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New Cambrian Lobopods and Chaetognaths of the Siberian Platform

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Abstract—The association of isolated remains of lobopods with a netlike structure, including plates of *Microdictyon rozanovi* sp. nov. and sclerites with spinelike process of *Onychomicrodictyon spiniferum* gen. et sp. nov., as well as saberlike sclerites of *Protohertzina yudomica* sp. nov. interpreted as grasping spines of chaetognaths, is described from the middle part of the Inikan Formation of the Toyonian Stage of the Lower Cambrian (*Lermontovia dzevanovskii* Zone). The diagnoses and species composition of the genera *Microdictyon* and *Protohertzina* are refined.

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Key words: lobopods, protoconodonts, Chaetognatha, Early Cambrian, Toyonian Stage, Yudoma River, Siberian Platform, Russia.

INTRODUCTION

The field study of Lower–Middle Cambrian deposits on the Yudoma River (southeast Siberian Platform) in 1998 by members of the Paleontological Institute of the Russian Academy of Sciences, A.Yu. Zhuravlev and A.Yu. Ivantsov, provided material for micropaleontological investigation. Under laboratory conditions samples of limestones were dissolved in 8–10% acetic acid in the traditional technique. The sample from the middle part of the Inikan Formation yielded unique material on Lower Cambrian small shelly fossils represented by phosphatic sclerites.

The Inikan Formation unconformably overlies deposits of the Pestrotsvetnaya Formation and is of Early–Middle Cambrian age ranging from the Late Botomian to Toyonian and Amgan stages (*The Cambrian System…*, 1991). Member 3 (Toyonian, *Lermontovia dzevanovskii* Zone) represents an alternation of black and dark gray evenly plated fine-grained and pelitomorphic limestones and shales (Suvorova, 1983) with occurrences of lenticular, oval, and rounded structures up to 1 m long and up to 20–40 cm thick. A sample from one of these lenticular bodies produced small shelly fossils including (a) sclerites with a curved spinelike process and netlike surface (*Onychomicrodictyon spiniferum* gen. et sp. nov.); (b) lenticular-flattened sclerites with a netlike external surface resembling that of sclerites with a spine (*Microdictyon rozanovi* sp. nov.); and (c) long, curved, clawlike sclerites (*Protohertzina yudomica* sp. nov.).

For a long time isolated sclerites of *Microdictyon* occurring in associations of diverse small shelly skeletal remains extracted by chemical preparation were considered as a group of uncertain classification (Missarzhevsky and Mambetov, 1981; Bengtson et al., 1986, 1990; Esakova and Zhegallo, 1996). Some authors saw a similarity between *Microdictyon* and another problematic Upper Cambrian–Middle Ordovician genus *Milaculum* Müller, 1973 (Müller, 1973; Nitecki et al., 1975; Ethington and Clark, 1981; Missarzhevsky and Mambetov, 1981) in the general form of the sclerites, the morphological structure (the convex upper and concave lower sides), and the identical chemical composition, joining them within the family Microdictyonidae Chen, Hou et Lu, 1989 (Chen et al., 1989). However, sclerites of *Microdictyon* are larger and have rounded holes circled by five to seven nodes, whereas sclerites of *Milaculum* have nodes but lack holes.

A clearer understanding of *Microdictyon* has emerged due to a unique record of numerous imprints of whole animals (more than 100 individuals) in the Chengjiang Biota of southern China (Chen et al., 1989, 1996; Hou and Bergström, 1995), the wormlike bodies of which have paired sclerites on their lateral sides directly above paired appendages.

Recently *Microdictyon* is considered within the family Eoconchariidae Hao et Shu, 1987 of the class Xenusia Dzik et Krumbiegel, 1989 and the phylum Tardipolypoda (e.g., Gravestock et al., 2001; Ivantsov et al., 2005). The spinelike sclerites of *Onychomicrodictyon spiniferum* gen. et sp. nov. found in the Lower Cambrian deposits of the Yudoma River combine features characteristic for members of the genera *Microdictyon* and *Onychodictyon* Hou, Ramskold et Bergström, 1991. They share with the former genus the netlike structure of sclerites expressed in rounded holes

decreasing in size to the periphery and in five to seven mushroom-shaped smaller nodes around the holes. With the latter genus the new species shows a strong similarity in the overall shape of sclerites, though sclerites of *Onychodictyon* are not perforated and have a smooth outer surface.

Bengtson (1991) illustrated a form from the Lower Cambrian of Greenland that should be assigned to *Onychomicrodictyon*. According to this author, it combines features of two different genera, *Microdictyon* in the similarity of the external sculpture, and *Hallucigenia* in the shape. No description of sclerites has been given. The record of a sclerite with a combination of characters of both *Microdictyon* and *Hallucigenia* suggests their affinity and that the "stilts" of *Hallucigenia* are homologous with the sclerites of *Microdictyon*.

It is highly probable that the animals with sclerites of *Microdictyon, Onychodictyon*, and *Onychomicrodictyon* gen. nov. are closely related. Also it cannot be exclude that spinelike sclerites of *Onychomicrodictyon* and co-occurring plates of *Microdictyon* showing the uniform perforated structure belonged to the same lobopod animal, with the former type providing a protective function.

