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Pennsylvanian Fauna of the Tarma Limestone, Central Andes, Peru Part 2. Bryozoan Paleontology

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Abstract The bryozoan fauna of the Tarma Limestone indicates a close relationship with those of the Kashirsky (late Early Moscovian) in the Ural-Russian Platform region. Of eighteen species of bryozoans described here, *Nikiforopora rangeli*, *Rhabdomeson newelli*, *Ascopora peruana*, *Pamirella andesensis* and *Streblascopora incaica* are proposed as new species.

Key words : Bryozoans, Biostratigraphy, Tarma Limestone, Pennsylvanian, Peru.

Introduction

The present article is the second installment of a study of Pennsylvanian fauna of the Tarma Limestone, Central Andes, Peru. In this Part 2, the bryozoan fauna is biostratigraphically analysed and systematically described.

The Bryozoan Fauna

The bryozoans are assembled in the middle (Horizons 12 to 15) and upper (Horizons 25, 27 and 29) parts of the Tarma Limestone. Generally, they are not associated with fusulines except for the Horizon 27. In total, eighteen species including 5 new, 4 compared and 9 indeterminable species in 13 genera of bryozoans were discriminated from the Tarma Limestone as shown in Fig. 1.

Nikiforopora rangeli, *Rhabdomeson newelli*, *Ascopora peruana*, *Pamirella andesensis* and *Streblascopora incaica* are described as new species. *Nikiforopora rangeli* is similar to *N. simplex* from the Carboniferous of the Donetz Basin and *Ascopora peruana* is similar to *A. sokolovae* from the Middle Carboniferous of the Russian Platform. *Rhabdomeson newelli* and *Pamirella andesensis* can be clearly distinguished from the described species. The genus *Pamirella* was originally known from the Lower Permian of Pamir, but three species of *Rhombopora* described from the Carboniferous of the Midcontinent by Ulrich (1890) have been recognized as in *Pamirella* by Blake (1983). *Streblascopora incaica* seems to be closely related to *Streblascopora nikiforovae* from the Middle Carboniferous in central Don (Russia) in general appearance. Indeterminable species belong to the following cosmopolitan genera: *Fistulipora*, *Meekopora*, *Dyscritella*, *Fenestella* (s.l.) and *Pennirepora*.

The present article is the first to report the Pennsylvanian bryozoan fauna in the

Andean region, and fills up the data-gap in the Upper Paleozoic bryozoan biogeography. The present study indicates that there would have been a close relationship between the Ural-Russian Platform province and Midcontinent-Andean province in the Middle Carboniferous (Desmoinesian), especially in the Kashirsky (late Early Moscovian).

Systematic Descriptions on Bryozoans

All specimens are deposited in the collections of the National Science Museum (NSM), Tokyo. Numbers in parentheses refer the horizons.

Order Cystoporida
Suborder Fistuliporina Astrova, 1964
Family Fistuliporidae Ulrich, 1882
Genus *Fistulipora* McCoy, 1850

Fistulipora aff. ***F. monoseriata*** Shulga-Nesterenko, 1955

(Fig. 2-1)

Compared *Fistulipora monoseriata* Shulga-Nesterenko, 1955, p. 65, 66, pl. 2, figs. 3, 4, text-fig. 1.

Material and Horizon: NSM PA-14230a (27).

Description: A single obliquely tangential section was examined. Zoarium probably thinnly encrusting, but the thickness is not determinable. Zooecial tubes regularly circular, shorter diameter ranging from 0.48 to 0.64 mm. Lunarium present but small and thin. Vesicular tissue bubble-like, irregularly and coarsely developed, one or two vesicles between adjacent zooecia but absent in immature zone. Diaphragms seemingly abundant.

Remarks: The present form is characterized by the irregular margin of zooecial walls, very thick diameter of zooecial tube and well developed but thin lunarium. The present form is similar to *Fistulipora monoseriata* which was described by Shulga-Nesterenko (1955) from the Steshevsky horizon (C_1^{2st}) of Lower Carboniferous of the Russian Platform in the general appearance, but it differs from *F. monoseriata* in thicker zooecial diameter and in having many diaphragms. The present form may be a new species, but because of only one tangential section of zoarium, the exact specific identification is reserved for the present.

Fistulipora sp. indet. A and B

(Figs. 2-2, 3 a, 4)

Material and Horizon: NSM PA-14137 (12), 14223 (27) (*F.* sp. indet. A) and 14228a (27), 14229a (27), 14229b (27), 14230b (27) (*F.* sp. indet. B).

Remarks: At least two species belonging to *Fistulipora* are recognized but in-

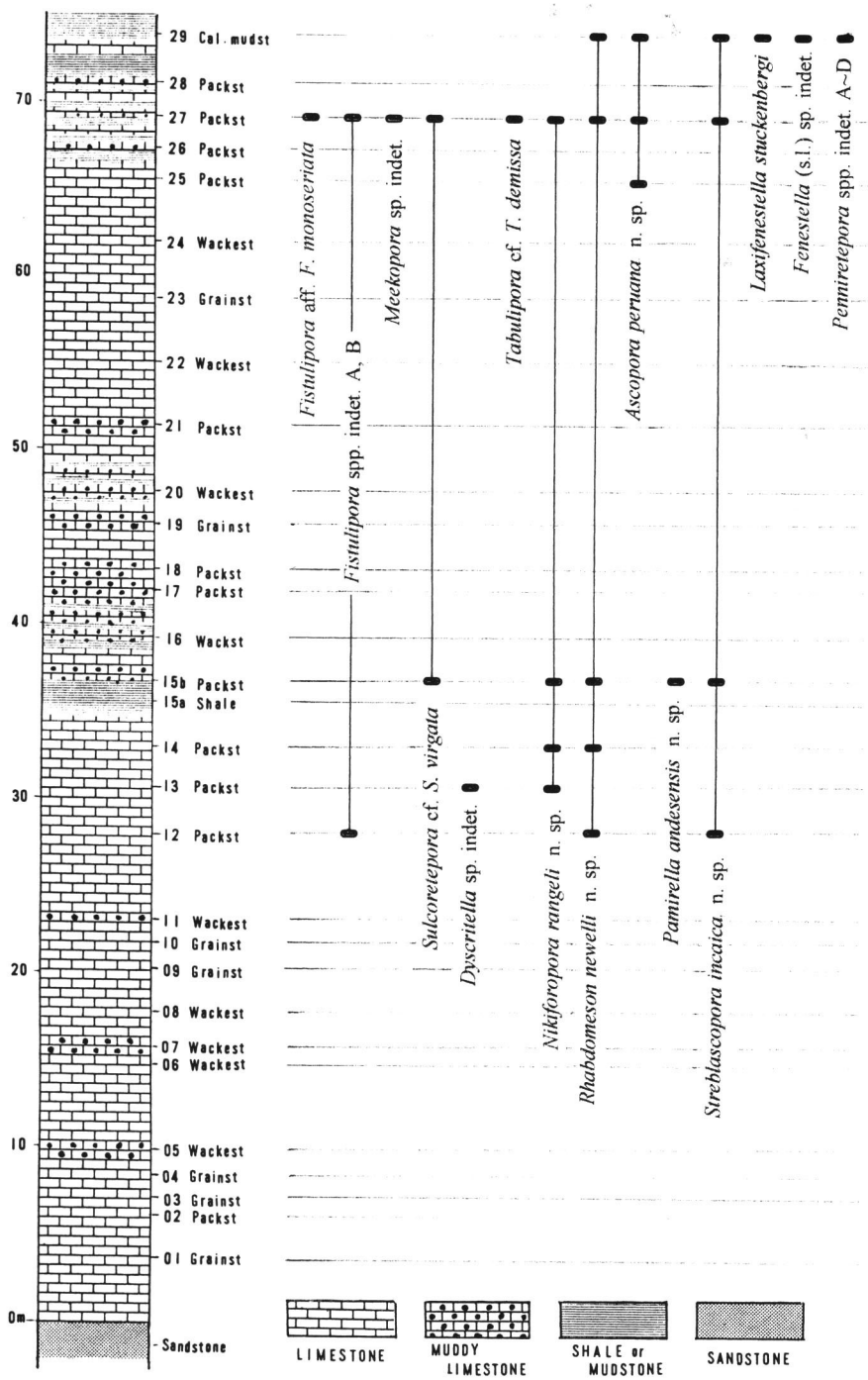

Fig. 1. Generalized columnar section of the Tarma Limestone showing stratigraphic distribution of bryozoans.

