

The Cave Myriapods of the Ryukyu Islands (I)¹⁾

By

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(Communicated by Yoshinori IMAIZUMI)

Since *Mecistocephalus mirandus* and four other species of millipeds were described by POOCK (1895, pp. 346–372) for the first time from Is. Okinawa, about sixty species of diplopods and chilopods have been reported from the Ryukyu Islands (formerly Loo-Choo Islands). Their descriptions and records are scattered over a number of publications, and are not easily summed up. So far as the cave forms are concerned, however, only six species have previously been recorded from this island chain. They are: *Dolichoglyphius asper*, *Epanerchodus* (*Riuerchodus*) *subterraneus*, *Kylindogaster nodulosa*, *Thereuopoda jamashinai*, *Tygarrup takarazimensis* and *Polydesmus tanakai*. The first four species were described by VERHOEFF in 1938 and 1939, and though the exact type-localities were not given in his original accounts, their descriptions were based on the material collected by Mr. Hajime S. TORII. According to Dr. Shun-Ichi UENO, *D. asper* and *E. subterraneus* were taken in Nisshû-dô Cave at Kin, Okinawa, on April 14, 1938, *K. nodulosa* in Fukafugi-iizaa Cave, at Ishigaki on March 18–23, 1938, and *T. jamashinai* in Hakka-dô Cave at Nakijin, Okinawa, on March 13, 1938. The fifth species was described by MIYOSI (1957, p. 265, fig. 3) on the basis of the specimen collected by Dr. UENO in Ashibikigô-no-iwaya Cave of the Island of Takara-jima, and the last-named was reported by the present author (MURAKAMI, 1970, p. 109, fig. 3) on the specimen taken by Mr. Shingo TANAKA in Shôryû-dô Cave of the Island of Okinoêrabu-jima.

Recently, the present author was given an opportunity to study on a large collection of myriapods obtained by Dr. Shun-Ichi UENO and Mr. Matsuei SHIMOJANA in the caves of the Ryukyu Islands. The main part of this collection was made in the summer of 1972, containing about 240 specimens from 25 caves. The remaining materials were collected by Mr. SHIMOJANA after that time but some specimens taken by Dr. Tadashi KURAMOTO in 1965 were also included in the present study. Thus, the collection as a whole comprises 259 specimens from 33 caves, which are classified into thirteen species and subspecies of diplopods and nine species of chilopods. Of these, four millipeds are recognized as new species and subspecies, and will be described in the present paper under the new names of *Dolichoglyphius asper brevipes*,

1) Contribution No. 151 from the Spelaeological Society of Japan.

Glyphiulus septentrionalis, *Riukiupeltis uenoi* and *Corypholophus ryukyuensis*. All the other species are also enumerated, and redescribed if necessary.

This paper is divided into two parts. The first part is devoted to the list of localities and descriptions of diplopods. Systematic accounts of chilopods, zoogeographic notes and a list of references will be published as the second part.

The specimens examined including all the holotypes will be deposited in the collection of the Department of Zoology, National Science Museum, Tokyo. Some of the paratypes and duplicates are retained in the author's collection.

Before going further, the author wishes to express his sincere thanks to Dr. Shun-ichi UÉNO of the National Science Museum, Tokyo, and to Mr. Matsuei SHIMOJANA of Futenma High School, Okinawa, for giving the author the opportunity of studying on the very interesting materials. Dr. UÉNO gave the author constant guidance and encouragement during the course of this study, and kindly read the original manuscript. The author is also greatly indebted to Dr. Tadashi KURAMOTO of the Akiyoshi-dai Science Museum, Yamaguchi Prefecture, for his kindness in submitting the additional materials to the author for study.

List of Localities and the Species Obtained

I. Is. Kikai-jima

1. Mumei-no-gama Cave, Takigawa; July 31, 1972, M. SHIMOJANA.
Thereuopoda sp.

II. Is. Toku-no-shima

2. Maeyama Cave, Tokuwasé, Tokunoshima-chô; Aug. 2, 1972, M. SHIMOJANA.
Corypholophus ryukyuensis n. sp. (?)

III. Is. Okinoérabu-jima

3. Erabu-dô Cave, China-chô; Aug. 4, 1972, M. SHIMOJANA.
Oxidus gracilis, *Corypholophus ryukyuensis* n. sp. (?)

IV. Is. Yoron-tô

4. Ya-gô Cave, Gusuku; Aug. 6, 1972, M. SHIMOJANA.
Corypholophus ryukyuensis n. sp. (?)

V. Is. Okinawa

5. Nobaru-gama Cave, Nobaru, Motobu-chô, Kunigami-gun; Sept. 9, 1972, M. SHIMOJANA.
Dolichoglyphius asper, *Thereuopoda* sp.
6. Nishibûmabaru-dô Cave, Bûma, Nago-shi; Aug. 26, 1971, M. SHIMOJANA.
Mecistocephalus takakuwai.
7. Mee-gaa Cave, Matsuda, Ginoza-son, Kunigami-gun; Aug. 30, 1971, M. SHIMOJANA; July 27, 1972, S. UÉNO.
Monographis sp., *Dolichoglyphius asper*, *Scolioplanes maritimus japonicus*.
8. Nisshû-dô Cave, Kin, Kin-son, Kunigami-gun; May 22, 1965, T. KURAMOTO; Aug. 25, 1970, M. SHIMOJANA; July 23, 1972, S. UÉNO.

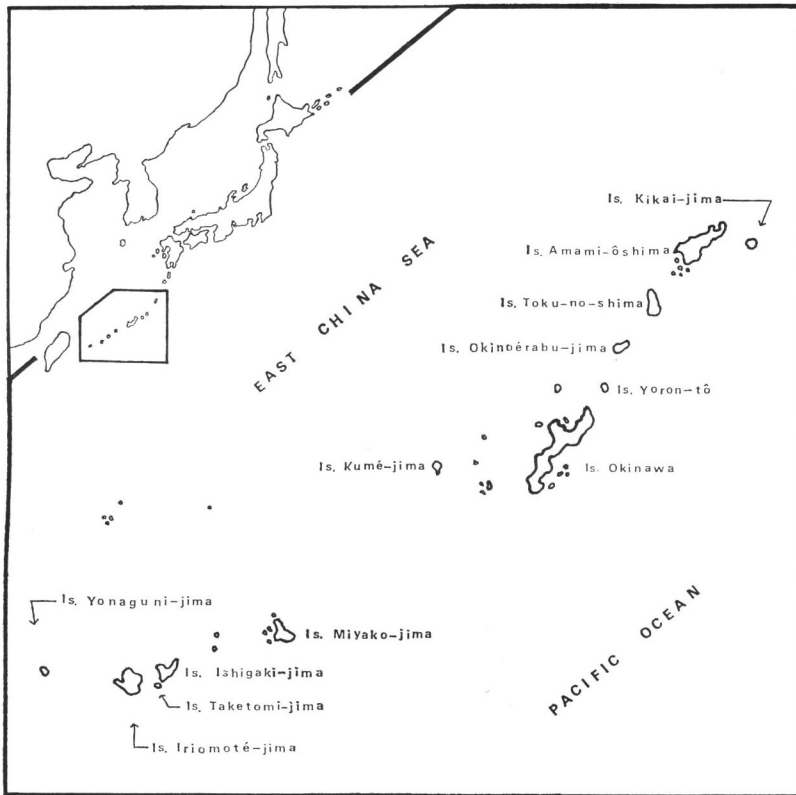


Fig. 1. Main islands of the Ryukyus.

Hyleoglomeris yamashinai, *Dolichoglyphius asper*, *Oxidus* sp., *Epanerchodus subterraneus*.

9. Kabuyaa-gama Cave, Yamada, Onna-son, Nakagami-gun; Feb. 8, 1971, M. SHIMOJANA; July 23, 1972, S. UÉNO.

Dolichoglyphius asper, *Epanerchodus subterraneus*.

10. Tera-no-gama Cave, Kadekaru, Ishikawa-shi; July 23, 1972, S. UÉNO.

Monographis sp., *Dolichoglyphius asper*, *Epanerchodus subterraneus*.

11. Mayaa-gama Cave, Uezu, Gushikawa-shi; Aug. 29, 1970, M. SHIMOJANA; July 23, 1972, S. UÉNO.

Monographis sp., *Hyleoglomeris yamashinai*, *Dolichoglyphius asper*, *Esastigmatobius* sp.

12. Zukeran-dô Cave, Zukeran, Kitanakagusuku-son, Nakagami-gun; Feb. 22, 1972, M. SHIMOJANA.

Hyleoglomeris yamashinai, *Dolichoglyphius asper*, *Glyphiulus septentrionalis* n. sp., *Anaulaciulus* sp.

13. Futenma-dô Cave, Futenma, Ginowan-shi; July 25, 1972, S. UÉNO.
Dolichoglyphius asper, *Glyphiulus septentrionalis* n. sp., *Oxidus gracilis*, *Epanerchodus subterraneus*.
14. Taabaru-gama Cave, Nodaké, Ginowan-shi; July 25, 1972, S. UÉNO.
Dolichoglyphius asper, *Glyphiulus septentrionalis* n. sp., *Oxidus gracilis*, *Epanerchodus subterraneus*.
15. Mayaa-abu Cave, Mashiki, Ginowan-shi; Feb. 22, 1971, M. SHIMOJANA;
July 25, 1972, S. UÉNO.
Hyleoglomeris yamashinai, *Glyphiulus septentrionalis* n. sp., *Prolamnonyx holstii*, *Bothropolys* sp.
16. Amachijô-gama Cave, Eekibaru, Tamashiro-son, Shimajiri-gun; July 29, 1972, S. UÉNO.
Dolichoglyphius asper, *Epanerchodus subterraneus*, *Monotarsobius* sp.
17. Ufuniku-gama Cave, Eekibaru, Tamashiro-son, Shimajiri-gun; July 17, 1972, M. SHIMOJANA.
Hyleoglomeris yamashinai.
18. Gyokusen-dô Cave, Maekawa, Gushikami-son, Shimajiri-gun; July 28, 1972, S. UÉNO.
Corypholophus ryukyuensis n. sp.
19. Uganju-gama Cave, Toobaru, Chatan-son, Nakagami-gun; Dec. 10, 1972, S. UEIYO.
Prolamnonyx holstii.
20. Ôabu-gama Cave, Hamahiga, Yonagusuku-son, Nakagami-gun; May 24, 1965, T. KURAMOTO.
Dolichoglyphius asper.
- VI. Is. Kumé-jima
 21. Yajaa-gama Cave, Nakachi, Gushikawa-son; Aug. 4, 1972, S. UÉNO.
Dolichoglyphius asper brevipes n. subsp., *Oxidus gracilis*, *Niponia* sp.
- VII. Is. Miyako-jima
 22. Iza-gaa Cave, Higashinaka, Hirara-shi; Aug. 3, 1972, S. UÉNO.
Riukiupeltis jamashinai (?).
 23. Rinkô-abu Cave, Narikaa, Hirara-shi; Aug. 3, 1972, S. UÉNO.
Corypholophus ryukyuensis n. sp.
 24. Abucha-dô Cave, Nakabari, Gusukubé-chô; Oct. 18, 1963, S. UÉNO.
Oxidus gracilis.
- VIII. Is. Ishigaki-jima
 25. Sabichi-gô Cave, Ibaruma, Ishigaki-shi; July 31, 1972, S. UÉNO.
Riukiupeltis uenoi n. sp.
 26. Fukubuku-iizaa Cave, Shiinabaru, Ishigaki-shi; July 30, 1972, S. UÉNO.
Oxidus gracilis.
 27. Hai-fusutô-iizaa Cave, Furusuto, Ôhama, Ishigaki-shi; July 31, 1972, S. UÉNO.