According to Dzik (2003), netlike sclerites of *Microdictyon* resemble schizochroal eyes of trilobites, which consist of rather large rounded biconvex lenses divided by a netlike frame. The number of lenses usually does not exceed several hundred, but can be reduced to one or two (Clarkson, 1997). Dzik assumed that each hole in the sclerite of *Microdictyon* originally contained a non-phosphatized lenslike body, thus presenting an interpretation of the *Microdictyon* sclerite as a compound eye.

The material studied also provided interesting finds of new clawlike sclerites attributed to the genus *Protohertzina*, a group widespread in the Upper Vendian (Nemakit-Daldynian) and Lower Cambrian deposits, and sporadically occurring in the Middle to Upper Cambrian of Europe (Bengtson, 1983). *P. yudomica* sp. nov., described below, is the first occurrence of the genus in the Toyonian of the Siberian Platform. In morphology and external shape, sclerites of *Protohertzina* are very close to conodonts and for a long time were considered within the group of protoconodonts, straight or curved spines consisting of a denticle and wide base with the basal cavity reaching the apex of the denticle. The position of the genus among protoconodonts was confirmed by microstructure study (Bengtson, 1976, 1983). It became known that the wall of *Protohertzina* is from 10 to 100 μm thick and has a three-layered structure with two thin external layers surrounding the thickest intermediate lamellar layer. In early protoconodonts, like *P. unguliformis* and *P. anabarica*, it consists of fibers (Bengtson, 1983). The growth proceeded owing to the basal accretion and the formation of new lamellae on the internal sides of an element.

Studies of Szaniawski (1982) allowed further progress in systematic interpretation of protoconodont elements. Based on morphological similarity and the microstructural data on the species *Prooneotodus*? *tenuis*, they were compared with grasping spines of the hunting apparatus in modern chaetognath *Sagitta setosa* Müller, 1847. But non-mineralized spines and a fibrous medium layer are typical only for early protoconodonts. Similarity in the structure of spines of *Prooneotodus*? *tenuis* and probably others protoconodonts suggests relationship between all protoconodont animals and Chaetognatha. Lately, this point of view became widespread and the presence of chaetognathans in the Cambrian is important and provides new clues for phylogenetic reconstructions within Metazoa.

MATERIAL

The collection studied is housed in the Paleontological Institute, Russian Academy of Sciences, collection no. 5119.

SYSTEMATIC PALEONTOLOGY

Phylum Tardipolypoda

CLASS XENUSIA

Order Scleronychophora

Family Eoconchariidae Hao et Shu, 1987

Genus *Microdictyon* Bengtson, Matthews et Missarzhevsky, 1986

Bengtson, Matthews et Missarzhevsky, 1981

Microdictyon Missarzhevsky and Mambetov, 1981, p. 78 (nom. nud.); Grigorieva, 1983, p. 169 (nom. nud.).

Microdictyon Bengtson, Matthews et Missarzhevsky, 1986: Bengtson et al., 1986, p. 99; Chen et al., 1989, p. 13; Tong, 1989, p. 100; Missarzhevsky, 1989, p. 211; Bengtson et al., 1990, p. 332; Hou and Bergström, 1995, p. 14; Esakova and Zhegallo, 1996, p. 124.

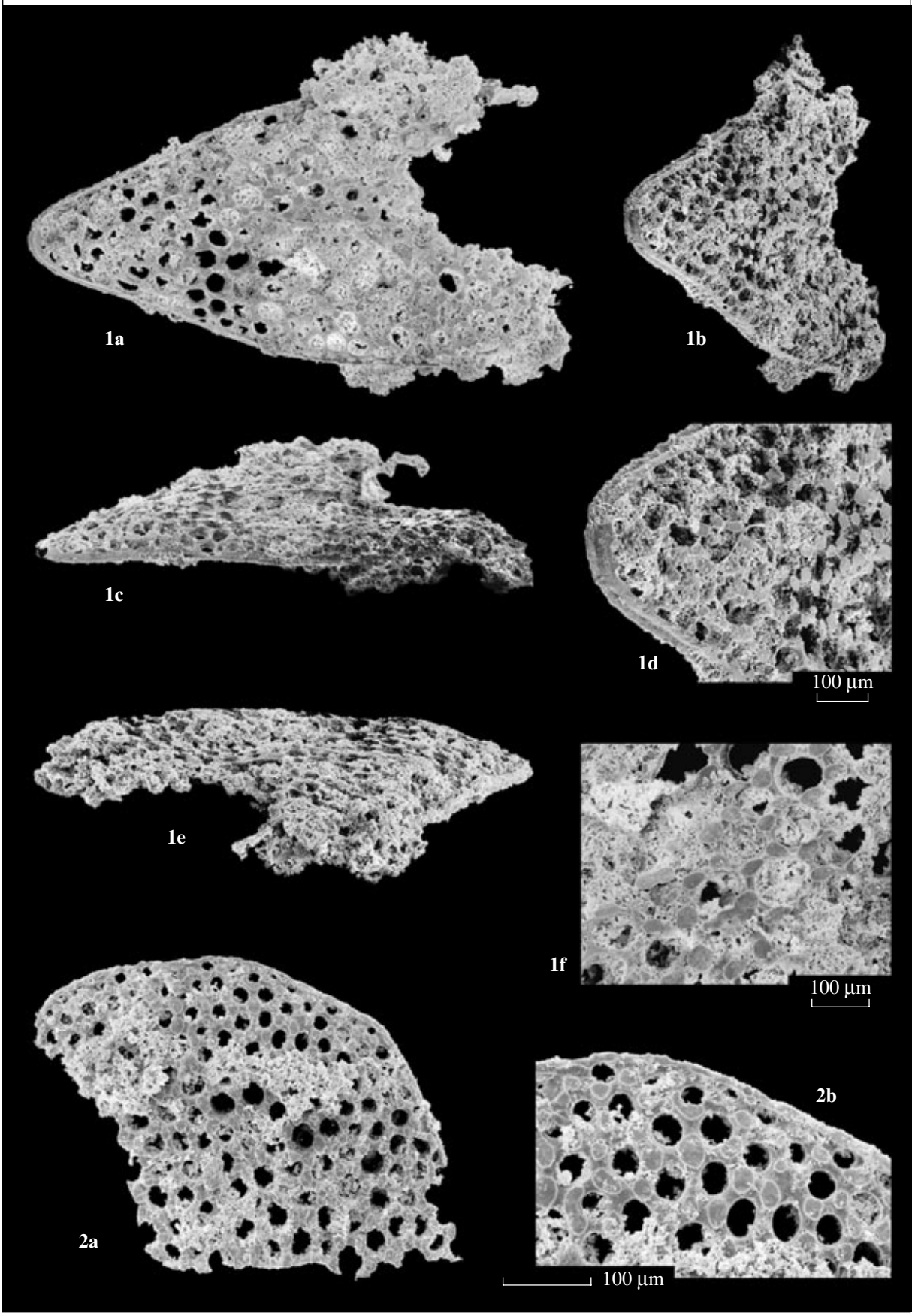
Eoconcharium Hao et Shu, 1987: Hao and Shu, 1987, p. 304.

