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FAUNAS AND CORRELATION OF THE LATE PALEOZOIC ROCKS OF NORTHEAST GREENLAND

Part II
FUSULINIDAE

BY

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WITH 7 PLATES

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LIST OF GENERA

In the Lower Marine group of northeast Greenland we recognize 15 species and 10 genera of fusulines, all identical with or closely allied to forms in the Moscovian Series of the U.S.S.R.

In the Upper Marine group we have 6 species and 5 genera of fusulines all showing close affinities with the early Permian of the U.S.S.R.

The collections studied are mostly very small and some of the species in each group have yielded too few specimens for specific identification or satisfactory description and these are not named.

TAXONOMIC DESCRIPTION

Schubertella STAFF and WEDEKIND, 1909.

Schubertella STAFF and WEDEKIND, 1909, Geol. Inst. Upsala, Bull., v. 10, p. 112, 121, pl. 4, figs. 7, 8. — THOMPSON, M. L., 1937, Jour. Paleont., v. 11, p. 120—121, Pl. 22, figs. 1, 3—6.

Generotype. *Schubertella transitoria* STAFF and WEDEKIND

Diagnosis. Extremely minute meloniform fusulines commonly having 4 to 5 volutions and attaining a length of about 1.0 mm and a diameter slightly less than half as great. They commonly have an endothyroid juvenarium of 1 to 2 volutions coiled at a high angle to the axis of the shell; but occasional megalospheric shells lack such a juvenarium. In the latter the first volution is commonly somewhat askew.

The proloculus is minute and the spiral wall is extremely thin (commonly between 10 and 15 microns in the outer whorl). Commonly no distinct wall layers can be recognized but when well preserved in the outer volutions it can be seen to consist of two layers, a tectum and a somewhat thicker inner layer. No tectoria are present.

The septa are nearly plane though commonly somewhat irregular in their course, especially near the ends of the outer whorls.

The tunnel is rather low and is defined by well developed but narrow chomata.

Discussion. In their original diagnosis of the genus and their description of the type species, *S. transitoria*, STAFF and WEDEKIND

indicated that the wall consisted of a single layer. Their illustrations of the species were somewhat diagrammatic drawings. One of the types had a relatively large proloculus and was essentially bilaterally symmetrical; the other had a much smaller proloculus and the first two volutions were somewhat askew. They regarded the first as megalospheric and the second as microspheric. Their brief description and poor illustrations leave much to be desired, and our interpretation of the genus rests largely on THOMPSON's later study of specimens from Spitzbergen. Although not the original types, THOMPSON's material probably included topotypes.

As interpreted by THOMPSON (1937) this genus is locally common and is widespread in the early Permian formations (beginning in the Wolfcampian and ranging up into the Leonardian).

Schubertella transitoria STAFF and WEDEKIND, 1910.

Plate 7, figs. 12—14.

Schubertella transitoria STAFF and WEDEKIND, 1910, Geol. Institute, Univ. of Upsala, Bull., v. 10, p. 121, Pl. 4, figs. 7, 8.

Schubertella transitoria THOMPSON, 1937, Jour. Paleont., v. 11, p. 121—123, Pl. 22, figs. 1, 3—6.

Material studied. Three axial and several random sections.

Discussion. This minute species, first described from Spitzbergen, has never been adequately described or illustrated. The original illustrations were simple drawings and the description left much to be desired. THOMPSON later studied material from Spitzbergen, presumably topotypes, but his specimens were apparently not well preserved and his illustrations were quite inadequate. Our specimens are too few to make possible a satisfactory study of the species. Our shells are undoubtedly congeneric with the well known *Schubertella kingi* of the American Wolfcampian Series.

These minute shells are melon-shaped, have a length of about 1.0 mm and an equatorial diameter a little less than half as great, consist of about 5 volutions, have simple septa and an extremely thin and simple spiral wall. The shells are dimorphic, as in the case of *S. kingi*, the microspheric shells having an endothyroid juvenarium coiled at a high angle to the axis of the mature shell, and the megalospheric shells having a somewhat larger proloculus and a short, nearly spheriodal first volution that is commonly slightly askew. Both forms are equal in size at maturity and cannot be distinguished before sectioning.

In our best preserved specimen (Pl. 7, fig. 13) the wall is only about 2 microns thick in the first volution, about 5 microns thick in the second and third, and 10 microns in the fourth. In the first three volutions no

subdivisions can be recognized but in the fourth very high magnification reveals two layers, a very thin tectum underlain by a lighter and thicker layer.

The tunnel is relatively wide and slit-like and is well defined by narrow chomata. The septa are somewhat irregular in their course and do not closely follow the meridional plane, especially near the ends of the shell where they commonly cross an axial section, but septal folds seem to be lacking.

