MYRIAPODOLOGICA

Virginia Museum of Natural History

Vol. 3, No. 11 ISSN 0163-5395 February 17, 1995

JAPANESE CHORDEUMATID MILLIPEDS. III. *YASUDATYLA*, A NEW GENUS OF ALPINE CONOTYLID MILLIPEDS (DIPLOPODA, CHORDEUMATIDA, CONOTYLIDAE)

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ABSTRACT

Yasudatyla, new genus, with three new species, *yasudai*, *shariensis*, and *hidakaensis*, is described from the northern Japanese island of Hokkaido. The new genus is the second in the Conotylidae to be described from Japan (after *Japanosoma* Verhoeff 1914) and appears to be closest to the Siberian genus *Crassotyla* Golovatch. The species of *Yasudatyla* are known only from high altitude (including alpine) habitats. While not a troglobite, *yasudai* is unpigmented and eyeless.

This paper is the third in a series[1] on the chordeumatid millipeds of Japan, based largely on the collections of the second author of this paper (Tsurusaki), those of Tsutomu Tanabe, Tokushima Prefectural Museum, and others.

The milliped family Conotylidae in North America has been the subject of a number of studies by the first author (Shear, 1971, 1974, 1976), and the only previously described Japanese representative, *Japanosoma scabrum* Verhoeff, was returned to this family (Shear, 1987) after a brief, unwarranted sojourn in the unrelated superfamily Acrochordoidea (Mauriès, 1987). The subfamily Japanosomatinae Verhoeff was placed in the synonymy of the Conotylinae, emphasizing similarities with the western North American genera *Taiyutyula* Chamberlin, *Plumatyla* Shear, and *Bollmanella* Chamberlin.

Golovatch (1980) described *Crassotyla amurica* from the Far Eastern Province of the former Soviet Union. While this species has pregonopodal leg modifications in the males that are unique in the family, the gonopod plan is similar to that of *Yasudatyla*, *Japanosoma*, *Taiyutyla*, *Plumatyla* and *Bollmanella*. *Crassotyla* and *Yasudatyla*, however, have much more complicated gonopods than the other listed genera, and their anterior gonopods are the largest and most elaborate in the family. In view of the apparent trend in conotylids towards simplification and reduction of the anterior gonopods, this suggests a basal position on the phylogenetic tree for the Asian genera, rather than a migration of the family from North

[1] Part I: Shear, Tsurusaki, & Tanabe, 1994, Myriapodologica 3: 25-36; Part II, Shear & Tanabe, 1994, Myriapodologica 3: 43-51.

America to Asia, as suggested by Golovatch (1980). The plesiomorphic sister group of the Conotylidae and Adritylidae[2] (the two North American families of the superfamily Heterochordeumatoidea) may be the East Asian family Megalotylidae, with two genera ranging from the Himalayas to Viet Nam and the Primorsky Region of the Russian Far East.[3] This is further evidence for an Asian, not North American, origin for the family.

Cordial thanks are due Mr. Nobuki Yasuda, curator of the Sounkyo Museum, Kamikawa, Hokkaido, for giving us the opportunity to study the present material, collected as by-products of a faunal survey of ground-dwelling beetles in the higher mountains of Hokkaido. The survey was carried out by Mr. Yasuda with the permission of the Environment Agency and the Agency for Cultural Affairs in Japan. We also thank Dr. S. I. Golovatch for the loan of specimens of *Crassotyla amurica* Golovatch and *Megalotyla brevichaeta* Golovatch & Mikhaljova, and Dr. R. L. Hoffman for comments on the manuscript. Type and other material has been deposited in the National Science Museum (Natural History), Tokyo (NSMT) and the Virginia Museum of Natural History, Martinsville (VMNH).

SYSTEMATIC TREATMENT

Superfamily Heterochordeumatoidea Pocock

The extent of this superfamily is currently the subject of debate. Both Mauriès (1988) and Golovatch & Mikhaljova (1978) are inclined to recongnize other superfamilies (Conotyloidea, Metopidiotrichoidea, Diplomaragnoidea) for components of Shear's original (1972) concept of the superfamily Heterochordeumatoidea. The discovery of each new generic or family-level taxon seems to provide occasion for rearranging the entire complex. Pending the completion of revisionary studies and a cladistic analysis of the entire assemblage, we prefer to continue with the 1972 concept. Possibly the other superfamilies can be recognized if Heterochordeumatoidea is raised to the level of a suborder.

