The *Cylindroiulus truncorum*-group (Diplopoda: Julidae)

Z. KORSÓS and H. ENGHOFF

Ent. scand.

Korsós, Z. & Enghoff, H.: The *Cylindroiulus truncorum*-group (Diplopoda: Julidae). *Ent. scand.* 21: 345–360. Copenhagen, Denmark October 1990. ISSN 0013-8711.

The four species of the *C. truncorum*-group are reviewed: *Cylindroiulus truncorum* (Silvestri, 1896), *C. parisiorum* (Brölemann & Verhoeff, 1896), *C. bellus* (Lignau, 1903) and *C. arborum* Verhoeff, 1928. Male gonopods and female vulvae of each species are fully described and illustrated. Non-sexual characters such as developmental stadia, numbers of segments and anal setae, and metazonital sculpture, are also discussed. A key to the species is given, and a new synonymy: *C. costatus* Verhoeff, 1941 = *C. bellus* (Lignau, 1903), is established. As an addendum, *Julus luscus* Meinert, 1868 is reconsidered, and a lectotype is designated.

Z. Korsós, Zoological Department, Hungarian Natural History Museum, H-1088 Budapest, Baross u. 13, Hungary.

H. Enghoff, Zoological Museum, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen, Denmark.

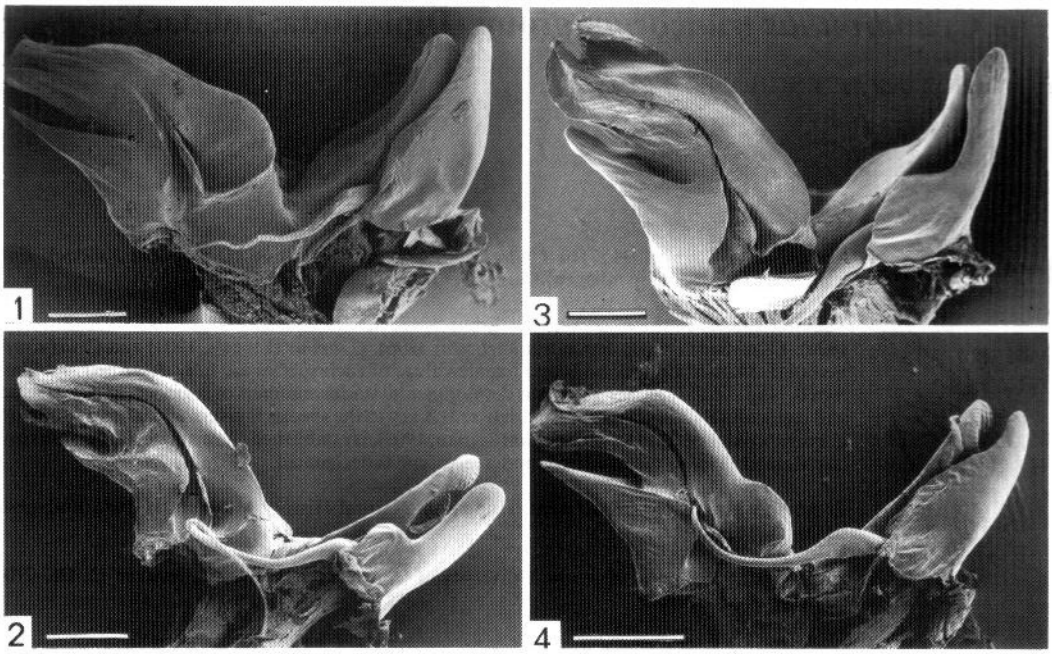
Introduction

The genus *Cylindroiulus* Verhoeff, 1894, as recently defined by Read (1990), is one of the largest genera in the millipede family Julidae, see, e.g., Attems (1927) and Enghoff (1982). Numerous subgenera have been proposed, one of the largest being *Aneuloboiulus* Verhoeff, 1899 (regarded as full genus by Mauriès 1987). The *Cylindroiulus truncorum*-group belongs to *Aneuloboiulus*. The group as such has not been generally recognized, although it was characterized already by Verhoeff (1930). Thus the two group-members occurring in the British Isles (*C. truncorum* (Silvestri, 1896) and *C. parisiorum* (Brölemann & Verhoeff, 1896)) were grouped by Blower (1985) in the so-called "*luscus*-group" which also includes *C. latestriatus* (Curtis, 1845) and *C. britannicus* (Verhoeff, 1891). Whereas the latter two species agree with those of the *C. truncorum*-group in most external characters, they differ in having only 3 setae on each anal valve (cf. below). *C. truncorum* and *C. parisiorum* have at least 5 such setae (with rare exceptions) and furthermore extremely similar gonopods. They share these characteristics with two more eastern species: *C. arborum* Verhoeff, 1928, and *C. bellus* (Lignau, 1903). These four species are very closely related, rarely distinguishable by external characters. They form the subject of the present paper, which includes a detailed comparison of them as well as descriptions and illustrations of male gonopods and female vulvae.

Hoffman (1977, 1979) rightly maintained that in its current conception, the genus in question should be called by the name *Allajulus* C. L. Koch, 1847, rather than the much younger *Cylindroiulus*, and several authors have recently followed Hoffman's suggestion. However, Read's recent analysis (1990) restores *Cylindroiulus* as the valid name for the majority of species, including the *truncorum*-group, formerly assigned to *Allajulus*.

Material and methods

A total of 183 specimens of *Cylindroiulus truncorum* (3 ♀ syntypes, 46 ♂, 114 ♀, 20 juveniles), 11 of *C. parisiorum* (6 ♂, 5 ♀), 16 of *C. bellus* (8 ♂, 8 ♀) and 45 of *C. arborum* (1 ♀ paratype, 21 ♂, 16 ♀, 7 juveniles) has been examined. The numbers of podous segments, of ocelli in the left ocular field, and of setae on the left anal valve, were recorded for most specimens. Midbody vertical diameter was measured to the nearest 0.02 mm, and metazonital structure was observed. Data on the number of podous segments (p.s.), body length (L), and midbody vertical diameter (H) listed in the descriptive notes of each species paragraph, are a combination of literature records and of our own observations, these latter being shown in



Figs 1–4. Right male gonopods in mesal view; flagella, except for *arborum,* have been moved out of the groove: (1) *Cylindroiulus truncorum;* (2) *C. parisiorum;* (3) *C. bellus;* (4) *C. arborum.* Scanning electron micrographs. Scales = 100 μm.

Table 1. Post-embryonic developmental stadia were determined by counting the rows of ocelli (Blower 1970, Enghoff 1982), i.e. stadium number is equal to number of rows plus one. A limited number of specimens was used for closer analysis of male gonopods and female vulvae. Either permanent slides or mounts for scanning electron microscopy (Jeol JSM-840) were made at the Zoological Museum, University of Copenhagen.

Abbreviations: L = body length, H = midbody vertical diameter, p.s. = pedous segments.

Acknowledgements

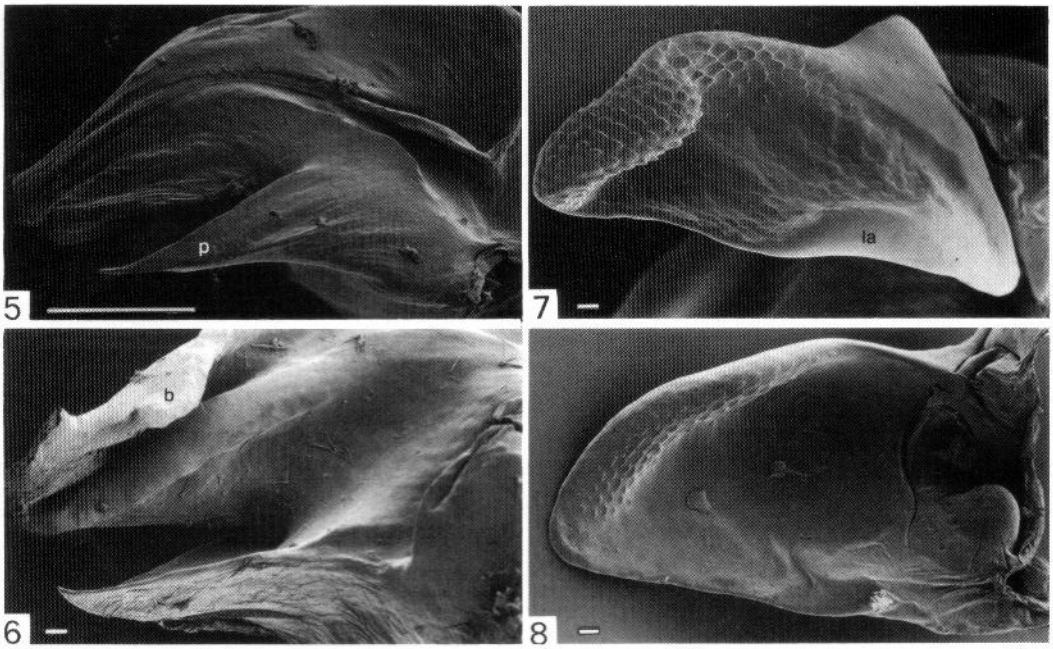
We would like to express our sincere thanks to G. Rack (Hamburg) and W. Jędryczkowski (Warsaw) for loaning/donating material, and J. Gruber (Vienna) for his efforts in trying to find Latzel's "*luscus*" specimens. We are indebted to S. I. Golovatch (Moscow) for calling our attention to *bellus,* and to R. L. Hoffman (Radford) for helping to solve the question of *ignoratus.* Thanks are due to B. W. Rasmussen (Copenhagen) for the scanning electron micrographs. A study tour to Copenhagen (ZK) was granted through the scholarship agreement between the Danish Ministry of Education and the Hungarian Ministry of Culture.

