legs black, coxae in part yellow.

Wings as in other cordulegastrids, with yellow suffusion near extreme base of fore wings, in hind wings extended into basal space; right fore wing missing except for basal part, extending to 8th antenodal crossvein (first and sixth primaries); left fore wing with apex missing, broken between second primary antenodal crossvein and nodus (first and sixth primaries); right hind wing broken just apically of nodus, 15 antenodal crossveins (first and sixth primaries) and 19 Px; left hind wing broken just basally of nodus, approximately 14 Ax (first and sixth primaries) and 20 Px; pterostigma light reddish brown, length in fore wing 3.5 mm, in hind wing 4.0 mm; anal triangle in both hind wings four-celled.

Abdomen (figs 41-42) damaged at right part of segment 2; 1 with postero-ventral spot; 2 with auriculae yellow except for small obscured patches, region posterior of these and anterior of yellow postero-ventral region reddish brown, dorsal markings confluent on 2-8, on 7-8 posteriorly indented; apical lunules present on 2-7, vestigial on 8; anteroventral markings on 3-8, on 8 confluent with dorsal spot; 9 with large basal streaks; 10 with tiny basal spots.

Appendages (figs 34, 38) black; superiors broken off at half of their length, bases widely separated, near apex of inferior appendage touching; in lateral view two teeth visible, one basal tooth and a smaller one near half of inferior appendage; inferior appendage narrowed towards apex.

Dimensions (in mm).— Total length including appendages 75.0; length abdomen including appendages 56.0; length hind wing 45.0.

Distribution.— This taxon is only known from the type specimen from "Pékin".

Remarks.— This taxon was described by Sélys on the basis of a single male, sent to him by his colleague H. Albarda (Leeuwarden, the Netherlands). McLachlan (1896: 368) associated some specimens with this specimen: "Of these [six] I should be inclined to refer three males to *luniferus* and one male and two females to *pekinensis*, irrespective of locality, according to the description. Having now so much more material before me, the distinctness of *luniferus* and *pekinensis*, seems very doubtful. I have seen no male so large as is indicated for *pekinensis*."

McLachlan's views were followed by Fraser (1929: 121-123), whose description of *C. pekinensis* is a rather odd mixture of the characters mentioned in the original description and those found in the McLachlan specimens. While McLachlan noted that *C. pekinensis* is larger than his own specimens, Fraser denied Sélys' observation on the abdominal length (57 mm) and noted "54 mm" (although he separated the two taxa by their size). Moreover, Fraser noted "paired apical lunules on 8 & 9", while Sélys stated: no apical lunules present on segment 8 and segment 9 black. However, Fraser's statement that the apices of the superior appendages were "fractured off" in the type, indicates, that he actually examined the type.

Sélys (1886: clxxxiii) stated that *pekinensis* is probably not more than a race of "*C. luniferus*", and noted as the only differences between "*pekinensis*" and "*luniferus*": "in *luniferus* the labrum is largely bordered with ferruginous brown, the rhinarium [post- and anteclypeus] obscured, the two basal spots on the frons united into one single, and the 9-10th segments black [sic! cf. figs 41-42]. It is also larger." In fact, *pekinensis* is larger, and its abdominal markings are larger than those of the *lunifera* type.

The superior appendages of the two taxa are generally similar, although in *pekinensis* they are basally more separated, touching each other near the inferior's hind margin (possibly a matter of preservation), while the posterior teeth are situated somewhat more posteriorly.

***Cordulegaster jinensis* Zhu & Han, 1992**
(figs 16-18, 43-44, 46)

Cordulegaster jinensis Zhu & Han, 1992: 18-21, figs 1-7.

Thecagaster jinensis; Lohmann, 1992: 12.

Material.— China. Shaanxi, "South Shensi", 15.vi. 1936 leg. E. Suenson, one female, (RMNH, ex coll. Lieftinck, ex coll. mus. Stockholm). With labels: "Central China South Shensi 15 VI 1936 E. Suenson spec B" (written in black), "Museum Leiden ex verz. M.A. Lieftinck" (printed in black), "*Cordulegaster luniferus* Sel. det. M.A. Lieftinck 1958 Preliminary identification!", "*Cordul. (Neallo?) not luniferus* det M.A. Lieftinck 1977 cpd. with types MP", "frons interm. *Cord.-Neall!* frontal marks diff. from *luniferus* typ. Seg. 2 with mid-basal spot additional!" (all written in Lieftinck's hand).

Description of female.— Head (figs 16-17) with labium ochreous; labrum yellow, narrowly bordered with black at anterior and lateral margins, reddish brown at interior of posterior margin, virgule black; postclypeus black, posterior margin yellow; anteclypeus yellow with posterior margin black, impressions somewhat obscured; frons yellow with protruding area completely black, upper excavated part yellow with at lateral margins black areas, connected with bar at outer corners; occipital triangle black with two yellowish spots, rear side yellow with virgule vaguely obscured; rear of head completely yellow except for black stripe from incurvation of margin of compound eye towards occipital triangle, with yellow spots near margin of rear side of occipital triangle; black hairs on black parts of labrum, postclypeus, frons and occipital triangle.