Occurrence. In the original description of the species the type locality was not given and the horizon within the section in Spitzbergen was not recorded. THOMPSON based his redescription on specimens from Temple Bay and indicated that the horizon is Permian. Our best specimen was in collection E-138 in Holm Land where it is associated with *Rugosofusulina arctica* and *Pseudoschwagerina pavlovi*. Two other axial sections are from collection 169 near Sophus Müller Næs and probably belong to the lower part of the upper marine group. It occurs with *P. pavlovi* in collection 191 from Henrik Kröyer Holme.

Ozawainella THOMPSON, 1935.

Ozawainella THOMPSON, 1935, Jour. Paleont., v. 9, p. 114—115;
— 1948, Univ. of Kansas Paleontological Contrib., Art. 1, p. 28.

Generotype. *Fusulinella angulata* COLANI, 1924.

Diagnosis. Shell minute, discoidal, the axis distinctly shorter than the equatorial diameter, the poles very obtusely subangular, the equator acutely subangular in all whorls, and the lateral slopes nearly flat; planispirally coiled throughout.

A narrow tunnel is bordered by slender chomata. The septa are not fluted but normally arch backward toward the periphery. The spiral wall is thin and is commonly less well preserved than in associated larger fusulines, suggesting that its chemical composition differed somewhat from that of most other fusulines. A tectum and thin tectoria are recognizable in well preserved specimens, and the outer volutions of large shells may show what appears to be a thin diaphanotheca between the tectum and the inner tectorium.

Discussion. In 1948 RAUSER-CHERNOUSSOVA distinguished two new subgenera of lenticular staffelloids, *Eostaffella*, and *Parastaffella*. *Ozawainella*, as restricted, is distinguished by its lenticular shape at all stages of growth whereas the other two subgenera are nautiliform and have a rounded periphery, curved lateral slopes, and umbilicate poles until nearly full grown, developing an angular periphery only in the last one or two volutions.

Eostaffella is the oldest, its generotype, *E. parastruvii* RAUSER-CHERNOUSSOVA, occurring in the *Gigantella* beds of the Visean (Lower Carboniferous). It is very small and its wall appears dark and undifferentiated in thin section or at most shows only 3 layers, the tectum and tectoria. *Parastaffella*, in contrast, is somewhat younger, its generotype, *Fusulina struvii* MÖLLER, occurring in the Middle Carboniferous beds. Its wall appears light gray in thin section and consists of 4 layers.

Another subgenus, *Reichelina* ERK (1941), is apparently a specialized offshoot of *Ozawainella* in which the outer volution becomes more or less evolute and develops a thin peripheral flange.

Ozawainella mosquensis RAUSER-CHERNOUSSOVA.

Pl. 1, figs. 1—7.

Ozawainella mosquensis RAUSER-CHERNOUSSOVA, 1951, Akad. Nauk. U.S.S.R., Inst. Geol. Nauk., Minist. Petrol. Prosp. U.S.S.R., p. 136, pl. 10, figs. 14—16.

Material studied. Sixteen axial sections from collections B-119, A-124, A-126, and O-116 in Holm Land and collection F_1-238 in Amdrup Land, plus numerous random sections.

Description. This small species has slightly umbilicate poles, a heavy outer tectorium, and an angular periphery. Tests of 7 volutions reach 1.2 mm in diameter and 0.5 mm in length.

The proloculus is small (about 40 microns in outside diameter), and the volutions increase gradually in height. The test is lenticular and its periphery angular throughout its growth.

The wall is thin and indistinct in the early volutions but in the third volution a tectum, thin inner layer (possibly a diaphanotheca), and a heavy outer tectorium become distinguishable.

The septa are thin, numerous, and slant forward to the floor of the chamber so that two or more septa may be cut in axial sections (Pl. 1, fig. 3).

The tunnel is narrow throughout the test (tunnel angle about 10 degrees), and it follows the mid plane of the test. The heavy outer tectorium is lacking beneath the tunnel. The low asymmetrical chomata merge with the heavy outer tectorium and together they extend down the lateral slopes to the poles.

Discussion. Our specimens agree closely with those described from the Moscovian Series in the Moscow Basin (RAUSER-CHERNOUSSOVA, 1951, p. 136). Comparable species are *O. vozhgalica* SAFRONOVA (1951) and *O. magna* SHENG (1958). In the former the wall is thicker than in *O. mosquensis* and *O. magna* is somewhat more slender.

Measurement of specimens of *Ozawainella mosquensis* illustrated on Plate 1.