Characterization of the *truncorum*-group

The *truncorum*-group is a distinctive group of species within the genus *Cylindroiulus,* subgenus *Aneuloboiulus.* Verhoeff (1930) was the first to employ the term "die *truncorum*-Gruppe", to which he referred *truncorum, ignoratus* and *arborum.*

The only distinguishing character for the *truncorum*-group given by Verhoeff (1930) was an anteriorly projecting, rounded accessory lamella exteriorly on the mesomerites. This lamella ("la" in Figs 7, 11) is obvious in *truncorum, parisiorum* and *arborum,* but not in *bellus.* The absence of the lamella in *bellus* may explain why Verhoeff (1941), when he described *costatus* (a synonym of *bellus*) did not include this species in the *truncorum*-group, although he specifically mentioned the similarity of *costatus* gonopods to *truncorum, parisiorum,* and *arborum.* Strasser (1966) opposed *bellus* to the species of the *truncorum*-group because of the lack of a mesomerital lamella in the former species.

However, in light of the great overall similarity between the four species involved, it seems better to broaden the definition of the *truncorum*-group slightly. We thus understand the *truncorum*-group to include four species: *truncorum, parisiorum* (= *ignoratus*), *arborum,* and *bellus* (= *costatus*). Two



Figs 5–8. Male gonopods of *Cylindroiulus truncorum:* (5) right opisthomerite, mesal view; (6) left opisthomerite, lateral view; (7) left mesomerite, anterior view; (8) left promerite, posterior view. Scanning electron micrographs. Scales = 100 μm (5), 10 μm (6–8).

gonopodal characteristics may serve as diagnostic characters, probably even autapomorphies, of the *truncorum*-group:

1. The oblique crest running from anterior basis to posterior apex of the lateral side of the opisthomerite ("c" in Figs 10, 14). This crest was termed a false phylacum by Verhoeff (1930).

2. The apical-anterior, laterally bent brachite on the opisthomerite ("b" in Figs 6, 10).

The gonopods in the *truncorum*-group further agree in the presence of a well-developed paracoxal process ("p" in Fig. 5). Such processes, however, occur in numerous other *Cylindroiulus*-species. Also in characters of the female vulvae the four species in the *truncorum*-group are very much alike: the comparatively narrow operculum is devoid of setae, and the (sub-)spherical receptaculum seminis is connected to the surface through a coiled apodematic tube. In somatic characters the species in the *truncorum*-group agree with many other species of subgenus *Aneuloboiulus* in being small (< 22 mm long, < 1.6 mm in diameter), brownish, and without a preanal projection (Fig. 31). They differ from most of these in the enlarged number of setae (5–17, very rarely < 5 in adults) on each anal valve.

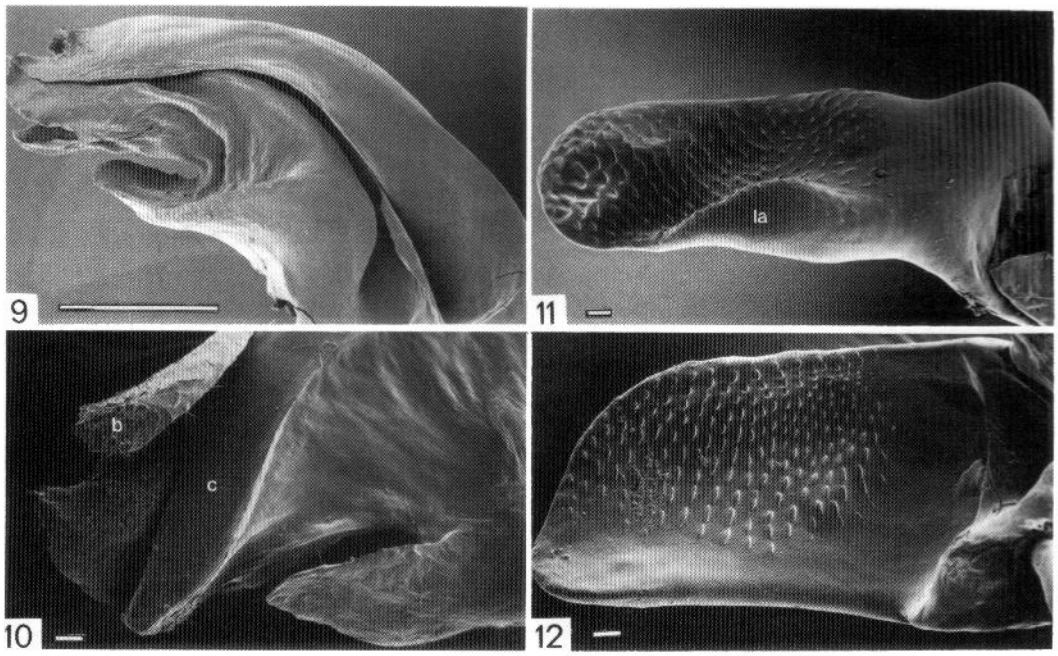
The species of the *truncorum*-group

Cylindroiulus truncorum (Silvestri, 1896)

(Figs 1, 5–8, 21, 30, 31)

Diploiulus truncorum Silvestri, 1896: 160.
Iulus (Anoploiulus) africanus Brölemann, 1897: 271 (synonymized by Attems 1927 (?)).
Cylindroiulus truncorum: Attems 1908: 112.
Cylindroiulus luscus salicis Verhoeff, 1926: 126.
Cylindroiulus salicis: Verhoeff 1928 (synonymized by Verhoeff 1930).
Cylindroiulus truncorum var. *striatulus* Schubart, 1931: 163 (synonymized by Schubart 1934).

Material examined. – TUNISIA: Tunis, Ain-Draham, 3 ♀ 1987, F. Silvestri leg. (syntypes of *truncorum,* Hung. Nat. Hist. Mus. Budapest). GERMANY: Berlin, hothouse, 1 ♀ (Zool. Inst. Mus. Hamburg). DENMARK: København, numerous samples, 30 ♂, 73 ♀, 15 juv. (Zool. Mus. Univ. Copenhagen). ALGERIA: Bona, 16 ♂, 39 ♀, 4 juv. (Zool. Mus. Univ. Copenhagen). PORTUGAL: Madeira Isl., Funchal, 1 ♀, 1 juv. 16. xi. 1980 (Zool. Mus. Univ. Copenhagen).



Figs 9–12. Male gonopods of *Cylindroiulus parisiorum:* (9) right opisthomerite, mesal view; (10) left opisthomerite, lateral view; (11) left mesomerite, anterior view; (12) left promerite, posterior view. Scanning electron micrographs. Scales = 100 μm (9), 10 μm (10–12).

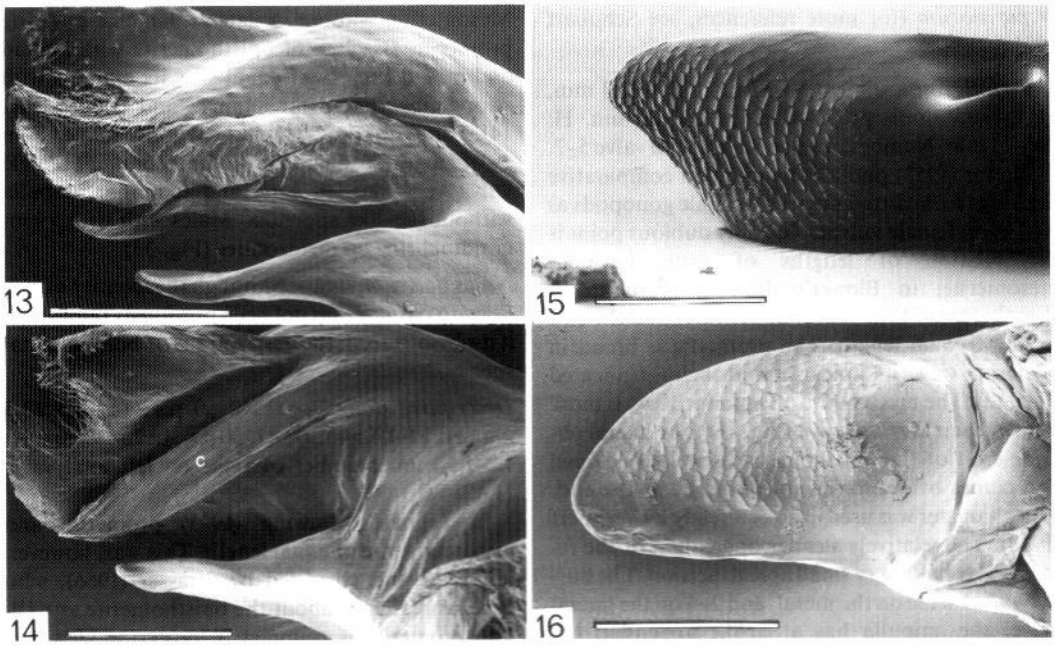
Diagnosis. – Promerite of male gonopods slightly longer than mesomerite, without a deep mesal incision. Opisthomerite with laterad bent smooth brachite, without hairs or protuberances. Paracoxal process long, slender and pointed, almost reaching end of solenomerite. Bursa of female vulva with 13–14 setae, ampulla with saclike appendix opposite to apodematic tube. Most males with characteristic metazonital structure (Fig. 30).