Synthorax (fig. 18) black with wedge-shaped antehumeral stripe yellow, with an additional spot below ventral point, which carries yellow hairs, stripe on mesepimeron straight, narrowed at middle of posterior margin, three superposed spots on metepisternum above spiracle, additional spot just below; metepimeron with broad yellow stripe, of which anterior margin almost straight, posterior margin incurved ventrally.

Legs black except for large yellow parts of coxae.

Wings hyaline, with yellow suffusion near bases restricted to anterior area of basal and costal spaces, not extending beyond first antenodal crossvein; upper side of costa yellow; costae yellowish brown, right fore wing with 22 Ax (first and eighth primaries) and 15 Px; left fore wing 19 Ax (first and seventh primaries) and 15 Px; left hind wing with 14 Ax (first and sixth primaries) and 16 Px; right hind wing with 14 Ax (first and seventh primaries) and 18 Px (apical primaries in both fore wings forked near costae); pterostigma dark brownish black, length in fore wing 4.0 mm, in hind wing 4.5 mm.

Abdomen (figs 43-44) black with yellow markings never connected at dorsal carina, except for dorso-basal spots on 1-3; 1 with a round posteroventral spot; 2 with dorsally a triangular dorso-basal spot, carrying yellow hairs, two small half lunule-shaped spots just posterior of jugal suture and two large apical lunules, the large anteroventral spot extending beyond jugal suture and a posteroventral spot which is

largely obscured (probably due to way of preservation); 3 with small dorso-basal spot; apical lunules present on 2-6; anteroventral markings on 3-8, confluent with dorsal spots on 7-8; 8 with streaks on distal carina; 9 with laterobasal spot.

Dimensions (in mm).— Total length including ovipositor 78.5; length abdomen including ovipositor 60.5; length fore wing 47.0; length hind wing 46.0; span of hind wings 99.0.

Distribution.— The locality of this female, "South Shensi" (= Shaanxi Prov.), is at most 750 km SW of the type locality of *C. jinensis* ("Lingshi County area" some 130 km SSW of the capital of the Shansi Prov., T'ai-yüan).

Remarks.— This specimen was collected by E. Suenson, who forwarded material from China to Lieftinck (Lieftinck, 1939: 277). It agrees with females recently described and figured as *Cordulegaster jinensis* by Zhu & Han, 1992. They described three males and three females from two localities in the Shansi Prov., China. Compared with characters mentioned in the English summary and the figures, this specimen lacks the humeral spot, but especially the shape of the abdominal markings is strikingly similar. Both 2 and 3 have the additional (compared with other *Cordulegaster* taxa) dorso-basal spot, but Zhu & Han figured such a spot also on 7, as well as ventral markings on 5-9.

I am not certain whether this specimen (and the specimens described by Zhu & Han) is specifically distinct from *Cordulegaster pekinensis*. The structure of the frons does not appear to be different, the male superior appendages are similar in general shape, but in *pekinensis* the posterior teeth are situated somewhat more posteriorly. There are no remarkable differences in the colour pattern, although in *pekinensis* the abdominal dorsal markings are larger and the anteroventral markings smaller than in *C. jinensis*.

Discussion.— The intensity and extension of the light and dark (reddish) brown markings on the head and the ventral abdominal markings in the three *Cordulegaster* species might be (partly) due to the state of preservation. Therefore, the sizes of these are not taken into account. New, well-preserved material is necessary to determine the characteristics of these taxa and their intraspecific variability.

The frons in the types of *Cordulegaster luniferus*, *C. pekinensis* and *C. jinensis* are more excavated than in the type species of *Neallogaster* (cf. Asahina, 1982b). It is also less broad and projected. Lieftinck already noted that the shape of the frons of the female from South Shensi was "intermediate *Cordulegaster*-*Neallogaster*". In fact, it is shaped more like the frons in *Anotogaster*. Possibly the three *Cordulegaster* species form a separate, yet to be described species-group. The yellow suffusion on the wing bases might be an additional character separating this species-group from other *Cordulegaster* species.

In South Shensi, where this female was caught, also three specimens of (tentatively) *Anotogaster sieboldii kuchenbeiseri* ("spec A", according to the collector, E. Suenson) were collected. Thus, *C. jinensis* might have a different habitat preference. I have not been able to find any references on the habitat preferences of Chinese *Cordulegaster* species. The only note on the habitat preference of *Anotogaster* I have been able to find has been made by Fraser. He (1929: 90) found the exuviae of *Anotogaster nipalensis* Sélys, 1850, clinging to rushes in a small meandering stream through a swamp at Mungpoo, above Teesta valley, 3000 ft., a situation very similar (according to Fraser) to ones favoured by *Cordulegaster boltonii*. If *Anotogaster* occurs

in brooks and brooklets, it cannot be excluded that other species-groups are restricted to the spring areas of these brooklets in China. This would be a similar arrangement as found as in Europe: representatives of the *C. boltonii* species-group in swift, small, meandering brooklets, and those of the *C. bidentata* species-group restricted to the spring areas of brooklets.