	Volution	Fig. 2	Fig. 4	Fig. 5
Radius vector	0	.02 mm	.02 mm	?
	1	.04	.07	.08 mm
	2	.07	.11	.15
	3	.11	.18	.25
	4	.22	.29	.38
	5	.27	.38	.55
	6	.40	..	..
	7	.60	..	..
Half length	1	.02 mm	.02 mm	.05 mm
	2	.03	.04	.07
	3	.04	.08	.10
	4	.10	.15	.15
	5	.14	.23	.20
	6	.22	..	..
	7	.27	..	..
Form ratio	1	.5	.3	.6
	2	.4	.4	.5
	3	.4	.5	.4
	4	.5	.5	.4
	5	.5	.6	.4
	6	.5	..	..
	7	.4	..	..
Tunnel angle	1	10°	10°	..
	2	10	10	..
	3	10	10	10°
	4	10	10	10
	5	10	..	..
	7	..	..	..
Wall thickness	0	.01 mm	.01 mm	?
	1	.01	.01	?
	2	.01	.01	.01 mm
	3	.02	.02	.01
	4	.02	.01	.02
	5	.02	.03	.01
	6	.02	..	..
	7	.01	..	..

Occurrence. This species was described from the Kashira Stage in the Moscow Basin but is widely distributed across the Russian Platform and ranges up into the Podolsk Stage. In northeast Greenland it ranges throughout the Lower Marine Group and is commobly associated with *Pseudostaffella greenlandica.*

Pseudostaffella THOMPSON, 1942.

Pseudostaffella THOMPSON, 1942, Amer. Jour. Sci., v. 240, p. 411, Pl. 1, figs. 15—20; Pl. 3, figs. 10—14.

Generotype. *Pseudostaffella needhami* THOMPSON, 1942.

Diagnosis. Minute, subspherical tests generally between 1 and 2 mm in diameter and consisting of 6 to 8 volutions. The equatorial and polar diameters are subequal throughout growth. The early whorls are broadly rounded and the first one or two may be somewhat oblique to the axis of later volutions. In most species the whorls remain broadly rounded throughout growth, but in some species the adult whorls become flattened at the ends and flattened or slightly depressed across the middle so that axial sections appear subquadrate.

The tunnel is narrow and is bounded by broad and rather massive chomata. The wall is thin and normally displays 3 layers, a tectum and inner and outer tectoria, but in the outer whorls of large tests a thin diaphanotheca may be detected. The septa are plane.

Discussion. *Pseudostaffella* resembles *Staffella*, and the relation of the two genera is still somewhat uncertain. Before 1925 all such small spheroidal fusulines were referred either to *Fusulina* or to *Fusulinella*. In that year OZAWA proposed for them a distinct genus, *Staffella*, for which he selected as generotype "*Staffella sphaerica* MÖLLER" [= *Fusulina sphaerica* ABICH, 1858].

ABICH's types were from the upper part of the "Bergkalk of Armenia and Azerbeidjan" — beds now recognized as Lower Permian (LIKHAREV, 1939). Although ABICH stated that this is the most common and distinctive fossil in these beds, the shells were completely silicified and his description of the species was very brief and his illustrations quite inadequate. MÖLLER (1878) redescribed the species, basing his study on collections from the same formation in Armenia — probably the original collections of ABICH. He made the first study of thin sections and published enlarged drawings showing an axial and a sagittal section; but since all the specimens were silicified and poorly preserved his sections leave much to be desired. LIKHAREV (1939, p. 34 and Pl. 1, figs. 14, 15) again redescribed the species, basing his study on original collections of ABICH, but his illustrations also fail to show satisfactory details of the wall structure. MÖLLER's sections are somewhat confusing since the axial section (Pl. XV, fig. 3a) clearly indicates a wall of 3 layers (tectum and inner and outer tectoria), whereas a part of the penultimate whorl of his sagittal section (Pl. XV, fig. 3b) clearly shows a fourth layer, the diaphanotheca, between the tectum and the inner tectorium. In his measurements of this section he records the "zwischenraum", 15 microns

thick, which can be nothing but the diaphanotheca. It seems probable, therefore, that the shell had a four-layered wall and that the diaphanotheca was only recognized in a favorably preserved fragment of this section. LIKHAREV did not mention the wall structure. The axial sections of both MÖLLER and LIKHAREV show that the early whorls were nautiliform with the polar diameter considerably shorter than the equatorial. Both MÖLLER and LIKHAREV indicate that the species attained a diameter of 4 mm or more and that large shells consisted of 10 or more volutions. Chomata were not mentioned by MÖLLER nor are they indicated in his axial section, but LIKHAREV states that "along the sides of the tunnel are rather massive chomata which fade out in the last whorl". His axial section, however, indicates that, although the chomata are conspicuous and broad, they are much lower than is normal in *Pseudostaffella*. Thus, in spite of poor preservation and inadequate description, the generotype of *Staffella* is known to be an Early Permian species of relatively large size in which the early whorls were nautiliform, and we infer that the wall, at least in the outer whorls, consisted of four layers. If this be granted, *Staffella* and *Pseudostaffella* may be distinguished, as THOMPSON (1942) did, in the following way:

In *Staffella* the early volutions are nautiliform and the wall, at least in the adult whorls, consists of four layers as in *Fusulinella*, whereas in *Pseudostaffella* the early whorls are broadly rounded, the young shell being subspheroidal, and the wall consists of only 3 layers in the early whorls, though a fourth layer, the diaphanotheca may be recognizable in the outer whorls. All the mid Pennsylvanian species fall into the genus *Pseudostaffella* and the known Permian species belong to *Staffella*. It is not known whether the genera overlap in the upper part of the Pennsylvanian System.

Pseudostaffella greenlandica sp. nov.

Pl. 1, figs. 8—13.

Material studied. Thirty-two axial sections from the Lower Marine group (collections B-117$_2$, B-119, B-124, O-116, and A-126 in Holm Land, and F$_1$-240 in Amdrup Land).

Description. A large species for the genus, consisting of 6 to 7 volutions and commonly reaching an equatorial diameter of 1.5 to 1.8 mm and a polar diameter of 1.3 to 1.4 mm. The periphery is flattened or broadly concave throughout growth and the ends of the shell are flattened or slightly concave at the poles so that in axial sections the profile is distinctly subquadrate.

The proloculus is relatively large (commonly 100 to 120 microns in outside diameter), and the first volution is low and spheroidal and com-

Measurements of specimens of *Pseudostaffella greenlandicus* shown on Plate I

	Volution	Fig. 13	Fig. 11	Fig. 8	Fig. 9
Radius vector....	0	.06 mm	.06 mm	.05 mm	.05 mm
	1	.15	.09	.10	.12
	2	.25	.15	.15	.20
	3	.37	.25	.22	.28
	4	.50	.35	.34	.40
	5	.65	.45	.47	.55
	6	.85	.57	.60	.70
	7	..	.72	..	..
Half length.....	1	.15 mm	.12 mm	.09 mm	.15 mm
	2	.22	.15	.16	.22
	3	.32	.21	.26	.30
	4	.42	.30	.37	.40
	5	.55	.35	.50	.46
	6	.65	.48	.60	.60
	7	..	.56	..	..
Form ratio.....	1	1.0	1.1	1.1	1.2
	2	0.9	1.0	1.1	1.1
	3	0.9	0.8	1.2	1.1
	4	0.8	0.9	1.1	1.0
	5	0.8	0.8	1.1	0.8
	6	0.8	0.8	1.0	0.9
	7	..	0.8	..	..
Tunnel angle.....	1	20°	17°	17°	20°
	2	22	18	17	22
	3	22	17	19	22
	4	22	20	23	23
	5	43	25	25	25
	6	..	25	..	..
Wall thickness...	0	.012 mm	.015 mm	.010 mm	.01 mm
	1	.025	.015	.012	.01
	2	.030	.020	.025	.02
	3	.025	.020	.020	.03
	4	.025	.010	.020	.01
	5	.030	.025	.025	.02
	6	.025	.025	.020	.02
	7	..	.025	..	..

monly somewhat askew. The second and third volutions are also low but later ones gradually increase in height.

The wall is thin and is differentiated into tectum, a thin diaphanotheca, and inner and outer tectoria; it gradually increases in thickness from about 12 microns in the proloculus to 25 or 30 microns in the outer whorls. The outer tectorium is about equal in thickness to the diaphanotheca and extends across the floor of the tunnel but the inner tectorium

is commonly developed only near the middle of the shell. The septa are plane and the tunnel is narrow and closely follows the sagittal plane of the shell. The chomata are massive and unsymmetrical, rising steeply beside the tunnel, reaching maximum height at the shoulders where the wall curves abruptly into the end of the shell, and thinning toward the poles. Commonly the chomata reach almost to the top of the chamber at each septum, but are lower between septa.

Discussion. This species resembles *P. paradoxa* (DOUTKEVITCH) but that species is more loosely coiled and more specialized in shape having a more deeply depressed venter and more concave ends so that in axial sections the corners are more exaggerated and more acutely subangular. *P. quadrata* (DEPRAT) 1913, is very similar in size and number of volutions but is relatively broader than *P. greenlandica*, its polar and equatorial diameters being subequal, and its chomata are much lower than in our species.

