

Lower Devonian (Lochkovian) thelodonts from October Revolution Island (Severnaya Zemlya Archipelago, Russia)

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ABSTRACT

Two new thelodont species, *Turinia composita* n. sp. and *Nikolivia aligera* n. sp., and two already known, *Boreania minima* Karatajūtė-Talimaa, 1985 and *Canonia* sp. cf. *C. grossi* Vieth, 1980, are described. Isolated scales of all of them are distributed at different levels of the Pod"emnaya Formation outcropping along the Matusevich, Pod"emnaya and Spokojnaya rivers. Thelodont assemblage from the lower part of the Formation allows a correlation with the Lochkovian series of Laurussia, e.g., with the lower Lochkovian part of Canadian Arctic.

RÉSUMÉ

Thélodontes du Dévonien inférieur (Lochkovien) de l'Île de la Révolution d'Octobre (Archipel de Severnaya Zemlya, Russie).

Deux nouvelles espèces de thélodontes, *Turinia composita* n. sp. et *Nikolivia aligera* n. sp., et deux espèces déjà connues, *Boreania minima* Karatajūtė-Talimaa, 1985 et *Canonia* sp. cf. *C. grossi* Vieth, 1980, sont décrites. Les écailles isolées de ces espèces sont distribuées à différents niveaux de la Formation Pod"emnaya située le long des rivières Matusevich, Pod"emnaya et Spokojnaya. L'assemblage des thélodontes de la partie inférieure de la formation permet une corrélation avec les séries lochkoviennes de la Laurussie, e.g., avec le Lochkovien inférieur de l'Arctique canadien.

KEY WORDS

Agnatha,
Thelodonti,
Lower Devonian,
Pod"emnaya Formation,
Severnaya Zemlya Archipelago,
Russia,
scale morphology.

MOTS CLÉS

Agnatha,
Thelodonti,
Dévonien inférieur,
Formation de Pod"emnaya,
Archipel de Severnaya Zemlya,
Russie,
morphologie des écailles.

INTRODUCTION

Most of the material for research on Lower Devonian thelodonts was collected in 1978 during the field work on October Revolution Island (Karatajūtė-Talimaa and Valiukevičius). Unfortunately, the sampling of rock for dissolution within the Lochkovian geological sequence was only possible from interlayers with carbonate cement or those, bearing vertebrate macroremains. As a result, the vertical distribution of thelodonts is insufficiently clear.

The distribution of isolated thelodont scales from the main Ordovician, Silurian and Lower Devonian sections on October Revolution Island is taken from Märss & Karatajūtė-Talimaa (2002: fig. 1).

Doubtful Thelodontida indet. scales are found in the Severnaya Zemlya Formation (Fm.) (the lower part of Lochkovian) outcropping at the Pod"emnaya River (outcrop 68, bed 1).

Samples from the Pod"emnaya Fm. have yielded thelodont scales in its lower, middle and upper parts. Rare *Turinia pagei* (Powrie, 1970) scales were collected from red silty limestone interlayers dispersed within the lower part of the Fm. (Ushakov River, outcrop 23, bed 2). Several beds, composing the middle part of this Fm., have yielded numerous scales of species characteristic of the *Turinia pagei* Zone: *T. pagei*, *T. cf. pagei*, *T. polita* Karatajūtė-Talimaa, 1978, *Turinia* sp., *Boreania minima* Karatajūtė-Talimaa, 1985, *Nikolivia elongata* Karatajūtė-Talimaa, 1978, *N. aligera* n. sp. and *Canonia* sp. cf. *C. grossi* Vieth, 1980. The association is most completely represented at the Matusевич River (outcrop 4, bed 3). The Spokojnaya and Pod"emnaya River sections yielded thelodonts in the upper part of the Pod"emnaya Fm. Large numbers of *T. composita* n. sp., *N. elongata* and *Canonia* sp. scales were collected from thin interlayers of sandy siltstones (outcrop 69, bed 26). Thelodonts are also found within outcrops 40 (beds 17, 21, 25, 27), 60 (bed 12) and 69 (beds 24 and 28).

The scales having collection number LIG 35 are stored in the Lithuanian Institute of Geology, Vilnius.

Displacement of outcrops and stratigraphical subdivision of the Lower Devonian series on Severnaya Zemlya is taken by Männik *et al.* (2002: figs 2, 3, 6, 7).

SYSTEMATICS

The thelodont taxonomy (order Thelodontida) applied in this article is elaborated by Obruchev (1964), Gross (1967), Karatajūtė-Talimaa (1978, 1985) and Vieth (1980).

Subclass THELODONTI Kiaer, 1932
Order THELODONTIDA Kiaer, 1932
Family TURINIIDAE Obruchev, 1964

Genus *Turinia* Traquair, 1896

TYPE SPECIES. — *Turinia pagei* (Powrie, 1870).

Turinia composita n. sp.
(Figs 1; 2)

Turinia sp. 1 — Märss & Karatajūtė-Talimaa 2002: fig. 1.

HOLOTYPE. — Trunk scale (LIG 35-496) (Fig. 1J).

ETYMOLOGY. — *Composita* (Latin): compound, composite.

TYPE LOCALITY AND AGE. — Outcrop 69, bed 26, the Pod"emnaya River section, October Revolution Island, Pod"emnaya Fm., Lochkovian, Lower Devonian.

MATERIAL EXAMINED. — About 100 scales, mainly in the rock.

OCCURRENCE. — Type locality is outcrop 69, bed 26 at the Pod"emnaya River: the upper part of the Pod"emnaya Fm., Lochkovian, Lower Devonian. *T. composita* n. sp. scales are also found in the upper part of the Pod"emnaya Fm. outcropping at the Spokojnaya River.