Niponia sp., *Corypholophus ryukyuensis* n. sp.

28. Taamoto-iizaa Cave, Kabira, Ishigaki-shi; Oct. 28, 1972, M. SHIMOJANA.

Thalhybius tenuicollis.

IX. Is. Taketomi-jima

29. Yangaa-dô Cave, Kaijibaru, Taketomi-chô; Oct. 25, 1972, M. SHIMOJANA.

Lithobius trichopus, *Esastigmatobius* sp.

X. Is. Yonaguni-jima

30. Adigara-dô Cave, Kubura, Yonaguni-chô; Oct. 23, 1972, M. SHIMOJANA.

Corypholophus ryukyuensis n. sp.

31. Hyandagu-abu Cave, Kubura, Yonaguni-chô; Oct. 22, 1972, M. SHIMOJANA.

Gen. et sp. inedit. (Oniscodesmidae).

32. Shiobaru-abu Cave, Shiobaru, Yonaguni-chô; Oct. 21, 1972, M. SHIMOJANA.

Corypholophus ryukyuensis n. sp., Gen. et sp. inedit. (Symphyla).

33. Tarumai-abu Cave, Kubura, Yonaguni-chô; Oct. 22, 1972, M. SHIMOJANA.

Prolamnonyx holstii.

DIPLOPODA

Family Pollyxenidae

Monographis sp.

Specimens examined. 2 ♂♂, Tera-no-gama Cave, 23 July 1972, coll. by S. UÉNO; 1 ♂, 1 ♀ (damaged), Mayaa-gama Cave, 29 August 1970, coll. by M. SHIMOJANA; 1 ♂, the same cave, 23 July 1972, coll. by S. UÉNO; 1 ♀, Mee-gaa Cave, 27 July 1972, coll. by S. UÉNO; 1 ♀, 1 ? (damaged), Rinkô-abu Cave, 3 August 1972, coll. by S. UÉNO.

Notes. About forty years ago, five specimens of a pollyxenid milliped were collected by Mr. TÔMA at Shuri in Is. Okinawa, and were determined by TAKAKUWA and TAKASHIMA (1942) with *Monographis kraepelini*, which was originally described by ATTEMS from Java (ATTEMS, 1907, pp. 96, 99, figs. X–XVII, pl. 1, figs. 11–22). Later, MIYOSI (1947) described *M. takakuwai* from Shikoku in Japan. This species is widely distributed in the Japanese Islands and is tentatively divided into three local races.

Monographis kraepelini and *M. takakuwai* are very similar to each other in the somatic characters, but the following differences have been recognized between them:

	<i>M. kraepelini</i> (after ATTEMS)	<i>M. takakuwai</i> (after MIYOSI)
Articles 6 and 7 of antenna	many sensory hairs present	two or three transparent small bristles present
Tactile bristles on legs:		
leg 1	2, 1, 2, 1, 1, 0	1, 1, 1, 1, 1, 0
leg 2	2, 1, 5, 1, 1, 0, 0	4–6, 1, 1–3, 1, 1, 0, 0
legs 3–13	3, 0, 1, 6, to many, 1, 1, 0, 0	3–5, 0, 1, 1–2, 1, 1, 0, 0
Barbed hooks in bristle brush on anal segment	2	3–6 (rarely 2)

The Ryukyu examples examined resemble *M. takakuwai* in the diagnostic characters of antennae and legs, but the diagnostic feature of barbed hooks in the anal bristle brush and other somatic characters could not be observed satisfactorily. Therefore, it is difficult to determine them with confidence.

Family Glomeridae

Hyleoglomeris yamashinai VERHOEFF

[Japanese name: Yamashina Tamayasude]

(Figs. 2 and 3)

Hyleoglomeris (Perkeomeris) yamashinai VERHOEFF, 1937, Zool. Anz., **119**, p. 39, fig. 9.

Specimens examined. 2 ♀♀, Nisshû-dô Cave, 22 May 1965, coll. by T. KURAMOTO; 1 ♂, Zukeran-dô Cave, 22 February 1972, coll. by M. SHIMOJANA; 2 ♀♀, Ufuniku-gama Cave, 17 July 1972, coll. by M. SHIMOJANA; 2 ♂♂, Mayaa-gama Cave, 23 July 1972, coll. by S. UÉNO; 1 ♂, 1 ♀, Mayaa-abu Cave, 25 July 1972, coll. by S. UÉNO.

Length of both sexes 5.5–6.0 mm, width 2.6–2.8 mm, with 17 pairs of legs in female and 19 in male including gonopodal telopodites. General color brownish black; front of head, basal two and last articles of antennae pale brown; first half of second tergite pale yellowish white; succeeding tergites with light-maculate area on each lateral side; posterior and lateral margins of all tergites yellowish white.

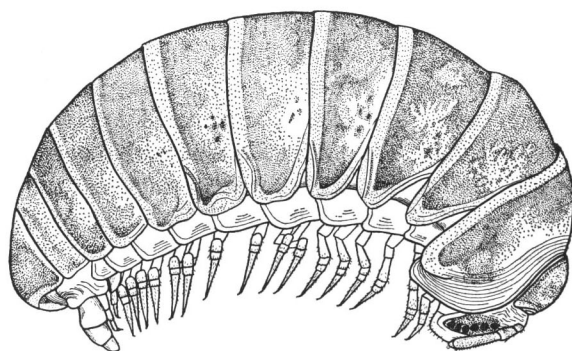


Fig. 2. *Hyleoglomeris yamashinai* VERHOEFF, ♂, of Mayaa-abu Cave.

Anterior view of head as shown in Fig. 3 A; vertex almost straight and narrowly carinate; front of head slightly convex, and moderately depressed at the lateral sides; eyes small and black, each consisting of 6–8 ocelli, which are arranged in a single series; clypeus covered with scattered hairs; labrum with fine marginal hairs and with one median tooth. Antennae rather short, thick and composed of 7 articles, of which the last article is very short and has four sensory cones; article 6 the largest (ratio of length to width 7: 3) and columnar; articles 3–7 covered with short fine setae, and with

a few fine sensory bristles dorso-terminally. Collum nearly semicircular; posterior side feebly bordered, and with 2 submarginal striae which entirely run across the dorsal surface. Second tergite smooth and shining; at the lateral side, the upper part distinctly marked from the lower part; lower part with 10–12 submarginal striae, of which usually 5 (sometimes 4) extend over the dorsum as shown in Fig. 3 D. Succeeding tergites

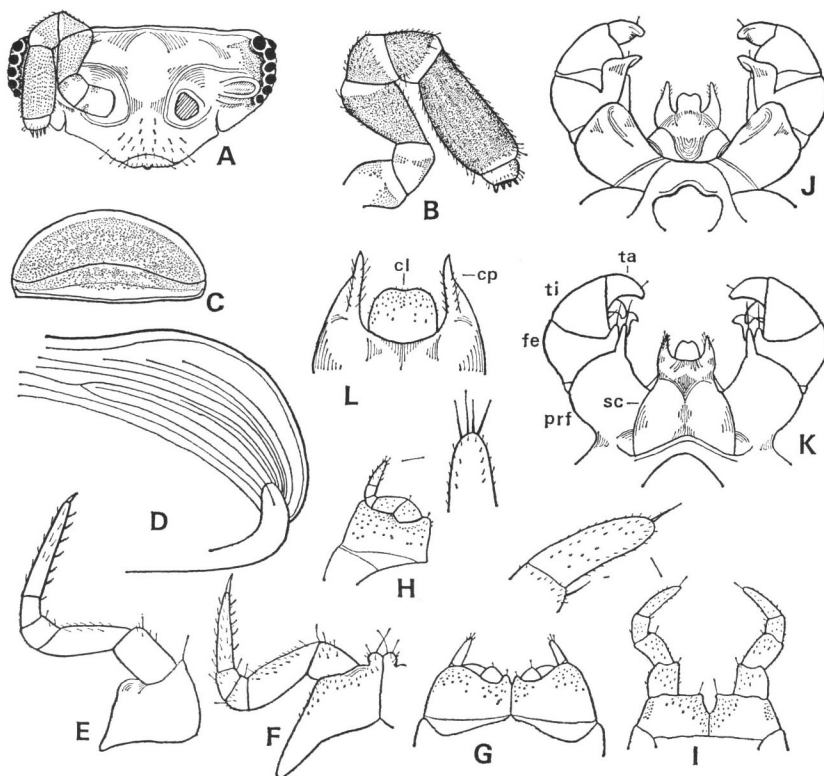


Fig. 3. *Hyleoglomeris yamashinai* VERHOEFF. — A, Frontal aspect of head, excluding left antenna. B, Left antenna, frontal aspect. C, Collum. D, Lateral half of second tergite, showing dorsal striation. E, Leg 12, frontal aspect. F, First leg pair, caudal aspect. G, Leg 17, caudal aspect. H, The same, frontal aspect. I, Leg 18, frontal aspect. J, Gonopods (leg pair 19), caudal aspect. K, The same, frontal aspect. L, Syncoxite, frontal aspect. cl=coxal lobe, cp=coxal process, fe=femur, prf=prefemur, sc=syncoxite, ta=tarsus, ti=tibia.

basically similar in structure to one another, smooth and shining, with several weak striae along the lateral side; lateral corners of tergites 3–5 narrower than those of the others. Pygidium hood-like, smooth and shining; posterior margin semicircular in dorsal view. Coxae of first pair of legs with small globular protuberance on the disto-inner side. Typical legs as shown in Fig. 3 E. Leg pairs of 17th and 18th in male somewhat reduced in size, each telopodite consisting of 4 articles; terminal articles

bearing distal setae on each apex.

Male gonopods (pair 19) as shown in Fig. 3 J-L. Syncoxite with 2 processes and a lobe; coxal processes longer than coxal lobe, bearing 2 series of fine bristles on the anterior surface; lobe emarginate, its surface being covered with microscopic hairs. Prefemur, femur and tibia each with a finger-shaped process bearing a long apical bristle on the disto-inner side. Femur and tibia each with an additional lamellar process on the inner side.