Occurrence. This species ranges widely through the Lower Marine group of northeast Greenland, but is most common in the lower and middle portions. Similar species (*P. paradoxa*, *P. subquadrata*, and *P. cuboides*) in the Moscow Basin of the U.S.S.R. are confined to the lower and middle parts of the Moscovian Series.

Pseudostaffella sphaeroidea (EHRENBERG).

Pl. 2, figs. 9—12.

Material studied. Nine axial and one sagittal section from collections N-130, N-132 and C-121 in Holm Land, and two from collection F_1-240 and F_1-238b in Amdrup Land, all in the Lower Marine group.

Description. A subspheroidal species of 7 to 8 volutions attaining an equatorial diameter of 1.1 to 1.2 mm and a polar diameter of about 1.0 mm. The proloculus is small, the maximum outside diameter in the specimens studied being 80 microns. The coiling is plainspiral throughout and the whorls are relatively low. The form ratio changes only slightly during growth and in axial sections the periphery of each whorl appears almost semicircular. The poles normally are slightly dimpled but not umbilicate (the shell shown as fig. 9 of Pl. 2 being abnormal on the right side).

The spiral wall consists of 3 layers, tectum and inner and outer tectoria. It is very thin in the first volution, gradually increasing to between 20 and 30 microns in the adult whorls. The septa are plane. The tunnel is narrow and commonly follows an irregular course near the equatorial plane of the shell. The tunnel angle reaches a maximum of only about 17° in the penultimate whorl. Chomata are massive and very

broad, reaching from the sides of the tunnel almost to the poles. In most of our sections they appear to be relatively low but in this feature there is considerable variation depending on whether the slice falls close to a septum or midway between septa. Figures 11 and 12 of Plate 2 show contrasting extremes.

Measurements of specimens of *Pseudostaffella sphaeroidea* shown on Plate 2 and one other.

	Volution	Fig. 12	Fig.	Fig. 9
Radius vector....	0	.04 mm	.04 mm	.04 mm
	1	.07	.08	.09
	2	.14	.14	.16
	3	.24	.22	.25
	4	.35	.32	.35
	5	.47	.44	.48
	6	.61	.57	..
Half length.....	1	.10 mm	.09 mm	.05 mm
	2	.15	.15	.11
	3	.25	.20	.21
	4	.37	.30	.30
	5	.45	.40	.38
	6	.52	.52	.48
Form ratio.....	1	0.7	0.9	0.6
	2	0.9	0.9	0.7
	3	1.0	0.9	0.8
	4	1.0	1.0	0.9
	5	1.0	0.9	0.8
	6	0.9	0.9	..
Tunnel angle.....	1	12	14	14
	2	12	14	16
	3	12	14	16
	4	12	16	18
	5	12	17	20
	6	13	..	..
Wall thickness...	0	.005 mm	?	.01 mm
	1	.007	.01 mm	.01
	2	.010	.015	.02
	3	.015	.020	.02
	4	.015	.025	.02
	5	.015	.030	.02
	6	.020	.030	..

Discussion. RAUSER-CHERNOUSSOVA (1951, p. 129) cast doubt on the authorship and validity of this specific name when she noted that LAMARCK first used the name *sphaeroidea* in 1816 as *Melonia sphaeroidea.*

If his species were a fusuline of the group now referred to *Pseudostaffella*, the use of the name by EHRENBERG (1842, 1854) and by MÖLLER (1879) might be either synonyms or homonyms. Actually LAMARCK's work makes it evident that he applied the name to one of the alvionellids and not to a fusuline. Hence there is no conflict and *Pseudostaffella sphaeroidea* (EHRENBERG) is valid.

This is one of the largest species of *Pseudostaffella*. It differs conspicuously from typical examples of *P. greenlandica* which is subquadrate in axial profile, having a slightly concave periphery and flat or concave ends. *P. sphaeroidea* normally has a fully rounded periphery but a few of our sections (eg. Pl. 2, fig. 11) are slightly flattened across the periphery in several of the immature whorls and rather closely resemble some specimens of *P. greenlandica* and *P. sphaeroidea* var. *cuboides* RAUSER-CHERNOUSSOVA. This species is closely similar to *P. syzranica* RAUSER-CHERNOUSSOVA and SAFONOVA (1951) but it attains appreciably larger size and is somewhat larger in corresponding whorls throughout. *P. larionova* RAUSER-CHERNOUSSOVA and SAFONOVA (1951) is somewhat narrower and has slightly higher volutions and a distinctly wider tunnel. *P. rostovzevi* RAUSER is somewhat larger and broader, being almost perfectly spherical.

Occurrence. This species ranges from high in the lower third of the Lower Marine group of Holm Land (Collection C-121) through the upper part (Collections N-130 and N-132) and occurs in the upper part in Amdrup Land (Collections F_1-240 and F_1-238b). It is widespread in the Moscovian Series of the U.S.S.R.