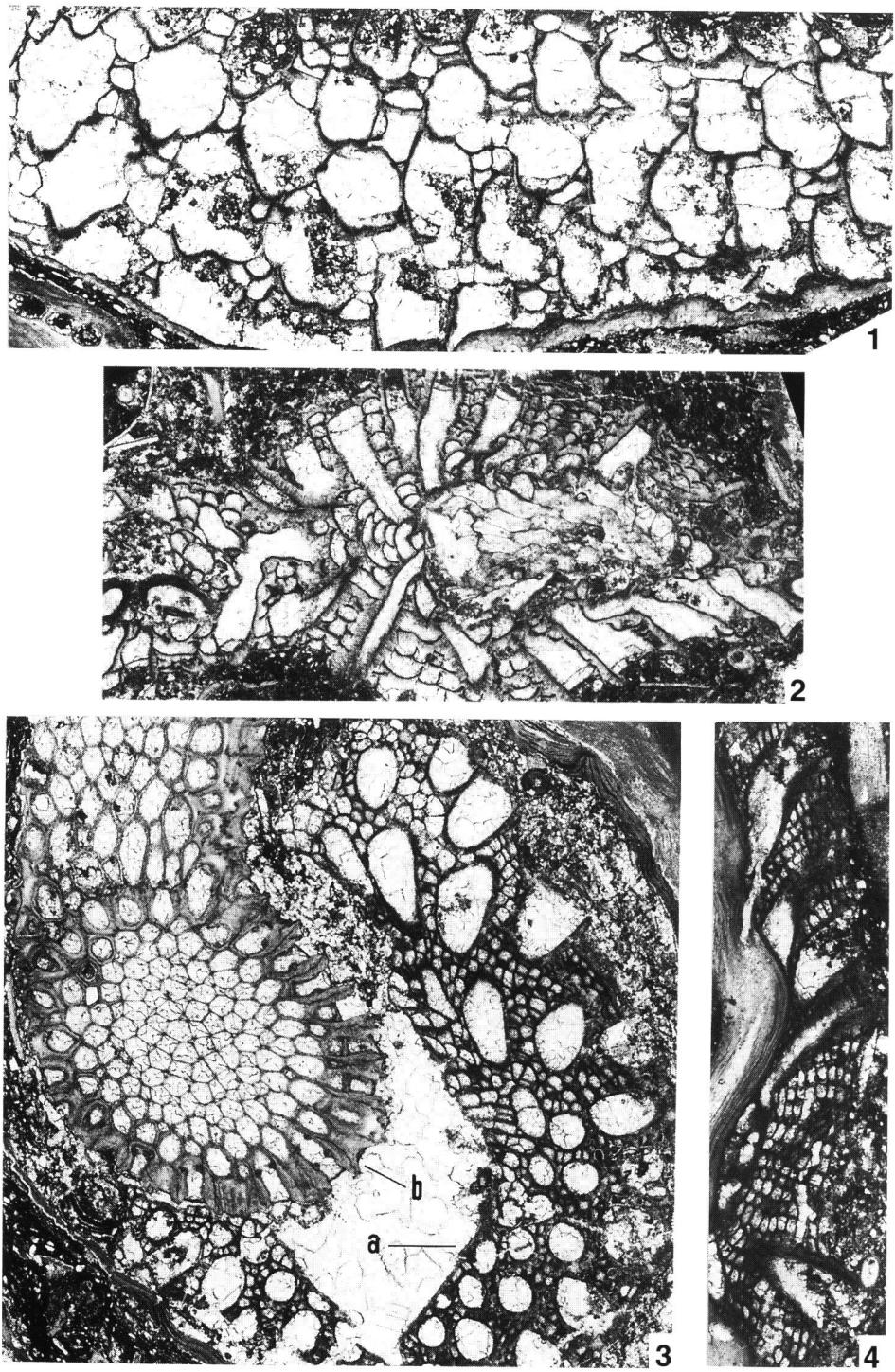

Fig. 2. 1, *Fistulipora* aff. *F. monoseriata* Shulga-Nesterenko, ×20, NSM PA-14230a. 2, *Fistulipora* sp. indet. A, ×20, NSM PA-14137. 3a, 4, *Fistulipora* sp. indet. B, ×20, NSM PA-14230b and 14228a, respectively. 3b, *Nikiforopora rangeli* n. sp., ×20, NSM PA-14230c.

sufficient for the specific identification because of only fragmentary nature in thin sections. Therefore, suffice it to show only illustrations of them at present.

Family Hexagonellidae Crockford, 1947
Genus *Meekopora* Ulrich, 1889
Meekopora sp. indet.
(Fig. 3-1)

Material and Horizon: NSM PA-14227 (27).

Remarks: Owing to only one ill-preserved specimen at hand, the specific identification cannot be made, but the present form is not unlike to *Meekopora prosseri* which Moore and Dudley (1944) recorded from the Missourian (Pennsylvanian) to Wolfcampian (Lower Permian) of the Midcontinent region, U.S.A. in the general appearance.

Family Sulcoreteporidae Bassler, 1935
Genus *Sulcoretepora* d'Orbigny, 1849
Sulcoretepora cf. ***S. virgata*** Shulga-Nesterenko, 1955
(Figs. 3-2, 3)

Compared *Sulcoretepora virgata* Shulga-Nesterenko, 1955, p. 171, 172, pl. 31, figs. 3–5; Morozova, 1955, p. 68, 69, pl. 2, figs. 4 a, b.

Material and Horizon: NSM PA-14144a (15b), 14145a (15b), 14146a (15b), 14228b (27), 14229c.

Description: Zoarium bifoliate, branching in plane of mesotheca, elongated, about 1.6 to 2.0 mm in width and 1.1 mm in thickness. Mesotheca apparently a closely joined double layer, reaching surface at edge of zoarium. In tangential section, zooecial tubes elliptical, longer diameter 0.19 to 0.26 mm, shorter diameter 0.13 to 0.15 mm, arranged longitudinally about 7 rows in common, well developed peristomes, and usually 3.5 per 2 mm longitudinally, about 5 in 2 mm diagonally. Vesicular tissue consists of usually 1 to 2 rows of vesicles between adjacent zooecia, and about one half of the near surface covered by dense fibrous tissue.

In longitudinal section, zooecial tubes proximally parallel to mesotheca, then rapidly curved upward, making a large angle with outer surface of zoarium. Diaphragms absent.

Remarks: The present taxon was originally described from the Kashirsky Formation of Middle Carboniferous (C_2^k) which may be correlated to the Atokan Stage in U.S.A., of the Russian Platform. The present form may be identical with the original specimen in the essential characters and measurements.