Notes. Eight species of this genus have hitherto been known from the Japanese Islands, i.e., *H. stuxbergi* ATTEMS (1909, p. 26, pl. 1, fig. 18), *H. japonica* VERHOEFF (1936 b, pp. 164, 165, pl. 4, figs. 15-18), *H. insularum* VERHOEFF (1936 b, pp. 164, 166), *H. yamashinai* VERHOEFF (1937, p. 39, fig. 9), *H. nigra* VERHOEFF (1942, p. 216, figs. 18, 19), *H. sulcata* VERHOEFF (1942, p. 216), *H. uenoi* MIYOSI (1955, p. 267, fig. 2) and *H. lucidus* HAGA (1956, p. 331, pl. 1, figs. 2a-2b). Of these, *H. yamashinai* and *H. uenoi* are distinguished from the others by having 5-6 entire striae on the second tergite (cf. VERHOEFF, 1937, p. 39; MIYOSI, 1959, p. 60). They are very similar to each other in somatic and gonopodal characters, but the following differences are diagnostic:

	<i>H. yamashinai</i>	<i>H. uenoi</i>
Body length	approximately 6 mm	10 mm
Coloration	generally brownish black; first half of the second tergite yellowish white	very similar, but more brilliant
Striation on collum	2 submarginal striae entirely crossing the dorsum	2, of which the anterior one is not entire
Striation on second tergite	5-7 short striae on lateral sides of lower part	3 short striae on lateral sides
Coxal lobe of syncoxite	usually emarginate and shorter than coxal processes	usually orbicular and as long as coxal processes

The redescription given above is based on the specimens from five caves. A female specimen from Ufuniku-gama Cave is somewhat different from the others in the following points: Body length approximately 9.0 mm, the second tergite has 4 entirely crossing striae, and the color of the first half brownish orange. These differences may suggest that the specimen is not referable to the same species.

Family Cambalidae

This family name seems to have been used as a nomenclatorial anomaly (cf. ATTEMS, 1928, p. 311; HOFFMAN, 1958, p. 94). JEEKEL (1970) listed 18 available family-group names under the suborder Cambaloidea, in which the name Cambalidae was not adopted in nomenclature.

Subfamily Glyphiulinae

Seven genera of this subfamily, including possible synonyms, have hitherto been recorded from South India, Ceylon, Indochina, Java, South China, Taiwan and several islands of the Indo-Pacific Ocean. Their common characters are summarized as follows: Ocelli generally present except in cave forms; collum and body segments with longitudinal crests; mentum divided into mentum and promentum; first legs of males generally modified in different degrees, usually small and reduced; coxosternum with median or lateral coxosternal processes, and with small telopodites. Gonopods, anterior and posterior, comparatively small and characteristically modified, without flagellum.

VERHOEFF (1936 a) recognized three genera in the subfamily Glyphiulinae: *Glyphiulus* (GERV.) ATTEMS (= *Keratoglyphiulus* ATT.), *Podoglyphiulus* ATTEMS and *Formosoglyphius* VERHOEFF. LOKSA (1960) added the genera *Octoglyphus* and *Trogloglyphus* to this subfamily. These groupings were mainly based on the ornamentation of collum, formation of the first leg pair, and the number of labral teeth. Recently, MAURIES (1970) described a new species (*Plusioglyphiulus boutini*) from a cave in Cambodia, and reexamined several types of POCKOCK's species belonging to the genera *Cambalomorpha* and *Cambalopsis*. He incorporated male genitalic characters to his classification, and recognized the following taxa:

A. Gen. *Glyphiulus* GERVAIS, 1847

Synonyms: *Cambalomorpha* POCKOCK, 1895 (in part); *Keratoglyphiulus* ATTEMS, 1909; *Formosoglyphius* VERHOEFF, 1936; *Trogloglyphus* LOKSA, 1960.

a. Subgen. *Glyphiulus* GERVAIS, 1847b. Subgen. *Octoglyphus* LOKSA, 1960

c. Subgen. No attributed species

B. Gen. *Podoglyphiulus* ATTEMS, 1909C. Gen. *Plusioglyphiulus* SILVESTRI, 1923

The present author has carefully analyzed general characters of these groups in the literature. Ornamented crests on collum and body segments, ocelli, labral teeth and gonopods are rather variable in shape and/or in number. However, the modification of the first leg pair is comparatively stable, and is easily distinguished into the following three types: 1) Two (or one) small and stump-shaped coxosternal processes are present. They are situated either at the lateral sides distant from each other, or at the middle close to each other. Telopodites are reduced. 2) A median coxosternal process is present. It is rather long and slender. Telopodites are reduced. 3) A small median coxosternal process is present. Telopodites remain in the normal shape of legs.

By regarding such modification of first leg pair as of primary importance in classification, the author refers not only *Trogloglyphus* but also *Octoglyphus* to the synonyms of *Glyphiulus*.

Formosoglyphius is one of the important cambalid groups in relation to the milliped fauna of the Japanese Islands. The genus was established by VERHOEFF (1936) for *F. tuberculatus* from Taiwan (precise type-locality was not assigned). Although it was described only on a female specimen, it was originally distinguished from *Podoglyphiulus* by the presence of 4 labral teeth and 14 longitudinal crests on collum, by the ornamentation on body segments, and by the shape of pore-crests and promentum. Later, the milliped was redescribed by WANG (1957, pp. 24–26) based on a male specimen from Pescadore Islets (Penghu in Chinese or Hôko-tô in Japanese). In his paper, the gonopodal characters were diagnosed in the following words: “Anterior gonopods is a little 2 jointed stump (Fig. 2). the coxae with a flagellate, telopodite with seminal duct. posterior gonopods is a little two or three jointed stump. (Fig. 3)” (*sic!*). Unfortunately, his redescription and figures of the genital characters are too brief and too inadequate to illustrate the exact form of gonopods. On the other hand, he made an interesting comment on the first pair of legs of this species, as follows: “I agree all the descriptions of VERHOEFF on the first three pairs of legs of the female however I think that there are no difference of walking legs between the two sexes and they are no importance for the diagnose on the specific level” (*sic!*). The present author cannot find out from his statement whether or not the first pair of male legs in this species is actually not modified. If there is actually no difference in the first legs between both sexes, the genus *Formosoglyphius* may have a close relationship with *Podoglyphiulus*. Geographically, however, the two groups are widely separated from each other, since all the known species of *Podoglyphiulus* occur in South Asia, from Burma in the east to Northwest India in the west.

A new cambalid milliped belonging to the genus *Glyphiulus* will be described in the present paper from Is. Okinawa in Japan. The new milliped is very similar to *Formosoglyphius tuberculatus* in the ornamentation of collum and body segments, whereas the male legs evidently show the modifications of *Glyphiulus*-type. Since Okinawa and Taiwan are geographically close to each other, the present author has some doubt as to WANG's description of the male legs of the Taiwanese species. Perhaps he overlooked a modification of the first pair of male legs. MAURIES (1970) reexamined the type of *Glyphiulus granulatus* deposited in the collection of the Muséum National d'Histoire Naturelle, Paris, and referred *Formosoglyphius* to a synonym of *Glyphiulus*.

Genus *Glyphiulus* GERVAIS

Glyphiulus GERVAIS, 1847, in WALCKENAER & GERVAIS, Histoire naturelle des Insectes, Aptères, 4, p. 170; ATTEMS, 1938, Mém. Mus. Hist. nat. Paris, (n. s.), 6, p. 263 (*partim*); MAURIES, 1970, Bull. Mus. Hist. nat. Paris, (2), 42, p. 518.

Cambalomorpha POCKOCK, 1895, Ann. Mag. nat. Hist., (VI), 15, p. 363 (*partim*).

Keratoglyphiulus ATTEMS, 1909, Ark. Zool., Stockholm, 5 (3), p. 63.

Formosoglyphius VERHOEFF, 1936, Zool. Anz., 113, pp. 49, 50. — WANG, 1957, Quart. J. Taiwan Mus., 10, p. 24. — TAKAKUWA, 1954, Diplopoden aus Japan, pp. 204–205.

Trogloglyphus LOKSA, 1960, Acta Zool. Ac. Sci. Hung., **6**, p. 139.

Octoglyphus LOKSA, 1960, *ibid.*, p. 142.

A short diagnosis. Juloid form, with noticeable longitudinal crests on body segments, and usually also on collum. The first pair of male legs markedly reduced; coxosternal processes very small and stump-shaped, being situated at the lateral sides and distant from each other, or situated at the middle close to each other; telopodites tiny, simple or two-segmented. Anterior gonopods usually consisting of coxae and telopodites; coxae large, distally protuberant in various shapes; telopodites comparatively long, having no segmentation, and with fine terminal setae. Posterior gonopods small, laminar, consisting of several segments, and with a characteristic terminal process on each side.

Species and their distribution. According to MAURIES (1970), ten species have been recognized as the members of *Glyphiulus*; a new species will be added to the list.

<i>granulatus</i> GERVAIS, 1847	Comores; Seychelles; Mauritius; Reunion; Loyoute; New Caledonia; Tahiti
<i>formosa</i> POCKOCK, 1895	Hong Kong
<i>superbus</i> SILVESTRI, 1923	Dalat, Langbian Province, Viet-Nam; Kampot, Cambodia
<i>capucinus</i> ATTEMS, 1938	Bana, Viet-Nam
<i>mediator</i> ATTEMS, 1938	Bana, Viet-Nam
<i>javanicus</i> CARL, 1941	Java
<i>anophthalmus</i> LOKSA, 1960	Nyu-Jie Cave, Pulung, South China
<i>balazsi</i> LOKSA, 1960	A deep cave, Lodjen, South China
<i>pulcher</i> LOKSA, 1960	Nyu-Jie Cave, Pulung, South China
<i>tuberculatus</i> VERHOEFF, 1936	Taichun, Taipei and Pescadore Islets in Taiwan
<i>septentrionalis</i> n. sp.	Is. Okinawa in Japan

***Glyphiulus septentrionalis* n. sp.**

[Japanese name: Ryukyu Yahazuyasude]

(Figs. 4 and 5)

Diagnosis. A small cambaloid milliped not sufficiently comparable to any of the described forms of the genus, though resembling *G. capucinus* ATTEMS (1938, p. 266, figs. 134–143) in the shape of leg 1 and in the basic form of gonopods; also similar to *G. tuberculatus* (VERHOEFF) (1936, p. 57, figs. 7–9, 14) in the ornamentation of collum. Distinguished from all the other members, in which males are known, by the shape of gonopods, and by the details of ornamented crests on collum and body segments.