Pseudostaffella? *pseudosphaeroidea* (DOUTKEVITCH).

Pl. 2, figs. 1—8.

Staffella pseudosphaeroidea, DOUTKEVITCH, G. A., 1934, Petrol. Prosp. and Geol. Inst. (A), v. 36, p. 17—22, 66—68, Pl. 3, figs. 2—10.

— GORSKY, I., 1939, Centr. Geol. and Prosp. Inst., v. 5, p. 35, 36, pl. 1, figs. 26—27.

Material studied. Ten thin sections from collections B-117_1, C-121, and O-127_4 from the lower part of the Lower Marine group on Holm Land.

Description. Small subspheroidal tests commonly including about 6 volutions and reaching a diameter of 1.0 to 1.1 mm and a length of 0.6 to 0.8 mm. The periphery is broadly rounded and the poles distinctly umbilicate (Pl. 2, figs. 3, 4, 7).

The proloculus is small, ranging between 40 and 60 microns in outside diameter. The volutions are planispiral throughout and increase gradually in height. The first two volutions are nautiliform and the first

commonly does not quite cover the sides of the proloculus, but later whorls increase in width to become semicircular to transversely semi-elliptical in cross section.

In the specimens studied the wall is not well preserved but it appears originally to have comprised two layers, a thin tectum and a thicker inner layer. It is very thin in the first volutions but increases gradually to a thickness of about 30 microns in the fifth and sixth volutions. The tunnel is uncommonly wide for this genus and the chomata are rather broad but low.

Measurements of specimens of *Pseudostafella pseudosphaeroidea* shown on Plate 2.

	Volution	Fig. 1	Fig. 7	Fig. 8
Radius vector....	0	.02 mm	?	.02 mm
	1	.04	.05 mm	.05
	2	.10	.11	.10
	3	.16	.17	.17
	4	.27	.30	.30
	5	.40	.45	.45
	6	.55	.70	..
Half length.....	1	.04 mm	.04 mm	.03 mm
	2	.05	.07	.04
	3	.06	.10	.10
	4	.15	.30	.17
	5	.22	.42	.30
	6	.40	.50	..
Form ratio.....	1	1.0	0.8	1.5
	2	0.5	0.6	0.4
	3	0.4	0.6	0.6
	4	0.6	1.0	0.6
	5	0.6	0.9	0.7
	6	0.8	0.7	..
Tunnel angle.....	1	25°	30°	20°
	2	35	30	20
	3	35	30	30
	4	32	30	35
	5	45	..	..
	6	..	..	..
Wall thickness...	0	.005 mm	.01 mm	.01 mm
	1	.005	.01	.005
	2	.01	.01	.01
	3	.015	.02	.01
	4	.02	.03	.025
	5	.03	.04	.030
	6	.03	.06	..

Discussion. This species is doubtfully referred to the genus *Pseudostaffella* because its early whorls are narrow and nautiliform instead of subspheroidal, in this respect agreeing rather with the genus *Staffella*. It differs from most species of the genus in the progressive ontogenetic change from narrow early whorls to broad and transversely semielliptical whorls at maturity. It is also distinguished by its prominent umbilici, its wide tunnel, and its low chomata. *P. pseudosphaeroidea* closely resembles *P. struvei* (MÖLLER) but has a smaller proloculus and is more loosely coiled. It is larger and more globose than *P. moelleri* (OZAWA).

Occurrence. The figured types of this species are from the core of a well No. 2 in the Chussovaya River Valley in the west flank of the Urals, in beds ranging from 877 to 1687 meters below the surface. Here it is associated with other distinctively Middle Carboniferous fusulines such as *Pseudostaffella paradoxa* (DOUTKEVITCH) and *Taitzehoella librovitchi* (DOUTKEVITCH). DOUTKEVITCH (1934, p. 68) believed that in this well the species ranged from the upper part of the Middle Carboniferous into the middle part of the Upper Carboniferous. In addition, he indicated that this species occurs in the Juresan and Chernaiarechka formations in the Ufa Plateau which are now classified as Early Permian (SAKMARIAN). Probably modern refinements would separate the Early Permian from the Mid Carboniferous forms. In northeast Greenland this species has been found only in the lower part of the Lower Marine group (Collections B-117, C-121 and O 127_4) where it is associated with such characteristic early Moscovian forms as *Fusulinella eopulchra*, *Profusulinella priscoidea*, and *Paraeofusulina trianguliformis*.

Parastaffella RAUSER-CHERNOUSSOVA, 1948.