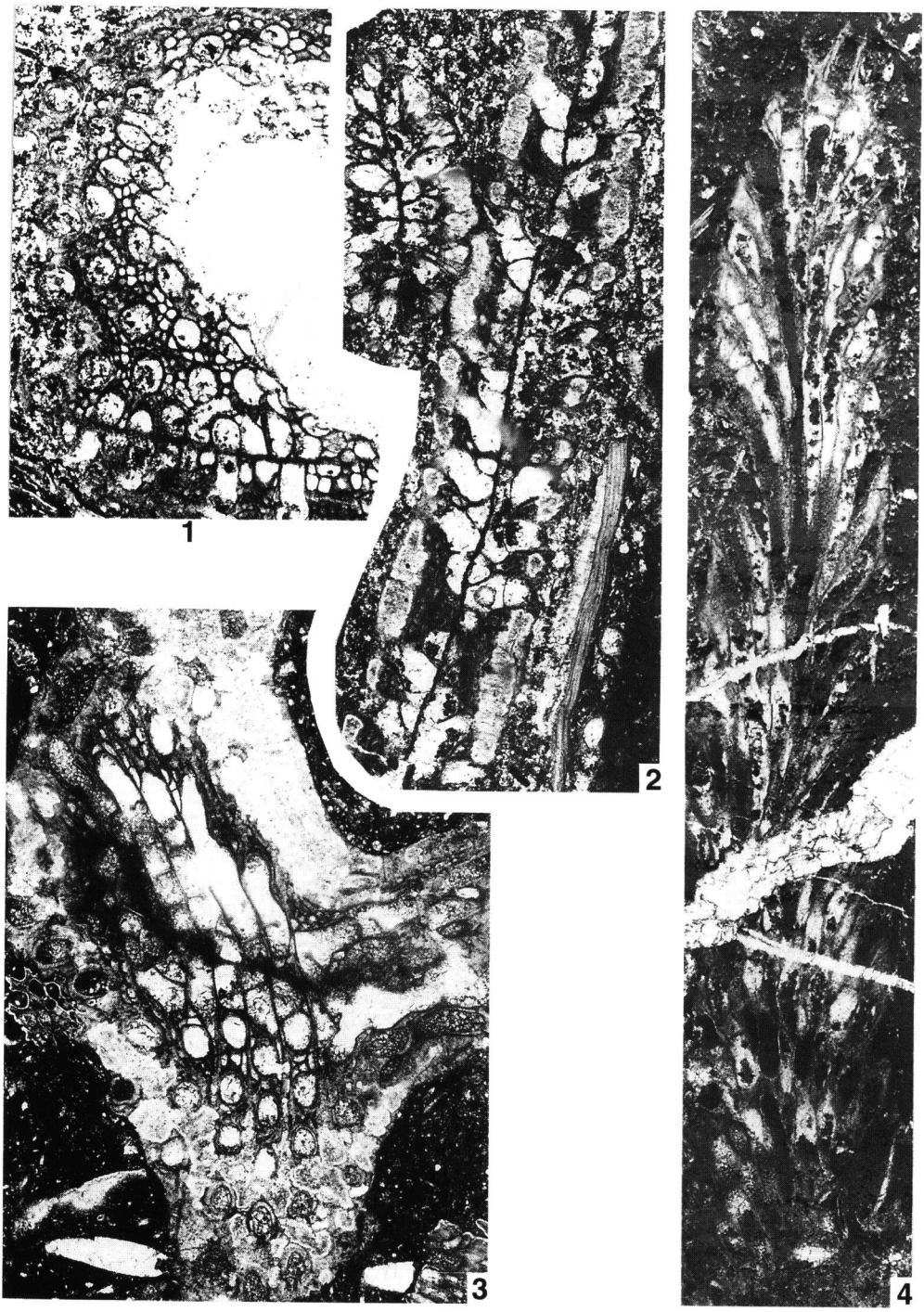

Fig. 3. 1, *Meekopora* sp. indet., ×20, NSM PA-14227. 2, 3, *Sulcoretepora* cf. *S. virgata* Shulga-Nesterenko, ×20, NSM PA-14229c and 14145a, respectively. 4, *Dyscritella* sp. indet., ×20, NSM PA-14139a.

Order Trepostomida

Family Dyscritellidae Dunaeva and Morozova, 1967

Genus *Dyscritella* Girty, 1911

Dyscritella sp. indet.

(Fig. 3-4)

Material and Horizon: NSM PA-14139a (13).

Descriptive remarks: A single longitudinal section was examined. Zoarium slender, cylindrical ramose branch, diameter about 1.4 mm. Zooecial tubes parallel to longitudinal direction of zoarium in inner part of endozone, gradually curved outward to meet outer surface of zoarium at an angle of about 30°. Diaphragm may be lacking. Zooecial walls thin, straight or slightly crenulate in endozone, and becoming gradually thickened with finely laminated fibers in exozone.

Owing to only one longitudinal section examined, the detailed observation and measurements could not be made. The specific identification must be postponed until better specimens are available.

Family Stenoporidae Waagen and Wentzel, 1886

Genus *Tabulipora* Young, 1883

Tabulipora cf. ***T. demissa*** Trizna, 1961

(Figs. 4-1–3)

Compared *Tabulipora demissa* Trizna, 1961, p. 38, 39, pl. 2, fig. 7; pl. 3, figs. 4, 5 and text-fig. 5.

Material and Horizon: NSM PA-14226 (27), 14230c (27), 14237c (27).

Description: Zoarium lamellate, occasionally double layers, thickness of single layer ranges from about 1 to 2 mm.

In longitudinal section, zooecial tubes proximally parallel to basal layer of zoarium, and then bending rapidly perpendicular to surface. Zooecial walls thin and crenulate in endozone and gradually thickened in exozone consisting of fine fibers, and with well developed monilae. Probably centrally peforated diaphragms distributed at regular intervals usually ranging from 0.38 to 0.52 mm in exozone.

In tangential section, zooecial tubes polygonal with thin zooecial walls in endozone, and polygonal with rounded corners and thick walls in exozone. Diameter of zooecial tubes ranges from 0.26 to 0.39 mm. Mesozooecia may be absent. Megacanthostyles having concentrically laminated walls developed at junctions of zooecial wall. Outside and inner diameters of megacanthostyles range about 0.13 mm and 0.01 mm, respectively. Micracanthostyles observable as small dark granules, but in some instances they may be completely lacking.

Remarks: The present taxon resembles *Tabulipora demissa* which Trizna (1961) described from the upper Moscovian (Middle Carboniferous, $C_2^{2\text{-}2}$) of the western slope of Urals in the essential characters and microscopic measurements. Detailed

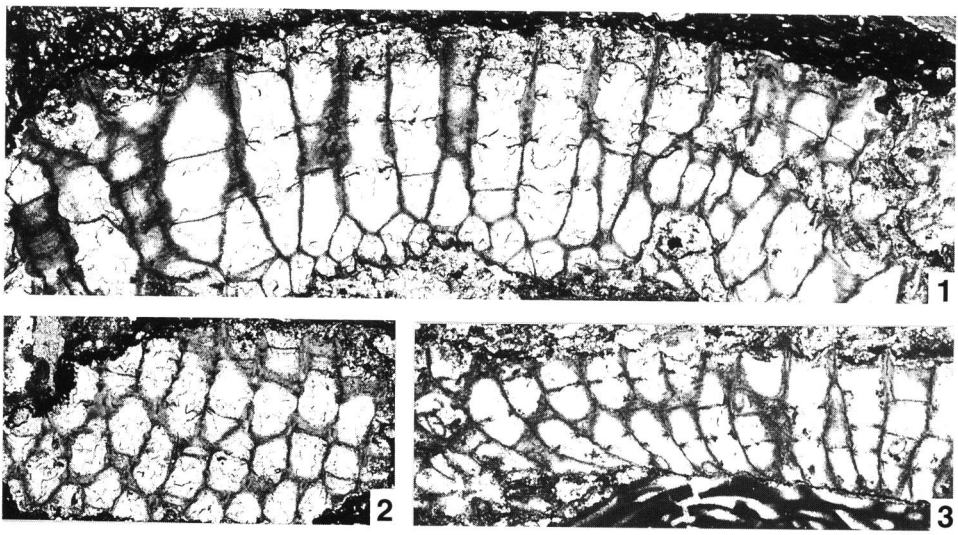

Fig. 4. 1–3, *Tabulipora* cf. *T. demissa* Trizna, ×20, NSM PA-14226, 14230c and 14237c, respectively.

comparison is, however, impossible because the Trizna's illustrations are not clear.

Genus *Nikiforopora* Dunaeva, 1964

Nikiforopora rangeli n. sp.

(Figs. 2-3 b; 5-1–5)

Material and Horizon: NSM PA-14138 (13), ?14140 (13), ?14143 (14), 14144b (15b), 14146b (15b), 14147a (15b), 14229d (27) (holotype), 14230d (27).

Description: Zoarium slender, cylindrical and ramose; 1.4 to 2.2 mm in zoarial diameter. Diameter of endozone varying 1.0 to 1.5 mm. Width of exozone narrow, usually less than 0.5 mm.