DIAGNOSIS. — Comparatively large scales (1.0–3.3 mm). Head scales with high, ridged, sometimes thorn-like crown and high base. Transitional scales have crowns of oval, "oak-leaf" form, or ridged, with separated posterior area and forward displaced base. Trunk scales, the largest, to 3.3 mm long. Crown form very variable. Some scales have composite crowns, with distinct shorter central area and wide marginal

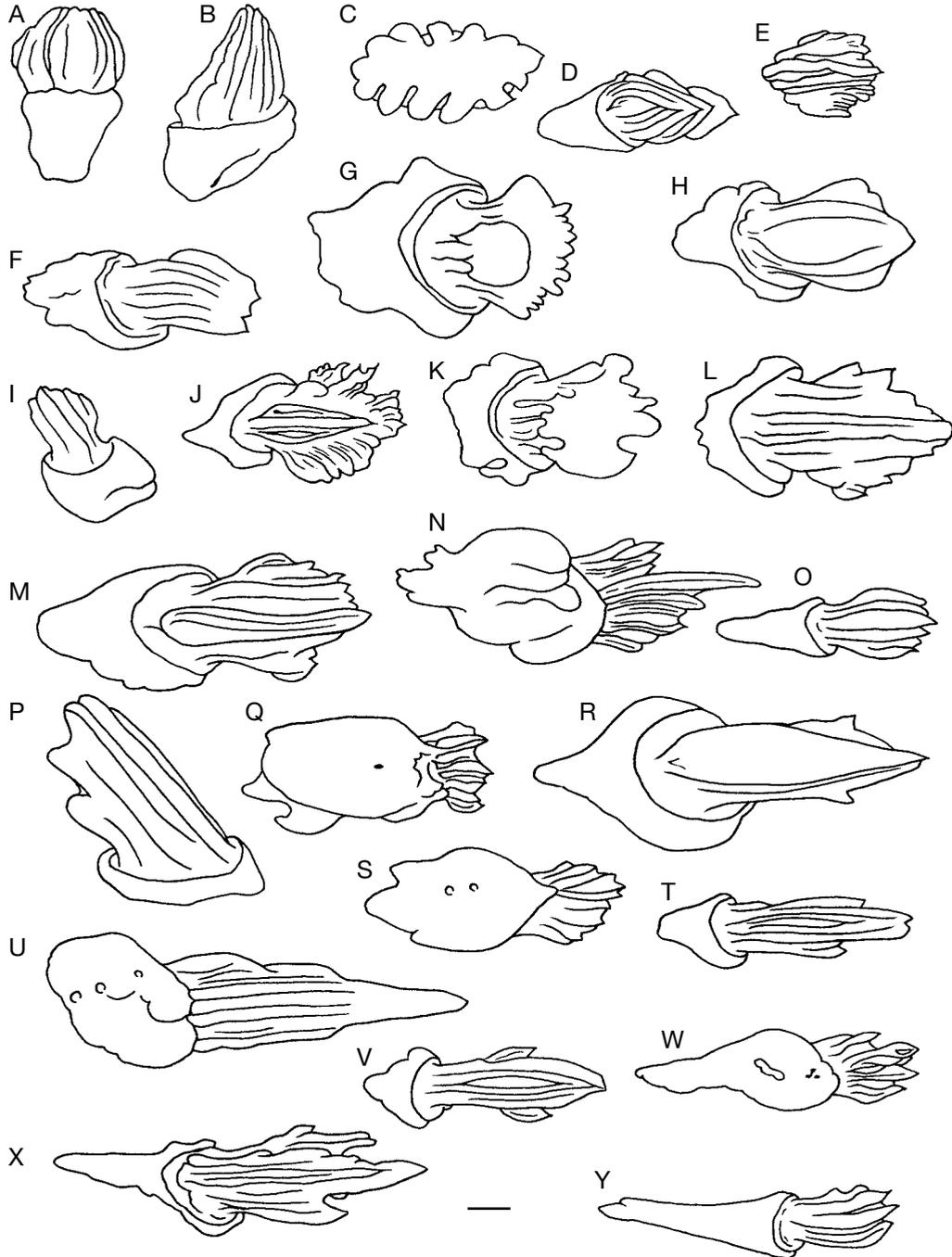


FIG. 1. — *Turinia composita* n. sp., set of scales; **A, B**, head scales; **C, D**, transitional scales; **E-I, K-N, P-S**, trunk scales; **J**, trunk scale (holotype); **O, T-Y**, undivided trunk and fin scales; **A, B**, scales in lateral view; **C-H, J-M, O, R, T, V, X, Y**, scales in crown view; **I, P**, scales in anterior-lateral view; **N, Q, S, U, W**, scales in base view; collection numbers: LIG 35-492-LIG 35-516 (holotype J: LIG 35-496). Sample 69-26, Pod"emnaya River, Pod"emnaya Formation, Lochkovian, Lower Devonian. Scale bar: 0.3 mm.