Notes on synonymy. – Attems (1927) listed *africanus* as a synoym of *truncorum,* but we have been unable to find out, whether he was the first to synonymize these two names. Brölemann (1921) included both species in his list of North African myriapods. Verhoeff (1926) described the subspecies *salicis* of what he thought to be Latzel's *Julus luscus.* It was elevated by him to species rank in 1928, but later he admitted that *salicis* is a junior synonym of *truncorum* (Verhoeff 1930). The variety *striatulus* refers to those males which have female-like, unspecialized metazonital sculpture (see below).

Descriptive notes. – ♂: 31–47 p.s., L: 10–17 mm, H: 0.9–1.3 mm. ♀: 31–50 p.s., L: 11–17 mm, H: 1.0–1.5 mm. Number of setae on left anal valve 3–17.

Schubart's drawing and description (1934) are quite satisfactory for this species. The promerite is broad and rounded in posterior view, with large, smooth posterior surface (Fig. 8), and has no deep mesal incision, unlike *parisiorum* and *bellus* (Fig. 1). The mesomerite has a conspicuous distal "hook" on its anterior side (Fig. 7). The lateral oblique crest on the posterior part of opisthomerite is not so strong as in *parisiorum* and *bellus* and is not separated from the end of solenomerite, as it is figured by Silvestri (1986) and Attems (1908). The operculum of the vulva is broad, almost parallel-sided. The bursa has 5–7 setae on the mesal and 7–8 on the lateral valve; the ampulla has a sac-like appendix; the coils of the apodematic tube are complicated (Fig. 21).

Distribution and biology. – Originally described from North Africa (Tunisia and Algeria), but also known from many countries in north and northwest



Figs 13–16. Male gonopods of *Cylindroiulus bellus:* (13) right opisthomerite, mesal view; (14) left opisthomerite, lateral view; (15) left mesomerite, anterior view; (16) left promerite, posterior view. Scanning electron micrographs. Scales = 100 μm.

Europe (probably introduced in most of these): there are records from France, Belgium, Holland, the British Isles, Denmark, Germany, Switzerland, Poland, Sweden and the European part of the USSR. Introduced also into Madeira (Demange 1970), the Canary Islands (HE, unpublished), the USA and Brazil (Schubart 1934, Blower 1985). Its habitats are mainly synanthropic: greenhouses, gardens, parks, etc.

Cylindroiulus parisiorum (Brölemann & Verhoeff, 1896)

(Figs 2, 9–12, 22, 32)

[*Julus latestriatus* Curtis, 1845 (in part): Blower 1953.]
[*Julus luscus* Meinert, 1868: sensu Latzel 1884: 283.]
Iulus (Anoploiulus) parisiorum Brölemann & Verhoeff, 1896: 214.
Cylindroiulus parisiorum: Brade-Birks & Brade-Birks 1918.
Cylindroiulus ignoratus Attems, 1927: 199 (synonymized by Blower 1957, Bielak 1965).

Material examined. – DENMARK: København, 4 ♂, 4 ♀; Lolland, Krenkerup, 1 ♂ 1976; Suserup Skov, 1 ♂ 16. v. 1979; Lekkende Skov, 1 ♂ 19. xi. 1972 (Zool. Mus. Univ. Copenhagen).

Diagnosis. – Promerite of male gonopods equal in length to mesomerite, with a deep incision on mesal side, delimiting a broad lobe at basis of promerite (Fig. 2). Opisthomerite with definite, laterad bent brachite, with slightly structured surface (Fig. 10). Paracoxal process bulky and blunt, shorter than in other group-members, not reaching ¾ of length of solenomerite. Operculum of female vulva tapering, apodematic tube of bursa a simple spiral (Fig. 22, and also Blower 1953). Metazonital sculpture of both sexes unspecialized (Fig. 32).

Notes on synonymy. – The identity of the original material of Curtis (1845) was clarified by Blower (1953). The role of *Julus luscus* Meinert, 1868, a name involved here as well as with *arborum,* is discussed later in this paper. *Cylindroiulus ignoratus* is, based on Attems' (1927) original drawings, clear-

ly *parisiorum* (for more references, see Schubart 1931a).

Descriptive notes. – ♂: 30–37 p.s., L: 8–12.3 mm, H: 0.7–0.9 mm. ♀: 30–43 p.s., L: 9–15 mm, H: 0.9–1.1 mm. Number of setae on left anal valve 5–7.

Blower (1953) published very good comparative drawings from different views on male gonopods as well as on female vulvae. The only dubious point is the relation of lengths of promerite and mesomerite: in Blower's drawing promerite is slightly longer than mesomerite, we found the two to be of equal length. The promerite is broad in posterior view, its apical margin being truncated (Fig. 12). The mesomerite, in anterior view, is more slender than in *truncorum* (Fig. 11). The lateral oblique crest of the opisthomerite is well-developed and comes off from the solenomerite at the end. This character was used in a key already by Verhoeff (1930). The relatively slender operculum of the female vulva has a very small apical incision. The bursa has 3–4 setae on the mesal, and 2–4 on the lateral valve; the ampulla has a saclike appendix; the apodematic tube is characteristically spiralled (Fig. 22).

Distribution and biology. – A rare species, being sporadically recorded from most of Europe: France, Belgium, Holland, the British Isles, Jersey, Danmark, Germany, Austria, Italy, Yugoslavia, Czechoslovakia, Poland and the USSR (Blower 1953, 1985). Also recorded from the African island Saint Helena, on the basis of a single female (Hoffman 1977) (misidentification of the more widespread *truncorum*?). It is mainly confined to greenhouses, graveyards, parks and similar places: a synanthropic species.

Cylindroiulus bellus (Lignau, 1903)

(Figs 3, 13–16, 23, 33)

Julus bellus Lignau, 1903: 107.
Cylindroiulus bellus: Lohmander 1939.
Cylindroiulus (Aneuloboiulus) costatus Verhoeff, 1941: 6, **syn.n.**
Cylindroiulus (Aneuloboiulus) bellus: Strasser 1966: 354.

Material examined. – TURKEY: Nilic ormani, 6 ♂, 7 ♀ 2.vii.1949, Kosswig leg.; Istanbul, 2 ♂, 1 ♀ 18.iii.1950. (Zool. Inst. Mus. Hamburg).

Diagnosis. – Slightly larger than other group-members (Figs 27–28). Promerite of male gonopods slightly longer than mesomerite, with a deep mesal incision delimiting a basal lobe (Fig. 3). Mesomerite without a lateral lamella covering promerite. Brachite of opisthomerite with laterad and mesad flanges of equal size, its margins with strong fingerlike protuberances and fringes (Fig. 14). Paracoxal process relatively long, longer than ¾ of length of solenomerite. Operculum of female vulva very slender, long and tapering, ampulla without sac-like appendix. Males with strong longitudinal ribs on metazonites (Fig. 33).

Notes on synonymy. – Although the identity of *bellus* with *costatus* has not been previously published, it is obvious from the descriptions of both nominal species.

Descriptive notes. – ♂: 42–50 p.s., L: 14.5–23.5 mm, H: 1.1–1.5 mm. ♀: 47–50 p.s., L: 20–22 mm, H: 1.2–1.5 mm. Number of setae on left anal valve 11–17.

In Lignau's drawing (1903) promerite and mesomerite are of equal length. This was, however, discussed and corrected by Strasser (1966), who gave more details about the opisthomerite as well. The promerite is rounded in posterior view like *truncorum* (Fig. 16). The mesomerite is broad in anterior view (Fig. 15) without a lateral lamella. The lateral oblique crest on the opisthomerite is well-developed and sometimes apically separated from the end of the solenomerite (Fig. 13). The operculum of female vulva is very narrow; the bursa has 5 and 5–7 setae on the lateral and mesal valve, respectively. The number of setae on the mesal valve is usually higher than that on the lateral one, in contrast to the other three species.