Male holotype. Body very slender, approximately 30 mm long and approximately 1.2 mm in diameter, with 62 segments, of which the last one and anal segments are legless. General color in alcohol pale brown; in life pale brownish gray (according to Dr. UENO, personal communication). Front of head markedly convex, smooth,

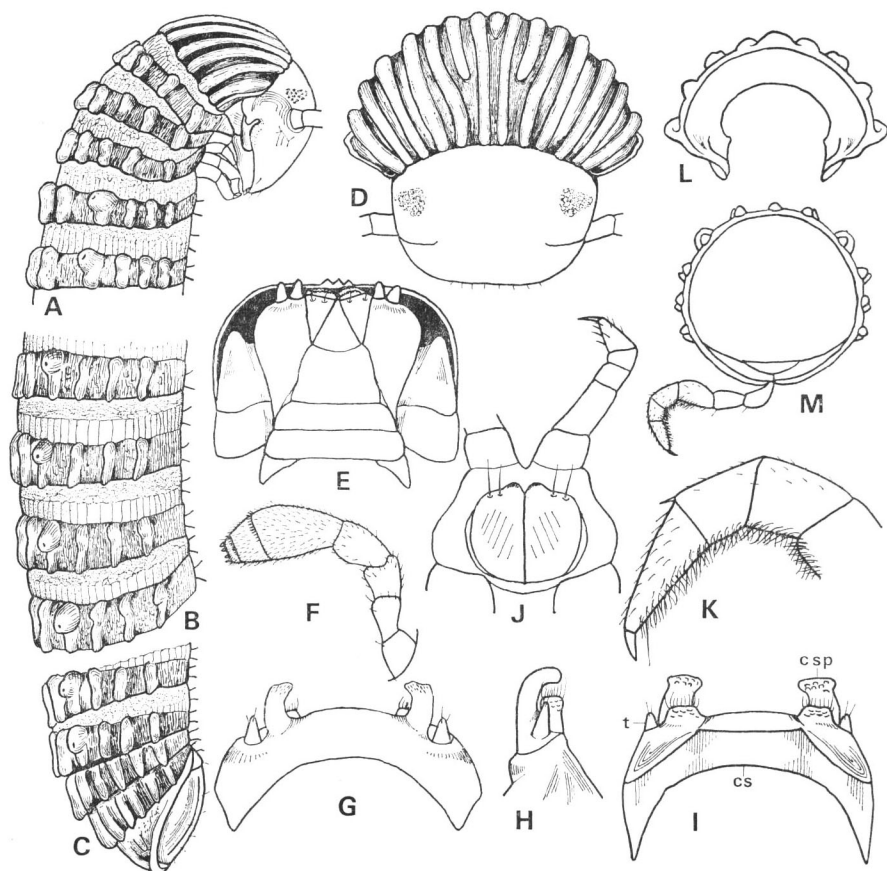


Fig. 4. *Glyphiulus septentrionalis* n. sp., holotype. — A, Head and six succeeding segments, lateral aspect. B, Four mid-body segments, lateral aspect. C, Caudal end of body segments, lateral aspect. D, Frontal aspect of head and collum. E, Gnatochilarium, mandibular cheeks and head plate, ventral aspect. F, Right antenna. G, First leg pair, caudal aspect. H, The same, lateral aspect. I, The same, cephalic aspect. J, Penis and second leg, caudal aspect. K, Last three podomeres and claw of left leg on mid-body segment. L, Segment 2, caudal aspect. M, Caudal aspect of mid-body segment. cs=coxosternum, csp=coxosternal process, t=telopodite.

polished and hairless. Clypeus with four, widely separated small setae. Labrum with five small teeth and about 12 fine marginal setae. Ocular patch black, subtriangular, ocelli about 25 in 6 rows, visible as follows: 4,4,5,5,4,3. Mandibular cheeks, *in situ*, covered with head plate. Antennae rather short and clavate, reaching back to segment 4 when appressed; first four articles short and sparsely setose; article 5 the longest, about twice as long as article 4, thick, moderately setose; articles 5 and 6 with sensory hairs on the disto-dorsal margin; the last article very short, with small terminal cones.

Collum much broader than head, with 17 conspicuous longitudinal crest, 14 of which completely run through the collum, while the remaining 3, one middle and two paramiddle, only exist on a part of proximal half; these short crests are unequal in length, the middle crest being the shortest; the ornamentation of collum evenly symmetrical as illustrated in Fig. 4 D.

First pair of legs very small, much modified as in *G. capucinus*, consisting of three parts. 1) Coxosternum (*cs*) transversely elongate, forming a foot-bridge, without median suture. 2) Coxosternal processes (*csp*) short and digitiform, situated at a distance from each other; each process bends cephalad at the terminal portion, the surface of which is microscopically rough; a small protuberance present near the base of each process, forming a stump-shape and with terminal hairs. 3) Telopodites (*t*) very small, not segmented, and with two fine terminal setae.

Segments 2–4 somewhat narrower than collum, metazonite with 9 longitudinal crests, each of which is weakly constricted at the anterior half. Typical ornamentation of succeeding segments as illustrated in Fig. 4 B. Metazonite with 11 longitudinal crests, each of which is divided into two tubercles, appearing to form a double row of 11 crests, although the tubercles are not completely disconnected with each other; anterior tubercles small and granular, but posterior ones are long. Pore crests large, beginning on segment 5; pores very small, opening on the top of crests. Surface between the crests with fine striations. Anal segment distally rounded and margined, with 3 weak crests on the dorsal surface.

Second pair of legs small and slender, consisting of 6 podomeres and claw; coxae wide, fused by a median suture. Penes short and wide, contiguous, each with two fine setae on the disto-lateral margin.

Legs of moderate length, tarsi mostly visible beyond the sides of body when viewed from above. Podomeres of femur through tarsus comparatively thick, and hairy on the ventral surface; claw rather short and obtuse. Sternites fused with pleurotergites from segment 4.

Gonopods relatively small, *in situ*, mostly concealed by segment 6 and not visible when viewed from the outside of body (Fig. 5 A). Anterior gonopods (Fig. 5 B–D) flattened, cordate in ventral aspect, and composed of 3 articles: 1) Sternite (*s*) rather large, triangular. 2) Coxae (*c*) large, fused with each other, evenly reflexed and with two short and wide processes (*cp*); lateral margin of outer process forming a brush at the dorsal side. 3) Telopodite (*t*) somewhat longer than coxal process, arm-like, bent inward, and not articulated, with several fine setae on the distal portion. Posterior gonopods (Fig. 5 E–G) small and laminated, completely covered with anterior gonopods consisting of 2 structural elements: 1) Coxae (*c*) forming a large syncoxite with fine median suture on the dorsal side. 2) Telopodite wide, divided into two articles (*t* 1 and *t* 2); the distal article with apical process (*tp*).

Female paratype. Length approximately 24 mm, with 58 body segments, of which the last two and anal segments are legless. Labrum with four teeth. First pair of legs not modified, normal in shape and size, its coxae transversely wide, fused with

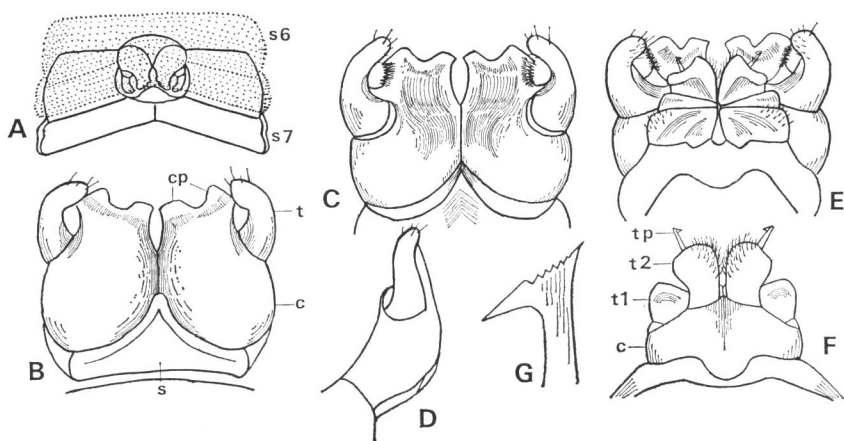


Fig. 5. *Glyphiulus septentrionalis* n. sp., holotype. — A, Ventral aspect of segments 6 and 7, showing, *in situ*, gonopods concealed by segment 6. B, Anterior gonopods, ventral aspect. C, Dorsal aspect of the same. D, Lateral aspect of the same. E, Anterior and posterior gonopods, dorsal aspect. F, Posterior gonopods. G, Terminal process of posterior gonopod. c=coxa, cp=coxal process, s=sternite, t=telopodite, tp=terminal process.

each other by a narrow medial bridge. Third pair of legs the smallest, slender, rectangular, its coxae fused with each other by median suture; telopodite about 1.5 times as long as coxae, composed of 4 podomeres and claw. Other somatic characters essentially as in the male.

Variations. Specimens from four populations show following variations: 20–30 mm in length; 52–66 body segments, of which the last one and anal segments are legless. 18–25 mm; 51–60 segments, of which the last two and anal segments are legless. 13–17 mm; 43–50 segments, of which the last three and anal segments are legless. 13 mm; 43–45 segments, of which the last four and anal segments are legless. Labrum with usually 4 or 5, rarely 3, small teeth. Ornamented crests on collum normally as described and illustrated in the male holotype, but exceptionally lacking in median short crest; two lateral crests are rarely connected at the distal portion.

Type-series. 3 ♂♂ (including the holotype), 7 ♀♀, Mayaa-abu Cave, 25 July 1972, coll. by S. UÉNO.

Other records. 1 ♂, Mayaa-abu Cave, 22 February 1971, coll. by M. SHIMOJANA; 1 ♂, 1 ♀, Futenma-dô Cave, 25 July 1972, coll. by S. UÉNO; 1 ♀, Zukeran-dô Cave, 22 February 1972, coll. by M. SHIMOJANA; 12 ♂♂, 7 ♀♀, Taabaru-gama Cave, 25 July 1972, coll. by S. UÉNO.

Notes. As was mentioned before, this new species is very closely related to *G. tuberculatus* in the ornamentation on collum and body segments. VERHOEFF schematized ornamentation on collum of *tuberculatus* in his figure 14, and described that as follows: “Es kommen überhaupt nur drei kurze Rippen (7, 8, 7) in der

Hinterhälfte des Collums vor, nämlich eine mediane und zwei paramediane, während die Rippen 1–6 einheitlich also durchlaufend sind, jedoch 1 vorn abgekürzt.” His description of body segments goes “im ganzen sind also an den meisten Rumpfringen vorhanden an Höckern:

$$\begin{array}{lcl} \text{vorn} & 3 + 1 + 4 + 1 + 3 = 12 & \} \\ \text{hinten} & 3 + 1 + 3 + 1 + 3 = 11 & \} \end{array} \text{ „}$$

WANG's redescription and illustration on the ornamentation of *tuberculatus* agree with VERHOEFF's.

In the shape of ornamentation, the present new species differs from *tuberculatus* in the following points: 1) Collum: three short crests not equal in length, and two long paramiddle crests entirely reaching the posterior margin of collum. 2) Body segments: number of crests equal between anterior and posterior rows, i.e., $3+1+3+1+3=11$ crests in either row.

In 1965, T. OMINE published a paper on the diplopods of the Ryukyus, in which he reported *tuberculatus* from Okinawa. He pointed out a difference of ornamentation between specimens of Okinawa and those of Taiwan (according to TAKAKUWA's redescription). His observation of the Ryukyu specimens agrees with the character of the present new species.

Subfamily Dolichoglyphiinae

Dolichoglyphius asper VERHOEFF

[Japanese name: Himoyasude]

(Figs. 6 and 7)

Dolichoglyphius asper VERHOEFF, 1938, Mitt. Höhlen- u. Karstforsch., 1938, p. 88, figs. 11–14; 1940, *ibid.*, 1940, p. 20, figs. 1–4. — TAKAKUWA, 1954, Diplopoden aus Japan, Tokyo, p. 206, figs. 233–235.