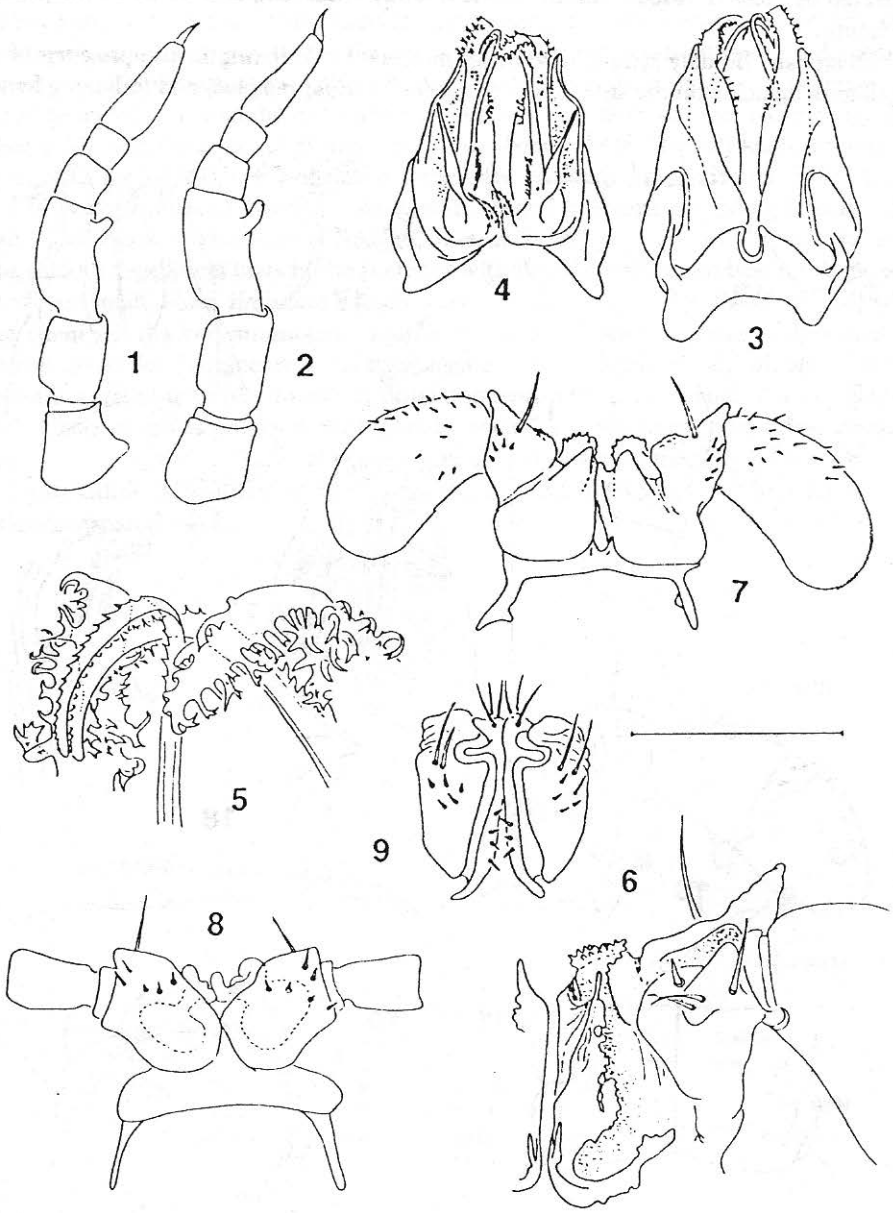
Family Conotylidae Cook

The subfamilies and genera of the Conotylidae were keyed by Shear (1976), but *Japanosoma*, *Crassotyla*, and, of course, *Yasudatyla*, the new genus diagnosed below, were not included. The key was based almost entirely on characters of the male gonopods, but *Japanosoma* can be immediately recognized by the cuticular ornamentation of small, acute nodules scattered over the dorsum and even on the pregonopodal legs (Shear, 1987). On gonopod characters, *Japanosoma* will come out in the key at *Taiyutyla*. *Crassotyla* and *Yasudatyla* will key out at *Bollmanella* on gonopodal characters, but *Crassotyla* may be recognized by the unique modifications of the third legs of the males–the prefemur bears a

2. This North American family was recently placed by Mauriès (1988) in a superfamily Metopidiothricoidea (recte: Metopidiotrichoidea). For some arguments against this placement, see Shear & Tanabe (1994).