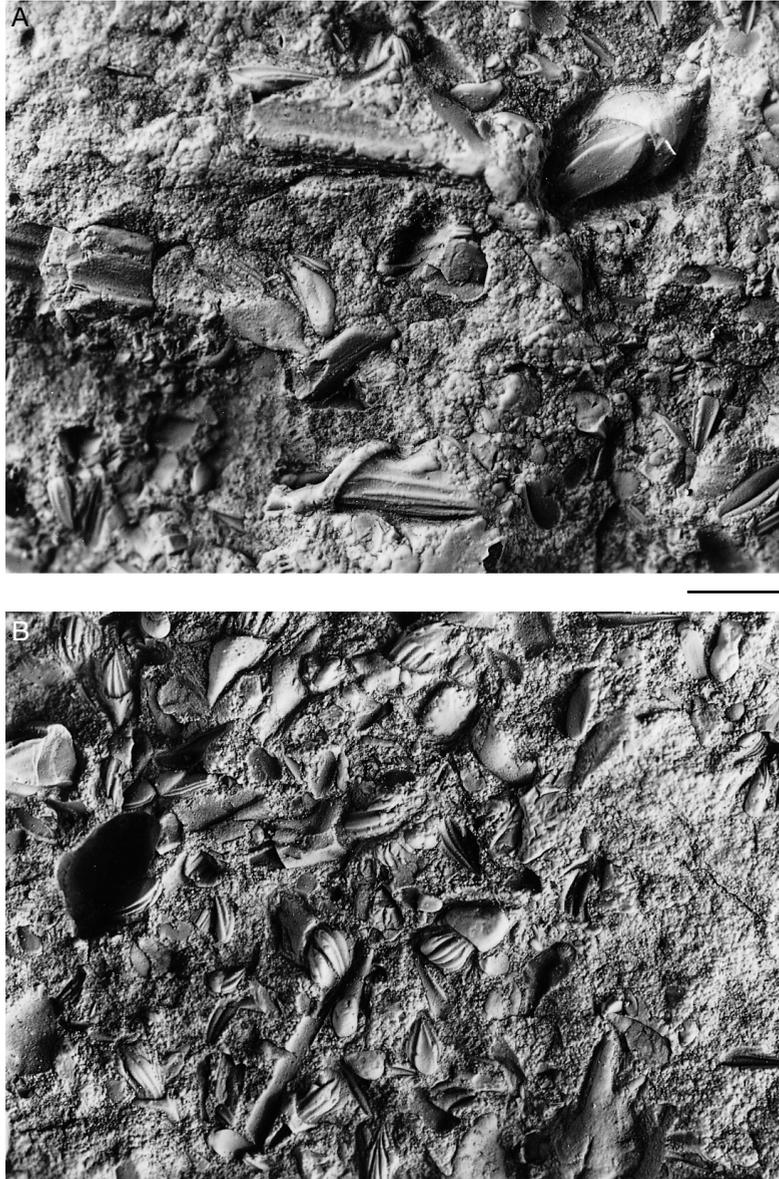


FIG. 2. — *Turinia composita* n. sp., scales on the surface of sandy siltstones of bed 26, outcrop 69, Pod"emnya River, Pod"emnya Formation, Lochkovian, Lower Devonian. Scale bar: 2 mm.

strip, divided into separate parts, ornamented with short ridgelets. Lower side of crown plate covered with longitudinal ribs. Anterior part of base large, with spur-like projection. Crowns of other morphologic varieties consist of the central area and one or two pairs of laterals. Lower surface of crown plate with strong longitudinal ribs. Base may reach a large size.

DESCRIPTION

The set of principal morphologic varieties of scales (Fig. 1) was composed using isolated scales not taken from associated specimen (Fig. 2). Surfaces of sandy siltstones resistant to dissolution have yielded numerous scales of two

species, *Turinia composita* n. sp. and *Nikolivia elongata*. Head scales with rather high, ridged, more symmetrical crowns, having a truncated (Fig. 1A) and asymmetric thorn-like tips (Fig. 1B) have been found. Neck is low, base is high.

To transitional scales are ascribed two varieties, with "oak-leaf" crowns (Fig. 1C) and ridged crowns with distinct posterior area and large, anteriorly placed base (Fig. 1D). This scale type, already defined earlier as transitional, however, based on unusual crown structure, was identified as *Turinia* sp. indet. (Karatajūtė-Talimaa 1978: pl. XLII, fig. 3).

Trunk scales display a great diversity. Several main morphologic types can be recognized:

– type A: crown consists of short central area and wide marginal strip, divided into separate parts (Fig. 1E, J) and ornamented with short ridgelets;

– type B: crown comparatively monolithic, with high ribbed neck; crown plate smooth, its posterior edge finely notched; base large, flattened, anteriorly vaulted (Fig. 1G, K);

– type C: crown covered with longitudinal ridgelets (Fig. 1F, H, J, M, N, Q, S); narrow central area higher, compared to remaining plate; the lower crown surface contains distinct longitudinal ribs; neck clearly developed; base strongly in advance of crown, large to moderately large, sometimes with marginal ledges (Fig. 1N, Q);

– type D (Fig. 1R, V): crown elongated, with large smooth (Fig. 1R) or concave central area (Fig. 1V) and pair of narrow laterals with small laterally pointed tips;

– type E: crown large, flattened, with smoothened (rounded) ridges (Fig. 1P); base low, strip-like;

– type F: narrow, modified scales with ridged crown (Fig. 1U–Y), displaced posteriorly; base small (Fig. 1U, V, T) or strongly anteriorly extended, spur-like (Fig. 1O, X, Y).

COMPARISON

T. composita n. sp. scales, especially trunk scales, are the largest as compared with other

Turinia species, distributed within the Lower Devonian of the northern hemisphere. The maximum length of trunk scales are: *Turinia pagei* 1.9 mm, *T. polita* 1.5 mm, *T. composita* n. sp. 3.3 mm. A similar length (3.5 mm) is reached also by trunk scales of *Turinia gondwana* Turner, 1988 (in Gagnier *et al.* 1988) from the Lower Devonian Catavi Fm. of Bolivia (Gagnier *et al.* 1988), whereas the trunk scales of *Turinia australiensis* Gross, 1971 from the Pragian of Australia do not exceed 1.6 mm (Gross 1971). Trunk scales of the A, B and C types are only characteristic for *T. composita* n. sp. and are not observed within the squamation of other species. Head, transitional and trunk scales of types D and F are identical in form to those of *T. pagei*. Generally, crown structure of *T. composita* n. sp. is more complex as compared with *T. pagei* and especially with *T. polita*. Most scales also have more complicated bases. The scale in Fig. 1V is nearly identical in form to *T. gondwana*, referred by Gagnier *et al.* (1988: fig. F).

Several scales of *T. composita* n. sp. resemble in crown complexity and general shape scales to *Turinia antarctica* Turner & Young, 1992 from the Middle Devonian of Antarctica, and also to other *Turinia* species, which have large scales and are characteristic of the Middle and early Late Devonian of Gondwana (Gross 1971; Turner & Dring 1981; Long *et al.* 1988; Turner & Young 1992; Turner 1997).

Genus *Boreania* Karatajūtė-Talimaa, 1985

TYPE AND ONLY SPECIES. — *Boreania minima* Karatajūtė-Talimaa, 1985. The new genus and species *Boreania minima* were briefly described in 1985. *B. minima* was also considered characteristic of the thelodont assemblages from the Pod"emnaya Fm. of the October Revolution Island (Karatajūtė-Talimaa 1985).

OCCURRENCE. — Middle part of the Pod"emnaya Fm. (Lochkovian) of October Revolution Island (Matusevich River, outcrop 4, bed 3). *Boreania minima* scales are found together with scales of *Goniporus alatus* (Gross, 1947) in a sample from talus of outcrop 45 in the Krasnaya Bukhta section, Pridoli,

Upper Silurian. It also occurs in lower Dittonian of the Welsh Borderland (Turner 1984, 1999), in the Tiltz Fm. and basal part of the Stoniskiai Fm. in Baltic, Domachevo Fm. of the Brest Depression (Western Byelorussia), and the lower part of the Ovinparma Regional Stage in the Polar Urals. The North Timan Subregion (the Velikaya River section) has yielded *B. minima* together with *Katoporodus timanicus* (Karatajūtė-Talimaa, 1967) from the second Member of the Eptarma Fm., whereas it occurs in the Varandei-Adzva Zone of the Khoreyver Depression (Timan-Pechora region) – from the uppermost Silurian – together with scales of *Katoporodus lithuanicus* (Karatajūtė-Talimaa, 1967). Many boreholes of the Timan-Pechora region bore *Boreania* scales from Lower Lochkovian sequences (Talimaa 2000).