In longitudinal section, zooecial tubes nearly straight, parallel to longitudinal direction in inner part of endozone, gradually curving outward to exozone. Zooecial wall thin and straight, with arcuate rows of monilae in endozone, rapidly thickened, composed of finely laminated fibrous tissue in exozone. Usually two perforated thick diaphragms in exozone of tube: one is disposed at proximal end and the other is at middle part of exozone.

In transverse section, zooecial tubes thin-walled, arranged not so regularly, quadrate or polygonal in endozone.

In tangential section, zooecia oval, irregularly arranged, longer diameter ranges from 0.17 to 0.19 mm, shorter diameter ranges from 0.10 to 0.13 mm. Mesozooecia

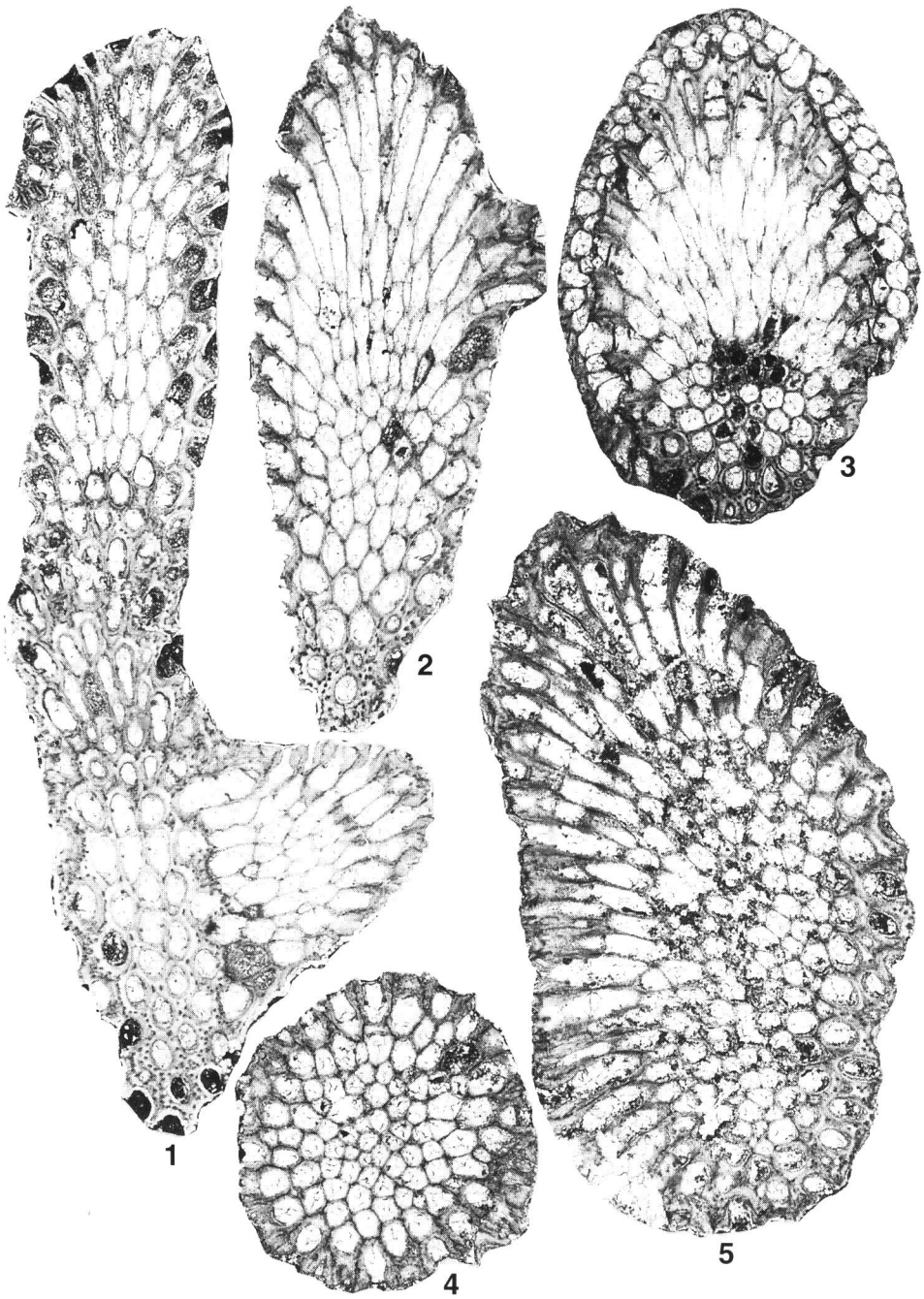

Fig. 5. 1–5, *Nikiforopora rangeli* n. sp., ×20, NSM PA-14144a, 14144b, 14140, 14230d and 14229d (holotype), respectively.

present but not numerous, diameter from 0.05 to 0.08 mm. Megacanthostyles located at junctions of zooecial walls but not prominent. A single, occasionally two, series of micracanthostyles arranged in outer part of zooecial walls as does an occasional mesopore. Outside diameters of megacanthostyles and micracanthostyles about 0.05 mm and less than 0.03 mm, respectively.

Remarks: *Nikiforopora rangeli* n. sp. is characterized by the slender zoarium and is not comparable with any previously described species. The present form is nearest to *Nikiforopora simplex* which was originally described as the genus *Rhombotrypella* from the Moscovian (Middle Carboniferous) of the Donetz Basin by Nikiforova (1933) in the essential characters except for the size of zoarium (3 to 5 mm diameters in *N. simplex*) and by the generic characters.

Although some species of the genus *Nikiforopora* established by Dunaeva (1964) were known only from the Carboniferous, the present form can be distinctly included in this genus characterized by the centrally perforated diaphragms and can be distinguished from *Rhombotrypella* by the irregularly polygonal cross section of the zooecia in the endozone.

The present form is not unlike to the type species: *Nikiforopora concentrica* as the genus *Batostomella* by Nikiforova (1927) from the Lower Carboniferous of the Donetz Basin, but it can be distinguished by the smaller diameter of zoarium and other microscopic measurements.

The specific name is dedicated to Dr. César Rangel Z., the former staff of Instituto Geologico Minero y Metalurgico (Peru), who always kindly and carefully helped our field survey in Peru.

Order Cryptostomida
Suborder Rhabdomesina Astrova and Morozova, 1956
Family Rhabdomesidae Vine, 1884
Genus *Rhabdomeson* Young and Young, 1874

Rhabdomeson newelli n. sp.

(Figs. 6-1–6; 7-1–3)

Material and Horizon: NSM PA-14136a (12), 14141 (14), 14144c (15b) (holotype), 14145b (15b), 14146a (15b), 14167a (15b),14167b (15b), 14228d (27), 14235c (27), 14241c (27), 14247a (29), 14248a (29), 14249a (29), 14250a (29).

Description: Zoarium consisting of cylindrical stem, diameter varies from 0.9 to 1.4 mm. Axial region formed by hollow, diameter varies from 0.23 to 0.40 mm. Secondary branch occasionally diverged at right angle from main branch. There may be about 20 to 22 alternating rows of zooecial apertures transversely around the stem.