Type species. *Microdictyon effusum* Bengtson, Matthews et Missarzhevsky, 1986; Lower Cambrian, Atdabanian Stage, the *Rhombocorniculum cancellatum* Zone, Kazakhstan, Lesser Karatau Range; Atdabanian and Botomian Stages, Russia (Siberian Platform) and England; Lower Cambrian, Sweden.

Diagnosis. Phosphatic perforated plates, flat or poorly convex, with distinct girdle along periphery. Shape in outline rounded, oval, lenticular, trapezoid or irregular. Holes rounded, arranged in rows with half inter-hole distance shift between centers of holes in neighboring rows. Hole diameter decreases toward periphery. Holes occasionally with thin bottoms below. Each hole typically surrounded by five to seven mushroom-shaped nodes or spines.

Species composition. In addition to the type species, ten species: *M. anus* Tong, 1989, Lower Cambrian, Meishucunian Stage, China (Shaanxi); *M. chinense* (Hao et Shu, 1987), Lower Cambrian,

Plate 1



Qiongzhusi Stage, China (Shaanxi); Atdabanian through Botomian stages, Siberian Platform; *M. depressum* Bengtson, 1990, Lower Cambrian, Atdabanian through Botomian Stages, South Australia; *M. fuchengense* Li et Zhu, 2001, Lower Cambrian, Meishucunian Stage, China (Shaanxi); *M. rhomboidale* Bengtson, Matthews et Missarzhevsky, 1986, Lower Cambrian, upper parts of the Atdabanian Stage, Kazakhstan; Atdabanian Stage, Canada, the United States (*M.* cf. *rhomboidale*); *M. robisoni* Bengtson, Matthews et Missarzhevsky, 1986, Middle Cambrian, Amgan Stage, the United States; *M. rozanovi* sp. nov.; *M. sinicum* Chen, Hou et Lu, 1989, Lower Cambrian, Meishucunian Stage, China (Yunnan); *M. sphaeroides* Hinz, 1987, Lower Cambrian, Atdabanian Stage, Great Britain; and *M. tenuiporatum* Bengtson, Matthews et Missarzhevsky, 1986, Lower Cambrian, Atdabanian Stage, Siberian Platform.

Remarks. The species *Microdictyon effusum* Bengtson, Matthews et Missarzhevsky, 1981 and ?*M. inceptor* Missarzhevsky, 1981 were described in the paper of Missarzhevsky and Mambetov (1981); however, no descriptions of the genus *Microdictyon* have been provided and its type species has not been specified. Therefore, this description of these taxa is considered unavailable. Later, Grigorieva (1983) described *M. effusum* with reference to the authorship of Bengtson, Matthews et Missarzhevsky, 1981; however, she did not describe the genus either. The availability of the genus *Microdictyon* and its type species *M. effusum* was provided by the publication of Bengtson, Matthews and Missarzhevsky (Bengtson et al., 1986), in which these taxa had been described according to the requirements of the ICZN.

The species *M. tenuiporatum* Bengtson, Matthews et Missarzhevsky, 1986 and *M. sphaeroides* Hinz 1987 are actually of Atdabanian age, and their reports from the Tommotian (Bengtson et al., 1986; Hinz, 1987) are mistakes.

The species *M.* cf. *M. ovalum* (Hao et Shu, 1987) was described from the Sinyaya Formation (Botomian Stage, Lower Cambrian) in the middle reaches of the Lena River. It is noted in remarks to the description that *M. ovalum* is a junior synonym of *M. chinense*; therefore, the species from the Sinyaya Formation should be treated as *M. chinense.*

Microdictyon rozanovi Demidenko, sp. nov.

Plate 1, figs. 1a–1f

Etymology. In honor of A.Yu. Rozanov.