DIAGNOSIS. — Small scales – circular, oval, rhombic, keel-like – 0.2-0.8 mm long. Head scales circular or irregularly shaped, having low, flattened crown with notched margins. Crown of transitional scales flat. Central anterior area separated from laterals by deep cuts. Trunk scales larger, with elongated crown, composed of longer central area and pair of laterals. Scales of all morphologic types with distinct, but low necks. Bases of circular or irregular form, smaller than crowns, convex, anteriorly vaulted and displaced forward. Short spur-like process observed only on several trunk scales. Pulp opening centrally in the base or displaced slightly posteriorly. Pulp cavity small, of complicated outline, with pocket-like branches. Dentine tubules comparatively smooth, long, parasasally widened.

COMPARISON

In scale size, general shape, crown ornamentation, size and form of base, size and displacement of pulp opening, resembles scales of *Thelodus* Agassiz, 1839, especially several morphologic varieties of *T. sculptilis* Gross, 1967. In presence of single pulp cavity and in form, diameter and branching style of dentine tubules, *Boreania* scales can be attributed to the “*Thelodus*” histologic type. Widened proximal parts of dentine tubules complicate outline of pulp cavity. This feature slightly links *Boreania* with *Turinia* scales, and strongly separates them from the other genera of Thelodontida, having a large pulp cavity with distinct outline (*Thelodus*, *Apalolepis* Karatajūtė-Talimaa, 1967, *Nikolivia* Oervig, 1969 and *Amaltheolepis*). This suggested placement of *Boreania* within family Turiniidae.

Boreania minima Karatajūtė-Talimaa, 1985 (Figs 3; 4A-H; 5)

For synonymy see Karatajūtė-Talimaa (1985: 54).

HOLOTYPE. — Trunk scale (LIG 35-456) (Fig. 3R).

TYPE LOCALITY AND HORIZON. — Matusевич River, outcrop 4, bed 3. Pod”emnya Fm., Lochkovian.

MATERIAL EXAMINED. — About 500 well-preserved scales.

OCCURRENCE. — *B. minima* scales are found on the Severnaya Zemlya Archipelago only on October Revolution Island (outcrop 4, bed 3 at the Matusевич River, middle part of the Pod”emnya Fm., Lochkovian, Lower Devonian and in a sample from talus of outcrop 45 of the Krasnaya Bukhta section, Pridoli, Upper Silurian).

DIAGNOSIS. — As for genus.

DESCRIPTION

Morphology

The set of principal morphologic varieties is shown in Fig. 3. Transitional or trunk scales are very conventional.

Head scales (Fig. 3A-C, E) may be circular or of irregular form, asymmetric, with lower or higher spine-like crown and lateral ledges all around margins or situated only anteriorly. Base of moderate height with centrally placed pulp opening. Neck distinct, but low. Transitional scales (Fig. 3D, F-H, K, M, O) with comparatively monolithic, flat crown having sharp short anterior cuts. Asymmetric scales may have unequal numbers of cuts on each side (Fig. 3D). Some transitional scales have more distinctive central area. Lateral crown areas displaced slightly lower. Distal crown area flat, three- or five-pointed (Figs 3M; 4A, B). Base may be high (Fig. 3F, K), equally convex or with central convexity. Several scales have bases smaller than crowns (Fig. 3M), the bases protruded anteriorly.

Trunk scales crowns (Figs 3I, J, L, N, P-Z; 4C-H) more elongated and more distinctly divided into central and lateral areas. Crown ornamentation varies widely. Type A (Figs 3I, J, N, V; 4D, E): crown rather monolithic, elongated, with deep anterior cuts; crowns overhang base posteriorly; posterior crown tip