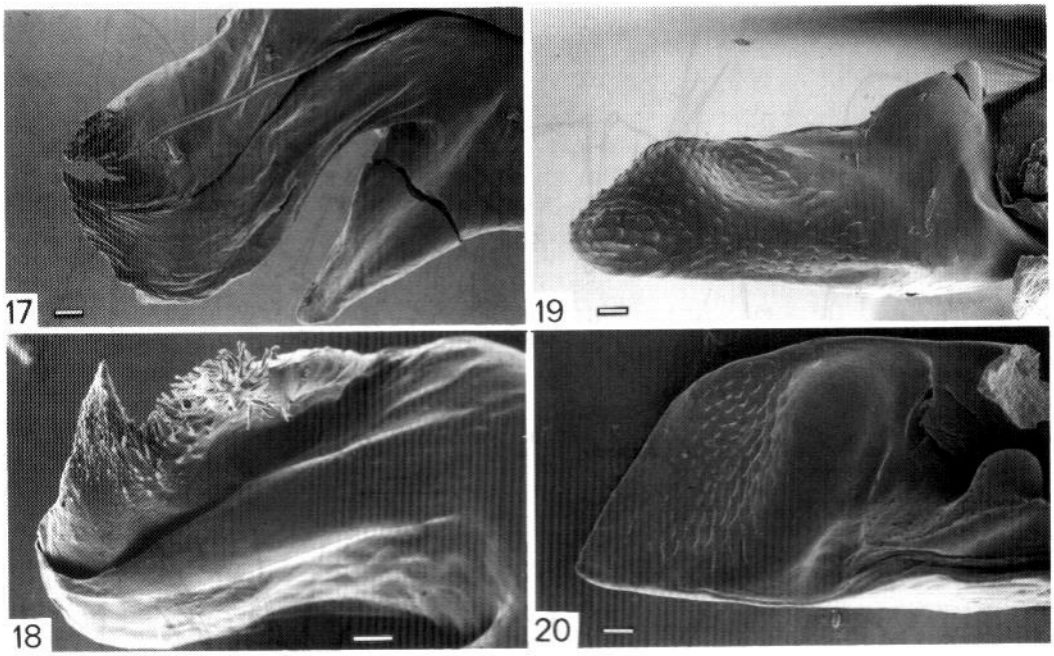
Distribution and biology. – Described from the Western Caucasus, USSR, and later recorded from quite a coherent range: Turkey (Anatolia, Bosporus) (Lohmander 1939, Verhoeff 1941), and Southeast-Bulgaria (Mts. Strandzha) (Strasser 1966). It seems to occur in natural woodland habitats (Lignau 1903).

Cylindroiulus arborum Verhoeff, 1928

(Figs 4, 17–20, 24)

[*Julus luscus* Meinert, 1868: sensu Verhoeff 1899, 1907.]
[*Cylindroiulus luscus:* sensu Verhoeff 1926.]
Cylindroiulus arborum Verhoeff, 1928: 291.
Cylindroiulus arborum: Schubart 1960: 583.
Cylindroiulus arborum var. *dentata* Strasser, 1966: 353.

Material examined. – HUNGARY: 1 ♀ (paratype, Zool. Inst. Mus. Hamburg). POLAND: rez. Chetmowa, 19 ♂, 14 ♀, 7 juv. 22.x.1981, W. Jedryczkowski leg.; Warsaw, greenhouse 2 ♂, 2 ♀ 10.iii.1985, H. Jawlowski leg. (Zool. Mus. Univ. Copenhagen).



Figs 17–20. Male gonopods of *Cylindroiulus arborum:* (17) right opisthomerite, mesal view, paracoxal process has been broken during preparation; (18) left opisthomerite, lateral view, paracoxal process has been omitted; (19) left mesomerite, anterior view; (20) left promerite, posterior view. Scanning electron micrographs. Scales = 10 μm.

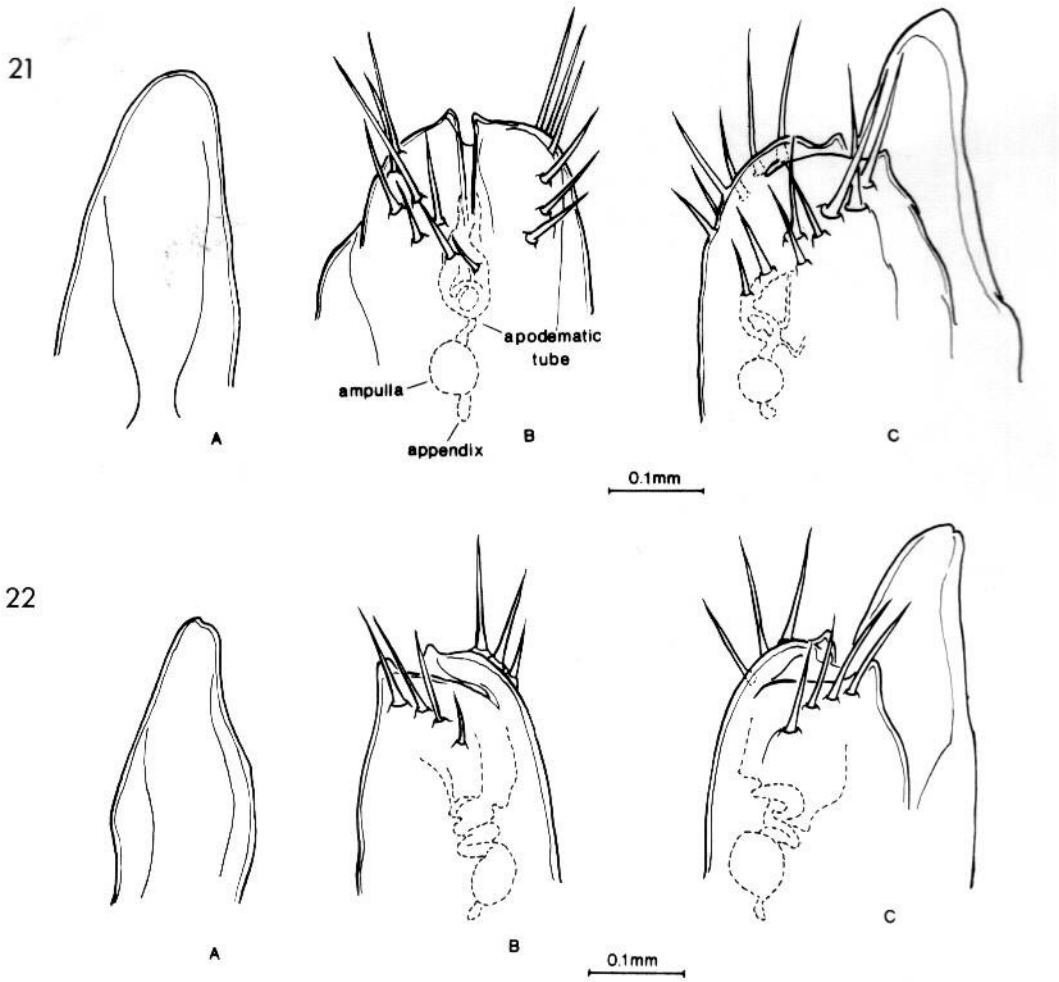
Diagnosis. – Slightly smaller than other group-members (Figs 27–28). Promerite and mesomerite of male gonopods of more or less equal length; opisthomerite with triangular apical projection behind a laterally bent spinose brachite (Fig. 18). Paracoxal process apparently short, being thick and broad at its basis (Fig. 17), but longer than ¾ of the length of the solenomerite. Operculum of female vulva broad and short, bursa with 6–8 setae. Metazonital sculpture of both sexes unspecialized (as Fig. 32).

Notes on synonymy. – *Cylindroiulus arborum* is a replacement name for *Julus luscus* sensu Verhoeff (1899, 1907, 1926, 1928). For more details about *Julus luscus* Meinert, 1868, see final section of this paper. A list of synonymies was published by Schubart (1960), his findings from a cave in France, however, being not considered as *arborum* by Strasser (1966). This latter author at the same time distinguished a variety from the surroundings of Sofia (Bulgaria), the males of which have a small tooth on their brachite.

Descriptive notes. – ♂: 32–39 p.s., L: 8–10 mm, H: 0.7–0.8 mm. ♀: 32–43 p.s., L: 9–12.5 mm, H: 0.8–1.1 mm. Number of setae on left anal valve 2–7.

No good illustration of the male gonopods exists. Those of Schubart (1934, 1960) are inaccurate, not emphasizing the important diagnostic triangle at the end of solenomerite. The promerite is short and broad in posterior view, subtrapeziform, truncated at the end (Fig. 20), without a deep mesal incision (Fig. 4). The mesomerite is slender in anterior view (Fig. 19), and has the lateral lamella partly covering the promerite in situ. The opisthomerite has a well-developed oblique crest which is curved slightly distad. On the edge of solenomerite in front of the characteristic triangle, there is a laterally bent projection with a group of fingerlike fringes (Fig. 18). At the top of the operculum of female vulva there is a small incision (Fig. 24, and also Bielak 1965). The number and arrangement of setae on the bursa is as in *parisiorum.* The ampulla has a sac-like appendix opposite to the apodematic tube.