Holotype. PIN, no. 5119/126; Siberian Platform, right bank of the Yudoma River, 40 km upstream from the river mouth, 5 km upstream from Suorbalaakh Spring; Lower Cambrian, Toyonian Stage, middle part of the Inikan Formation, Member 3, Sample 1.

Description. Symmetrical (?) elongated-lenticular perforated sclerites appearing as plates with a length estimated to be about 3 mm and the maximal width of 0.95 mm. The upper side of the sclerite is convex. The sclerite bears rounded open holes with a diameter of 0.03–0.09 mm that diminishes peripherally. On the upper side of the sclerite, each large open hole is surrounded by five to seven mushroom-shaped nodes, the diameter of which (0.03–0.04 mm) is smaller that of the holes. The lateral zone at the base of the sclerite has a girdle up to 0.01–0.02 mm wide. The central part of the girdle has a wide deepening.

Measurements, mm:

Specimen PIN, no.	Length of preserved part of sclerite	Width of sclerite	Diameter of holes	Diameter of nodes
5119/126	1.7	0.95	0.03–0.09	0.03–0.04

Comparison. The new form differs from all the other species of the genus in the characteristic extended edge of a sclerite.

Remarks. The incomplete preservation of the holotype obscures the true shape of a sclerite. Anterior and posterior edges of the sclerite were probably symmetrical and the sclerite had an elongated-lenticular shape. However, the presence in the same sample of a sclerite fragment of *Microdictyon* sp. (Pl. 1, figs. 2a, 2b), which may represent a destroyed part of a sclerite of *M. rozanovi* sp. nov., may indicate that sclerites of *M. rozanovi* sp. nov. were generally droplike rather than elongated-lenticular in shape and had extended and rounded edges.

Material. Holotype.

Genus *Onychomicrodictyon* Demidenko, gen. nov.

Etymology. From the genera *Onychodictyon* and *Microdictyon*.

Type species. *O. spiniferum* sp. nov.

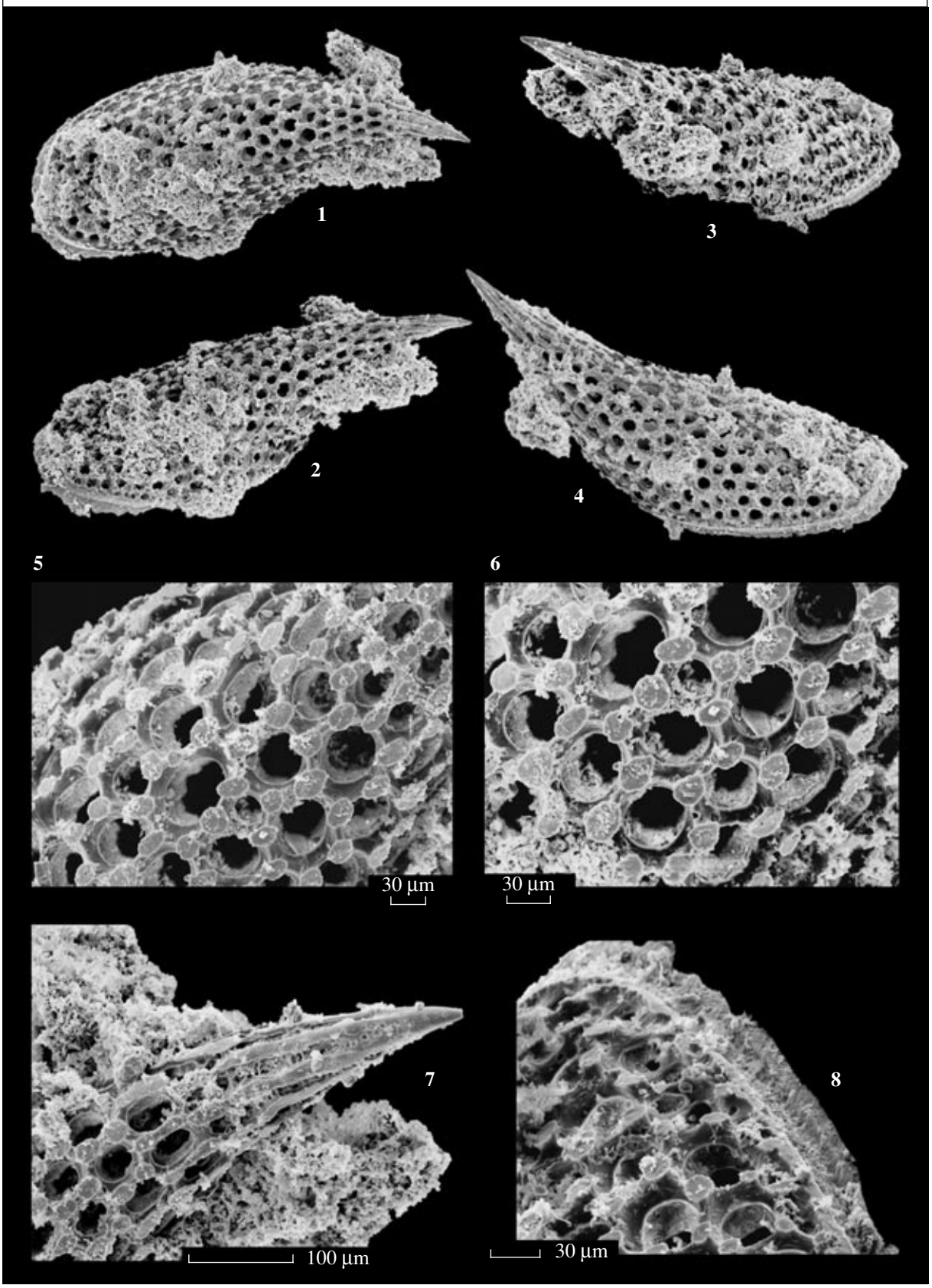
Diagnosis. Sclerites with oval base and dorsal side transformed into bent conical spine. Maximal basal width of sclerite 0.5 mm. Base of sclerite with lateral girdle. Sclerite perforated by open holes decreasing in size to periphery. On upper side of sclerite, each hole