Specimens examined. 1 ♀, Nisshû-dô Cave, 22 May 1965, coll. by T. KURAMOTO; 8 ♂♂, 12 ♀♀, 2 larvae, same cave, 23 July 1972, coll. by S. UÉNO; 1 ♂, Zukeran-dô Cave, 22 February 1972, coll. by M. SHIMOJANA; 1 ♂, 1 ♀, Kabuyaa-gama Cave, 23 July 1972, coll. by S. UÉNO; 2 ♂♂, 1 ♀, Mayaa-gama Cave, 23 July 1972, coll. by S. UÉNO; 1 ♀, 1 larva, Tera-no-gama Cave, 23 July 1972, coll. by S. UÉNO; 1 ♀, Futenma-dô Cave, 25 July 1972, coll. by S. UÉNO; 1 ♂, 3 ♀♀, Taabaru-gama Cave, 25 July 1972, coll. by S. UÉNO; 1 ♂, 1 ♀, Mee-gaa Cave, 27 July 1972, coll. by S. UÉNO; 2 ♂♂, Amachijô-gama Cave, 29 July 1972, coll. by S. UÉNO; 1 ♂, 1 ♀, Nobaru-gama Cave, 9 September 1972, coll. by M. SHIMOJANA; 1 ♂, 3 ♀♀, Ôabu-gama Cave, 24 May 1965, coll. by T. KURAMOTO.

Body medium-sized and slender; in dorsal aspect, anterior segments 2 to 4 somewhat narrowed, several succeeding segments becoming gradually broader caudally, and nearly equal in diameter from segment 9 or thereabout; each segment with noticeable dorsal crest. Length of adult males 29 to 35 mm with 49 to 60 segments, of which the

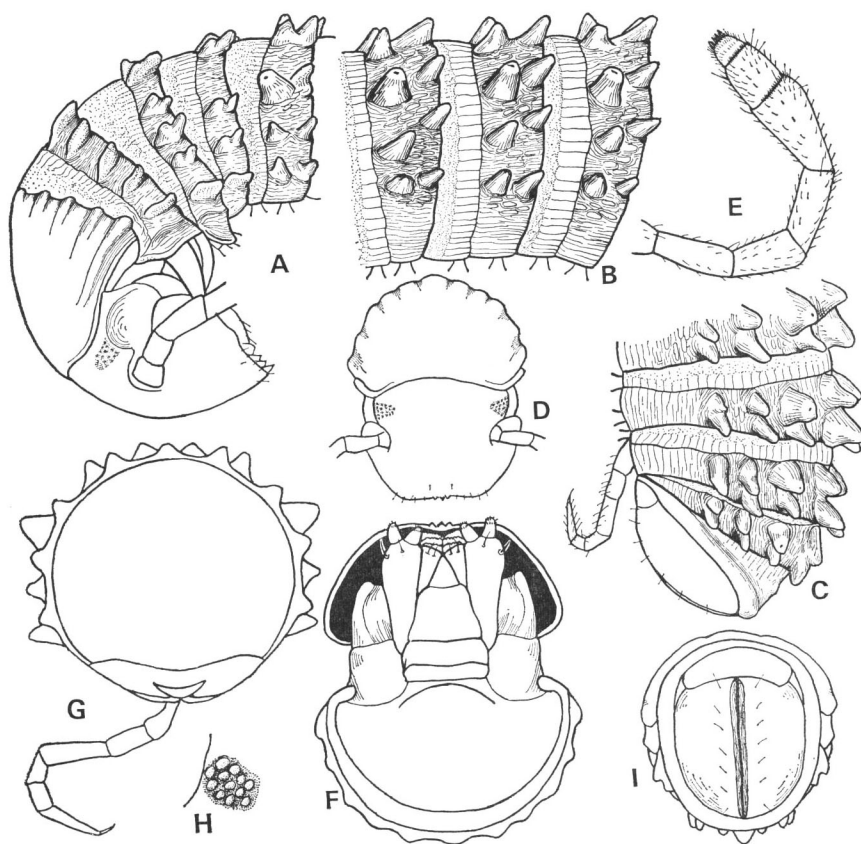


Fig. 6. *Dolichoglyphius asper* VERHOEFF, of Nisshû-dô Cave. — A, Head and five succeeding segments, lateral aspect. B, Three mid-body segments, lateral aspect. C, Caudal end of body segments, lateral aspect. D, Frontal aspect of head and collum. E, Right antenna. F, Gnathochilarium, mandibular cheeks, head plate and collum, ventral aspect. G, Caudal aspect of a mid-body segment. H, Eyes of right side. I, Anal segment, ventral aspect.

last one and anal segments are legless; that of adult females 31 to 41 mm with 50 to 58 segments of which the last and anal segments are legless. General color in alcohol grayish brown with dark spot on lateral side of most segments; in life grayish white.

Front of head convex, smooth and polished, clypeus wide, with several fine setae, and labrum with three small teeth and fine marginal setae. Ocular patch suboval, each consisting of about 12 ocelli, which are irregularly ranged in 4 or 5 rows. Mentum divided into two parts. Mandibular cheeks covered with head plate, *in situ*, not visible in outer aspect. Antennae not so long, reaching back to 4th segment when appressed, articles sparsely setose, the articles in decreasing order of length 5-4-3-2-1-7; the last article with four terminal sensory cones; sensory hairs present on the outer distal edge of articles 5 and 6.

Collum a little broader than head; surface evenly convex and smooth except for posterior and lateral portions; 11 longitudinal, rather flat crests in a transverse series present along the posterior margin; the lateralmost crest long, extending to near the anterior margin, but the others are short; lateral margins conspicuously bordered, its caudo-ventral angle a little elongated and reflexed ventrad.

First pair of legs in male peculiar to this genus, being composed of three articles, sternite, coxae and telopodite; their modification is as shown in Fig. 7 A–C. Sternite wide, its distal portion acutely projecting as triangular processes (*sp*), and with four

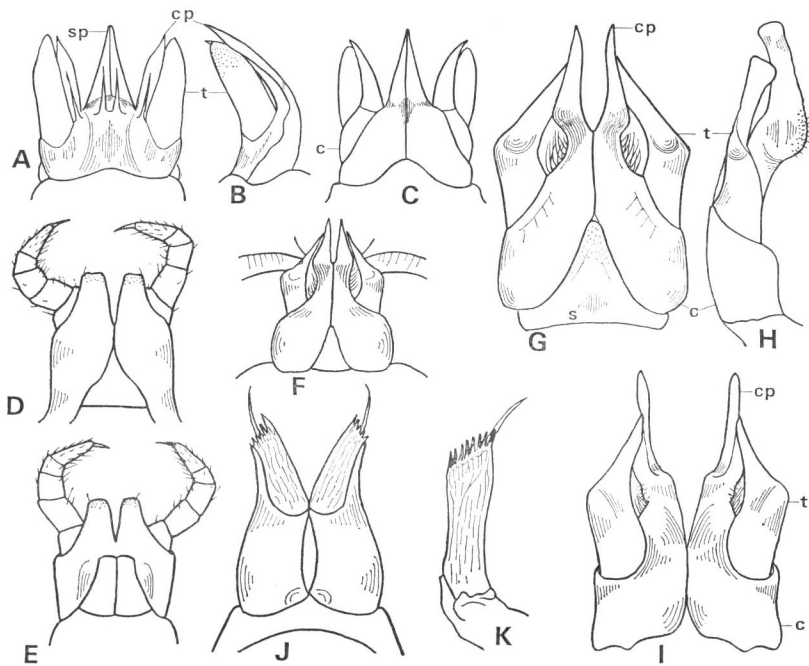


Fig. 7. *Dolichoglyphius asper* VERHOEFF, of Nisshû-dô Cave. — A–C. First pair of legs, cephalic, lateral and caudal aspects. D, Second pair of legs, cephalic aspect. E, Penis and second pair of legs, caudal aspect. F, Gonopods, ventral aspect. G–I, Anterior gonopods, ventral, lateral and dorsal aspects. J, Posterior gonopods, ventral aspect. K, Lateral aspect of the same. c=coxa, cp=coxal process, s=sternite, sp=sternal process, t=telopodite.

macro-setae at the caudal side. Each coxa with long coxal process (*cp*), and with two macro-setae at the caudal side. Telopodites simple and finger-shaped, with the terminal portion somewhat rough on the surface. Second pair of legs in male small and slender, with five podomeres and claw, the coxae fused and moderately produced at the end. Penis short and wide, almost one half as long as coxa, with the tip rather round and without setae.

Segment 2 with 11 prominent and longitudinal crests in a transverse series, of which the medial one is somewhat large. Segments 3 and 4 with 11 similar crests; the lateral-most crest simple, the medial one divided into three small crests arranged in $\cdot\cdot\cdot$ -shape, and others incised at each apex. Succeeding segments basically similar in structure to one another, typical arrangement of crests as illustrated in Fig. 6 B. Crests prominent and subconical, each metazonite with 19 crests in two transverse series, which are regularly arranged 10 in anterior row and 9 in posterior one. Pore crests large and conspicuous, beginning on segment 5. Surface between crests with trace of transverse striae and scabbed. Surface of prozonite minutely reticulated on anterior half and longitudinally striated on posterior one. Anal segment a little longer than penult segment; caudal margin rounded with marginal groove; dorsal surface smooth with a small longitudinal protuberance on the median axis; anal scale suboval, and valves margined with fine setae. Legs of moderate size and length, the tarsi mostly visible beyond sides of body when viewed from above; each podomere of prefemur through tarsus with texture setae on ventral surface; claw long and acute.

Gonopods relatively large, of the form illustrated in Fig. 7 F-K; *in situ*, anterior gonopods fully visible outside of the body. Anterior gonopods composed of three articles. 1) Sternite (*s*) large and subtriangular, firmly attached to coxae. 2) Coxae large, fused at the distal half; distal portion constricted, with long marginal hairs at the disto-lateral sides; coxal processes (*cp*) long, somewhat bent, flattened, and with scattering short hairs on the dorsal surface. 3) Telopodites (*t*) a little shorter than the coxal processes, the distal half somewhat bent inward and distally flattened. Posterior gonopods smaller and shorter than the anterior ones; distal half laminated with several marginal processes, of which the outer one is enlarged.

Notes. This species was originally described by VERHOEFF in 1938 based only on a female specimen from Is. Okinawa. He gave the diagnosis on the basis of obvious differences in external morphology. Generic and male characters were given by the same author in 1940, two years after the publication of the original account. VERHOEFF's (1940) illustration of the first leg pair of male is drawn from the ventral aspect, and on page 22, he stated that "Sternit und Gliedmassen bleiben vollkommen borstenlos." It seems that he overlooked the presence of macro-setae on the dorsal side.

The type-series of this species was said in the original description in 1938 to have come from "Riu-Kiu-Inseln an Rande eines Höhlenbaches", and the accurate locality was not recorded in the supplementary description (1940), either. Later, TAKAKUWA (1954) redescribed the same species with VERHOEFF's original illustrations, and he corrected its locality to "Kin-dô Cave (Is. Okinawa in the Ryukyus)". As was explained in the introduction of this paper, Dr. UÉNO has clarified that the type material of this species was obtained by Mr. TORII in Nisshû-dô Cave (=Kin-dô Cave) and that Mr. TORII submitted his collection to the late Dr. TAKAKUWA, who in turn sent the material to VERHOEFF for examination. Therefore, the type-locality of *D. asper* is Nisshû-dô Cave at Kin in central Okinawa.