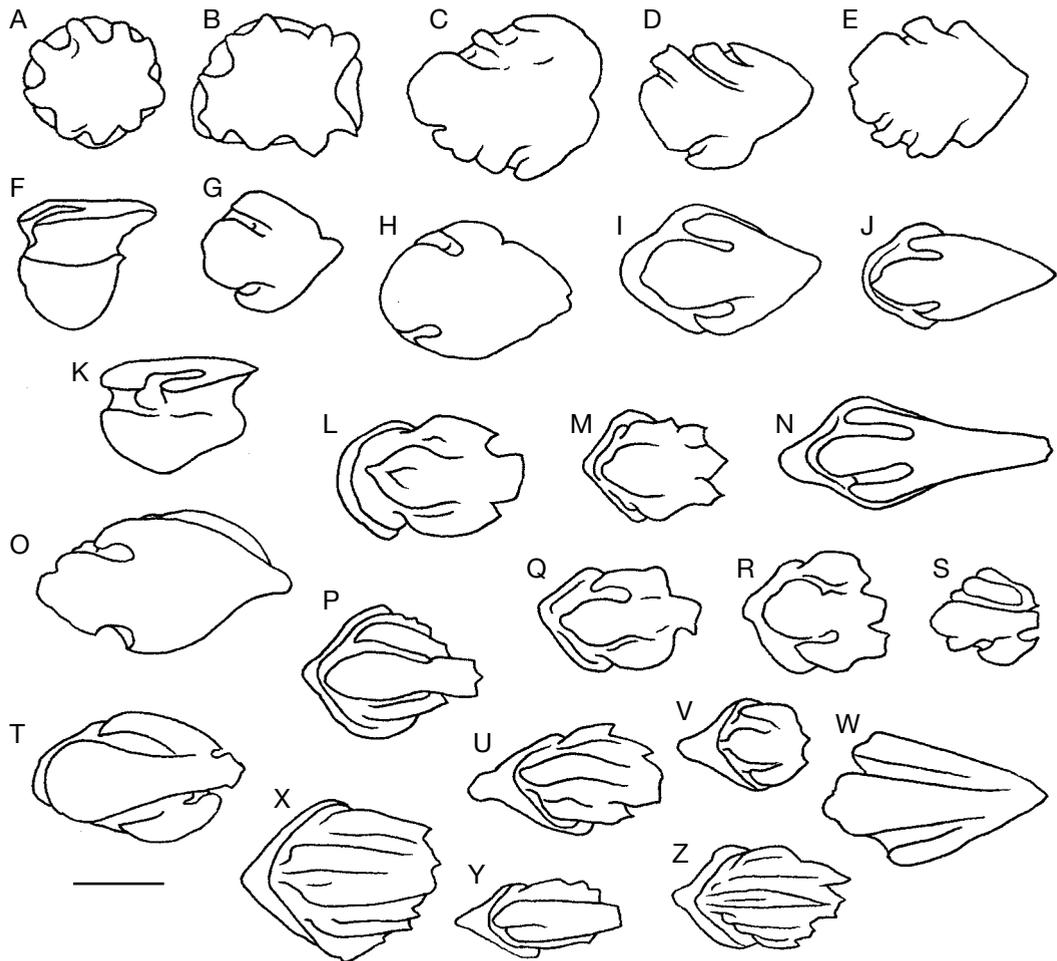


FIG. 3. — *Boreania minima* Karatajūtė-Talimaa, 1985, set of scales (see Karatajūtė-Talimaa 1985: fig. 1): **A-E**, head scales; **F-H, K, M**, transitional scales; **I, J, L, N-Z**, trunk scales; **A-E, G-J, L-Z**, scales in crown view; **F, K**, scales in lateral view; collection numbers: LIG 35-433, LIG 35-434, LIG 35-436-LIG 35-444, LIG 35-447, LIG 35-449-LIG 35-456, LIG 35-458-LIG 35-464 (holotype R: LIG 35-456). Sample 4-3, Matusevich River, Pod'emnaya Formation, Lochkovian, Lower Devonian. Scale bar: 0.2 mm.

monopointed. Type B (Figs 3L, P-T, Y, Z; 4C, H): anterior central area higher than laterals and separated from them by groovelets extended throughout the crown; distal crown part three- or five-pointed with enlarged central area. There are scales with keel-like crowns (Figs 3W; 4F, G), having medial area separated by deep grooves. Bases of all varieties, ascribed to trunk scales, are low, anteriorly vaulted, rarely developing short spur-like projection. Neck low.

Histology

Vertical sections of two trunk and one transitional scale are shown in Fig. 5. Pulp cavity comparatively small. Dentine tubules long, rather smooth, linear, branching at several levels. Proximal canal edges widened, as a rule, complicating outline of pulp cavity.

COMPARISON

Comparison is given with the generic description.

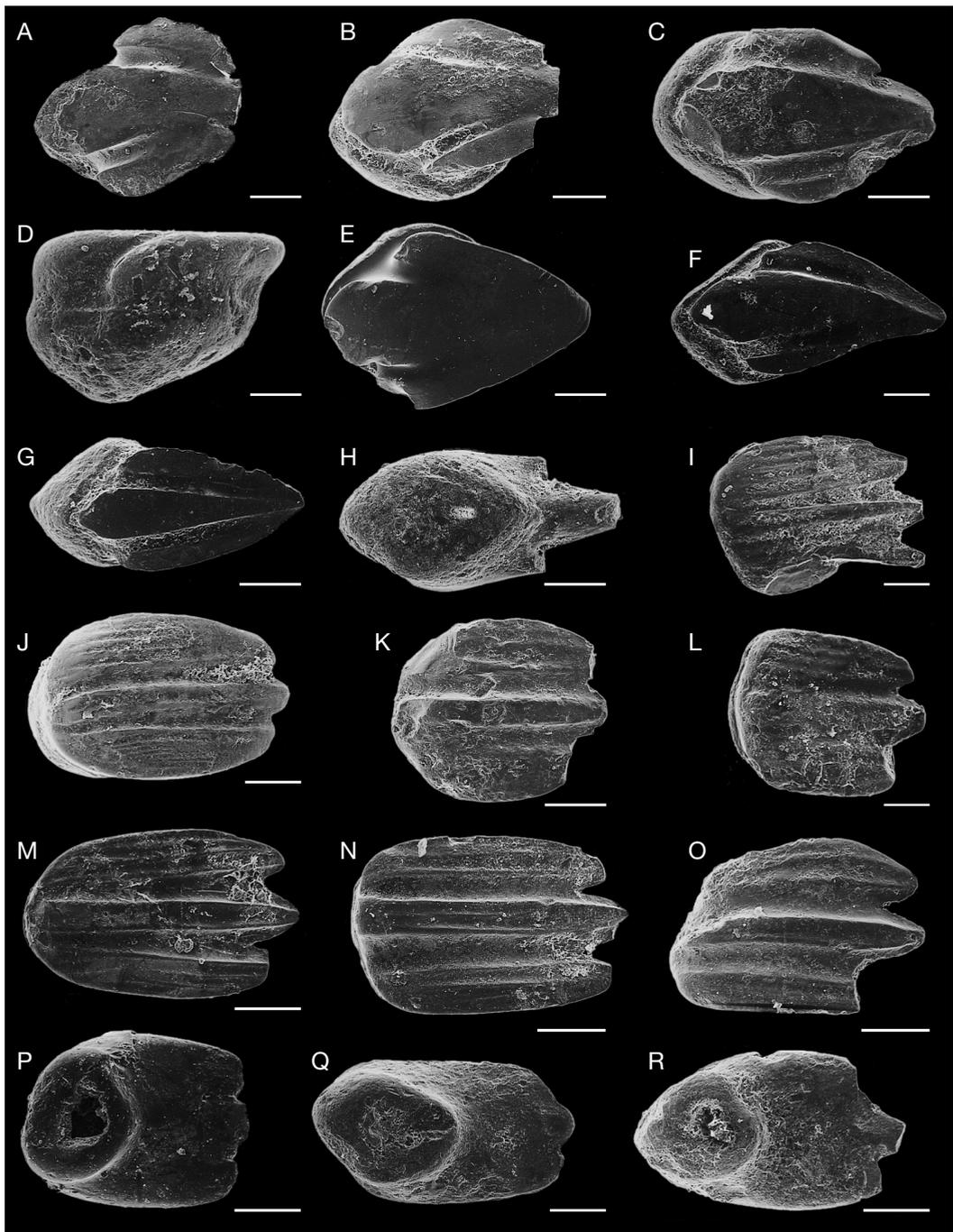


FIG. 4. — **A-H**, *Boreania minima* Karatajüte-Talimaa, 1985; **A, B**, transitional scales; **C-H**, trunk scales; **A-C, E-G**, scales in crown view; **D**, scale in lateral view; **H**, scale in base view; collection numbers: LIG 35-808-LIG 35-815; **I-R**, *Canonina* sp. cf. *C. grossi* Vieth, 1980; **I-O**, scales in crown view; **P-R**, scales in base view; collection numbers: LIG 35-816-LIG 35-825. Sample 4-3, Matusевич River, Pod'emnaya Formation, Lochkovian, Lower Devonian. Scale bars: A-H, 0.1 mm; I-R, 0.1 mm.