Explanation of Plate 1

Fig. 1. *Microdictyon rozanovi* sp. nov., holotype PIN, no. 5119/126; (1a) general view of sclerite from above, ×55; (1b) oblique view on the sclerite from above, ×53; (1c) oblique view on the sclerite in upper-lateral position, ×53; (1d) magnified fragment of Fig. 1b; (1e) slanting inclined view on the sclerite in upper-lateral position, ×55; and (1f) magnified fragment of the sculptured external surface of the sclerite.

Fig. 2. *Microdictyon* sp., specimen PIN, no. 5119/134; (2a) general view of the sclerite from above, ×82; (2b) magnified fragment of the sculptured external surface of the sclerite.

Plate 2



surrounded by four to seven mushroom-shaped nodes with diameters smaller than those of holes.

Species composition. Type species.

Comparison. This genus differs from the genus *Microdictyon* in the presence of a conical curved spine extending from the median part of the base. From the genus *Onychodictyon* the new genus differs in the net-like sclerites and the external sculpture expressed in four to seven nodes located around open holes.

Remarks. The spinelike sclerite from the Lower Cambrian of Greenland illustrated by Bengtson (1991) without description is close to the type species of the genus in the general sclerite shape and the presence of holes. It is likely that this form represents a different species of the genus distinct from *O. spiniferum* sp. nov. in the more flattened lower side of a sclerite.

***Onychomicrodictyon spiniferum* Demidenko, sp. nov.**

Plate 2, figs. 1–8

Etymology. From the Latin *spina* (spine) and *ferre* (to carry).

Holotype. PIN, no. 5119/123; Siberian Platform, right bank of the Yudoma River, 40 km upstream from the river mouth, 5 km upstream from Suorbalaakh Spring; Lower Cambrian, Toyonian Stage, middle part of the Inikan Formation, Member 3, Sample 1.

Description. Asymmetrical spinelike sclerites have an overall length of 1.3 mm and an oval convex base with a length of 1.2 mm. The spine runs from the base; it is curved, 0.8 mm long, and tapers toward the apex. Sclerites are perforated by rounded holes 0.03–0.04 mm in diameter that decrease in size to the periphery. On the upper side of a sclerite, each open hole is surrounded by four to seven mushroom-shaped nodes with diameters smaller (0.01–0.03 mm) than those of the holes. The external surface of a sclerite is sculptured by nodes. In the apical part of a spine (0.25 mm), nodes fuse into 0.01-mm-wide longitudinal ribs, which are divided by equally wide grooves. At the apex of the spine, convex ribs merge to form a smooth surface. The lateral zone at the base of a sclerite has a girdle up to 0.06 mm wide. A groove runs along the middle zone of the girdle.

Measurements, mm:

Specimen PIN, no.	Length of sclerite	Width of sclerite	Diameter of holes	Diameter of nodes
5119/123	1.3	0.49	0.03–0.04	0.01–0.03

Material. Holotype.

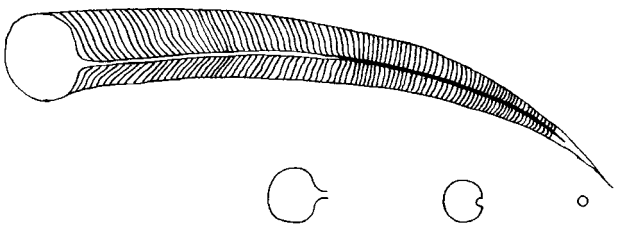


Fig. 1. Reconstruction of the sclerite of *Protohertzina yudomica* sp. nov., oblique posterolateral view on a sclerite from the base.

Phylum Chaetognatha

Class, order, and family have not been established

Genus *Protohertzina* Missarzhevsky, 1973

Protohertzina Missarzhevsky, 1973: Missarzhevsky, 1973, p. 54; 1989, p. 212; Bengtson, 1983, p. 8; Mambetov, 1988, p. 152; Qian, 1989, p. 211; Qian and Bengtson, 1989, p. 64; Bengtson et al., 1990, p. 330.

Emeidus Chen, 1982: Chen, 1982, p. 258.

Hastina Yang et He, 1984: Yang and He, 1984, p. 38.