3. Recent examination by one of us (WS) of *Megalotyla brevichaeta* Golovatch & Mikhaljova raises questions regarding placement of *Nepalella* Shear in the same family. While the anterior gonopods of *Megalotyla* are indeed reduced to a simple coxosternal plate, the posterior gonopod telopodites, form of legpair 10, and the presence of glands on coxae 11 of males are not conotylid-like. Except for the glands of coxae 11 in some species of *Nepalella*, they closely approach the North American conotylid genus *Brunsonia* Loomis & Schmitt. The original position of *Nepalella* in the Conotylidae may have been correct.

long mesal process, and the femur is enormously inflated (Golovatch, 1980). Species of *Yasudatyla* are all larger (12 mm or more in length) than the largest *Bollmanella* (only 7 mm long) and do not have the third leg modifications of *Crassotyla*, though their third and fourth legs are enlarged and bear distal processes on the femora.



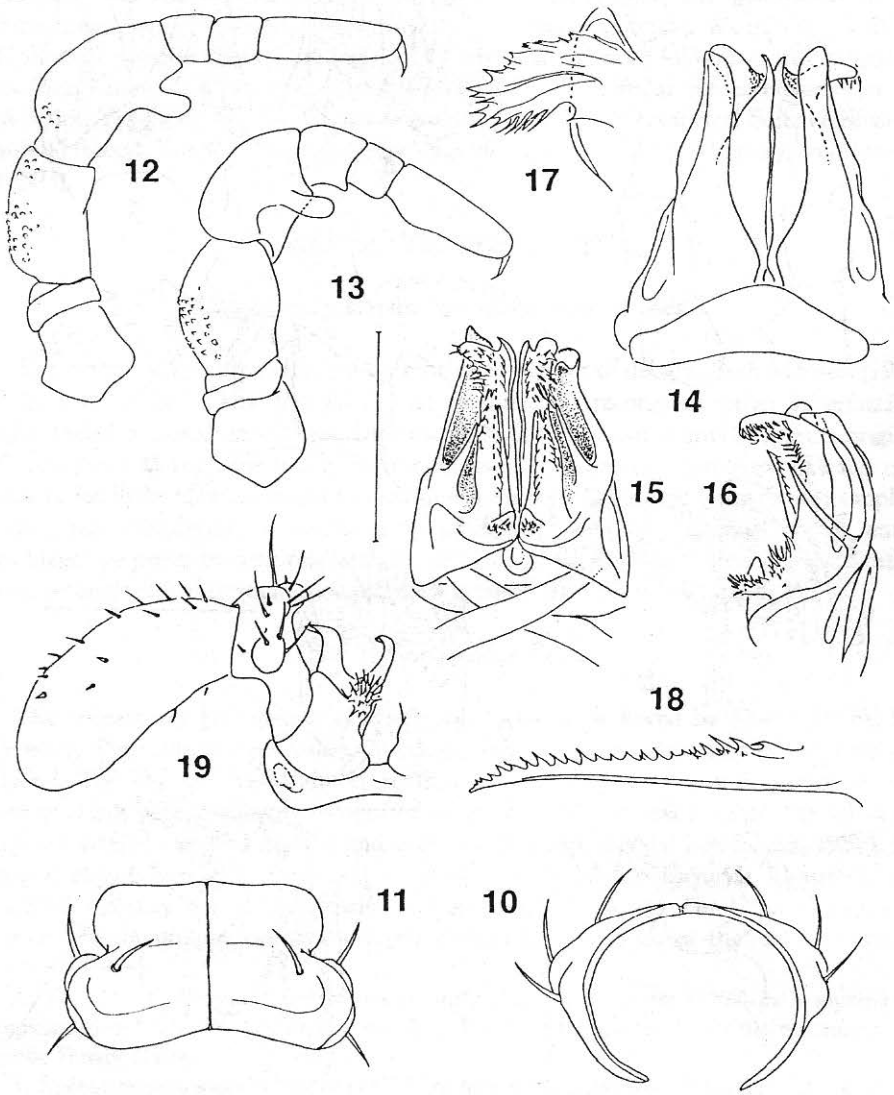
Figs. 1-9. *Yasudatyla yasudai*, n. sp. Fig. 1. Leg 3 of male, 100X. Fig. 2. Leg 4 of male, 100X. Fig. 3. Anterior gonopods, anterior view. Fig. 4. Anterior gonopods, posterior view, 100X. Fig. 5. Anterior gonopod coxite tips, 400X. Fig. 6. Posterior gonopod coxites, posterior view, 200X. Fig. 7. Posterior gonopods, anterior view, 100X. Fig. 8. Coxae 10 of male, posterior view, 100X. Fig. 9. Right cyphopod, 100X. Scale line = 0.6 mm for figs. 1-4, 7-9; 0.3 mm for fig. 6; 0.15 mm for fig. 5.