In longitudinal section, zooecial tubes arise from wall of axial tubes at an angle of about 20°, straight in endozone and curving rapidly outward at inner edge of exozone. Thickness of exozone varies from 0.15 to 0.32 mm. Superior hemiseptum well

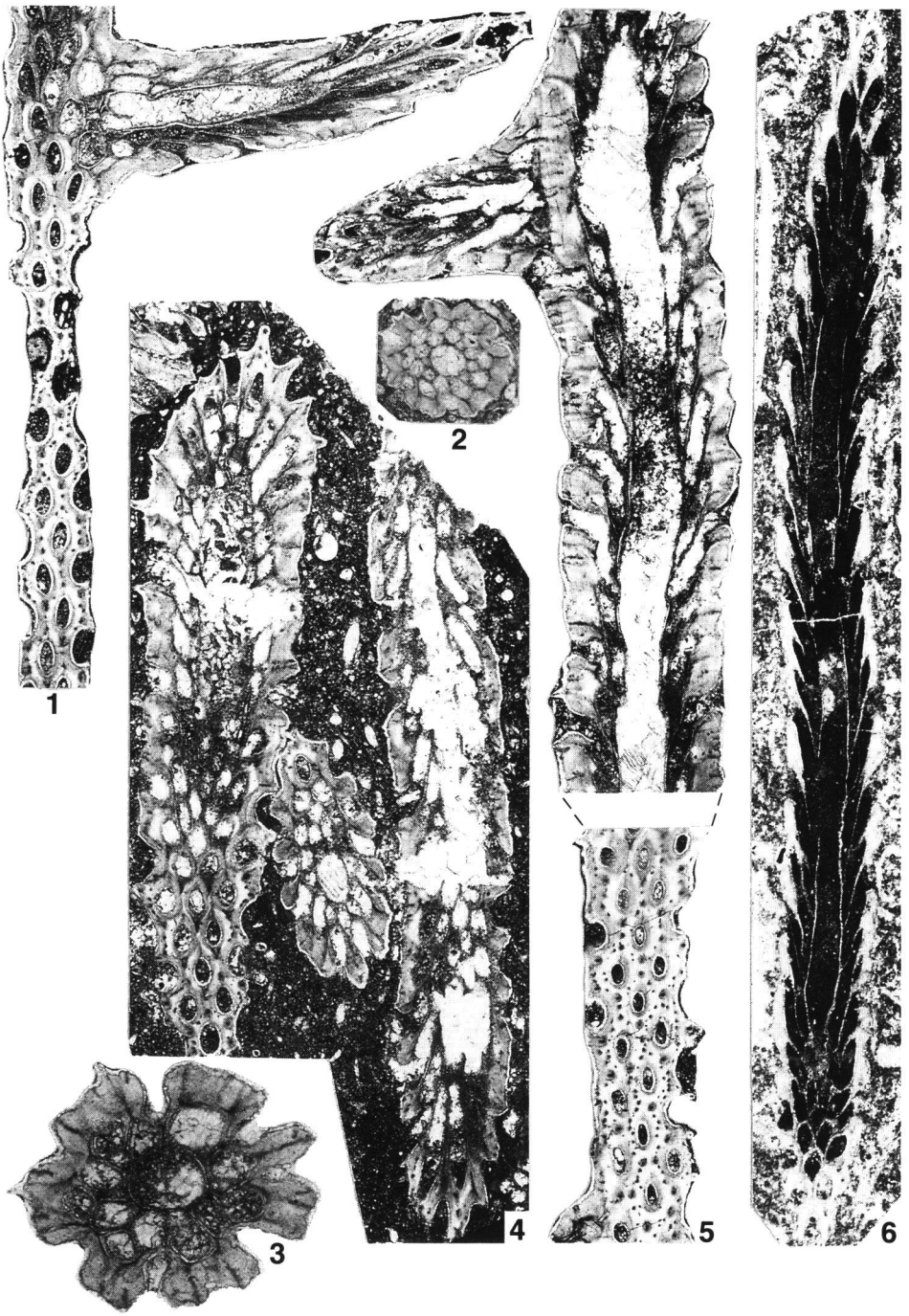

Fig. 6. 1–6, *Rhabdomeson newelli* n. sp., ×20 except for 3 which is in ×40, NSM PA-14144c (holotype), 14147a, 14147b, 14144d, 14144e and 14141, respectively.

developed at inner edge of exozone. Diaphragm not present.

In tangential section of central part of exozone, zooecial tubes oval, longer diameter ranges from 0.15 to 0.21 mm, shorter diameter ranges from 0.06 to 0.10 mm, regularly arranged in longitudinal and diagonal directions, 3.5 to 4 zooecia per 2 mm longitudinally and 6 to 7 per 2 mm diagonally. One to 2, occasionally 3, acanthostyles at each corner of zooecial tube and surrounded by concentric fibers; outside and inside diameters range from 0.04 to 0.06 mm and 0.003 to 0.005 mm, respectively. Usually one row of paurostyles between acanthostyles; outside diameter about 0.020 mm but the inside diameter is not measurable because they are too small.

Remarks: *Rhabdomeson newelli* n. sp. is abundant in the Tarma Limestone and occurs from the Horizon Nos. 12 to 29. The present species is not unlike to *Rhabdomeson simulatum* which Moore (1929) described from the upper Graham Formation of Pennsylvanian of north central Texas, U.S.A. in the general appearance and measurements, but it can be distinguished clearly from the latter species in having no diaphragm in zooecial tube.

The species is named in honour of Dr. Norman D. Newell who is one of the great pioneers engaged in the Andean geology and paleontology.

Genus *Ascopora* Trautschold, 1876

Ascopora peruana n. sp.

(Figs. 7-4–7; 8-1, 2)

Material and Horizon: NSM PA-14219 (25), 14229d (27), 14234 (27), 14235d (27), 14238b (27), 14239 (27), 14240c (27) (holotype), 14247b (29), 14248b (29), 14249b (29), 14250b (29).

Description: Zoarium consisting of cylindrical stem, varying from 1.5 to 2.3 mm in diameter as measured on 7 specimens. Axial region formed by indistinct bundle. In typical longitudinal section, diameter of central bundle ranging from 0.4 to 0.5 mm, and number of tubes in central bundle usually 3. Zooecial tubes arise from central bundle at an angle of about 20°, straight in endozone curving outward at inner edge of exozone. Thickness of exozone varies from 0.20 to 0.58 mm. Superior and inferior hemisepta present but not prominent. Usually one diaphragm near the zooecial opening.

In tangential section, zooecial tubes elliptical, longer diameter ranges from 0.15 to 0.26 mm, shorter diameter ranges from 0.09 to 0.13 mm, regularly arranged in longitudinal and diagonal directions, 4 to 5 zooeia per 2 mm longitudinally and 6 to 6.5 per 2 mm diagonally. Usually one acanthostyle at each corner of zooecial tube and surrounded by concentric fibers; outside diameter ranges from 0.04 to 0.08 mm and inner diameter less than 0.003 mm. A single series of 2 to 4 paurostyles arranged between acanthostyles. Outside diameter of paurostyle ranges from 0.02 to 0.03 mm.