Epilogue

Recently, many new species of Chinese Gomphidae (of which family several species are known to occur in the same habitat as cordulegastrids) have been described (Chao, 1990). A new *Anotogaster* species has been described by Zhou (1988) from E China (Zhejiang prov.). It cannot be excluded that, in the immense country of China, several yet undescribed cordulegastrid taxa occur. A single male specimen from Tsingtau (= Ch'ing-tao, Shantung prov., NE China), found in Lieftinck's collection, could not be associated with any of the species-groups known to occur in the East Palaearctic. In fact, it resembles the representatives of the European *Cordulegaster boltonii* species-group in all characters separating it from other *Cordulegaster* species. It will therefore be described as a new species in a revision of this species-group (van Pelt, in prep.)

Acknowledgements

I wish to thank Prof Dr E. Gittenberger (RMNH) for his helpful comments on the draft versions of this paper, J. van Tol (RMNH) for his general assistance and the following persons for presenting material on loan: Drs S. Brooks (BM(NH)), J. Legrand (MNHN) and P. Grottaert (IRSIN).

References

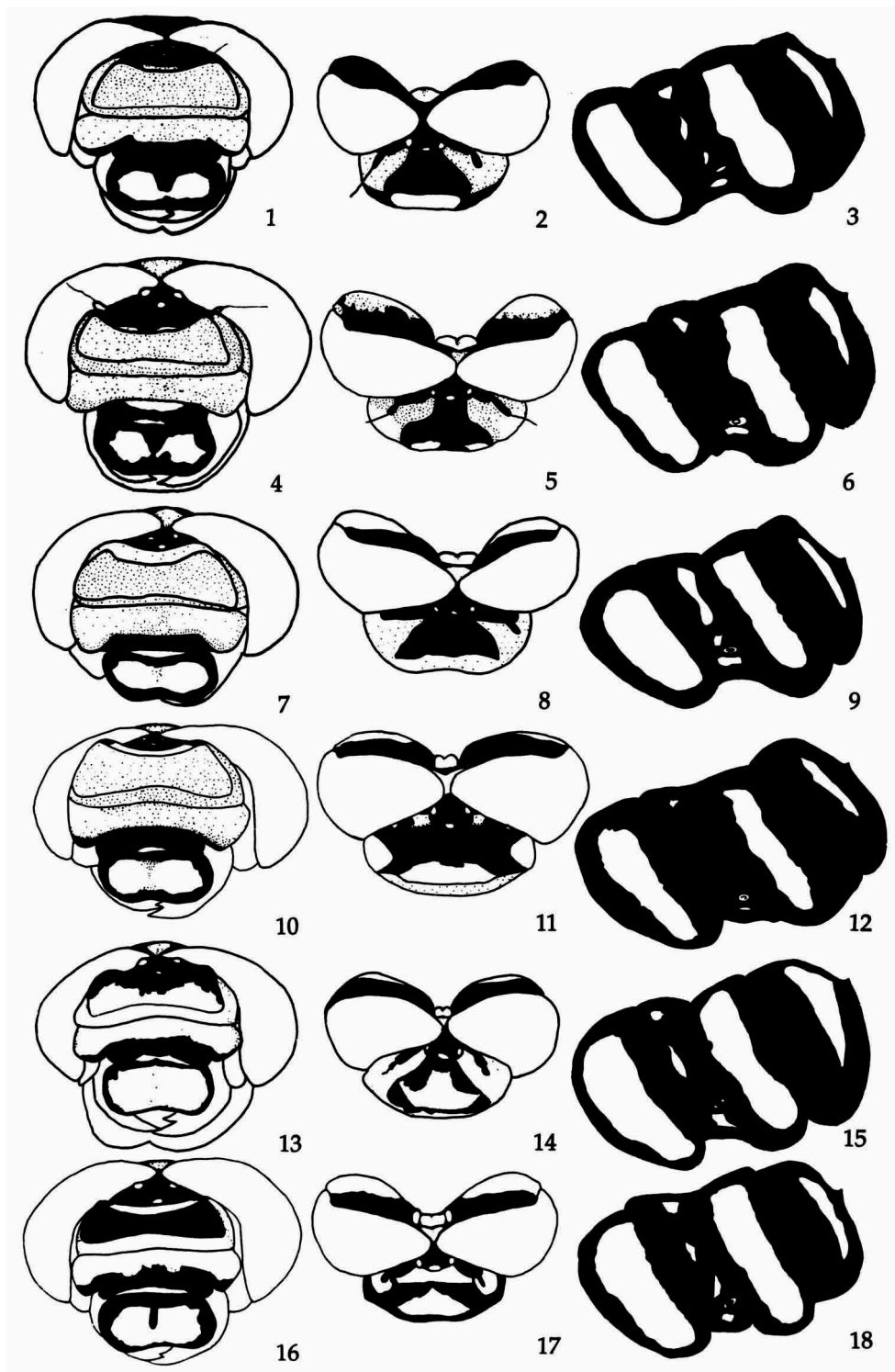
- Asahina, S., 1982a. The larval stage of the Himalayan *Neallogaster hermoniae* (Fraser) (Anisoptera, Cordulegasteridae).— *Odonatologica* 11(4): 309-315.