***Yasudatyla*, new genus**

Type species: *Yasudatyla yasudai* Shear & Tsurusaki, described below as new.

Derivation of name: All of the available material of the three species of this genus was collected by Nabuki Yasuda, curator of the Sounkyo Museum, and we name the genus in his honor.

Diagnosis: Broadly sympatric with *Japanosoma*, but differing in the presence of two flagelliform branches on the anterior gonopods (none in *Japanosoma*) and in having femoral

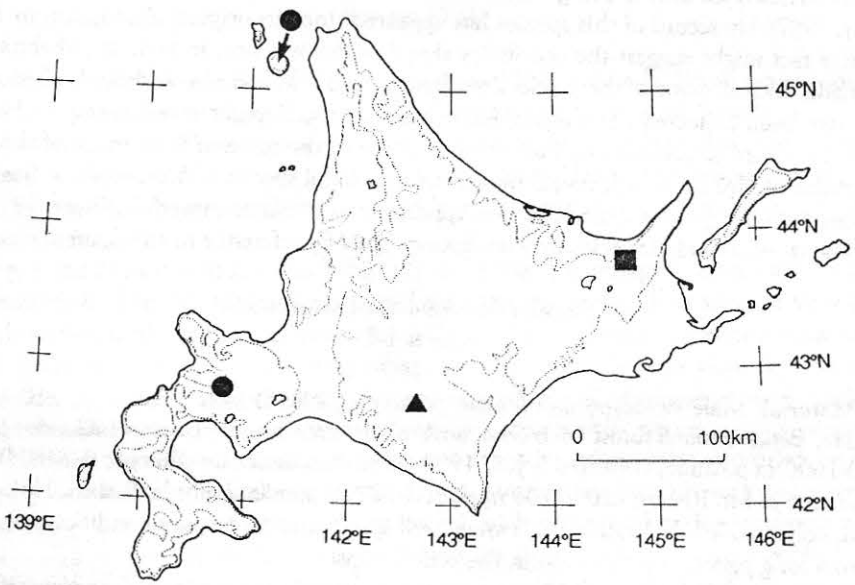


Figs. 10-19. *Yasudatyla shariensis*, n. sp. Fig. 10. Diplosegment 10 of male, posterior view, 40X. Fig. 11. Same, dorsal view, 40X. Fig. 12. Leg 3 of male, 100X. Fig. 13. Leg 4 of male, 100X. Fig. 14. Anterior gonopods, anterior view, 100X. Fig. 15. Anterior gonopods, posterior view, 100X. Fig. 16. Left anterior gonopods, lateral view, 100X. Fig. 17. Posterior process of anterior gonopods, 400X. Fig. 18. Posterior flagelliform branch of anterior gonopods, 400X. Fig. 19. Posterior gonopods, posterior view, 100X. Scale line 0.6 mm for figs. 12-16, 19; 0.15 mm for figs. 17, 18.

knobs on male legs 3 and 4; differing from the related *Crassotyla* in lacking a strongly inflated femur in male leg 3. Distinct from all other conotyline genera in the tendency for the prefemora of the posterior gonopods to fuse to the coxae.