Remarks: This new species is near to *Ascopora sokolovae* which Shulga-

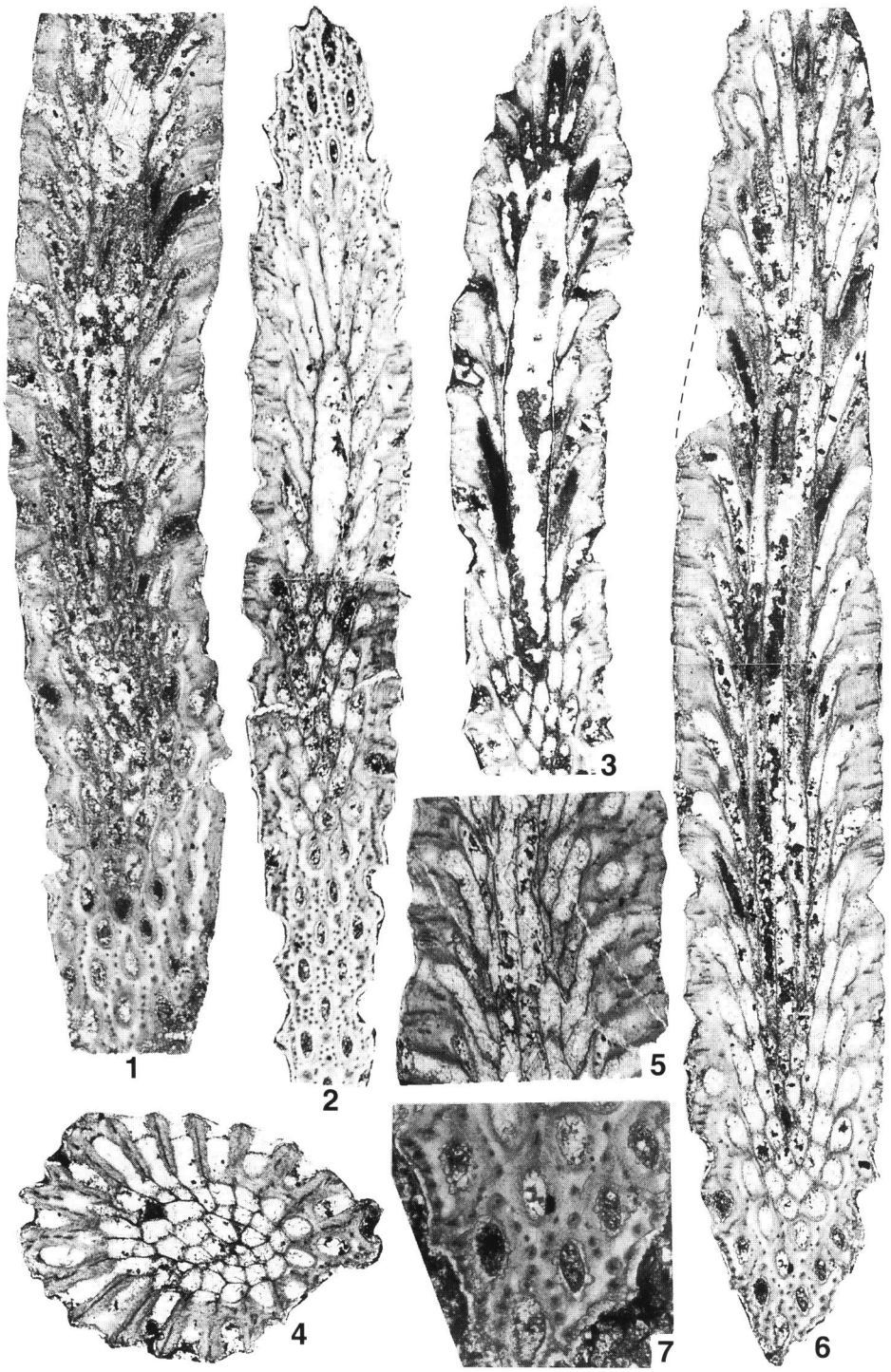

Fig. 7. 1–3, *Rhabdomeson newelli* n. sp., ×20, NSM PA-14241c, 14247a and 14136a, respectively. 4–7, *Ascopora peruana* n. sp., ×20 except for 7 which is enlarged part of 6, in ×40, NSM PA-14235d, 14238b and 14240c (holotype), respectively.

Nesterenko (1955) described from C_2^k, Kashirsky horizon (Middle Carboniferous) in the Russian Platform but is not closely comparable with any previously described species. The present form differs from *Ascopora sokolovae* in having less prominent superior and inferior hemisepta, and distinct paurostyles well arranged between the relatively small acanthostyles.

Family Rhomboporidae Simpson, 1895
Genus *Pamirella* Gorjunova, 1975
Pamirella andesensis n. sp.
(Figs. 8-3–7)

Material and Horizon: NSM PA-14144f (15b) (holotype), 14144g (15b), 14147c (15b).

Description: Two longitudinal, partly tangential sections were examined. Zoarium consisting of cylindrical stem; diameter 0.9 to 1.0 mm. Branching mode of zoarium not observed. Diameter of endozone about 0.5 mm. Thickness of exozone, ranging from 0.19 to 0.26 mm.

In longitudinal section, axial region consists of a nearly straight axis and straight zooecial tubes, making a small angle with longitudinal direction in endozone, and rapidly bending outward at posterior end of tubes in exozone. Zooecial tubes in exozone curved outward and perpendicular to surface. Superior hemiseptum at posterior end of exozone. Diaphragms lacking.

In tangential section of exozone, zooecial tubes oval, longer diameter ranges from 0.13 to 0.21 mm, shorter diameter ranges from 0.12 to 0.13 mm, not regularly arranged. Mesozooecia uncommon. Large acanthostyles abundant; outside diameter ranges from 0.04 to 0.06 mm, shorter diameter ranges from 0.01 to 0.03 mm, not aligned in well defined series.

Remarks: Gorjunova (1975) established the genus *Pamirella* as the type species: *P. nitida*, from the Lower Permian (Artinskian) of Pamir. Later, Blake (1983) additionally included three species which were described as in *Rhombopora* from the Carboniferous of North America by Ulrich (1890). Two of them, *Rhombopora nicklesi* and *R. minor* are both much thinner in the zoarial diameter than that of the present form. Another one, *Rhombopora*? *asperula* can be easily distinguished from the present species by the irregular shape and arrangement of zooecia.

Familly Hyphasmoporidae Vine, 1886
Genus *Streblascopora* Bassler, 1952
Streblascopora incaica n. sp.
(Figs. 9-1–6)

Material and Horizon: NSM PA-14136b (12), 14144h (15b) (holotype), 14144i

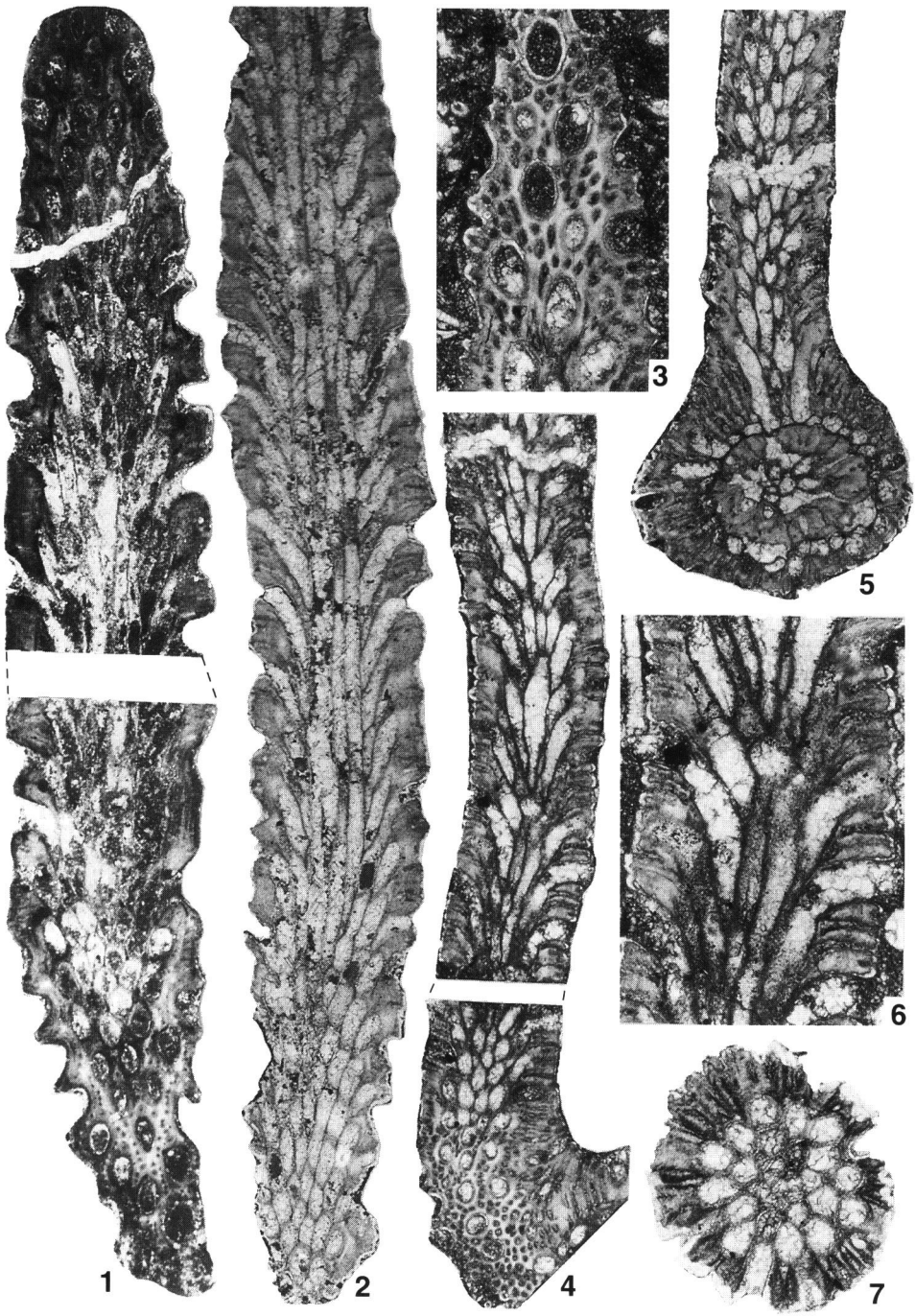

Fig. 8. 1, 2, *Ascopora peruana* n. sp., ×20, NSM PA-14219 and 14249b, respectively. 3–7, *Pamirella andesensis* n. sp., 4, 5, ×20, NSM PA-14144f (holotype) and 14147c, respectively. 3, 6, enlarged parts of 4, in ×40; 7, ×40, NSM PA-14144g.