Family NIKOLIVIIDAE Karatajūtė-Talimaa, 1978

Genus *Nikolivia* Karatajūtė-Talimaa, 1978

TYPE SPECIES. — *Nikolivia oervigi* (Karatajūtė-Talimaa, 1967).

Nikolivia aligera n. sp.
(Fig. 6)

HOLOTYPE. — Transitional(?) scale (LIG 35-474) (Fig. 6H).

ETYMOLOGY. — *Aligera* (Latin): containing wings.

TYPE LOCALITY AND HORIZON. — Sample 4-3 (outcrop 4, bed 3) from the Matusевич River, October Revolution Island, Pod'ėmnaya Fm., Lochkovian, Lower Devonian.

MATERIAL EXAMINED. — About 80 scales well-preserved.

OCCURRENCE. — *N. aligera* n. sp. scales are identified only from a single sample (outcrop 4, bed 3) along the Matusевич River (October Revolution Island), Lower Devonian, Lochkovian, Pod'ėmnaya Fm.

DIAGNOSIS. — Small and medium-sized scales (0.3–1.3 mm long). Head scales smaller (0.3–0.5 mm), with high, spine-like crown, composed of concave central area and one to two pairs of laterals. Transitional scales comparatively small (0.4–0.7 mm). Crown consists of widened central area and wing-like laterals. Trunk scales the largest (0.8–1.3 mm), drop-shared or keel-like. Crown composed of wide central area with smooth surface and pair of narrowed laterals (type A), or of narrow groove-like central and one to two pairs of laterals (type B). Base of transitional and trunk scales of type A low, roller-like, displaced anteriorly. Keel-like trunk scales of type B with more convex and higher base.

DESCRIPTION

Division of scales into head and transitional types is rather conventional (Fig. 6A–M, O, Q). Head scales smaller, with higher, sometimes spine-like crown (Fig. 6A–E) and upward sloping distal area. Crown composed of central area and one or two pairs of laterals, sometimes widened and wing-like (Fig. 6A). Crowns of transitional scales distinguished by wing-like lateral areas with sometimes notched margins. Central area keel-like, somewhat higher, with smooth surface and usually not prolonged to the crown edge (Fig. 6F–M, O, Q).

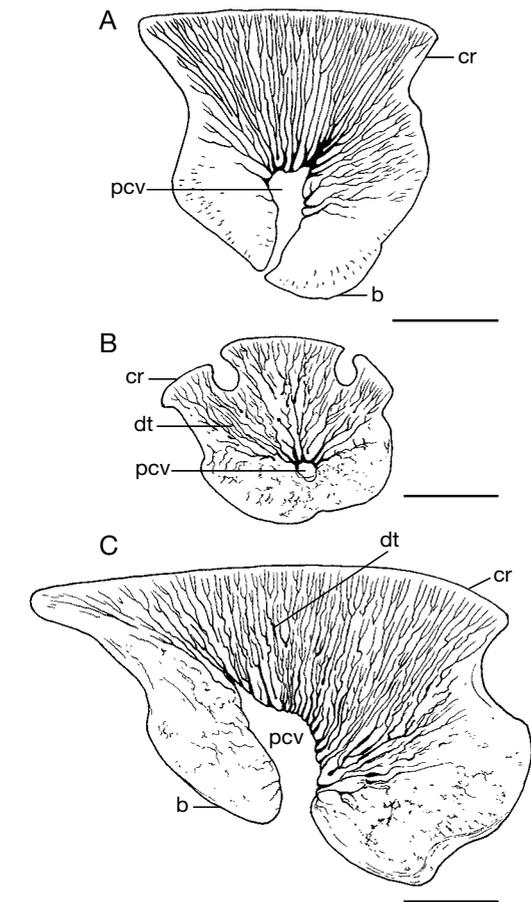


FIG. 5. — *Boreania minima* Karatajūtė-Talimaa, 1985, histological structure of scales: **A**, vertical longitudinal section of trunk scale with high base (see Karatajūtė-Talimaa 1985: fig. 2), No. 1089; **B**, vertical transverse section in anterior part of transitional scale, No. 1074; **C**, vertical longitudinal section of trunk scale, No. 1091. Sample 4-3, Matusевич River, Pod'ėmnaya Formation, Lochkovian, Lower Devonian. Abbreviations: **b**, base; **cr**, crown; **dt**, dentine tubules; **pcv**, pulp cavity. Scale bars: 0.1 mm.

As typical trunk scales are recognized large drop- or keel-like examples (type A) with central area having wide, flat and smooth surface (Fig. 6N, U–Y). Narrow keel-like scales (Fig. 6U, V, Y), probably covered the tail area and fins. To type B are conventionally attributed trunk scales with more complicated ridged crowns, having narrow, central area. Lateral areas are not always strongly symmetric and may consist of one pair of widened or several pairs of narrowed members (Fig. 6P, R–T).