- Asahina, S., 1982b. A revision of the Himalayan Dragonflies of the Genus *Neallogaster* (Odonata, Cordulegasteridae).— *Bull. natn. Sci. Mus., Tokyo, (A)*, 8(4): 153-171.
- Asahina, S., 1988. Notes on two cordulegastrid dragonflies in the collection of Museum National d'Histoire Naturelle, Paris.— *Proc. Japn. Soc. syst. Zool.* 38: 31-36.
- Chao, H.-f., 1990. The gomphid dragonflies of China (Odonata: Gomphidae).— *Sci & Technol. Publ. House, Fuzhou*. xiv. + 486 pp. (over 1400 texfigs incl.). (Chin. with 31 pp. Engl. s.).
- Cowley, J., 1934. Changes in the generic names of the Odonata.— *Entomologist* 67: 200-205.
- Fraser, F.C., 1927. Descriptions of twenty new Indian dragonflies.— *Rec. Indian Mus.*, 29: 63-90.
- Fraser, F.C., 1929. A revision of the Fissilabioidea, part 1: Cordulegasteridae.— *Mem. Indian Mus.* 9: 69-167, plates ix-xii.
- Fraser, F.C., 1936. *Fauna of British India, Odonata*, III, 461 pp. 2 plates, 1 map. London.
- Kiauta, B. & M.A.J.E. Kiauta, 1976. The chromosomes of some dragonflies from the Langtang Valley, Central Nepal.— *Odonatologica* 5: 347-354.
- Kimmins, D.E., 1966. A list of the Odonata types described by F.C. Fraser, now in the British Museum (Nat. Hist.).— *Bull. Br. Mus.nat. Hist (B)* 18: 175-227.
- Kirby, W.F., 1890. *A Synonymic Catalogue of Neuroptera Odonata or Dragonflies, with an Appendix of Fossil Species*: 1-202. London.