Dolichoglyphius asper brevipes n. subsp.

[Japanese name: Kumejima Himoyasude]

(Fig. 8)

Diagnosis. Distinguished from the nominate form of *D. asper* VERHOEFF (above-mentioned) by the shape of ornamented crests on the body segments and by the short leg pair 1.

Male holotype. Length approximately 31 mm. Width 1.4 mm. 59 segments, of which the last and anal segments are legless. Color dark brown in alcohol. Crests of collum somewhat low and round. Typical body segments as illustrated in Fig. 8 A-B. The ornamentation basically similar to that in the nominate subspecies, though differing from the latter in the shape of crests. Crests generally small and not so

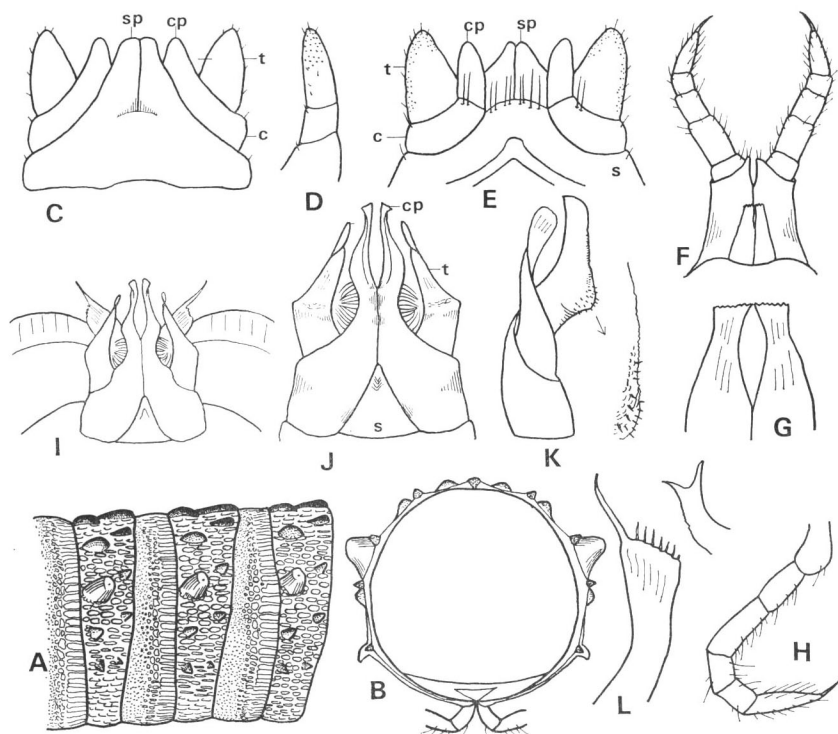


Fig. 8. *Dolichoglyphius asper brevipes* n. subsp., of Yajaa-gama Cave. — A, Three mid-body segments, lateral aspect. B, Caudal aspect of a mid-body segment. C-E, First pair of legs, caudal, lateral and cephalic aspects. F, Penis and second pair of legs, caudal aspect. G, Penis. H, Left leg on a mid-body segment. I, Ventral aspect of gonopods. J-K, Anterior gonopods, ventral and lateral aspects. L, Terminal portion of posterior gonopod. c=coxa, cp=coxal process, s=sternite, sp=sternal process, t=telopodite.

prominent, conical on the lateral side, and tubercular on the dorsal side; pore crests large, being on segment 5. Surface of metazonites minutely scabbed; posterior half of prozonites weakly reticulated.

First pair of legs externally similar to that in the nominate subspecies, but the following differences are observed: sternite wide with eight macro-setae on the dorsal side; telopodites and coxal processes comparatively short and thick, forming an obtuse triangle. Second pair of legs slender, with five podomeres, and distal portion of coxae not so produced; penes short, almost straight and minutely serrated at the end.

Gonopods basically similar to those in the nominate subspecies, though differing from the latter in certain details. Anterior gonopods: terminal portion of coxal process somewhat acute, its dorsal surface being microscopically rough. Posterior gonopods: terminal process relatively long and the apex bifurcated.

Female paratype. Length approximately 30 mm. 58 body segments, of which the last one and anal segments are legless.

Variations. Length of mature specimens 24 to 31 mm, with 45 to 59 segments in male; 23 to 32 mm, with 49 to 58 segments in female.

Type-series. 11 ♂♂ (including the holotype), 32 ♀♀, Yajaa-gama Cave, 4 August 1972, coll. by S. UENO.

Notes. *Dolichoglyphius asper* is one of the species endemic to the Ryukyus, and is found only in the caves of Is. Okinawa and Is. Kumé-jima. These islands are about 90 km distant from each other. The Kumé-jima specimens are very similar in the shape of segments and gonopods to Okinawan ones, but the differences mentioned above are constantly observed between them. The author is convinced at present that those differences are sufficient to divide *D. asper* into two geographical races.

Family Julidae

Anaulaciulus sp.

Specimen examined. 1 ♀, Zukeran-dô Cave, 22 February 1972, coll. by M. SHIMAJANA.

The present material probably belongs to *A. yamashinai* (originally as *Fusiulus yamashinai*), described by VERHOEFF (1939 c, p. 118, figs. 1-3) on the basis of specimens from "Ryukyu-Insel (Okinawa)". Recently, it was recorded by IKEHARA and SHIMAJANA (1971) from Is. Uotsuri-jima in the Senkaku Islands.

Family Paradoxosomatidae

Oxidus gracilis (KOCH)

[Japanese name: Yakeyasude]

Fontaria gracilis C. L. KOCH, 1847, in PANZER, Krit. Revis., 3, p. 142.

Oxidus gracilis: CHAMBERLIN & WANG, 1953, Amer. Mus. Novit., (1621), p. 7. — MIYOSI, 1959, Über japanische Diplopoden, Osaka, p. 68, pl. 2, fig. 18.

Other references are omitted.

Specimens examined. 2 ♂♂, Erabu-dô Cave, 4 August 1972, coll. by M. SHIMOJANA; 1 ♂, 1 ♀, 1 larva, Futenma-dô Cave, 25 July 1972, coll. by S. UÉNO; 4 ♂♂, 2 ♀♀, Taabarugama Cave, 25 July 1972, coll. by S. UÉNO; 6 ♂♂, 4 ♀♀, Yajaa-gama Cave, 4 August 1972, coll. by S. UÉNO; 1 ♂, Abucha-dô Cave, 18 October 1963, coll. by S. UÉNO; 1 ♂, 2 ♀♀, Fukubuku-iizaa Cave, 30 July 1972, coll. by S. UÉNO.

Notes. One of the best known paradoxosomatid millipeds.

Riukiupeltis uenoi n. sp.

[Japanese name: Ishigaki Miitsuyasude]

(Fig. 9)

Diagnosis. Very similar to the type-species of the genus, *R. jamashinai* VERHOEFF (1939 a, p. 125, figs. 8–9), but distinguished from the latter by markedly bifurcated telopodite of gonopods.

Male holotype. Body slender, length approximately 24 mm, greatest width 3.9 mm. Color not fully developed (probably just after a molt); head and antennae pale yellowish brown though the middle of vertex and distal parts of last two articles slightly brownish; collum and body segments pale yellowish brown, each of them being slightly brownish at the anterior half and looking like a dark bar intervening on dorsum. The shape of head and of some selected segments as shown in Fig. 9 A–C; the width values of them as follows:

Head = 2.5 mm	Collum = 3.0 mm	Seg. 2 = 3.2 mm
Seg. 4 = 3.4 mm	Seg. 7 = 3.9 mm	Seg. 16 = 3.6 mm
Seg. 17 = 3.1 mm	Seg. 18 = 3.0 mm.	

Vertex polished and glabrous, the median sulcus well impressed. Front of head wide, rather flattened, with long and fine setae on lower surface. Clypeus weakly convex, moderately depressed, with marginal setae. Labrum moderately emarginate. Antennae rather long and slender, approximately 4.3 mm in length; articles 2 to 6 similar in shape and of equal length, the article 6 with fine sensory hairs on disto-dorsal corner; article 7 small, and with four sensory cones and feeble prominence. Collum elliptical, wider than head, its lateral sides symmetrically narrowed and rounded (rather acutely angular in dorsal aspect), and with marginal groove; surface moderately convex, smooth and shining. Outline of body segments as shown in Fig. 9 A–F, essentially similar in structure to one another. Metazonites smooth, shining and hairless, and moderately arched. Transverse furrow present on segments 5 to 18, not so sharply impressed and extending far laterad; the furrow usually not reaching the lateral keels, and with weak striation. Lateral keels moderately developed. Keels of segment 2, *in situ*, at about the same level as those of collum and segment 3. Lateral borders slightly convex or practically straight; marginal grooves distinct, rather thick, and present on all sides. The pores small, opening at lateral pit. Posterior corners nearly

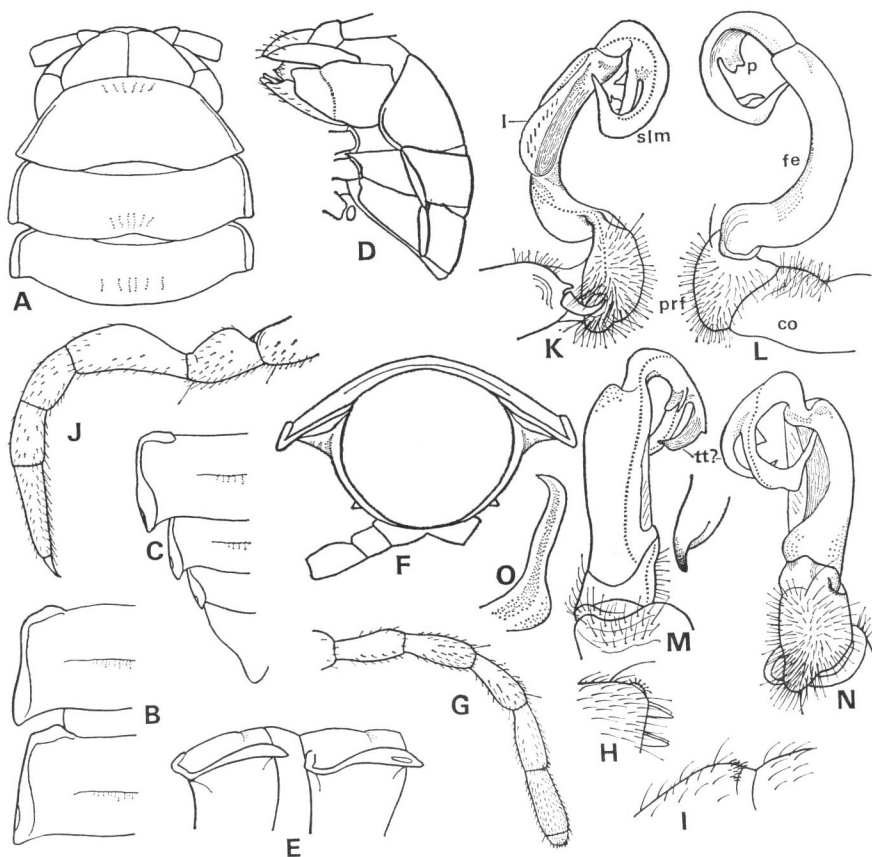


Fig. 9. *Riukiupeltis uenoi* n. sp., holotype. — A, Head and three succeeding segments, dorsal aspect. B, Left keels of segments 8 and 9, dorsal aspect. C, Outline of lateral keels of caudal body end, dorsal aspect. D, Head and three succeeding segments, lateral aspect. E, Lateral aspect of segments 8 and 9. F, Caudal aspect of segment 9. G, Left antenna. H, The same, dorso-terminal portion of article 7. I, The same, of article 6. J, Left leg on segment 9. K–N, Left gonopod, mesial, lateral, dorsal and ventral aspects. O, Terminal portion of solenomerite. co=coxa, fe=femur, l=laminal lobe, p=peculiar process, prf=praefemur, slm=solenomerite, tt?=tibiotarsus.