Description: Medium-sized (12-15 mm long) conotylid millipeds, about 10 times as long as broad. Head not covered by collum, not modified in males. Thirty segments in both sexes. Diplosegments cylindrical, nearly circular in cross-section, with metazonites swollen and laterally projecting. Segmental setae slender, acute, short; mesal seta situated on dorsum of metazonite about two times its length from median sulcus, next lateralmost seta anterior and ventral to mesal seta, lateralmost seta low on segment, below transverse midline (fig. 10). Legpairs 3-7 of males enlarged, 3 and 4 much the largest, bearing mesal knobs on femora (figs. 1, 2, 12, 13, 20, 21), pair 7 of almost normal size. Anterior gonopods (figs. 3, 4, 14, 15, 22, 23) with incompletly formed coxosternum, sternal elements extending laterally and distally along coxae. Coxae fused at basal midline, each with two coxites, the anterior with acute, smooth flagelliform branch, the posterior with flagelliform branch bearing single row of teeth and small, basal, fimbriate branch. Posterior gonopod coxites (figs. 6, 19, 26) with three elements, the two anteriomost simple, the posterior with fimbriae. Telopodites of posterior gonopods 2-segmented, the basal segments (prefemora) cylindrical, with various distal lobes, tending to fuse to coxae, distal segment swollen and ovoid (figs. 7, 19, 24). Tenth coxae of males enlarged, with glands, posterior projections; telopodites normal. Eleventh coxae without glands, of normal size. Cyphopods as in figs. 9 and 28.

Distribution: Mountains of Hokkaido and Is. Rishiri off the northernmost part of Hokkaido, Japan (Map 1).



Map 1. Distribution of three species of *Yasudatyla* in Hokkaido and adjacent islands. Circles, *Y. yasudai*; square, *Y. shariensis*; triangle, *Y. hidakaensis*. Dotted lines indicate rough contours for 100 m in altitude.

Included species: The type, *shariensis* and *hidakaensis*, both new and described below.

Remarks: The consistent pattern of modification of legs 3 and 4 of the males points to a common origin for the three species. While *yasudai* and *shariensis* have relatively similar anterior gonopods, *hidakaensis* is strongly divergent, though the latter species retains the basic plan of the genus. The size and location of the flagelliform branches vary. The posterior flagelliform branch always bears a marginal row of small, acute teeth and is very long in *yasudai*, of intermediate length in *shariensis*, and shortest in *hidakaensis*. However, it always arises from the posterior base of the posterior coxite. The anterior flagellar branch is enormously developed in *hidakaensis*, and much shorter in *shari;* in both these species it arises from the margin of the anterior coxite. The anterior flagellar branch of *yasudai*, however, is quite short and appears to arise from near the base of the posterior flagellar branch. In the posterior gonopods, the coxites would seem to be of reduced functional importance and are strongly suppressed in *yasudai;* in both that species and *shariensis* the coxae of the posterior gonopods are fused to the lobed prefemora. The fusion is less complete in *hidakaensis*.

Despite the fact that it is not a cave species, *yasudai* seems to lack eyes--at least none could be detected in the three available specimens. The eyes of *shariensis* appear to be strongly reduced, and both these species are very poorly pigmented, *yasudai* being entirely white. On the other hand, *hidakaensis* has large, black eyes and is normally pigmented for a conotylid.

The new genus is obviously close to *Crassotyla amurica* Golovatch, but the anterior gonopods are even larger and more complex, with additional flagelliform branches. On the other hand, *Japanosoma scabrum* Verhoeff has considerably simpler anterior gonopods, and more complex posterior gonopod coxites. No specific localities are known for *J. scabrum*, which was described only as being from "Hokkaido," even on the labels of the type material (Shear, 1987). No record of this species has appeared since its original description in 1914, and this fact might suggest the possibility that *J. scabrum* is not, in fact, an inhabitant of Hokkaido. Indeed, none of the species described as from Hokkaido in Verhoeff's 1914 paper have ever been collected there again, but subsequent work might reveal them.

We venture to predict that further exploration of the soil and litter fauna of the high mountains of Hokkaido will reveal numerous additional species of *Yasudatyla*, as has been the case with the genus *Conotyla* in the Appalachians of North America (Shear, 1971).

The three included species may be distinguished by reference to the figures.

Yasudatyla yasudai, new species
Figures 1-8

Material: Male holotype and female paratype (NSMT) from Mt. Yôtei, 110-160 m altitude, *Betula ermanii* forest with *Sasa kurilensis* as main undergrowth, Hokkaido, Japan, 1100-1600 m altitude, collected 7 July 1989 by N. Yasuda; Male paratype (VMNH) from alpine zone of Mt. Rishiri, 1200-1700 m altitude, *Pinus pumila* scrub, Is. Rishiri, Hokkaido, Japan, collected 1 July 1990 by N. Yasuda. All specimens are in poor condition, probably due to a long period of immersion in the pitfall traps.