Parastaffella RAUSER-CHERNOUSSOVA, 1948, Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Trudy, fasc. 66 (Geol. Ser. 21), p. 13, 14.

— 1951, Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Minist. Neftianoi Prom. S.S.S.R.

Generotype. *Fusulinella struvii* MÖLLER, 1879. (Part.).

Diagnosis. Minute plainspiral tests in which all but the last whorl are nautiliform, the polar diameter being much less than the equatorial and the periphery narrowly rounded; the final volution becomes acutely angular at the periphery.

The spiral wall consists of 4 layers, tectum, diaphanotheca, and tectoria. The septa are plane. The tunnel is narrow and is bordered by chomata that thicken at the septa and are slight between septa.

Discussion. In 1948 RAUSER-CHERNOUSSOVA recognized *Parastaffella* and *Eostaffella* as subgenera of *Staffella*. Both are similar in form having rather narrow, nautiliform early whorls and developing an acute periphery only in the last volution. In shape and outogeny both differ from her *Staffella* [= *Pseudostaffella*] which is subspheroidal at all stages of growth and has a broad periphery at maturity.

Eostaffella is the more primitive, structually, including very minute species in which the wall appears dark in thin sections and commonly cannot be resolved into distinct layers, and at the most shows only 3 layers, tectum and tectoria, in the outer whorls. *Parastaffella* includes species that are generally larger and in which the wall in thin sections appears grey and shows 4 layers, at least in the outer whorls. In 1951 RAUSER-CHERNOUSSOVA proposed to raise both *Eostaffella* and *Parastaffella* to full generic rank.

A nomenclatorial problem exists since MIKHAILOV (1939) had previously proposed the genus *Pseudendothyra*, citing as its type *Fusulinella struvii* MÖLLER, 1879, pl. 5, fig. 4a, a sagittal section displaying a three-layered wall. Apparently he did not select a holotype for MÖLLER's species. RAUSER-CHERNOUSSOVA (1948) decided that MÖLLER's Pl. 5, fig. 4b should be the holotype. It is an axial section showing a four-layered wall. On this specimen she based the genus *Parastaffella*. If, as she stated, MÖLLER's fig. 4a belongs to her *Eostaffella*, then *Eostaffella* is a synonym of *Pseudendothyra* which has priority by 11 years.

Parastaffella holmensis n. sp.

Pl. 3, figs. 1—6.

Material studied. Fourteen axial, 5 sagittal, and 31 oblique sections from collection B-117, in the lower part of the Lower Marine group in Holm Land.

Description. This minute species is rather thickly lenticular and consists of 5 or 6 volutions, attaining an equatorial diameter of 1.5 mm and a polar diameter of about 0.6 mm. The proloculus is spheroidal and only about 50 microns in diameter. The shell is plainspirally coiled throughout and the first 3 or 4 volutions are nautiliform with their periphery gradually becoming relatively narrower but distinctly rounded; thereafter the periphery becomes subacute and generally sharply angular in the mature whorls. The poles are narrowly umbilicate throughout growth.

The wall of the proloculus is very thin (only about 5 microns thick) and the spiral wall increases gradually to a thickness of about 30 microns in the sixth volution. The wall consists of 4 layers, tectum, diaphanotheca and inner and outer tectoria. The outer tectorium is present on the floor of the tunnel and underlies the chomata which are low and asymmetrical.

The septa are plane and lie essentially in a radial plane. The tunnel is low and narrow and is bordered by well developed but low chomata that extend far down the lateral slopes.

Measurement of specimens of *Parastaffella holmensis* shown on Plate 3.

	Volution	Fig. 2	Fig. 3	Fig. 5
Radius vector....	0	0.02 mm	..	..
	1	.05	.06? mm	.04 mm
	2	.09	.15	.07
	3	.15	.25	.12
	4	.26	.38	.21
	5	.43	.61	.35
	6	.70	.90	.52
Half length.....	1	.02 mm	.02? mm	.03? mm
	2	.04	.07	.07
	3	.08	.16	.12
	4	.13	.20	.18
	5	.18	.30	.23
	6	.30	.30	.25
Form ratio.....	1	.4	0.3	0.8
	2	.4	0.5	1.0
	3	.5	0.6	1.0
	4	.5	0.5	0.9
	5	.4	0.5	0.7
	6	.4	0.3	0.5
Tunnel angle.....	1	18°	16°	20°
	2	22	20	20
	3	22	20	25
	4	22	20	25
	5	22	..	..
	6	22	..	.
Wall thickness...	0	.005 mm	..	..
	1	.008	?	..
	2	.01	.01 mm	.01 mm
	3	.01	.01	.01
	4	.01	.02	.01
	5	.02	.03	.01
	6	.03	.03	.02

Discussion. This is larger than other described species of the genus and fully twice as large as most of them. *P. timanica* Rauser-Chernoussova (1951) is closely similar and may prove to be identical but the described specimens of that species have only rarely as much as 5 volutions and do not reach the size of our specimens.