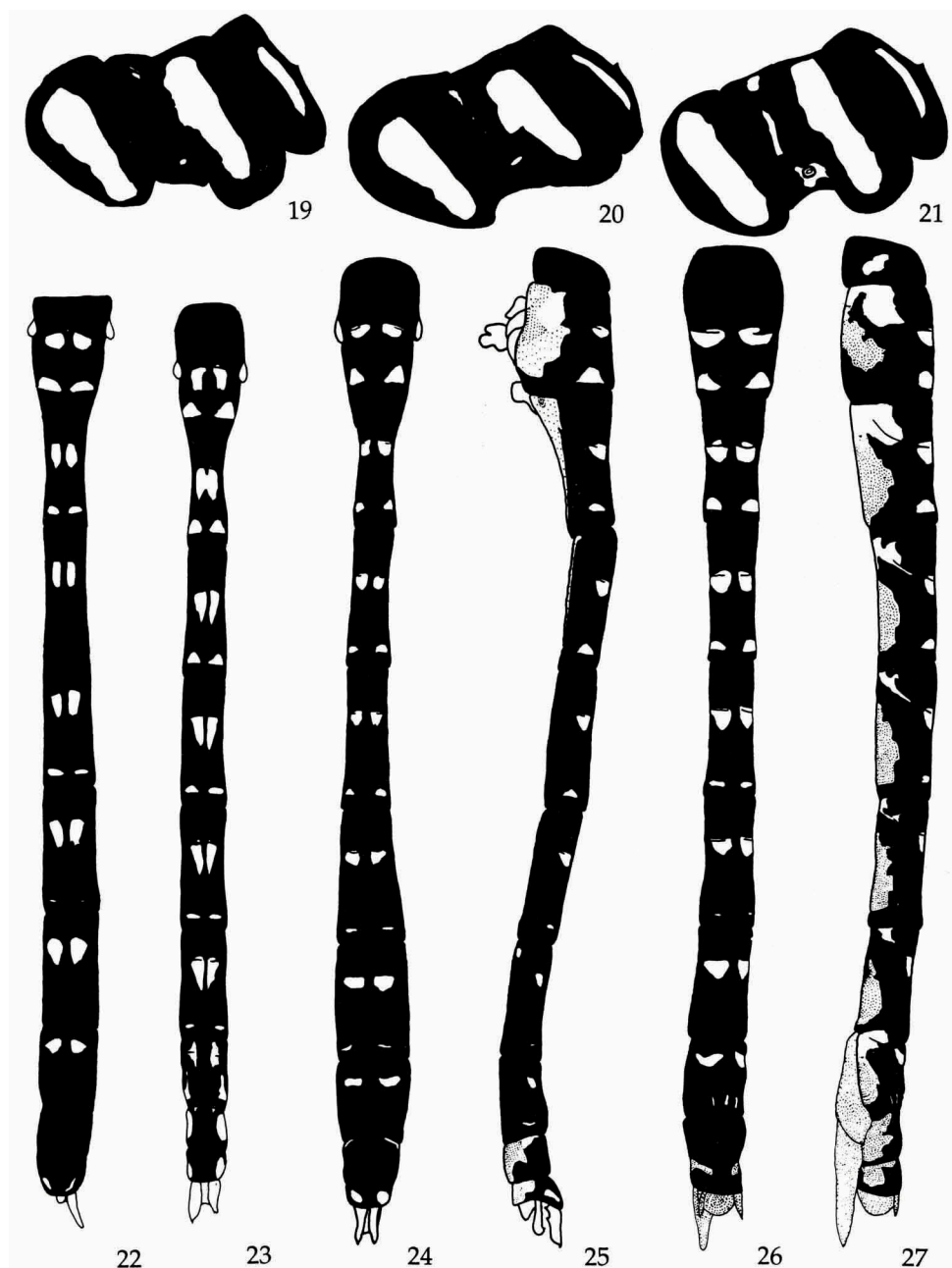
- Leach, W.E., 1815. Entomology. In: D. Brewster, Edinburgh Encyclopaedia 9: 57-172. Edinburgh.
- Lieftinck, M.A., 1939. Six new species of *Gomphus* from China (Odonata).—*Temminckia* 4: 277-297.
- Lohmann, H., 1992. Revision der Cordulegastridae. 1. Entwurf einer neuen Klassifizierung der Familie (Odonata: Anisoptera).—*Opusc. zool. flumin.* 96: 1-18.
- McLachlan, R., 1896. On Odonata from the province of Szechuen, in Western China, and from Moupin, in Eastern Thibet.—*Ann. Mag. nat. Hist. Ser. 6*, 17: 364-374.
- Needham, G.R., 1930. A manual of the dragonflies of China. A monographic study of the chinese Odonata.—*Zoologia Sinica (A)* 11(1): 1-304, 20 plates. Peking.
- Sélys-Longchamps, E. de, 1854. Synopsis des Gomphines.—*Bull. Acad. r. Belg.*, 21: 23-116.
- Sélys-Longchamps, E. de, 1858. Monographie des Gomphines. (Avec la collaboration de H.A. Hagen).—*Mém. Soc. r. Sci. Liège* 11: xxii+408 pp.
- Sélys-Longchamps, E. de, 1873. Synopsis des Gomphines, troisième additions.—*Bull. Acad. r. Belg. (II)* 35: 732-774; 36: 492-531 (4-87 sep.).
- Sélys-Longchamps, E. de, 1878. Synopsis des Gomphines, quatrième additions.—*Bull. Acad. r. Belg. (II)* 46: 408-472, 658-698.
- Sélys-Longchamps, E. de, 1886. Odonates nouveaux de Pékin.—*Annls. Soc. ent. Belg.* 1886: clxxvii-clxxxvi.
- Tangelder, I.R.M., 1988. The Holarctic *Nephrotoma dorsalis* species-group (Diptera, Tipulidae): taxonomy, phylogeny and historical biogeography. Amsterdam.
- Vick, G.S., 1989. List of the dragonflies recorded from Nepal, with a summary of their altitudinal distribution (Odonata).—*Opusc. zool. flumin.* 43: 1-21.
- Wagner, S., 1959. Monographie der ostasiatischen Formen der Gattung *Melanargia* Meigen (Lepidoptera, Satyridae).—*Zoologica, Stuttgart* 108(2): 41-98, figs 23-40.
- Zhou, W., 1988. [A study of Chinese *Anotogaster* Sélys, 1854 and *Neallogaster* Cowley, 1934 (Odonata: Cordulegastridae)].—*J. Hanzhong Teacher's Coll.* 1988(2): 60-62. (Chinese).
- Zhu, H. & F. Han, 1992. A new species of the genus *Cordulegaster* Leach (Odonata: Cordulegasteridae) from Shanxi.—*Entomotaxonomia* 14(1): 18-21. (Chinese with English summary).