rectangular on anterior segments, becoming slightly more acute and a little produced caudally back to segment 19. Surface of scapular areas covered with microscopic strigils on segments 6 through 17. Sternites in the middle part of body about as long as wide, covered with rather long hairs; transverse furrow wide and shallow. Legs moderately slender; a large part of each femur visible outside of lateral keels when extended laterad and viewed from above. Length order of podomeres: $3 > 6 > 2 = 5 = 4 > 1$. Coxa subcylindrical, praefemur moderately protuberant on the upper side, both segments with scattered short setae and a long slender seta at the ventro-distal end;

remaining podomeres becoming increasingly setose; claw rather thick and acute.

Gonopods of the form as shown in Fig. 9 K–O, *in situ*, extending forward parallel to each other at the femoral regions, and slightly crossing at terminal portions. Coxa (*co*) relatively slender, subcylindrical, the dorso-distal portion being rugose and setose. Femoral region (*fe*) large, slender, arcuate, concave at the distoventral side, and with a laminar lobe (*l*) on the intero-lateral margin. Terminal portion (VERHOEFF's "Resttelopodit") circularly curved, and bifurcated as solenomerite and short branch; solenomerite (*slm*) large and long, reaching femur; short branch (*tt*?) two-thirds as long as solenomerite, with a peculiar process (*p*) near the base, and with a small tooth on mid-lateral margin.

Female unknown.

Type-specimen. 1 ♂, Sabichi-gô Cave, 31 July 1972, coll. by S. UÉNO.

Notes. In his original description, VERHOEFF (1939 a) gave an account of the gonopod of *R. jamashinai*. According to him, the terminal portion of what he called a "Resttelopodit" consists of three elements: "Das Resttelopodit besteht aus Synmerit, einem kleinen sekundären Solänomerit und sekundären Tibiotarsus." He considered that the spermal groove ran into a small separate branch, which was indicated by symbol "sl" in his figure 9, and that the main branch was formed by tibiotarsus. Recently, JEEKEL (1968) published a very useful paper on the classification of the family Paradoxosomatidae, and referred the Indochinese milliped, *Haplogonosoma falcatus* ATTEMS (1953, p. 177, pl. 10, figs. 81–82), to the genus *Riukiupeltis*. He stated on the gonopodal structure of *Riukiupeltis* as follows: "It appears that in *Riukiupeltis* the gonopod tibiotarsus is also completely lost, although VERHOEFF was of a different opinion when he described *jamashinai*." In the present new species, however, the terminal portion of gonopod is more conspicuous than that of *R. jamashinai*, evidently showing bifurcation, and the spermal groove runs into a main branch as illustrated in Fig. 9 K–N. On the other hand, a short separate branch is also distinctive, perhaps representing a tibiotarsus. The present author agrees with VERHOEFF on his interpretation of the terminal portion of gonopod of the genus.

Family Cryptodesmidae

Niponia sp.

Specimens examined. 1 ♀, Hai-fusutô-iizaa Cave, 31 July 1972, coll. by S. UÉNO; 1 ♀, Yajaa-gama Cave, 4 August 1972, coll. by S. UÉNO.

The present materials probably belong to *N. nodulosa* VERHOEFF (1931, pp. 436, 441, 442, figs. 46–55). Its records from the Ryukyus are as follows: Islands of Okinawa, Ishigaki-jima and Iriomoté-jima (OMINE, 1965); Islands of Kumé-jima and Uotsuri-jima (IKEHARA & SHIMOJANA, 1971); Runada-abu Cave (Yonaguni-jima) (SHIMOJANA, 1973).

Family Vanhoeffeniidae

Genus *Corypholophus* ATTEMS

Corypholophus ATTEMS, 1938, Mém Mus. Hist. nat. Paris, (n. s.), 6, p. 249; 1940, in SCHULZE *et al.*, Tierreich, (70), p. 189.

Corypholophus ryukyuensis n. sp.

[Japanese name: Ryukyu Chibiyasude]

(Figs. 10 and 11)

Diagnosis. A very small cave milliped similar in appearance to *C. minutus* ATTEMS (1938, p. 249, figs. 102–109), from which it can be distinguished by the presence of two rows of setae on metatergites and by the shape of gonopods.

Male holotype. Length approximately 3.2 mm, greatest width 0.51 mm. Color in alcohol dirty white, in life white. Body very small, composed of 19 segments (20 in female); dorsum moderately convex, with two transverse rows of setae. The shape of head and of some selected segments as shown in Fig. 10 A–D; the width values of them

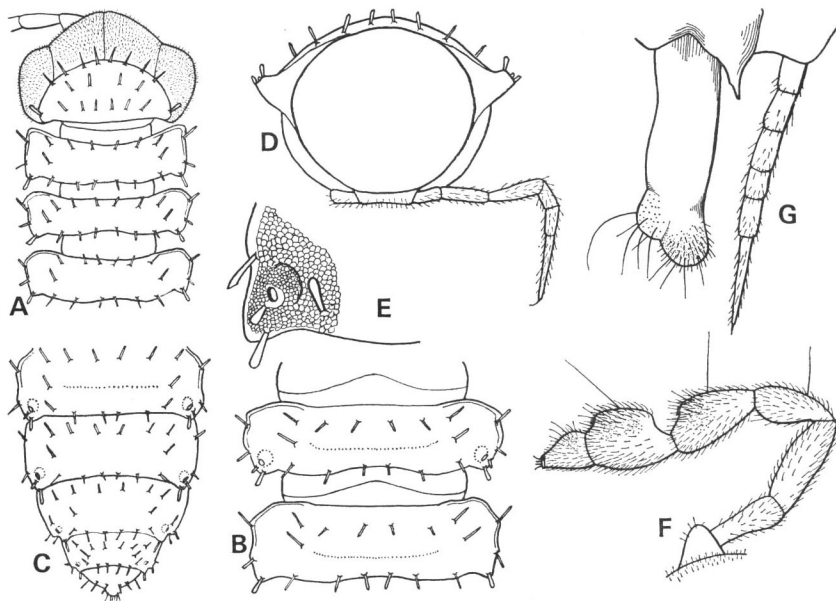


Fig. 10. *Corypholophus ryukyuensis* n. sp., a female paratype from Hai-fusutô-iizaa Cave. — A, Head and four succeeding segments, dorsal aspect. B, Segments 10 and 11, dorsal aspect. C, Last five segments, dorsal aspect. D, Caudal aspect of segment 12. E, Posterior corner of left keel of 12th body segment, dorsal aspect. F, Right antenna, dorsal aspect. G, Left cyphopod and third leg, lateral aspect.

as follows:

Head = 0.44 mm	Collum = 0.41 mm	Seg. 2 = 0.44 mm
Seg. 4 = 0.43 mm	Seg. 6 = 0.51 mm	Seg. 18 = 0.34 mm.

Head subglobular, no eyes; surface evenly covered with short hairs. Clypeus weakly convex, with three small teeth and several marginal setae. Antennae rather clavate and densely setiferous, especially in distal articles, about 0.7 mm in length and nearly reaching the posterior border of segment 4; articles 5 and 6 wider than the others, each with a rounded area of densely set sensory hairs on the upper side near apex; article 7 subconical with 4 small terminal cones. Collum narrower than head, semi-circular in dorsal outline; surface slightly convex in the middle, with an arcuate row of eight clubbed setae behind the anterior margin and two rows of four and six similar setae on the surface; each posterior corner weakly rounded and with a clubbed seta. Succeeding segments basically similar in structure to one another. Metatergites moderately arched, with weak transverse furrow on segments 5 to 16; each metatergite regularly with a row of eight setae on the front half and a row of six setae along the posterior margin. Lateral keels moderately developed; anterior border slightly advanced at the base, almost straight or slightly convex, and feebly bordered; anterior corners obtusely angular; lateral margins weakly convex, with 2 feeble notches bearing truncated or clubbed setae; each posterior corner subangulate or weakly produced, and with a clubbed seta. Pores present on segments 5, 7, 9, 10, 12, 13, 15–18 (19 in female), superior, opening from near the base of posterior angle and bearing a small clubbed seta on the outer side. Metatergites microscopically rough on the surface. Sternites nearly quadrate, with rather deep transverse furrow; surface covered with fine hairs; posterior corners not produced. Legs slender and normal in shape, and no secondary characters.

Gonopods small (about 0.28 mm in longitudinal length excluding coxa), W-shaped in posterior aspect; *in situ*, telopodites extending dorso-laterad, and the distal ends are slightly visible outside of body when viewed from above. Coxae coalesced with each other and broadened anteriorly; coxal horn very small. Telopodite segmented into three parts. Prefemur and femur short and densely covered with fine setae on the ventral surface. Tibiotarsus very long and slender, with a small process on the disto-lateral side; distal portion spoon-shaped, with a bush of small setae on the surface. Spermal groove runs along the medial side of tibiotarsus, reaching the terminal bush.

Female paratype. Length approximately 4.5 mm, greatest width 0.65 mm, and with 20 body segments. Cyphopod usually concealed within the body; when taken out, the shape is as shown in Fig. 10 G. Other somatic characters as in the male.

Type-series. 1 ♂ (holotype), Adigara-dô Cave, Is. Yonaguni-jima, 23 August 1972, coll. by M. SHIMOJANA; 2 ♀♀, Gyokusen-dô Cave, 28 July 1972, coll. by S. UÉNO; 1 ♀, 1 female larva, Hai-fusutô-iizaa Cave, 31 July 1972, coll. by S. UÉNO; 1 ♀, Rinkô-abu Cave, 3 August 1972, coll. by S. UÉNO.