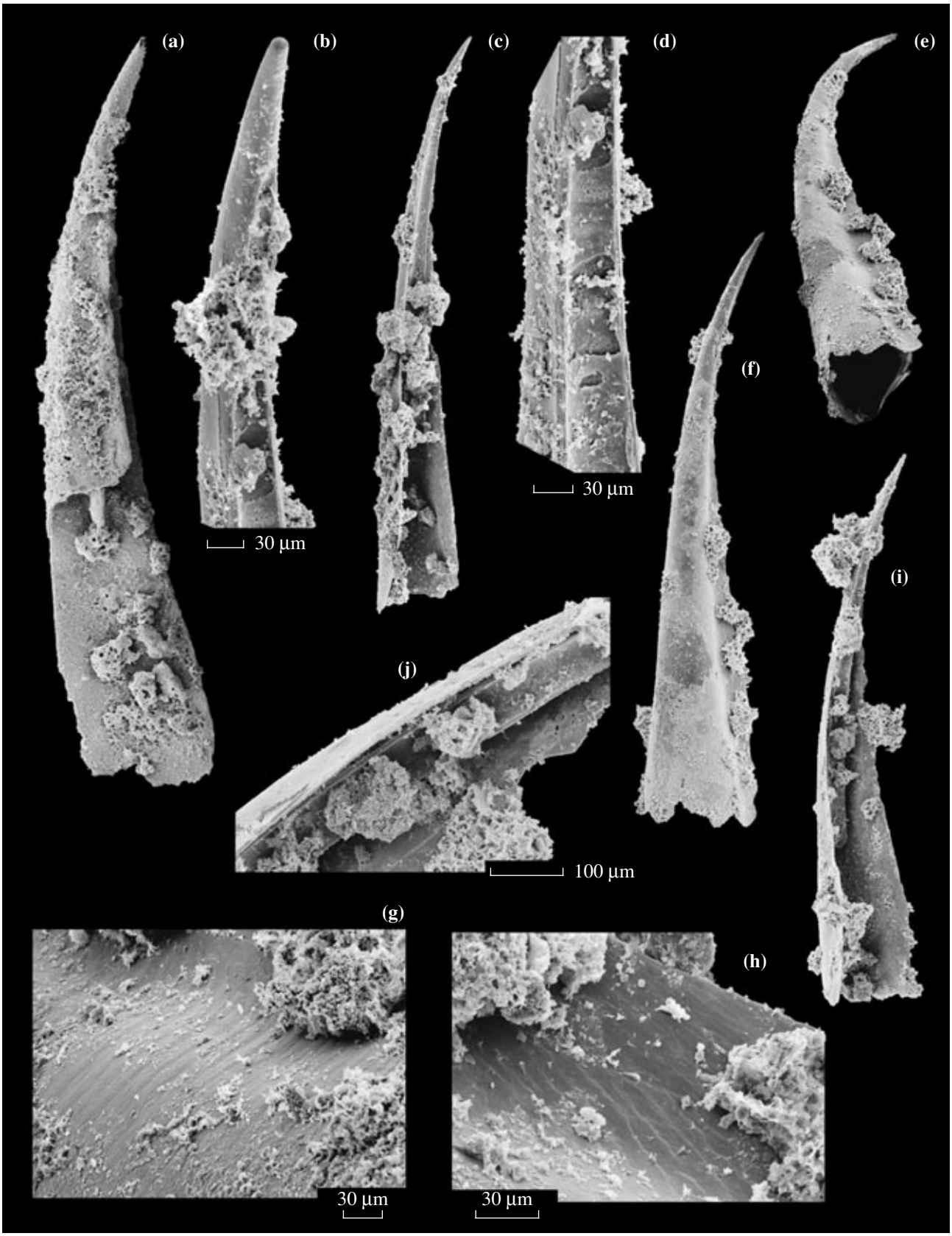
Type species. *Protohertzina anabarica* Missarzhevsky, 1973; Upper Vendian, Nemakit-Daldynian of Russia (Krasnoyarsk Region), Kazakhstan and Kyrgyzstan; upper parts of the Vendian to the basal Lower Cambrian of Canada; Lower Cambrian, Tommotian Stage of western Mongolia; Meishucunian Stage of China; Lower Cambrian of northern Iran and India.

Diagnosis. Bilaterally symmetrical, conelike, clawlike elements, straight or gently curved, with expanded basal part. Composition calcium phosphate. Basal cavity deep, reaching top of element. Anterior side convex, less often straight, rounded in cross section or rounded with small median deepening (groove) in basal part of element. Posterior side concave, less often straight, with longitudinal median keel. Anterior side of element rarely with longitudinal median keel. Sides separated from each other by lateral ribs.

Species composition. Seven species: *P. anabarica* Missarzhevsky, 1973, Upper Vendian, Nemakit-Daldynian, Krasnoyarsk Region, Russia; Kazakhstan (*Protohertzina anabarica* Zone); Kyrgyzstan; middle dolomites of the Soltanieh Formation, northern Iran; the siliceous-phosphorite member of the Tal Formation, Himalayas, India; upper parts of the Vendian to the lower Lower Cambrian, Yukon and Northwest Territories, Canada; Lower Cambrian, Tommotian Stage, western Mongolia (beds with *Mongolodus rostriformis*); lower part of the Meishucunian Stage, Hubei, Sichuan, Yunnan, Shaanxi and Guizhou, China;

Explanation of Plate 2

Figs. 1–8. *Onychomicrodictyon spiniferum*, sp. nov., holotype PIN, no. 5119/123: (1) general view of the sclerite from above, ×60; (2) lateral view, ×55; (3) oblique view of the sclerite in anterolateral position, ×70; (4) lateral view, ×60; (5, 6) magnified fragment of the sculpture of the external surface of the sclerite; (7) magnified fragment of the sclerite's spine apex; and (8) magnified fragment of the base of the sclerite, with peripheral girdle with a deepening in the central part.