Distribution and biology. – A central and eastern



Figs 21–22. Female vulvae: (A) right operculum, anterior view; (B) right bursa, posterior (21) and postero-lateral (22) view; (C) left vulva, postero-lateral view: (21) *Cylindroiulus truncorum;* (22) *C. parisiorum.*

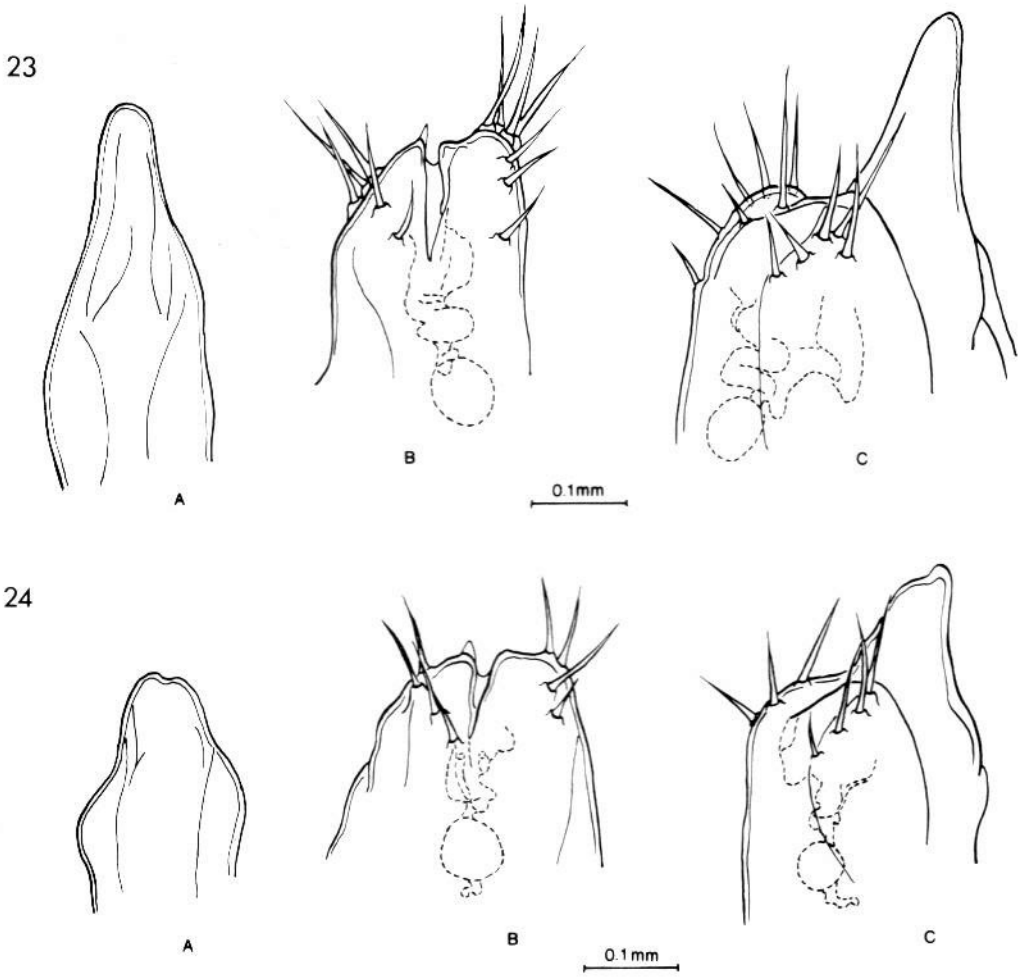
European species, occurring in Germany, Czechoslovakia, Poland, USSR, Hungary, Rumania and Bulgaria. Little is known about its biology, but it seems to be found mainly in forests, sometimes in man-made habitats as well (Schubart 1934).

Analysis of characters

Post-embryonic development

The studied material is insufficient for a proper analysis of the postembryonic development. However, some characters pertaining to the postembryonic development, and of potential taxonomic value, can be extracted from the data.

Developmental stadium of mature specimens. – In species of the *truncorum*-group, the developmental stadium of an individual is easily determined by counting the rows of ocelli and adding one. The most frequent stadium of mature specimens of the four species is shown in Table 1, together with the total range of stadia. It may be noted that in *parisiorum,* males appear in an earlier stadium than females, as is commonplace in Julidae (Blower 1985).



Figs 23–24. Female vulvae: (A) right operculum, anterior view; (B) right bursa, posterior view; (C) left vulva, postero-lateral view: (23) *Cylindroiulus bellus;* (24) *C. arborum.*

In spite of wide overlap, there are indications of interspecific differences in stadium number of mature males. Thus, 81% of the *arborum* males are stadium 7, 43% of *truncorum* and 66% of *parisiorum* males, stadium 8, and 63% of *bellus* males, stadium 9. In *truncorum,* a few females belong to very high stadia (2 ♀ : stadium 11; 2 ♀ : stadium 13; 1 ♀ : stadium 14). This agrees with a general tendency in *Cylindroiulus*: whereas males die after having reached maturity, females may moult into further mature stadia (Blower & Gabbutt 1964, Blower 1969, Enghoff 1982). The absence of females in high stadia in the other three species may be due to the small sample size. Summarizing, the stadium number is useless as a taxonomic character in the *truncorum*-group.

Number of podous segments according to stadia. – Whereas the number of podous segments per se is a dubious character in julids, when it is related to the developmental stadium of the specimen it may be taxonomically useful (e.g., Enghoff 1982). Fig. 25 shows segment number as a function of stadium number in the studied material. When for instance the number of segments in stadium 10 is considered, the material suggests interspecific differences

Table 1. Numerical characteristics of the species of the *truncorum*-group.

		truncorum	*parisiorum*	*bellus*	*arborum*
podous segments	♂	32–45	31–34	39–50	32–36
	♀	33–49	37–42	42–48	32–39
eyes in the left ocular field	♂	17–36	17–26	21–36	16–38
	♀	18–57	25–38	25–39	15–34
body diameter (mm)	♂	1.00–1.40	0.80–0.86	1.10–1.52	0.66–0.74
	♀	1.00–1.50	1.10–1.18	1.20–1.56	0.82–0.94
maturity (stadium)	♂	8 (7–10)	8 (7–8)	9 (7–10)	7 (7–8)
	♀	8 (6–15)	9–10 (8–10)	9 (8–10)	7 (6–10)
setae on left anal valve		7–8 (3–17)	5–7	11–17	5–7 (2–7)
setae on bursa (lateral/mesal)		13–14 7–8/5–7	6–8 2–4/3–4	10–12 5/5–7	6–8 2–4/3–4

(*truncorum:* 43–47, *parisiorum:* 40–42, *bellus:* 48–50, *arborum:* 39 segments). The difference between *arborum* and *parisiorum* on one side and *bellus* on the other appears significant, whereas *truncorum* (which is the only species represented by many individuals) bridges the gap. The full range of podous segments of mature specimens is shown in Table 1.

Number of ocelli according to stadia. – In the number of ocelli of the left ocular field plotted against stadia (Fig. 26) we could not find significant differences in the four species. In stadium 8, for instance, all four species have specimens with 25–30 ocelli on one side. See also Table 1.

Other somatic characters

Body diameter. – Body diameter as a function of number of segments is a potentially useful taxonomic character in juliformian millipedes. Figs 27 and 28 shows this relationship of the four species separately for adult males and females. Specimens of *arborum*, having low segment numbers and thin bodies, are well separated from those of *bellus* which are many-segmented and thick; *truncorum* and *parisiorum* are in intermediate positions, but nearer to *bellus*.

Number of anal setae. – The number of anal setae of each anal valve has for a long time been considered an important character separating the members of the *truncorum*-group. Schubart (1934) enumerated 5–6 (on one side) for *arborum* and *truncorum* and 3 for *parisiorum;* Blower (1985) corrected the number in *parisiorum* to "more than five", and counted 7–12 setae in *truncorum*. (See also Introduction). Our data (Fig. 29, Table 1) support the current view that species of the *truncorum*-group have more than 5 setae per anal valve, although there are a few exceptions (2 out of 134 mature *truncorum* and 3 out of 36 mature *arborum* had only 2–4 setae on the left anal valve). *C. bellus* with 11–17 setae is clearly separated from *parisiorum* and *arborum* (2–7 setae). *C. truncorum* (large material) again bridges the gap (3–17 setae).

Metazonital structure. – Already in the original descriptions of *truncorum* and *bellus,* and its synonym *costatus* (Silvestri 1896, Lignau 1903, Verhoeff 1941), the characteristic metazonital surface with longitudinal ribs in adult males was emphasized (Figs 30 and 33). Although transitions do occur, it is in general easy to decide whether a particular specimen shows such a ribbed pattern or not. Of the four species, neither *parisiorum* nor *arborum* has this feature, but in the males (and only in the males) of *bellus* it is most striking. In *truncorum,* the usual situation is the same. We have found, nevertheless, missing ribs in 3 of 42 adult *truncorum* males ("var. *striatulus*"), and ribs were present in 1 of 112 mature females.