Received: 1.iii.1993

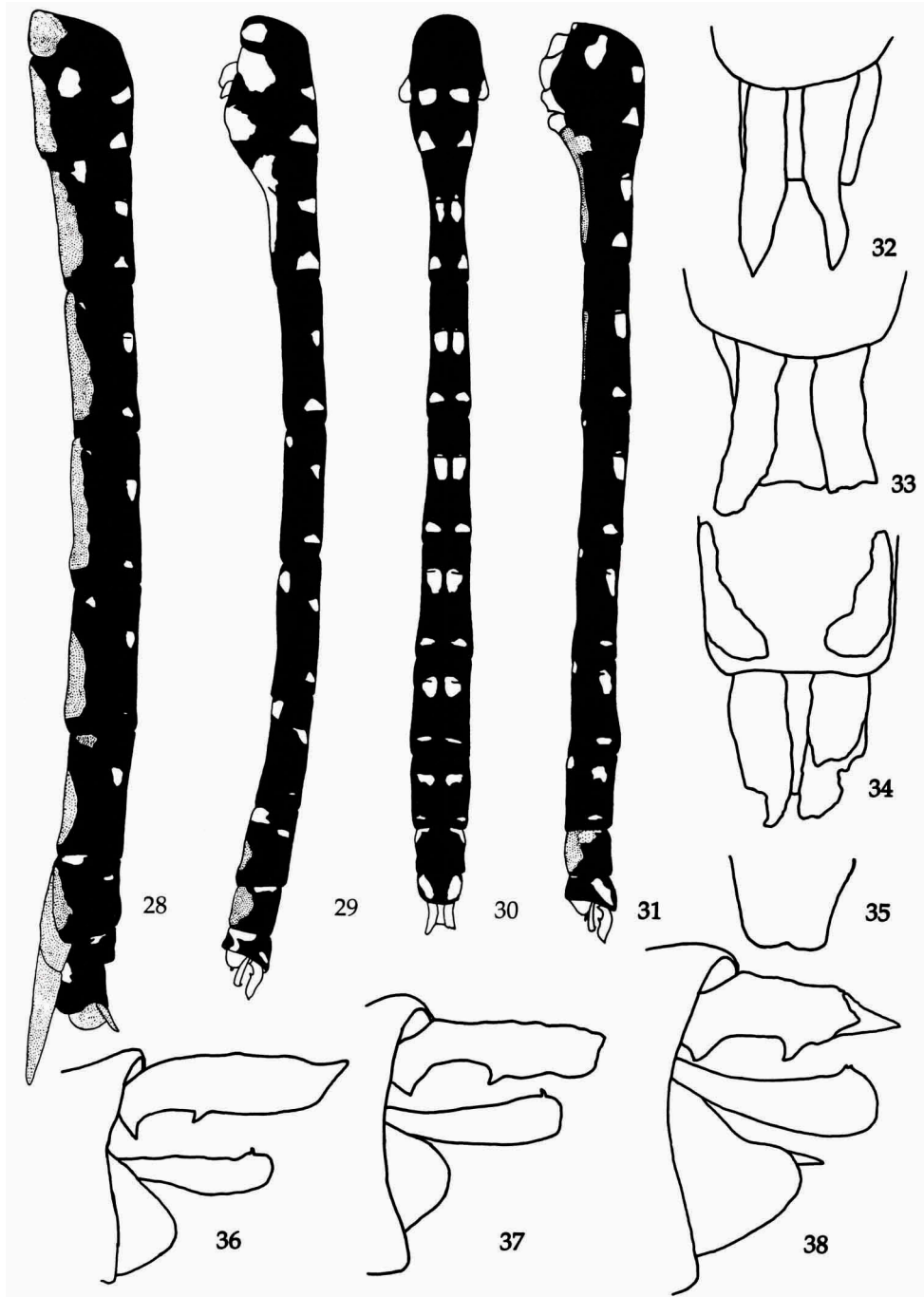
Accepted: 18.iii.1993

Edited: R. de Jong

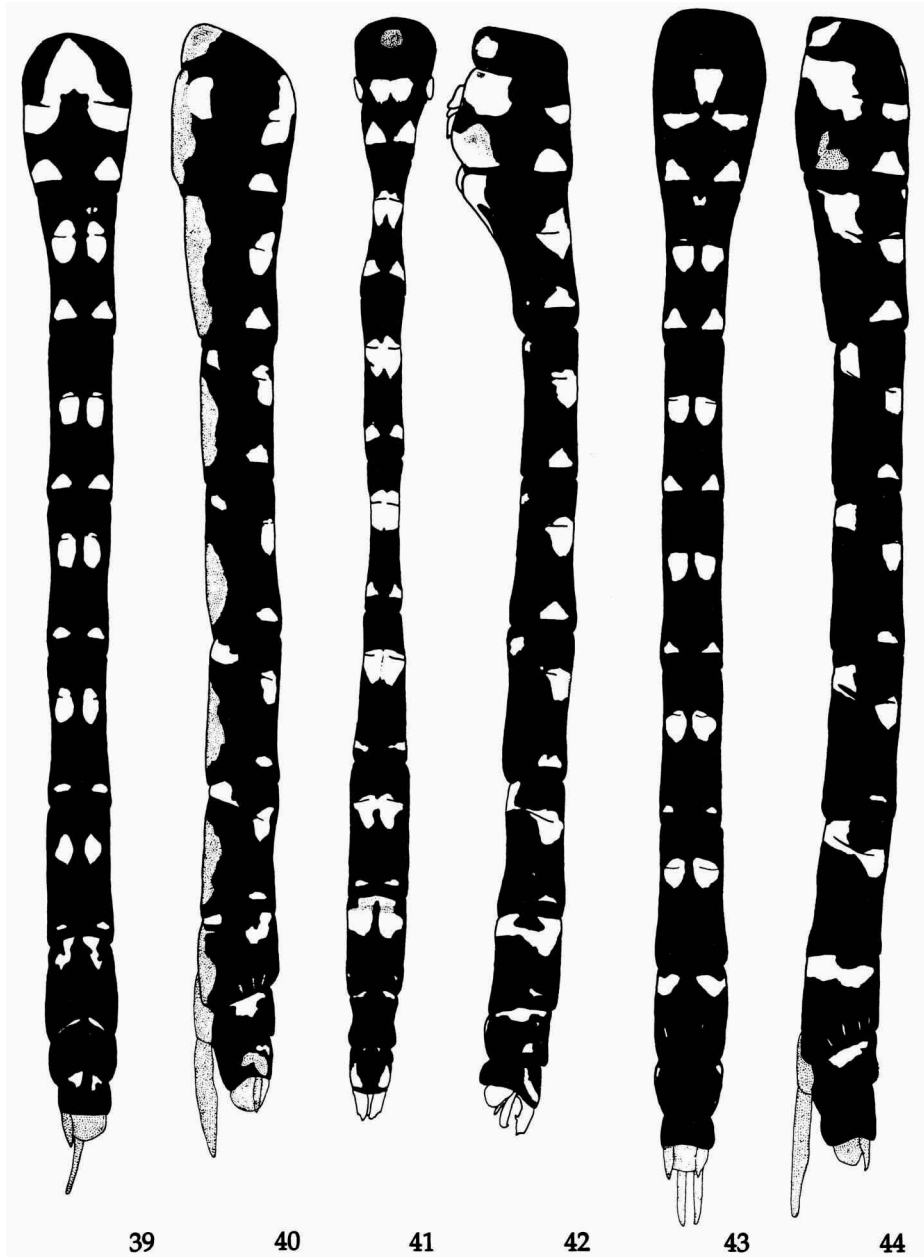




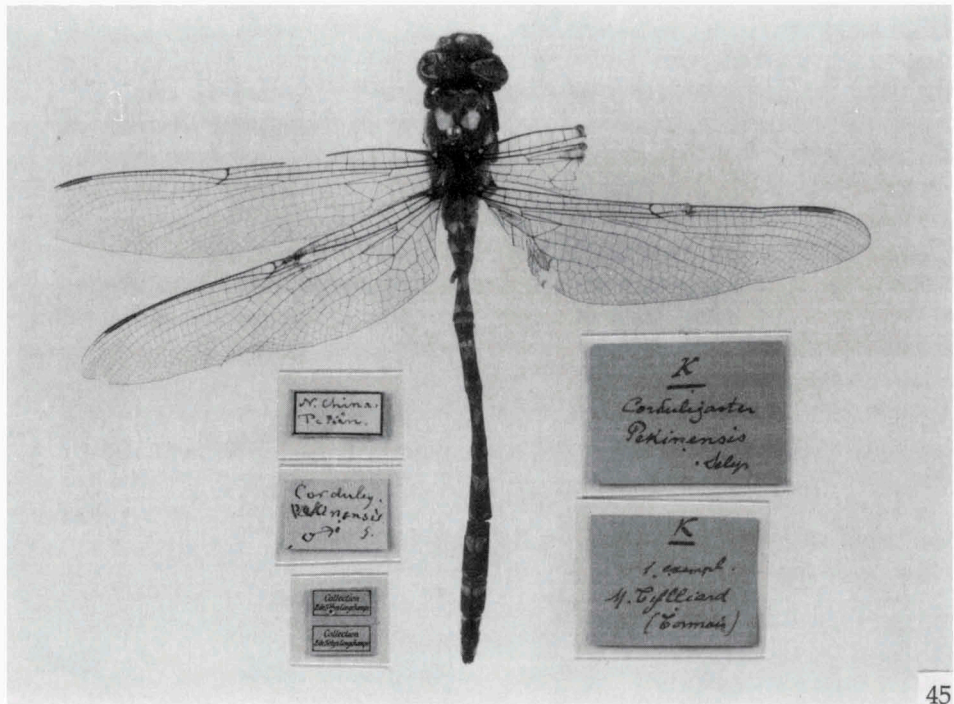
Figs 1-18. *Cordulegaster* spp., head in anterior (slightly left) and dorsal, thorax in right lateral view; 1-12, *C. lunifera* Sélys, 1878; 1-3, ♂ type; 4-6, ♀ type; 7-9, ♂ "Ta-chien-lu"; 10-11, ♀ "Ta-chien-lu"; 12, ♀ "Siao-Lou"; 13-15, *C. pekinensis* Sélys, 1886, ♂ type; 16-18, *C. jinensis* Zhu & Han, 1992, ♀. Figs 19-21. *Neallogaster* spp., thorax right lateral view; 19, *N. hermionae* (Fraser, 1927), ♂ "Baghi"; 20, *N. hermionae* (Fraser, 1927), ♂ "Bhahi"; 21, *N. ornata* Asahina, 1982, ♀ "Molta"; figs 22-23. *Neallogaster* spp., abdomen dorsal view; 22, *N. hermionae* (Fraser, 1927), ♂ "Baghi"; 23, *N. ornata* Asahina, 1982, ♂ "Syabru-Mangsen"; figs 24-27. *Cordulegaster lunifera* Sélys, 1878, abdomen in dorsal and left lateral view; 24-25, ♂ type; 26-27, ♀ type.