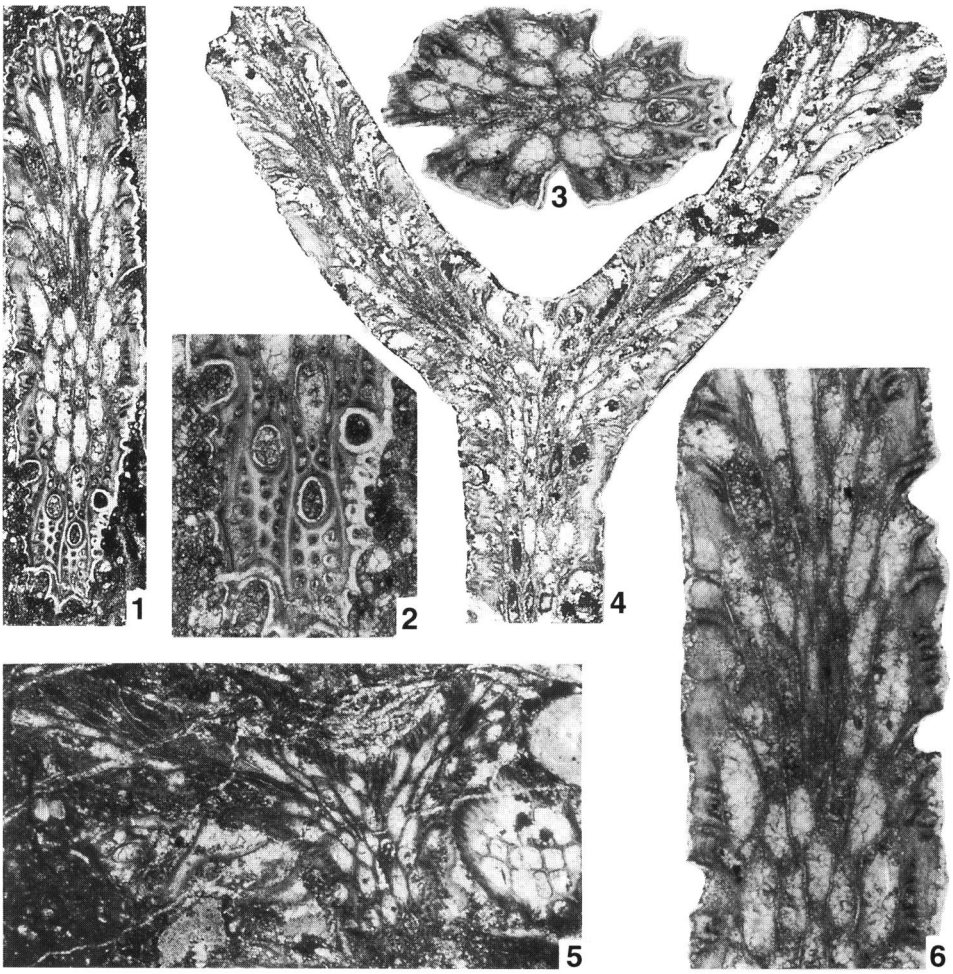

Fig. 9. *Streblascopora incaica* n. sp., ×20, 1, 4, 5, NSM PA-14144h (holotype), 14237d and 14136b, respectively. 2, 6, enlarged parts of 1, in ×40; 3, ×40, NSM PA-14144i.

(15b), 14146c (15b), 14146d (15b), 14147d (15b), 14237d (27), 14248c (29).

Description: Zoarium cylindrical ramose branches, varying 0.7 to 1.1 mm in diameter.

In longitudinal section, diameter of central bundle 0.20 to 0.26 mm, ratios of zoarial diameter to central bundle ranging from 4.0 : 1 to 4.5 : 1, and number of tubes in central bundle 3 to 4. Zooecial tubes arise from central bundle at an angle of about 20°, straight in endozone and curving rapidly at inner edge of exozone. Metapores arise from base of exozone, parallel to endozone wall for a very short distance, then curving rapidly outward and parallel to zooecial tubes in exozone. Number of tubes

in central bundle in transverse section may be less than 10.

In tangential section of exozone, zooecial tubes oval, longer diameter usually 0.13 to 0.14 mm, occasionally 0.17 mm in maximum, and shorter diameter 0.08 to 0.10 mm. Zooecial apertures arranged regularly longitudinal rows with about 4 zooecia in 2 mm measuring lengthwise. Superior hemiseptum at posterior end of exozone and inferior hemiseptum opposite side to superior hemiseptum present but occasionally lacking. Metapores usually circular, 0.02 to 0.03 mm in diameter, usually three rows with 4 to 5, occasionally 6 in both sides and 2 to 3 in central row. Total number of metapores disposed between zooecial tubes in one series usually about 12.

Remarks: *Streblascopora incaica* n. sp. is characterized by having the small diameter of central bundle and the ratio of zoarial diameter to central bundle. The present species is similar to *Streblascopora nikiforovae* which Morozova (1955) described to the genus *Streblotrypa* from the Kashirsky horizon (upper part of lower Moscovian) of the Middle Carboniferous in central Don (Russia) in the general appearance, but it can be distinguished by the arrangement of metapores. The present form is not unlike to *Streblascopora germana* which Bassler (1929) described form the Permian of Timor Island in the general appearance, especially in having the metapore arrangement showing in Bassler's illustration (Pl. 15, fig. 6, 1929).

Order Fenestrata
Family Fenestellidae King, 1849
Genus *Laxifenestella* Morozova, 1976
Laxifenestella stuckenbergi Nikiforova, 1938
(Figs. 10-1, 2)

Fenestella stuckenbergi Nikiforova, 1938, p. 87, 232, pl. 12, fig. 7, text-figs. 52–55; Shulga-Nesterenko, 1951, p.33–35, pl. 5, fig. 5, text-figs. 5, 6.

Material and Horizon: NSM PA-14247c (29).

Description: A single zoarium fan shaped, consists of straight, parallel branches connected by dissepiments at regular intervals. Branches bifurcate rather frequently. Branch width ranges from 0.19 to 0.26 mm; 22 to 24 branches per 10 mm horizontally. Fenestrules oval in outline, width ranging from 0.15 to 0.23 mm, length from 0.26 to 0.39 mm; about 18 fenestrules per 10 mm of branch length. Usually one tubercle is disposed on the reverse side of each dissepiment. Width of dissepiments ranging from 0.15 to 0.19 mm. Zooecial tubes arranged in 2 rows on each branch, probably about 25 per 5 mm length of one range, parallelogram or elongated quadrate in shape at lower to middle levels of branch because of no intercalated zooecial tubes in longitudinal series; usually 2.5 zooecia per fenestrule. Nodes present on straight carina, but not distinct in arrangement. Stereom covering reverse side of branch consists of inner semitransparent layer of colonial plexus with some capillary canals and outer sclerenchyma of dark fibers with fine granules.