Genital characters

Male gonopods. – The gonopods of the four species are relatively well-known, but we have been able to add a few details, e.g., the characteristic tri-

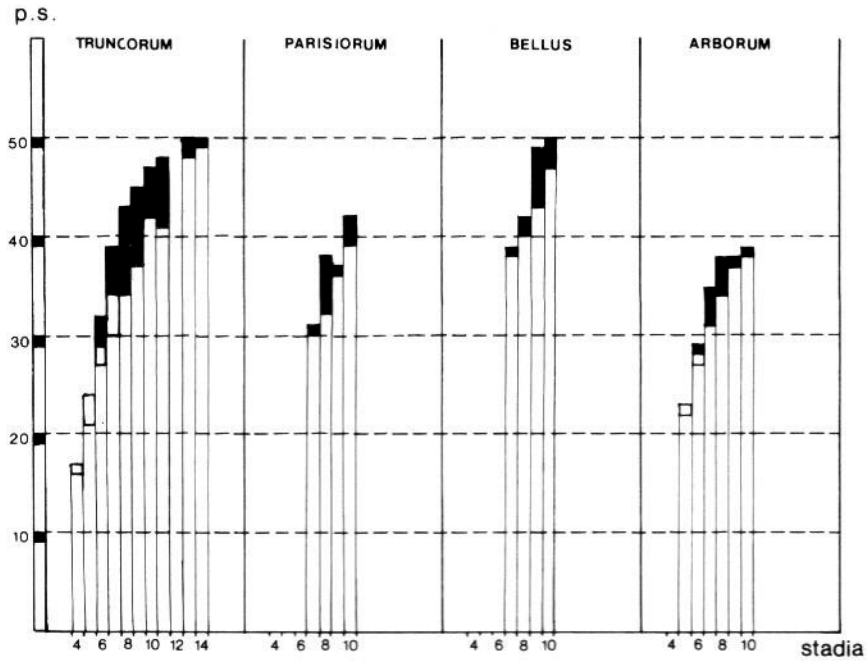


Fig. 25. Number of podous segments in each stadium. Black columns indicate mature animals.

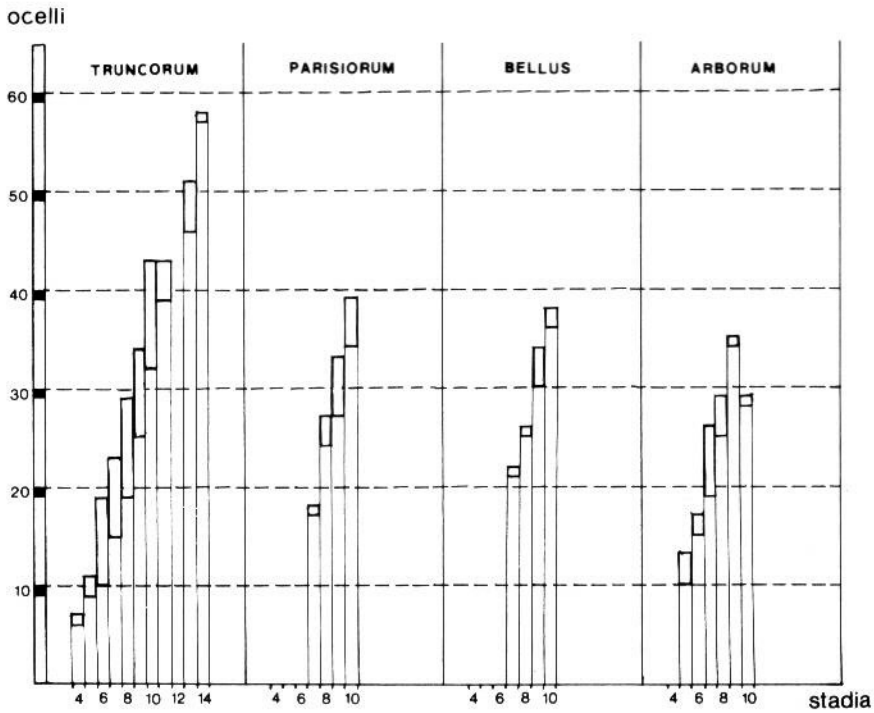


Fig. 26. Number of ocelli in the left ocular field in each stadium.

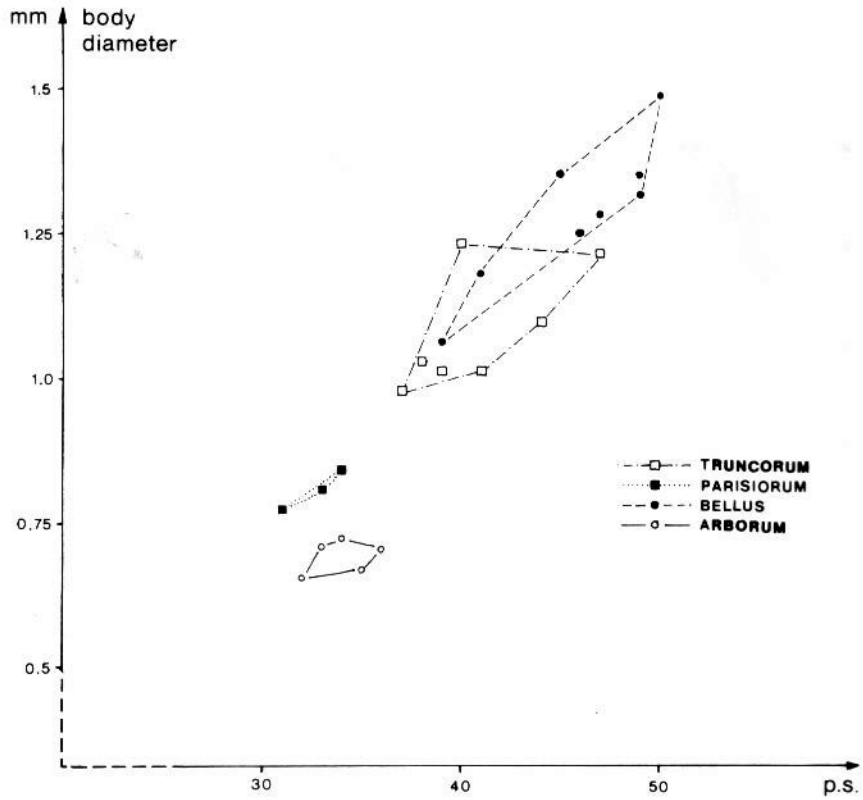


Fig. 27. Midbody vertical diameter and number of podous segments in males. Each point represents an individual.

angular projection on the solenomerite of *arborum*. See also the descriptive notes under each species.

Female vulvae. – Comparatively little attention has so far been given to the sexual organs as diagnostic characters of female millipedes. Those of the members of the *truncorum*-group have scarcely been illustrated (Blower 1953, Bielak 1965, Bielak-Oleksy & Stojałowska 1968). Only Blower's drawings of *truncorum* and *parisiorum* (1953, 1985) are of a standard rendering them taxonomically useful. Bielak's illustrations of *truncorum, parisiorum* and *arborum* do not show enough details to be of much use. We here present illustrations of all four species (Figs 21–24). They agree in having no setae on the operculum. (In this respect Bielak's data are quite strange, she repeatedly refers to bristles occurring on the operculum). The two valves of the bursa, on the contrary, are provided with rows of setae (Table 1). The ampulla in the bursa of *truncorum, parisiorum* and *arborum* has a sac-like appendix in addition to the coiled apodematic tube; *parisiorum* and *arborum* further agree in having quite few setae (6–8) on the bursal valves in similar arrangements; *bellus* stands alone with its almost perfectly spherical ampulla without an appendix, with a relatively high number (10–12) of bursal setae and very slender, tapering operculum. It seems that the number of bursal setae is positively correlated with body size in the *truncorum*-group. For more detailed characterization of the vulvae, see the descriptive notes under each species.

To facilitate comparison of the numerical characteristics of the four species, our data are summarized in Table 1.

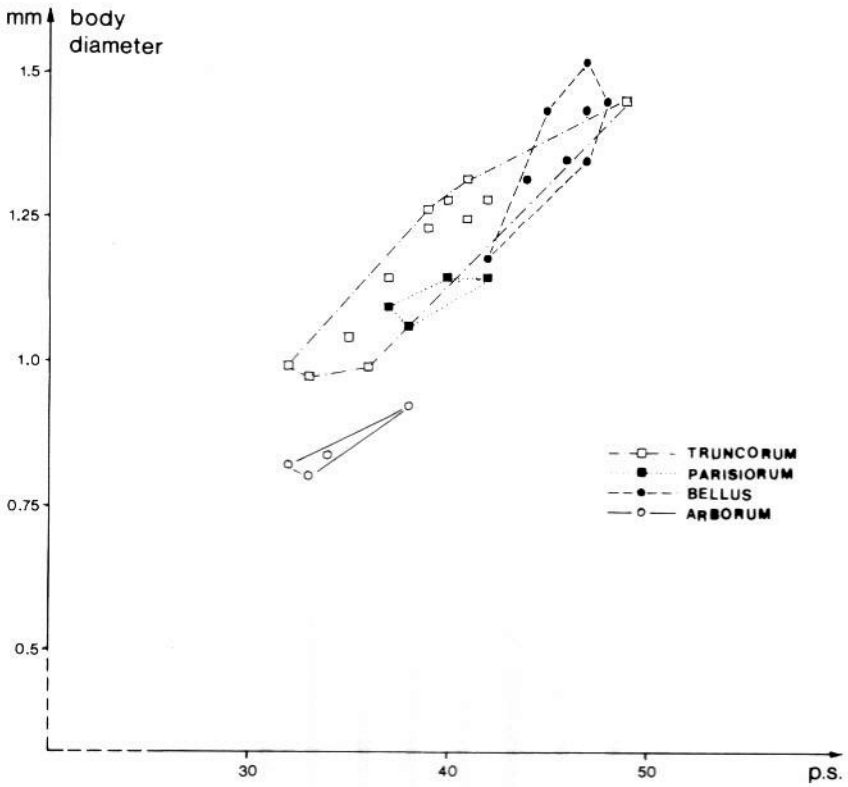


Fig. 28. Midbody vertical diameter and number of podous segments in females. Each point represents an individual.