Notes. The present new species is very closely related to *C. minutus* ATTEM

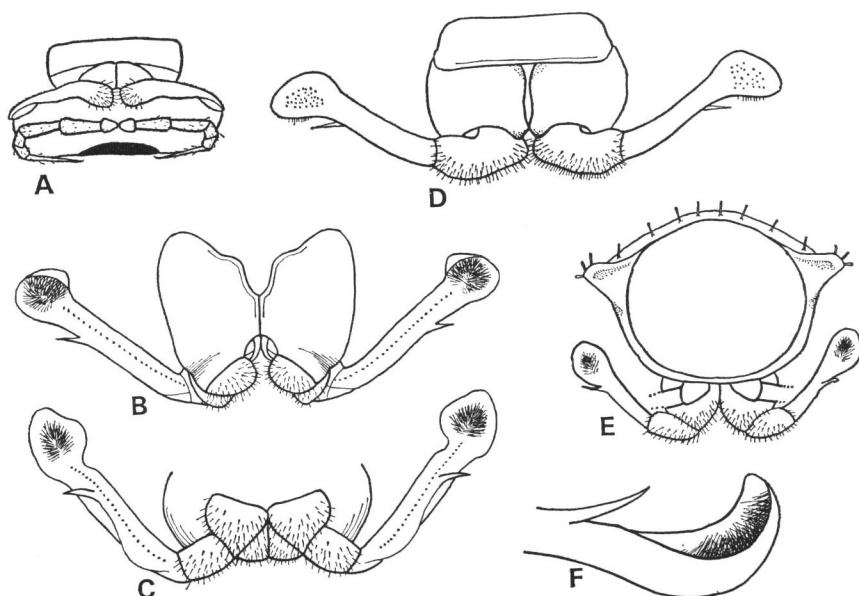


Fig. 11. *Corypholophus ryukyuensis* n. sp., holotype. — A, Ventral aspect of segment 7. B–D, Gonopods, dorsal, caudal and caudo-ventral aspects. E, Caudal aspect of segment 7, excluding legs. F, Posterior portion of gonopodal telopodite.

(1938) from Cauda of Nah-Trang in Viet-Nam. Both the species are very similar in the body form, but *minutus* differs from *ryukyuensis* in having three rows of erect setae on the metatergites. The structure of gonopods seems also different; in *minutus*, the gonopods bear a falcate process, into which the spermal groove runs, and two small processes on the disto-lateral side.

In addition to the type-series, four specimens of the same genus are examined. They are as follows: 1 ♀, Maeyama Cave (Is. Toku-no-shima), 2 August 1972; 1 ♀, Erabu-dô Cave (Is. Okinoérabu-jima), 4 August 1972; 2 ♀♀, Ya-gô Cave (Is. Yoron-tô), 6 August 1972. All these specimens were collected by M. SHIMOJANA.

These specimens are either females or damaged individuals, and cannot be determined with confidence. However, all of them are probably identified with the present new species.

Family Oniscodesmidae

[Gen. et sp. inedit.]

Specimen examined. 1 female larva, Hyandagu-abu Cave, 22 October 1972, coll. by M. SHIMOJANA.

Notes. As only a single larval specimen of the oniscodesmid milliped was ob-

tained, its systematic position could not be determined.

Family Polydesmidae

Epanerchodus subterraneus VERHOEFF

[Japanese name: Hora Obiyasude]

(Figs. 12 and 13)

Epanerchodus (*Riuerchodus*) *subterraneus* VERHOEFF, 1938, Mitt. Höhlen- u. Karstforsch., 1938, p. 90, figs. 15–17. — TAKAKUWA, 1954, Diplopoden aus Japan, Tokyo, pp. 91, 94, fig. 101.

Specimens examined. 1 ♂, 1 ♀, 1 female larva, Nisshû-dô Cave, 22 May 1965, coll. by T. KURAMOTO; 1 ♂, the same cave, 25 August 1970, coll. by M. SHIMOJANA; 3 ♂♂, 8 ♀♀, 6 larvae, the same cave, 23 July 1972, coll. by S. UÉNO; 1 ♂, Kabuyaa-gama Cave, 8 February 1971, coll. by M. SHIMOJANA; 1 ♂, Futenma-dô Cave, 25 July 1972, coll. by S. UÉNO; 1 ♀, 1 male larva, Taabaru-gama Cave, 25 July 1972, coll. by S. UÉNO; 1 male larva, Amachijô-gama Cave, 29 July 1972, coll. by S. UÉNO; 2 ♀♀, 1 larva, Tera-no-gama Cave, 23 July 1972, coll. by S. UÉNO.

A small troglobiontic species. Color pure white. Length 9.0–9.5 mm in both sexes. Body slender, almost parallel-sided between segments 5 and 18. The shape of head and of some selected segments in a male specimen (9.0 mm in length) as shown in Fig. 13 A–C, and the widths of them as follows:

Head = 0.8 mm Collum = 0.7 mm Seg. 3 = 0.8 mm
Seg. 4 = 0.8 mm Seg. 5 = 0.9 mm Seg. 19 = 0.6 mm.

Head large, oval, convex and densely covered with short or minute hairs. Antennae slender, approximately 1.4 mm, and reaching back to the posterior border of segment 3; the ratio in length and in width (in parentheses) of articles 2 through 7 is 6 : 7.5 : 6 : 6 (4) : 7.5 (5.5) : 3.5 (4); sensory hairs on articles 5 and 6 usually well developed; sensory prominence on last article rather small. Collum slightly narrower than head, elliptical, and slightly angulate at the posterior corners, and with a minute bristle-bearing notch at each lateral side; anterior margin feebly bordered, with 12 erect bristles; dorsal surface convex, rather smooth,

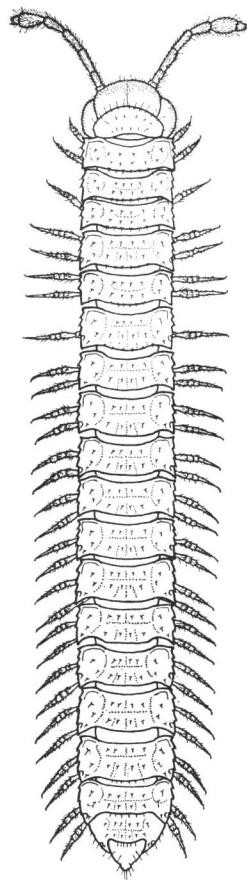


Fig. 12. *Epanerchodus subterraneus* VERHOEFF, a topotypical male from Nisshû-dô Cave.

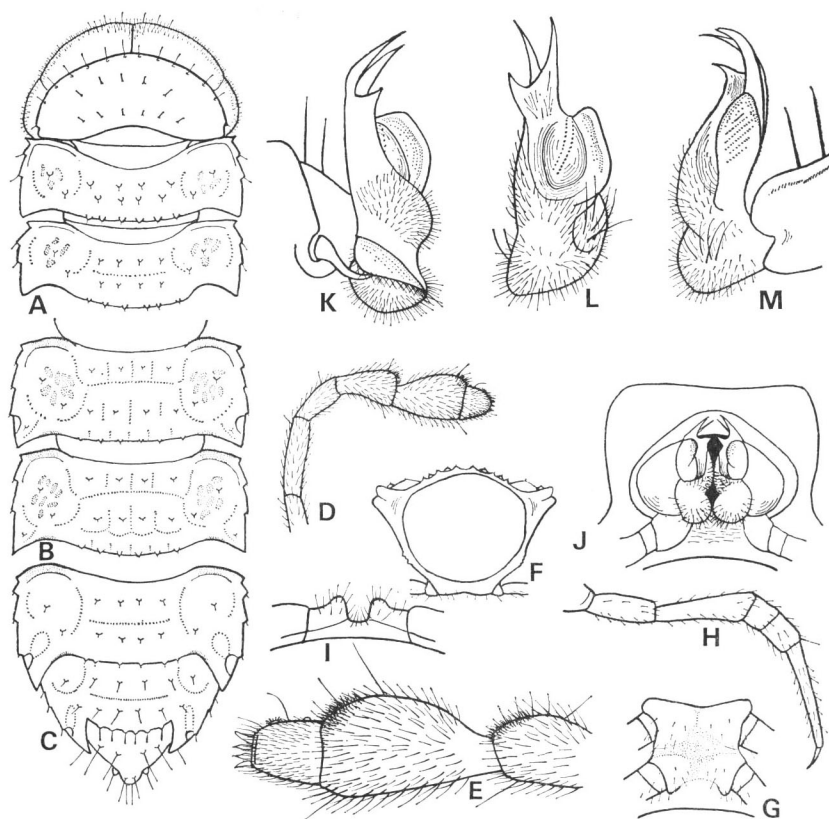


Fig. 13. *Epanerchodus subterraneus* VERHOEFF, a topotypical male from Nisshû-dô Cave. — A, Head and three succeeding segments, dorsal aspect. B, Segments 10 and 11, dorsal aspect. C, Caudal end of body, dorsal aspect. D, Left antenna. E, Last two articles of antenna. F, Caudal aspect of segment 10. G, Ventral aspect of the same. H, Right posterior leg on segment 10. I, Coxae of second legs, caudal aspect. J, Gonopods, *in situ*, ventral aspect. K–M, Left gonopod, mesial, ventral and lateral aspects.

and with two rows of small bristles. Succeeding segments basically similar to one another. Dorsum moderately arched, with three transverse rows of sculpture, each of which bears small bristles; bristles in the third row arranged along the posterior margin. Lateral keels slightly reflexed, the width being narrower than the length; posterior angle becoming more and more pointed from segment 2; lateral margin slightly convex, with 3 or 4 notches regularly, each of them bearing a small and simple bristle; segments 7 through 18 provided with microscopic strigils on the surface along anterior and posterior margins. Pores small, opening on the depressed lateral margin just behind the fourth notch of pore-bearing keels. Sternites as shown in Fig. 13 G, crossing furrow rather wide and shallow, and posterior corners slightly produced on segments 8–18. Legs moderately slender, without spherical bristles.

Coxae of leg 2 distally protuberant.

Gonopods very small (approximately 0.37 mm in longitudinal length excluding coxa); telopodites and distal ends of coxae exposed in ventral aspect; *in situ*, they adjoin each other at the femoral and prefemoral portions. Coxa large, cylindrical, without marginal incision. Femur well developed, swollen at the ventral side; clivus moderately protuberant and flattened; outer horn absent. Tibiotarsus simple and acutely tripartite. No postfemoral process.

Notes. *Epanerchodus subterraneus* which is the first described species of trogllobiontic *Epanerchodus* in the Japanese Islands, was placed by the original author in the new subgenus *Riuerchodus*. Later, several species of the genus occurring in Japanese caves were studied by the same author, who added new monotypic subgenera, *Antrochodus*, *Stygoerchodus* and *Huzichodus*. Many more trogllobiontic species belonging to the same genus have been described by several authors from the caves in southern and central Japan and in South Korea. They do not satisfactorily conform with VERHOEFF's classification, so that a new systematic treatment for these species is needed for establishing a sound phylogeny of the *Epanerchodus* complex.

In VERHOEFF's original description (p. 91), the type material of *E. subterraneus* was said to have come from "Höhle auf den Riu-Kiu Inseln." Later, a redescription of the same species was given by TAKAKUWA in his monograph, in which the locality of this species was recorded merely as "a cave of the Ryukyus." Actually, however, the original specimens were obtained by Mr. TORII in Nisshû-dô Cave at Kin. Therefore, this cave is the exact type-locality of the milliped.