Holotype: Length, about 12 mm, width about 1.3 mm (estimated because of poor condition of specimen), third antennal article 0.48 mm long. The head and segments cannot be accurately described because of the flattening of the specimen. Eyes apparently absent.

Legs 1, 2 reduced; legs 3, 4 (figs.1, 2) with enlarged podomeres and cylindrical, distal tubercles on femora, appearing to have an internal duct on those of leg 4. Legs 5-7 of nearly normal size.

Anterior gonopods in anterior view (fig. 3) with coxites fused to sternum, deeply

excavated laterally; anterior coxites broad, thin, acute-triangular. In posterior view (fig. 4) with basal small plumose branch, two flagellar branches, all arising close together; posterior flagellar branch the longest, equalling posterior coxites, with fine teeth; anterior flagellar branch shorter, basally broadened, bladelike. Posterior coxites curved posteriorly at tips, bearing complex cuticular branches (fig. 5). Posterior gonopods with coxae, reduced sternum, and prefemora all fused; coxites with anterior, short, spatulate branch, posteriorly (figs. 6, 7) with a complex, cupped lamella and blunt-topped middle branch; prefemora lobed, with acutely tapering distal knob. Leg 10 coxae (fig. 8) with glands of normal size.

Female paratype: About 15 mm long, 1.5 mm wide (estimated because of poor condition of specimen; likewise head and segments cannot be accurately described); antennal article 3 0.52 mm long. Eyes absent. Cyphopods (fig. 9) with inner and outer valves separated by deep channel sharply curved out and in at anterior part, receptacle small, setose.

Distribution: known only from the two type localities.

Notes: All the specimens were collected during pitfall trap surveys of ground-dwelling beetle communities. The traps were plastic cups baited with a syrup made of muscovado, black beer, and distilled spirits. Animals were collected 5-7 days after the installation of the traps. At Mt. Yôtei, the traps were set at 100 m elevation intervals, from 300 to 1885 m; 20 traps were placed at each interval (Kimoto & Yasuda, 1991). *Yasudatyla yasudai* was taken from the pooled samples of the traps set from 1100-1600 m altitude. On the other hand, at Mt. Rishiri this species was found only a mixed collection from the 1200-1700 m traps out of all the traps set from 100 to 1700 m altitude. These facts suggest that the species may be confined to alpine or subalpine zones of the high mountains of Hokkaido.

Yasudatyla shariensis, new species
Figures 10-19

Material: Male holotype (NSMT) from Mt. Shari, 1200 m altitude, *Betula ermanii* forest, Hokkaido, Japan, 1200 m altitude, collected 18 September 1988 by N. Yasuda.

Holotype: about 14 mm long (estimated because of hyperextended condition of specimen), 1.65 mm wide, antennal article 3 0.62 mm long. Head and trunk segments (figs. 10, 11) as described for genus. Ocelli 24, weakly pigmented, well-separated, in oval patch of 4 transverse rows.

Legs 1 and 2 reduced in size; legs 3 (fig. 12) and 4 (fig. 13) enlarged, femora with distal, cylindrical knobs. Legs 5-7 approaching normal size. Anterior gonopods in anterior view (fig. 14) with well-formed sternum; anterior coxites broad, blunt-tipped; posterior coxites with curved, acute tip, posteriorly projecting subapical process. In posterior view (fig. 15), this process with numerous complex cuticular projections similar to those seen in *yasudai*; posterior flagellar branch (fig. 16) short, about half length of posterior coxites; anterior flagellar branch (fig. 17) arising from near base of anterior coxite, about two-thirds length of posterior flagellar branch. Posterior gonopods in posterior view (fig. 19) with two curved, anteriorly projecting coxites, posterior blunt branch with cuticular fimbriae; prefemur with lobes; apical article ovoid, swollen. Tenth coxae with glands, otherwise not modified.