Key to the species

1. Males 2
– Females 6
2. With strong longitudinal ridges on metazonites (Figs 30, 33) 3
– Without well-developed metazonital ridges 4
3. Metazonital structure very well-developed (Fig. 33). Promerite with deep mesal incision (Fig. 3); brachite of opisthomerite with a mesal and a lateral flange with fringes and protuberances (Fig. 14) ..... *C. bellus*
– Metazonital structure not so strong (Fig. 30). Promerite without deep incision (Fig. 1), opisthomerite with smooth and only laterally bent brachite (Fig. 6) ..... *C. truncorum*
4. Paracoxal process short and blunt, in length less than ¾ of solenomerite. Promerite with deep mesal incision (Fig. 2) ..... *C. parisiorum*
– Paracoxal process long and pointed, longer than ¾ of solenomerite. Promerite without deep mesal incision 5
5. Brachite of opisthomerite smooth; no triangular projection behind brachite (Figs 1, 5–6) ... . *C. truncorum*
– Brachite of opisthomerite spinose; a triangular projection behind brachite (Figs 4, 18–19) .... *C. arborum*
6. Ampulla a perfect sphere, without an appendix (Fig. 23 B & C) ..... *C. bellus*
– Ampulla with sac-like appendix, opposite to the apodematic tube 7
7. Operculum tapering, the single apodematic tube simple, characteristically spiralled, 6–8 setae on bursa (Fig. 22) ..... *C. parisiorum*
– Operculum broader, course of apodematic tube more complicated 8
8. 13–14 setae on bursa ..... *C. truncorum*
– 6–8 setae on bursa ..... *C. arborum*

What is *Julus luscus* Meinert, 1868?

The name *Julus luscus* Meinert, 1868 has been out of general use for half a century, but the exact identity of Meinert's species has never been settled. Meinert's description did not include notes on gonopods. The first to publish gonopod drawings on purported *luscus* was Latzel (1884), who,

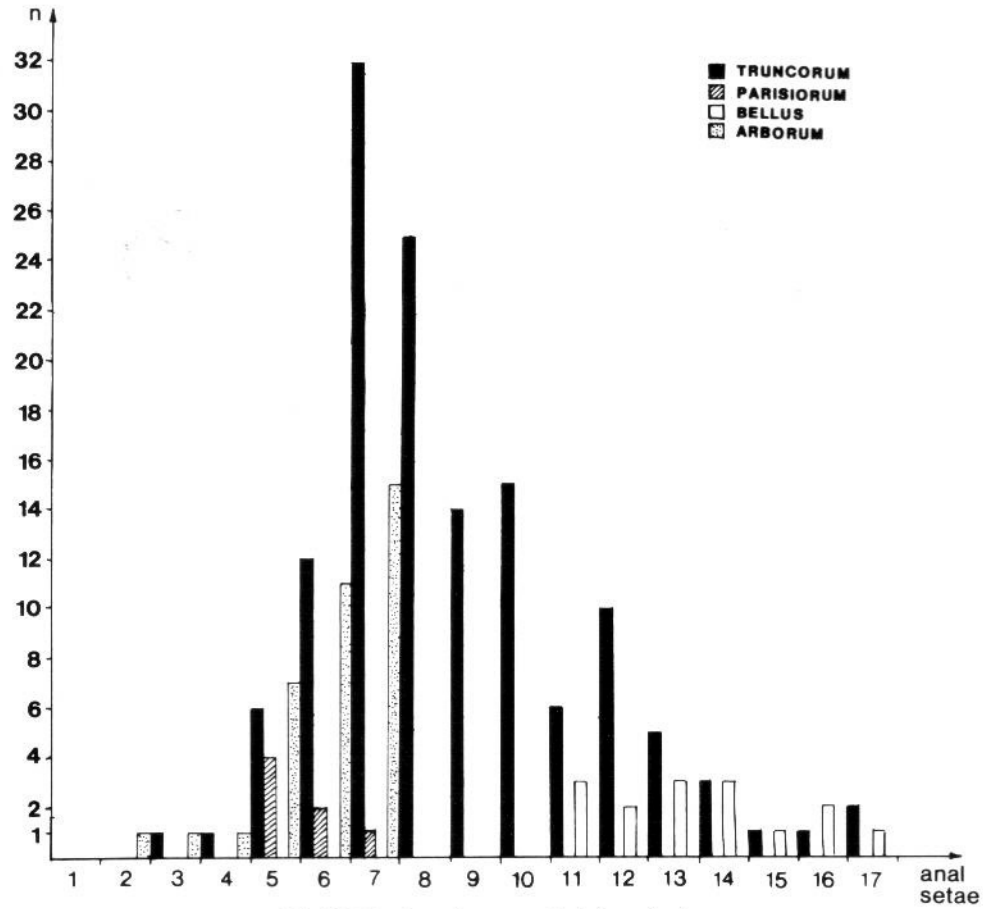
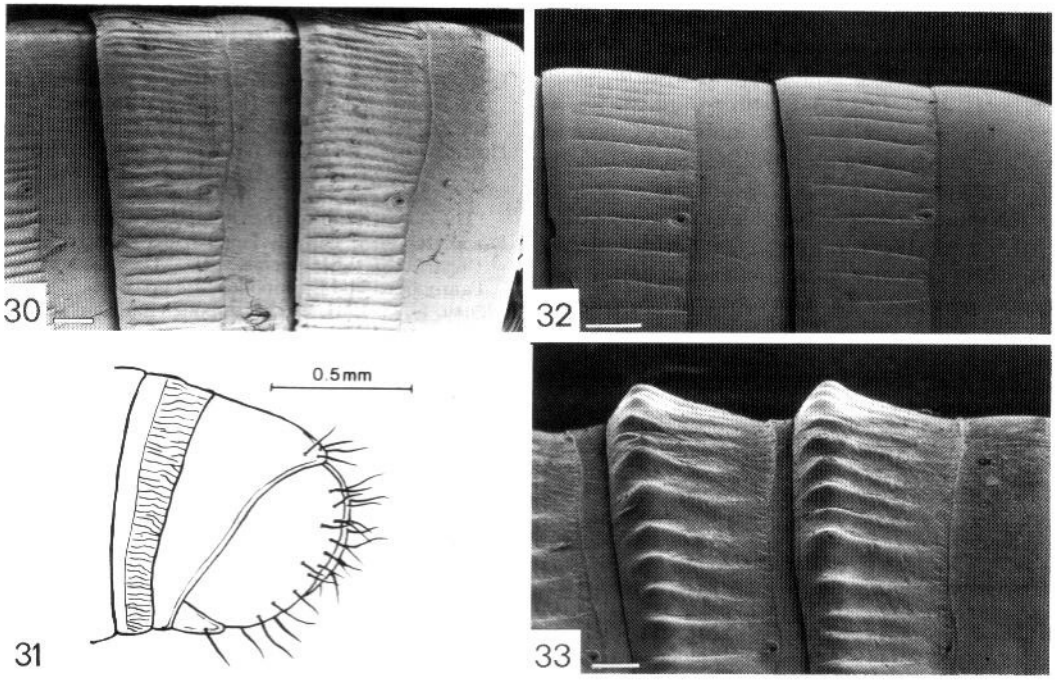


Fig. 29. Number of setae on the left anal valve.

however, had a different species before him. Since *luscus* sensu Latzel is a member of the *truncorum*-group, although *luscus* Meinert is not, we take the occasion to designate a lectotype of *luscus* so as to finally tie this name down.

Schubart (1926) examined Meinert's original material of *luscus,* housed in Zoologisk Museum, Copenhagen. According to Schubart, this consisted of 13 ♂ and 50 ♀. Schubart identified 11 ♂ as *Cylindroiulus frisius* (Verhoeff, 1891), and 2 ♂ as *C. britannicus* (Verhoeff, 1891). Although *luscus* predates both these names, Schubart (1926) recommended not to reinstall *luscus,* influenced by the confusion created by Latzel's misidentification of the species.

Schubart placed each of Meinert's *luscus*-males in a separate tube labelled either *"Cylindroiulus frisius"* or *"Cylindroiulus britannicus"* and further labelled with the segment and leg numbers recorded in his paper (1926). Under Meinert's original label, only the females were left. There must have been another original label in the tube that originally held the 13 males, since the label in the tube with females bears a "♀" sign. However, because the perfect correspondence between the published segment and leg numbers and those on the labels of the individual males, we do not hesitate to regard these males as part of the type series of *luscus* (1 male, the one with "42 (–3) Segm. 71 Beinp." (Schubart 1926) could not be found). We have selected one of these males as lectotype of *Julus luscus* Meinert, 1868. It is a *Cylindroiulus latestriatus* (Curtis, 1845) (=



Figs 30–33. (30) *Cylindroiulus truncorum,* male, metazonital sculpture; (31) *C. truncorum,* posterior end, showing setation of anal valves; (32) *C. parisiorum,* male, metazonital sculpture; (33) *C. bellus,* male, metazonital sculpture. Scanning electron micrographs (30, 32–33), scales = 100 μm.

frisius Verhoeff, 1891) with "39 (-3) Segm. 65 Beinp." in Schubart's notation. *Julus luscus* Meinert, 1868 thus enters into synonymy of *Cylindroiulus latestriatus* (Curtis, 1845). This is in accordance with Blower (1953), who was the first to point out that Schubart had been incorrect, in the strict sence of the Code, in rejecting the name *luscus;* and that the only possibility to overcome this ominous name would be to select an appropriate lectotype.