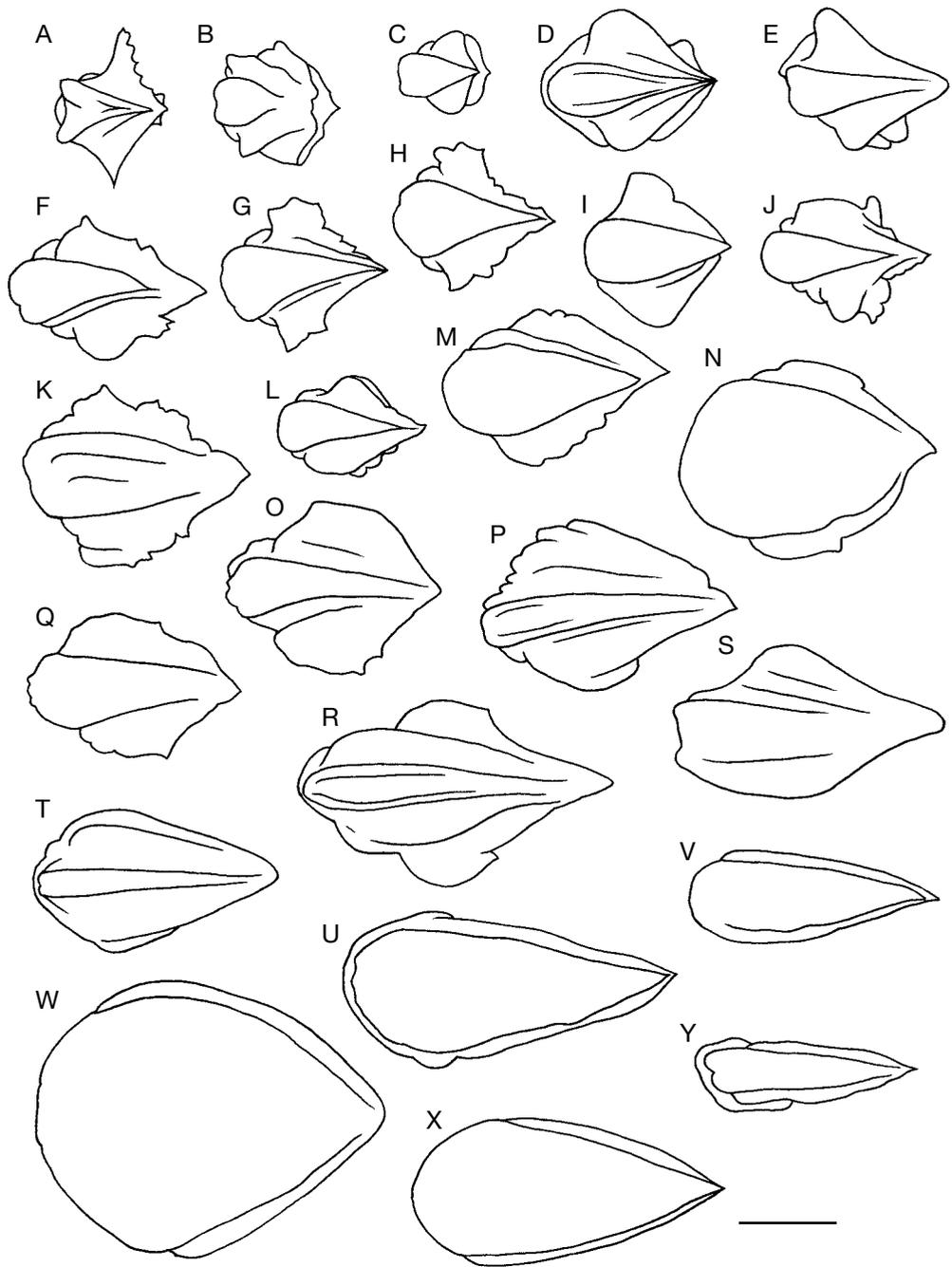


FIG. 6. — *Nikolivia aligera* n. sp., set of scales; **A-E**, head scales; **F-M**, **O-Q**, transitional scales; **N**, **R-Y**, trunk scales; all scales in crown view; collection numbers: LIG 35-466-LIG 35-489 (holotype H: LIG 35-474); sample 4-3, Matusевич River, Pod'ernaya Formation, Lochkovian, Lower Devonian. Scale bar: 0.3 mm.

Bases of scales of all types anteriorly vaulted, low, roller-like and only in keel-like variety reaching a larger height. Pulp opening comparatively large even in older scales.

COMPARISON

Scales of *N. aligera* n. sp. are close to scales of *N. gutta* Karatajūtė-Talimaa, 1978 in size. Trunk scales of type A do not differ in form from the drop-like scales of *N. gutta*. *N. aligera* n. sp. differs from all known species by presence within the morphologic set of transitional scales with wing-like lateral areas and also more distinctly recognizable head scales.

Order FURCACAUDIFORMES

Wilson & Caldwell, 1998
Family FURCACAUDIDAE?
Wilson & Caldwell, 1998

Genus *Canonia* Vieth, 1980

TYPE SPECIES. — *Canonia grossi* Vieth, 1980.

Canonia sp. cf. *C. grossi* Vieth, 1980
(Figs 4I-R; 7; 8)

OCCURRENCE. — Scales of *Canonia* sp. in the Lower Devonian of Severnaya Zemlya are found in samples from the outcrop 4, bed 3 at the Matusевич River and outcrop 69, bed 26 at the Pod'emnaya River, in the middle and upper parts of the Pod'emnaya Fm., Lochkovian, Lower Devonian.

REMARKS

Vieth (1980) made the following diagnosis of *Canonia grossi*: small symmetric scales; distal crown area frequently three-pointed; 55% of scales have concave and raised medial area compared with laterals; lateral areas ornamented with longitudinal ridgelets (two or fewer); neck well developed, base high; 45% of scales have flattened crown surface, ornamented with four-eight narrow longitudinal ridgelets, and low base; rather smooth linear dentine tubules arise only from the pulp cavity.

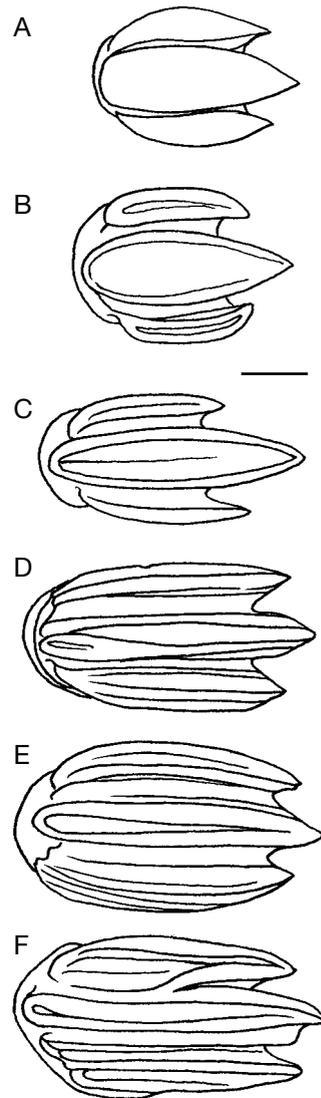


FIG. 7. — *Canonia* sp. cf. *C. grossi* Vieth, 1980, set of scales; all scales in crown view; collection numbers: LIG 35-826-LIG 35-831; sample 4-3, Matusевич River, Pod'emnaya Formation, Lochkovian, Lower Devonian. Scale bar: 0.1 mm.