(a)
(b)
(c)
(d)
(e)
(f)
(i)
(j)
(g)
(h)
30 μm
30 μm
30 μm
100 μm
30 μm
30 μm

?*P. biformis* Qian, 1989, Lower Cambrian, Meishucunian Stage, Huangshandong Member, Dengying Formation, Hubei, China (*Anabarites–Protohertzina–Arthrochites* and *Siphogonuchites–Paragloborilus* zones); *P. cultrata* Missarzhevsky, 1977, Lower Cambrian, the upper Atdabanian–Botomian stages: Siberian Platform; Mongolia; *P. dabashanensis* Yang et He, 1984, Lower Cambrian, Meishucunian Stage, Mofangyan Member, Dengying Formation, Sichuan, China; *P. siciformis* Missarzhevsky, 1973, Lower Cambrian, Tommotian Stage, Lesser Karatau Range, southern Kazakhstan (*Pseudorthotheca costata* Zone); Meishucunian Stage, Zhongyicun Member, Dengying Formation, Yunnan, China; *P. unguliformis* Missarzhevsky, 1973, Upper Vendian, Nemakit-Daldynian, middle dolomites and upper shales of the Soltanieh Formation, Northern Iran; Upper Vendian, Nemakit-Daldynian to Lower Cambrian, Tommotian Stage, Siberian Platform (*Nochoroicyathus sunnaginicus* Zone); Lower Cambrian, Meishucunian Stage, Shaanxi, Hubei, Sichuan (Zhongyicun and Dahai members) and Yunnan (Yuhucun Formation), China (*Anabarites–Protohertzina–Arthrochites* Zone); Upper Vendian, Nemakit-Daldynian (*Protohertzina anabarica* Zone) and Lower Cambrian, Tommotian Stage: Kazakhstan; Kyrgyzstan; Upper Vendian, Nemakit-Daldynian (beds with *Anabarites trisulcatus*) and Lower Cambrian, Tommotian Stage (beds with *Mongolodus rostriformis* and *Halkieria amorpha*), western Mongolia; ?Lower Cambrian, lower Vampire Formation, Yukon, Canada; *P. yudomica* sp. nov.

Comparison. From the close genus, *Hertzina* Müller, 1959, the new form differs in the absence of lateral grooves. From the genus *Mongolodus* Missarzhevsky, 1977, it differs in the strongly elongated elements that are rounded rather than laterally flattened in cross section.

***Protohertzina yudomica* Demidenko, sp. nov.**

Etymology. From the Yudoma River.

Holotype. PIN, no. 5119/133; Siberian Platform, right bank of the Yudoma River, 40 km upstream from the river mouth, 5 km upstream from Suorbalaakh Spring; Lower Cambrian, Toyonian Stage, middle part of the Inikan Formation, Member 3, Sample 1.

Description (Figs. 1–3). The elements are bilaterally symmetrical, conelike, from 1.35 up to 2.76 mm long, elongated, narrow, clawlike, slightly laterally flattened and gently curved along the entire length. The cross section differs along the entire length of the element (Fig. 1) from rounded in the apical part to flask-shaped (Figs. 3b) in the basal zone of the element due to the presence of a median keel, which has a specific complex structure. The lateral ribs (elevations) are low, smooth, and vaguely expressed and form a smooth transition from the anterior to the posterior side of the element; they are most conspicuous in the basal part of the element. Distinct lateral depressions are observed between lateral edges and median keel of the posterior side of the element (Figs. 2e, 3b, 3e). The anterior side of the element is rounded in cross section along the entire length, without any deepening or keels (Fig. 2e). The basal cavity is deep and reaches the apical part of the element (Figs. 2c, 2l). The longitudinal keel of the posterior side is clearly expressed and has a complex structure (Figs. 3b, 3c, 3e). In the basal part of the element, it has the greatest height and consists of two thin plates converging at an acute angle (lateral wings of the keel) with their height decreasing toward the apical part of the element. Gradually, the plates approach each other, merging approximately at the midpoint of the element and leaving a distinct longitudinal groove marking the suture (Figs. 2b–2d, 3b, 3c), which disappears near the apex of the element (Fig. 2b). The external surface of the element either smooth (probably due to the poor preservation of the material) or has poorly expressed terracelike microsculpture (Figs. 2g, 2h). The distance between the edges of "terraces" amounts to 0.01 mm.

Measurements, mm:

Specimen PIN, no.	Length of element	Basal width
Holotype, 5119/133	2.8	0.57
5119/127	1.78	0.32
5119/129	2.11	0.3
5119/132	2.56	–
5119/135	1.35	0.19
5119/136	3.48	0.64
5119/141	2.76	–

Comparison. From *P. anabarica* the new species differs in the presence of a more complex median keel of the posterior side of an element and in the fusion of lateral wings of keel rather than lateral ribs; from *P. biformis*, in the absence of a high longitudinal rib on the anterior side of an element. From *P. cultrata* it differs in the presence of a longitudinal median keel on the posterior rather than anterior side of an element; from *P. dabashanensis*, in the narrower elements. The new form differs from *P. siciformis* in the presence of a more complex median keel of the posterior side of an element; from *P. unguliformis*, in the presence of a more complex median keel of the posterior side of an element

Fig. 2. *Protohertzina yudomica* sp. nov.: (a) specimen PIN, no. 5119/136, sclerite, lateral view, ×39; (b–d) specimen PIN, no. 5119/141: (b) magnified fragment of the apical part of the sclerite; (c) posterior view, ×38; (d) magnified fragment near the apical part of the sclerite; (e–h) holotype PIN, no. 5119/133: (e) lateral oblique view from the base, ×40; (f) lateral view, ×39; (g, h) magnified fragment of the external surface of the sclerite; (i, j) specimen PIN, no. 5119/132: (i) posterior view, ×39; and (j) magnified fragment showing the wall structure of the sclerite in cross section (near the apical part).