Problems remain with *Julus luscus* sensu Latzel 1884. Attems (1927) proposed, referring to Schubart (1926), the new name *Cylindroiulus ignoratus* to replace it. From Latzel's gonopod drawings (1884: figs. 177–178) it is difficult to decide whether they represent *parisiorum* or *arborum* in the sense of the present paper. The spinose "brachite" would speak in favour of *arborum,* the short paracoxal process, in favour of *parisiorum.* To further complicate the matter, Attems (1927) gave some gonopod drawings of his *ignoratus,* based on his own material. These are clearly *parisiorum.* Attems (1927) did not consider *parisiorum* (published in 1896) in his "revision" of *Cylindroiulus,* although he did consider its subspecies, *p. miraculus* Brölemann & Verhoeff, 1896 (= *C. latestriatus* (Curtis, 1845)). Also Verhoeff (1930) ignored *parisiorum* (of which he was co-author) in his key to members of the *truncorum*-group. But two years earlier Verhoeff (1928) decided to give a replacement name for the species he had considered to be *Julus luscus,* since Schubart (1926) pointed out that Meinert's original specimens are two other species. They were not *luscus* sensu Verhoeff (1899, 1907, 1926), so he introduced the name *arborum.* Following him, Schubart (1934, 1960) mentioned *Julus luscus* sensu Latzel in the synonymy of *arborum.*

A re-examination of Latzel's specimens of *luscus* might solve the problem, but unfortunately we have been unable to find such specimens in Zoologisches Museum, Hamburg, and in Naturhistorisches Museum, Vienna (where, according to the catalogues, a sample of *luscus* bought from Latzel has once been present (J. Gruber *pers. comm.*)).

Thus the question whether *ignoratus* Attems,

1927 is a junior synonym of *parisiorum* Brölemann & Verhoeff, 1896, as stated by Blower (1953) and Bielak (1965), or a senior synonym of *arborum* Verhoeff, 1928, or perhaps still a third species, as hinted by Schubart (1934: 225, footnote), cannot be settled. The best solution will be, acknowledging that both *arborum* and *parisiorum* may have more or less spinose gonopod brachites, and emphasizing that Attems' (1927) drawing of *ignoratus* are clearly *parisiorum,* to refer *Julus luscus* sensu Latzel, and hence *ignoratus,* to *Cylindroiulus parisiorum* (Brölemann & Verhoeff, 1896).

References

Attems, C. G. 1908. Note sur les Myriopodes recueillis par M. Henri Gadeau de Kerville en Khroumirie, et description de deux espèces et d'une variété nouvelles provenant de cette region de la Tunisie. Pp. 103–116 *in* Gadeau de Kerville: Voyage zoologique en Khroumirie (Tunisie). Rouen.

– 1927. Über palaearktische Diplopoden. V. Revision mehrerer Iulidengattungen und neue Arten. *Arch. Naturgesch.* (Abt. A) 92: 116–253.

Bielak, T. 1965. Über Selbständigkeit der Art *Cylindroiulus parisiorum* (Bröl. et Verh.) (Diplopoda, Iulidae). *Bull. Acad. pol. Sci. Cl. II Biol.* 13: 399–402.

Bielak-Oleksy, T. & Stojałowska, W. 1968. Vulvae of the female in the taxonomy of the genus *Cylindroiulus, Unciger* and *Leptoiulus* (Diplopoda). *Folia Soc. Sci. Lubl.* (B) 7/8: 19–24. (in Polish).

Blower, J. G. 1953. On three species of *Cylindroiulus* Verhoeff (Diplopoda, Iulidae) in Britain. *Ann. Mag. nat. Hist.* (12) 6: 305–315.

– 1957. Some new and little-known British millipedes. *Ibid.* (12) 10: 497–508.

– 1969. Notes on the life-histories of some British Iulidae. *Bull. Mus. natn. Hist. Nat. Paris* 41, Suppl. 2: 19–23.

– 1970. The millipedes of a Cheshire wood. *J. Zool., Lond.* 160: 455–496.

– 1985. Millipedes. *Synopses Br. Fauna* (N.S.) 35, 242 pp.

Blower, J. G. & Gabbutt, P. D. 1964. Studies on the millipedes of a Devon oak wood. *Proc. zool. Soc. Lond.* 143: 143–176.

Brade-Birks, H. K. & Brade-Birks, S. G. 1918. Notes on Myriapoda – XIV. The re-discovery of *Cylindroiulus parisiorum* (Brölemann & Verhoeff). *Ann. Mag. nat. Hist.* (9) 2: 470–471.

Brölemann, H. 1896. Materiaux pour servir a une faune de Myriapodes de France. *Feuille jeun. Nat.* 26: 214–217.

– 1897. Iulides d'Algérie. *Annls Sci. nat.,* Zool. 4: 253–276.

– 1921. Liste des myriapodes signalés dans le nord de l'Afrique. *Bull. Soc. Sci. nat. Maroc* 1: 99–110.

Curtis, J. 1845. Observations on the natural history and economy of the insects called wireworms. *Jl R. agric. Soc.* 5: 180–237.

Demange, J.-M. 1970. Myriapodes Diplopodes de Madère et des Açores. *Bolm. Mus. munic. Funchal* 25: 5–43.

Enghoff, H. 1982. The millipede genus *Cylindroiulus* on Madeira – an insular species swarm (Diplopoda, Julida: Julidae). *Ent. scand.,* Suppl. 18, 142 pp.

Hoffman, R. L. 1977. Diplopoda. *In:* La faune terrestre de l'Ile de Sainte-Hélène. *Annls Mus. r. Afr. centr.* 220: 360–377.

– 1979. Classification of the Diplopoda. 238 pp. Genéve.

Latzel, R. 1884. Die Myriapoden der Österreichisch-Ungarischen Monarchie. II. Die Symphylen, Pauropoden und Diplopoden. 414 pp. Wien.

Lignau, N. G. 1903. Die Myriopoden am Kaukasischen Schwarzmeerufer *Zap. novoross. Obshch. Estest.* 25: 126–148.

Lohmander, H. 1939. Über einige neue Diplopoden aus dem östlichen Anatolien. *Verh. naturf. Ges. Basel* 50: 126–150.

Mauriès, J.-P. 1987. Les modes de peuplement des iles oceaniques par les diplopodes: Le cas des Antilles françaises. *Bull. Soc. zool. Fr.* 112: 343–353.

Meinert, F. 1868. Danmarks Chilognather. *Naturh. Tidsskr.* 5: 1–32.

Read, H. J. 1990. The generic composition and relationships of the Cylindroiulini – a cladistic analysis (Diplopoda, Julida: Julidae). *Ent. scand.* 21: 97–112.

Schubart, O. 1926. Die Diplopodenfauna Dänemarks. *Ent. Meddr* 16: 57–105.

– 1931. Ein weiterer Nachtrag zur Diplopodenfauna der Niederlande. *Tijdschr. ned. dierk. Vereen.* 2: 160–166.

– 1931a. Ein weiterer Beitrag über märkischen Diplopoden. *Sber. Ges. naturf. Freunde Berl.* 1931: 103–116.

– 1934. Tausendfüssler oder Myriapoda I: Diplopoda. *Tierwelt Dtl.* 28, iv + 318 pp.

– 1960. Über einige Höhlen-Diplopoden der Schweiz und Frankreichs. *Revue suisse Zool.* 67: 561–588.

Silvestri, F. 1896. Una excursione in Tunisia (Symphyla, Chilopoda, Diplopoda). *Naturalista sicil.* (N.S.) 1: 143–161.

Strasser, K. 1966. Über Diplopoden Bulgariens. *Annls zool. Warsz.* 23: 325–385.

Verhoeff, K. W. 1899. Beiträge zur Kenntniss paläarktischer Myriopoden. IX. Aufsats: Zur Systematik, Phylogenie und vergleichenden Morphologie der Juliden und über einige anderen Diplopoden. *Arch. Naturgesch.* 65: 183–220.

– 1907. Über Diplopoden. 6. (26.) Aufsatz: Tausendfüssler aus Brandenburg und andere Formen aus Ostdeutschland und Österreich-Ungarn. *Mitt. zool. Mus. Berl.* 3: 261–337.

– 1926. Chilognathen-Beiträge. 103. Diplopoden-Aufsatz. *Zool. Anz.* 68: 57–71, 109–127.

– 1928. Neue und besonders ostalpine Chilognathen-Beiträge. 108. Diplopoden-Aufsatz. *Zool. Jb.,* Syst. 55: 253–328.

– 1930. Über Diplopoden Italiens, namentlich Piemont. 114. Diplopoden-Aufsatz. *Ibid.* 59: 387–446.

– 1941. Über Diplopoden aus der Türkei. *Istanb. Univ. Fen Fak. Mecm.* (N. S.) 5: 1–49.

Revised manuscript accepted November 1989.