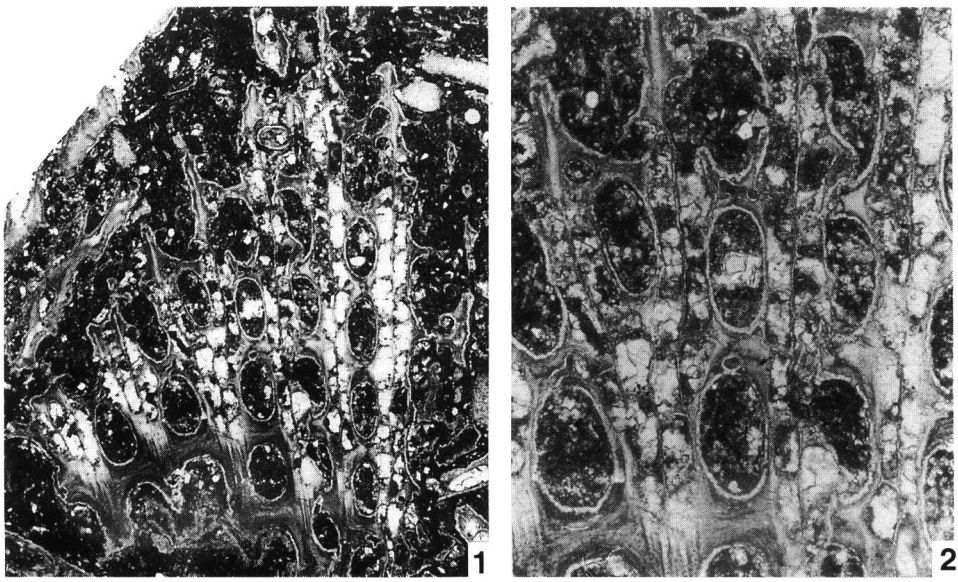

Fig. 10. 1, 2, *Laxifenestella stuckenbergi* Nikiforova, ×20 and ×40, respectively, NSM PA-14247c.

Meshwork formula: 22–24/18//22/?* (*22–24 branches in 10 mm of zoarial width; 18 fenestrules in 10 mm of zoaial length; 22 zooecia in 5 mm of branch length; ? nodes in 5 mm of branch length)

Remarks: Although this bifurcated, fan shaped zoarium is slightly different from the Russian original specimen consisting of rarely bifurcated branches, the present form is identical with *Fenestella stuckenbergi* described by Nikiforova (1938) from the Lower Carboniferous of Russia in the meshwork measurements, arrangements of zooecia in tangential section and other essential characters. Later, Shulga-Nesterenko (1951) also described this species from the Lower Carboniferous of the Russian Platform, and she illustrated the presence of one tubercle on the obverse side of each dissepiment in her Text figure (Fig. 5, p. 34) and Plate (Pl. V, fig. 5). It may be the most characteristic of this species. *Fenestella lahuseni* Stuckenberg described by Nikiforova (1938) and *Fenestella lahuseni* var. *microtuberculata* by Shulga-Nesterenko (1941), both from the Lower Permian of Russia have also such a tubercle on dissepiment, however, the present form can be distinguished from *Fenestella lahuseni* by the principal measurements of meshwork, namely, the present form differs from *Fenestella lahuseni*, meshwork of which is 15–16/9–10//17–18/19–20.

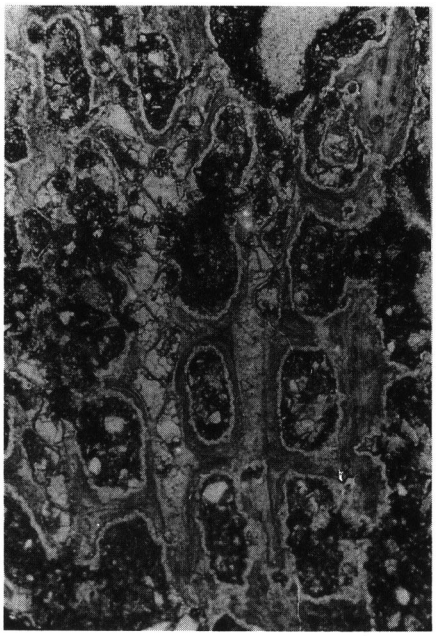

Fig. 11. *Fenestella* (s. l.) sp. indet., ×20, NSM PA-14247d.

Fenestella (s.l.) sp. indet.
(Fig. 11)

Material and Horizon: NSM PA-14247d (29).

Descriptive remarks: A single tangential section of fragmentary zoarium consists of nearly straight branches connected by dissepiments at regular intervals, width from 0.17 to 0.21 mm. Fenestrules quadrate with rounded corners, width from 0.14 to 0.19 mm and length about 0.32 mm. Zooecial tubes arranged in strongly alternating longitudinal series, usually triangular at middle level. Zooecial apertures may be consistently positioned in relation to dissepiment, 2 zooecia per fenestrule. Stereom covering reverse side of branch consists of inner semitransparent layer of colonial plexus and outer sclerenchyma with coarser fibers.

A detailed comparison with the described species cannot be made because only one fragmentary specimen at hand is too poor for specific identification.

Family Acanthocladiidae Zittel, 1880
Genus *Penniretepora* D'Orbigny, 1849
Penniretepora sp. indet. A, B, C and D
(Figs. 12-1–4)

Material and Horizon: NSM PA-14139b (13), 14144j (15b), 14145d (15b),

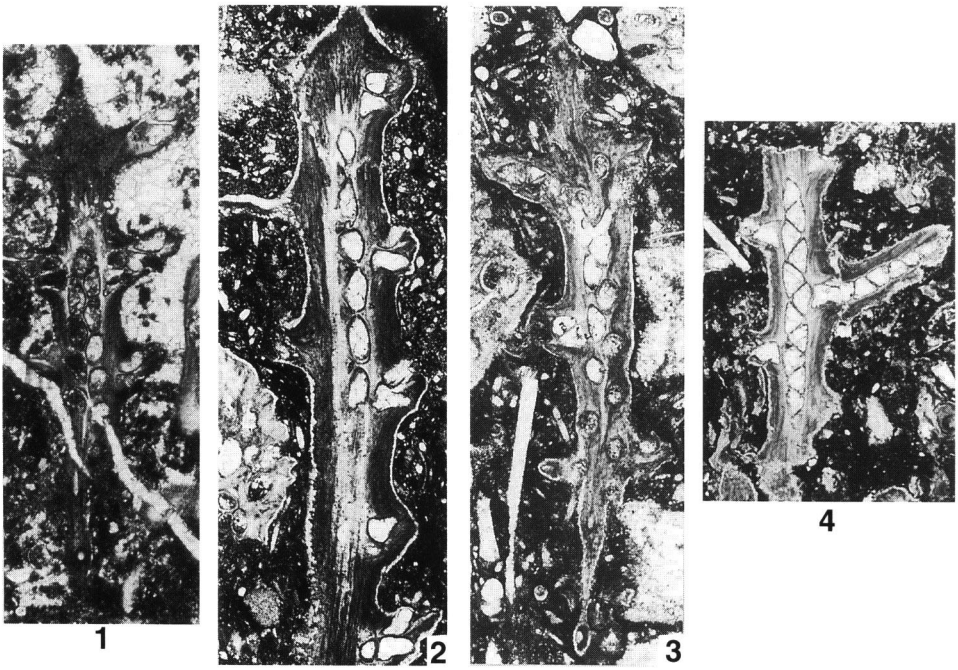

Fig. 12. 1–4, *Pennniretepora* sp. indet. A, B. C and D, ×20, NSM PA-14139b, 14144j, 14145d and 14247e, respectively.

14247e (29).

Dimensions:

Species	Spec. no. NSM PA-	A	B	C	D	E	F	G
P. sp. A	14139b	6–7	0.48	0.26	3	18–20	0.10	ca. 70°
P. sp. B	14144j	5	0.61	0.35	2	7–8	0.10	80°
P. sp. C	14145d	5	0.48	0.35	3	15	0.10	70°
P. sp. D	14247e	6–7	0.45–0.48	0.32	3	17–18	?	60°

A: Number of lateral branch in 5 mm length, B: Width of main branch, C: Width of lateral branch, D: Number of zooecia between lateral branches, E: Number of zooecia in 5 mm length, F: Diameter of zooecial tube near surface, G: Angle between main and lateral branches.

Remarks: Four specimens belonging to the genus *Pennniretepora* examined here are impossible to make the specific identification, because of the fragmentary and/or poorly preserved zoaria.

Pennniretepora sp. A and *P.* sp. D resemble each other, and *P.* sp. B is clearly

distinguishable to the others in the number of zooecia between lateral branches; 2 zooecia in *P.* sp. B but 3 zooecia in the others. *P.* sp. C is characterized by the well developed capillaries on the main branch and differs from *P.* sp. A in the number of zooecia in 5 mm length of branch.

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