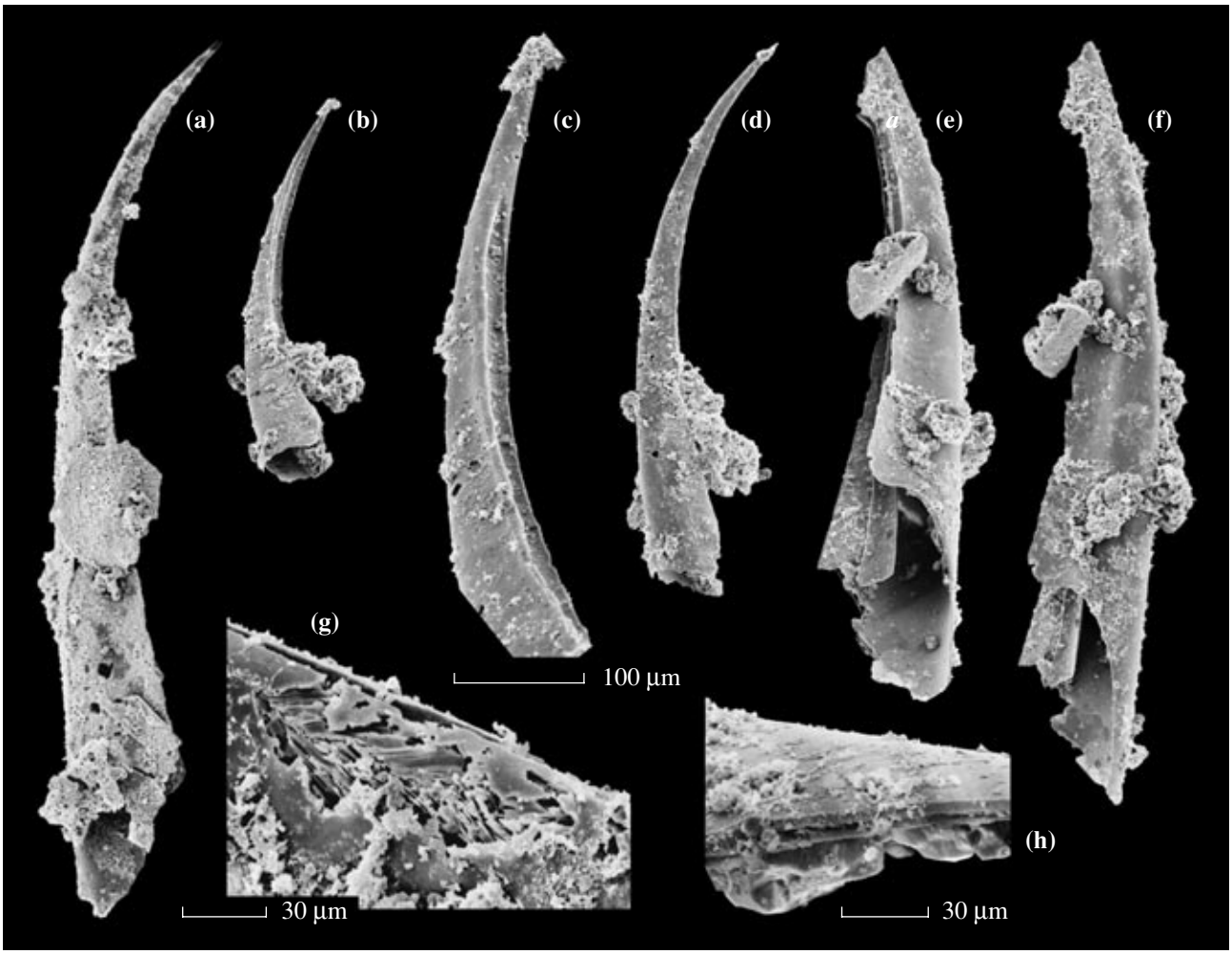


Fig. 3. *Protohertzina yudomica* sp. nov.: (a) specimen PIN, no. 5119/129, lateral view of the sclerite, ×59; (b–d) specimen PIN, no. 5119/135: (b) oblique lateral view on the sclerite from the base, ×57; (c) magnified fragment of the apical part of the sclerite; (d) lateral view, ×58; (e–h) specimen PIN, no. 5119/127: (e) oblique lateral view on the sclerite from the base, ×59; (f) lateral view, ×60; (g) magnified fragment of the external surface of the sclerite near the apical part; and (h) magnified fragment of the wall structure of the sclerite in cross section.

and in the absence of funnel-like expansion of the basal part of an element.

M a t e r i a l. Seven specimens of poor and satisfactory preservation from the type locality (Sample 1).

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