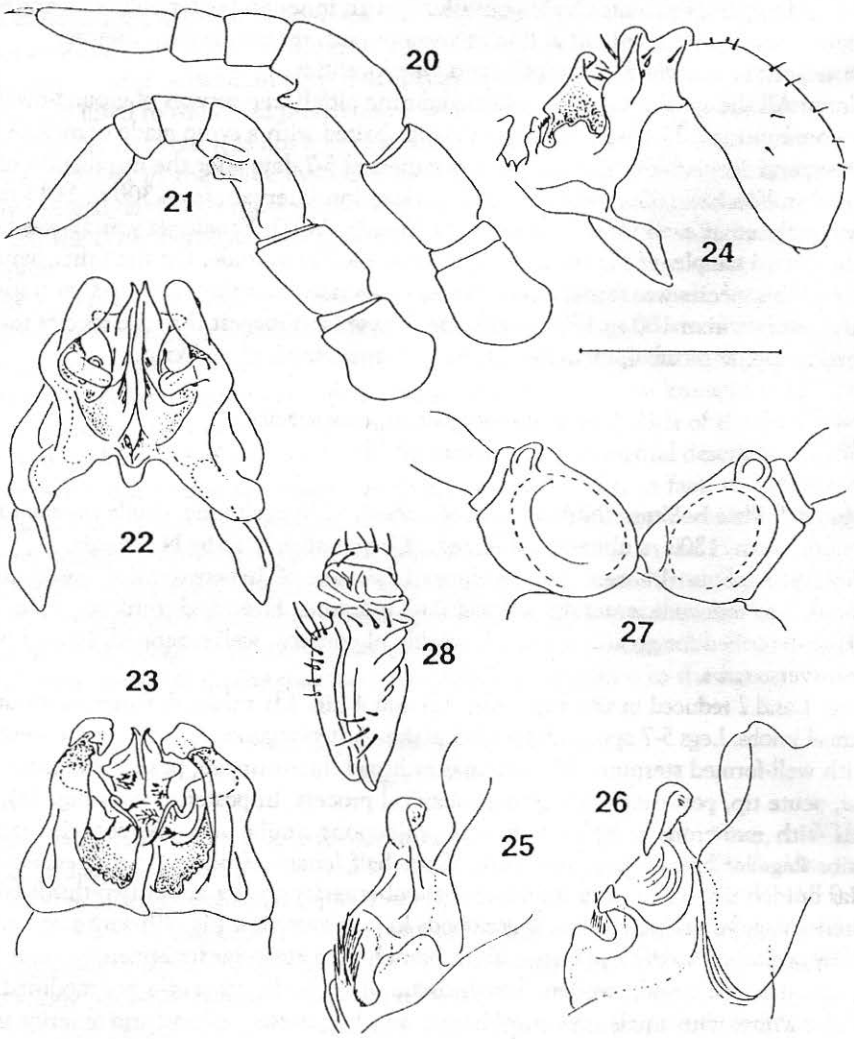
Color white, with small amount of brown mottling dorsal on head and anterior trunk segments. Females unknown.

Notes: This species was found in the alpine zone of Mt. Shari (peak: 1545 m).

Yasudatyla hidakaensis, n. sp.
Figures 20-28

Material: Male holotype, female paratype (NSMT) and male paratype (VMNH) from alpine zone of Mt. Poroshiri, 2050 m altitude, Hidaka Mtns., Hokkaido, Japan, collected 23 July 1988 by N. Yasuda.

Holotype: 17 mm long, 1.64 mm wide, antennal article 3 0.66 mm long. Head and trunk segments as described for genus. Ocelli 17, continguous, black, in oval patch of 4 transverse rows.



Figs. 20-29. *Yasudatyla hidakaensis*, n. sp. Fig. 20. Leg 3 of male, 100X. Fig. 21. Leg 4 of male, 100X. Fig. 22. Anterior gonopods, anterior view, 100X. Fig. 23. Anterior gonopods, posterior view, 100X. Fig. 24. Posterior gonopods, anterior view, 100X. Fig. 25. Posterior gonopod coxite, anterior view, 200X. Fig. 26. Posterior gonopod coxite, posterior view, 200X. Fig. 27. Coxae 10 of male, posterior view, 100X. Fig. 28. Cyphopods, posterior view, 100X. Scale line = 0.6 mm for figs. 20-25, 28, 29; 0.3 mm for figs. 26, 27.