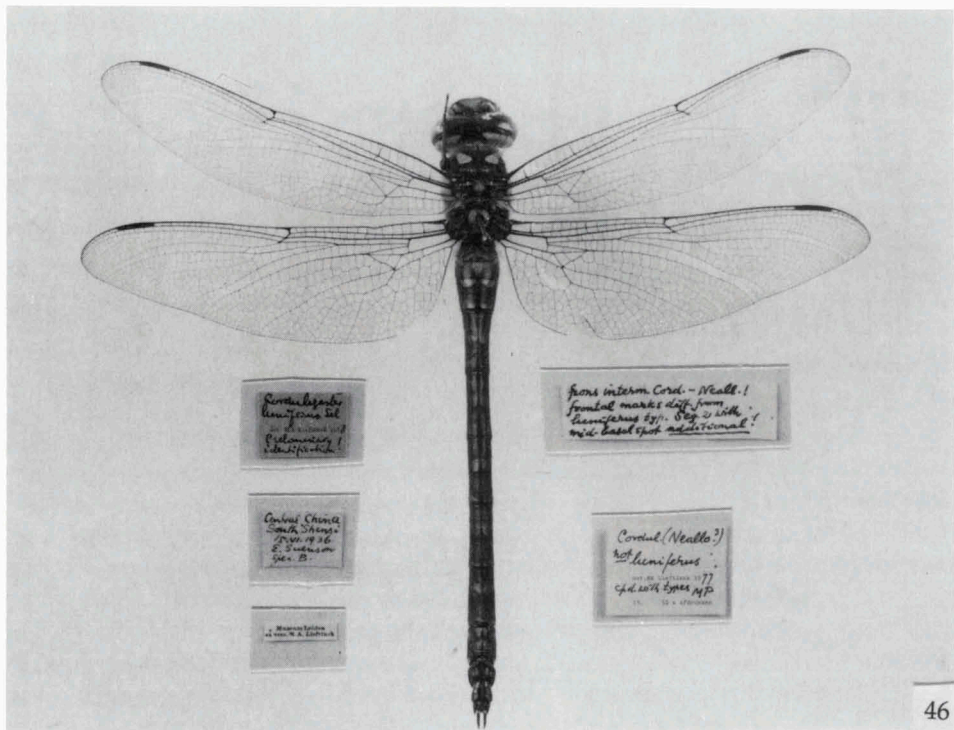
Figs. 28-38 *Cordulegaster* spp; figs 28-29. *C. lunifera* Sélys, 1878, abdomen left lateral view; 28, ♀ "Siao-Lou"; 29, ♂ "Mo-si-mien"; figs 30-31. *C. lunifera* Sélys, 1878, ♂ "Ta-chien-lu", abdomen; 30, dorsal view; 31, left lateral view; figs 32-34. appendages in dorsal view; 32, *C. lunifera* Sélys, 1878, ♂ type; 33, *C. lunifera* Sélys, 1878, ♂ "Ta-chien-lu"; 34, *C. pekinensis* Sélys, 1886, ♂ type; 35, *C. lunifera* Sélys, 1878, ♂ type, inferior appendage; figs 36-38. appendages in left lateral view; 36, *C. lunifera* Sélys, 1878, ♂ type; 37, *C. lunifera* Sélys, 1878, ♂ "Ta-chien-lu"; 38, *C. pekinensis* Sélys, 1886, ♂ type.



Figs 39-44. *Cordulegaster* spp., abdomen in dorsal and left lateral view; 39-40, *C. lunifera* Selys, 1878, ♀ "Ta-chien-lu"; 41-42, *C. pekinensis* Selys, 1886, ♂ type; 43-44, *C. jinensis* Zhu & Han, 1992, ♀.



45



46

Fig. 45. *C. pkinensis* Selys, 1886, ♂ type; 46, *C. jinensis* Zhu & Han, 1992, ♀.