Concerning size and morphologic features the Severnaya Zemlya specimens insignificantly differ from the Canadian ones. More representative material (about 150 scales) was found in outcrop 4, bed 3 at the Matusевич River. A minority consist of the simplest scales – crown of smooth central and one pair of lateral areas,

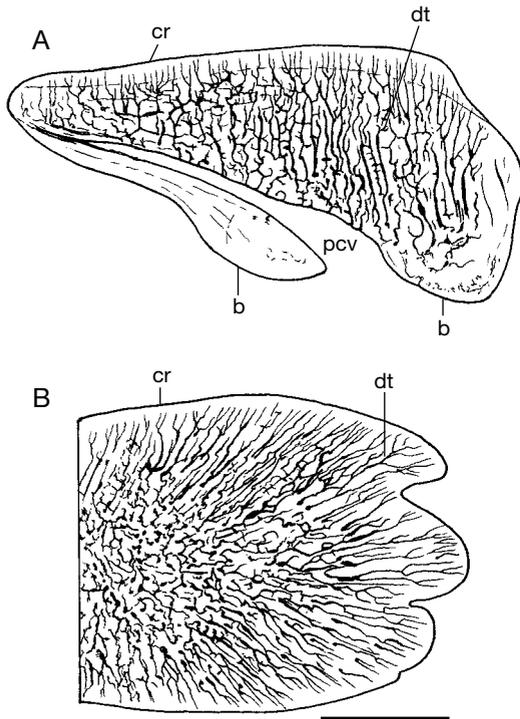


FIG. 8. — *Canonia* sp. cf. *C. grossi* Vieth, 1980, histological structure of scales; **A**, vertical longitudinal section, No. 1094; **B**, horizontal section of crown (without anterior part), No. 1095; sample 4-3, Matusevich River, Pod'emnaya Formation, Lochkovian, Lower Devonian. Abbreviations: **b**, base; **cr**, crown; **dt**, dentine tubules; **pcv**, pulp cavity. Scale bar: 0.1 mm.

separated by deep longitudinal grooves (Fig. 7A). Small numbers of scales have more complicated crown morphology: central area slightly concave and laterals ornamented with longitudinal grooves (Fig. 7B, C). All scales with three distinctly separated areas have three-pointed posterior crown edge, with the central point significantly longer than the laterals (Fig. 7C). The majority consists of large scales (up to 0.5 mm), in which crown shape resembles a quadrangle, comparatively widen and flattened. Proximal crown margin slightly convex or linear, lateral margins linear and distal area three-pointed (Figs 4J-O; 7D-F). All scales of that type have developed narrow central area, flat or with longitudinal groovelet, and one to three pairs of lateral areas also narrow, ornamented with shallow longitudinal

groovelets. The central area is usually separated from the laterals by deeper and wider grooves. Generally speaking, crowns of scales have well distinctive longitudinal sculpture. The sample yielded also some scales with asymmetric crown (Fig. 4I), base small, displaced anteriorly (Fig. 4P-R), comparatively low, only rarely higher, pulp opening in all observed scales large. Fig. 8A illustrates the extent of the pulp cavity, and also the type of dentine forming the crown (Fig. 8).

Vieth (1980) described for *Canonia* scales characteristic smooth, linear dentine canals, arising only from the pulp cavity, and also their short branch connecting arcade tubules. Based on drawings (Vieth 1980: text-fig. 18), they are not dominated by such linear dentine canals, but by comparatively wide and interwoven, lacuna-like structures. Tissue with dentine tubules is developed only superficially, confirmed also by our material (Fig. 8A).

Dentine tubules, developed in scales of *Canonia* sp. from Severnaya Zemlya, have a rather unusual form, not characteristic of orthodentine, forming crowns in representatives of the Nikoliviidae family (Fig. 8). Short linear or slightly curved arcades of branch connect vertically up-swept dentine canals. Sometimes they form small lacuna-like widenings. Similar dentine tissue is developed in scales of loganiid thelodonts and is not characteristic of representatives of order Thelodontida. At present, the attribution of the genus *Canonia* to family Nikoliviidae is rather doubtful.

CONCLUSIONS

From a chronostratigraphic viewpoint, thelodont assemblages are of great interest, in particular the assemblage from the lower part of Pod'emnaya Formation, where occur in the same stratigraphical level (the Matusevich River, outcrop 4, bed 3) scales of *Turinia pagei*, *Boreania minima*, *Nikolivia aligera* n. sp. and *Canonia* sp. cf. *C. grossi*. These scale-taxa base following conclusions:

– *T. pagei* findings allow to attribute this part of geological series to the *T. pagei* Zone embracing fully all Lochkovian;

– *B. minima* is distributed in other regions of the Baltica craton in the topmost Pridoli and Lower Lochkovian;

– comparatively small scales of *N. aligera* n. sp. and *Canonia* sp. cf. *C. grossi* are together represented in all samples taken from the third bed. The recent squamation research of articulated specimens attributed to the order Furcacaudiformes (Caldwell & Wilson 1995: fig. 2; Wilson & Caldwell 1998: fig. 3) takes possibility for comparison of the Severnaya Zemlya scale-taxa with Devonian species 2 = *Furcacauda fredholmae* Wilson & Caldwell, 1998. The flank/tail scales of this species mostly resemble scales of *N. aligera* n. sp. with wing-like lateral crown areas, whereas on the head/branchial body parts there are represented scales characteristic to *Canonia* genus;

– the taxonomic position of *Canonia* scales is not finally cleared yet. Basing on dentine type composing crowns of *Canonia* sp. cf. *C. grossi* from Severnaya Zemlya, the genus *Canonia* cannot be placed within family Nikoliviidae. Following suggestions of canadian researchers that “crown morphology of the genotype scale of *Canonia grossi* is indistinguishable from Dorsal and Ventral Median Ridge scales of several genera and species of furcacaudids” (Wilson & Caldwell 1998: 26), the species from Severnaya Zemlya is attributed to Furcacaudidae(?) family.

New species *Turinia composita* n. sp. is the latest representative of Early Devonian turiniids on the territory of North hemisphere.

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