Legs 1 and 2 reduced, legs 3 and 4 (figs. 20, 21) enlarged, with prominent femoral knobs; legs 5-7 of nearly normal size. Anterior gonopods in anterior view (fig. 22) with more or less completely fused coxosternum, both anterior and posterior coxites massive, anterior coxites curved posteriorward apically, with anterior flagellar branch arising from mesal surface; posterior coxites with acute tips, subapical lateral processes. In posterior view (fig. 23) anterior flagellar branch curves sinuously posteriorly, posterior flagellar branch arises from lateral basal part of posterior coxite. Posterior gonopods (figs. 24-26) with prefemora and coxae fused, single anterior coxite curves anteriorly, posteriorly arises small fimbriate branch and lamella; prefemur lobed, distal article ovoid, swollen. Coxae 10 (fig. 27) with glands, small posterior apical knob.

Color basically yellowish tan, with abundant darker brown mottlings on dorsum, legs whitish.

Female: Length, 19 mm (specimen hyperextended), width 1.7 mm, antennal article 3 0.64 mm long, ocelli 20, contiguous, black, in oval patch of 4 transverse rows. Cyphopods (fig. 28) with course of groove between inner and outer valves markedly less sinuous than in *yasudai*.

Notes: The anterior gonopods of this species diverge from those of the other two in their more massive nature and the large size and place of origin of the anterior flagellar branch.

Yasudatyla hidakaensis was found in samples collected from pitfall traps set up on windswept ground near the summit of Mt. Poroshiri (peak: 2052 m).

LITERATURE CITED

Golovatch, S. I. 1980. New forms of Diplopoda from the Soviet Far East and their zoogeographical relationships. Zoologicheskii Zhurnal (Moscow) 59: 199-207 [in Russian].

Golovatch, S. I., & E. V. Mikhaljova. 1978. A new family of East-Palearctic Chordeumida (Diplopoda), with a description of a new genus and a new species. Byulleten Moskovskogo Obshchestva Ispytatelei Prirody, Otdel Biologicheskii 83: 66-71 [in Russian].

Kimoto, S., & N. Yasuda. 1991. Bioenvironmental studies using ground-living beetle communities. 2. Vertical distribution at Mt. Yôtei, Hokkaido. Journal of the Institute for Comparative Culture (Kurume Univ.) 9: 21-48 [in Japanese].

Mauriès, J.-P. 1987. Craspedosomid millipeds discovered in Australia: *Reginaterreuma, Neocambrisoma* and *Peterjohnsia*, new genera (Myriapoda: Diplopoda: Craspedosomida). Memoirs of the Queensland Museum 25: 107-133.

———. 1988. Myriapodes du Nèpal. II. Diplopodes Craspedosomides nouveaux de l'Himalaya et de la région indo-malaise (Craspedosomidea et Chordeumidea). Revue suisse de Zoologie 95: 3-49.

Shear, W. A. 1971. The milliped Family Conotylidae in North America, with a description of the new Family Adritylidae (Diplopoda: Chordeumida). Bulletin of the Museum of Comparative Zoology 141: 55-96.

———. 1972. Studies in the milliped Order Chordeumida Diplopoda): revision of the Cleidogonidae and a reclassification of the order in the New World. Bulletin of the Museum of Comparative Zoology 144: 151-352.

———. 1974. The milliped genus *Bollmanella* (Diplopoda, Chordeumida, Conotylidae). Psyche 81: 134-146.

———. 1976. The milliped Family Conotylidae (Diplopoda, Chordeumida): Revision of the

genus *Taiyutyla*, with notes on recently proposed taxa. American Museum Novitates 2600: 1-22.

———. 1987. Systematic position of the milliped *Japanosoma scabrum* Verhoeff (Chordeumatida, Conotylidae). Myriapodologica 2: 21-27.

Shear, W. A., & T. Tanabe. 1994. Japanese chordeumatid millipeds. II. The new genus *Nipponothrix* (Diplopoda, Chordeumatida, Metopidiotrichidae). Myriapodologica 3: 43-51.

Shear, W. A., N. Tsurusaki, & T. Tanabe. 1994. Japanese chordeumatid millipeds. I. On the genus *Speophilosoma* Takakuwa (Diplopoda, Chordeumatida, Speophilosomatidae). Myriapodologica 3: 25-36.

Verhoeff, K. W. 1914 ("1913"). Ascospermophoren aus Japan. Zoologischer Anzeiger 43: 342-370.

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