P. propinqua var. *angulata* Rauser-Chernoussova (1948) is only about half as large as our species and is more convex in the umbilical

region. *P. propinqua* VISSARIONOVA is a smaller and much more thickly lenticular form.

Occurrence. This species has been found in only one collection, B 117_1, in the basal part of the Lower Marine group in Holm Land. Here it occurs in great numbers in a reddish argillaceous limestone and is associated with *P. nielseni* n. sp., *Pseudostaffella greenlandica* and *P. pseudosphaeroidea*. *Paraeofusulina trianguliformis* occurs both above and below it.

Parastaffella nielseni n. sp.

Pl. 3, figs. 7a—c.

Material studied. Three good axial sections and several oblique or excentric sections, all from collection B-117, in Holm Land.

Description. A small lenticular species of 4 to 5 volutions attaining an equatorial diameter of about 1.0 mm and a maximum width of about 0.4 mm. The proloculus is minute (about 10 microns in outside

Measurements of specimens of *Parastaffella nielseni* shown on Plate 3.

	Volution	Fig. 7A	Fig. 7B
Radius vector....	0	.02 mm	.06 mm
	1	.05	.05
	2	.11	.12
	3	.20	.25
	4	.30	.40
	5	.60	..
Half length.....	1	.02 mm	.04 mm
	2	.03	.05
	3	.04	.07
	4	.07	.12
	5	.15	..
Form ratio.....	1	.4	.8
	2	.3	.4
	3	.2	.3
	4	.2	.3
	5	.4	..
Tunnel angle.....	1	18°	20°
	2	20	22
	3	20	24
	4	20	..
	5	..	..
Wall thickness...	0	.005 mm	.005 mm
	1	.01	.005
	2	.01	.008
	3	.01	.01
	2	.02	.02
	5	.02	..

diameter), and the shell is plainspiral throughout and completely involute, the poles being dimpled but not umbilicate. The form ratio changes but little during growth, the width being about .4 of the equatorial diameter. The first 3 whorls are nautiliform with evenly rounded periphery, but the fourth volution becomes acutely angular. The wall structure is not clearly revealed in the specimens studied. The septa are plane. The tunnel is well defined by the chomata which are highest at the admedian margin and extend far down the sides of the whorl almost to the poles.

Discussion. This species is associated with the much more abundant shells of *P. holmensis* from which it differs in being much smaller and only about half as wide in corresponding volutions. It more closely resembles *P. composita* Doutkevitch (1951) which has about the same size and proportions but is conspicuously umbilicate, its last two volutions failing to cover the preceding whorls at the poles. *P. poststruvei* Rauser-Chernoussova (1951) is similar but develops an acutely angular periphery earlier in its ontogeny and is not fully involute in the last volution.

Occurrence. All our specimens are from a single collection, B-171$_1$, near the base of the Lower Marine group of Holm Land, where it is associated with *P. holmensis*.

Profusulinella Rauser-Chernoussova and Beljaev, 1936.

Profusulinella Rauser-Chernoussova and Beljaev, 1936, Akad. Nauk S.S.S.R., Poliarnaia Kommissia, Trudy, fasc. 28, 175 p.

Generotype. *Profusulinella pararhomboides* Rauser-Chernoussova and Beljaev, 1936, ibid.

Diagnosis. Shells small, fusiform; spiral wall of three layers, tectum and tectoria; septa only slightly folded; chomata rather massive but generally narrow. Microspheric individuals have an endothyroid juvenarium commonly coiled at a high angle to the axis of later whorls.

Discussion. This genus resembles *Fusulinella* but is structually more primitive in having a three-layered wall. It includes numerous species, all of very small size, and is characteristic of Lower Moscovian beds in the U.S.S.R. and of Atokan and Lower Desmoinesian formations in the U.S.A. In shape the species range from those with sharply pointed poles to others that are subelliptical in axial profile.

Fusiella, *Schubertella*, *Eoschubertella* and *Taitzehoella* are somewhat similar but are notably smaller and have even thinner walls in which only one or two layers can be detected.

Profusulinella priscoidea RAUSER-CHERNOUSSOVA.

Pl. 3, figs. 8—12.

Profusulinella priscoidea RAUSER-CHERNOUSSOVA, 1938, U.S.S.R. Akad. Nauk, Geol. Inst. Trudy, v. 7, p. 102, 154, pl. 2, figs. 1—3.

Material studied. Thirty-seven thin sections from collections B-116, B-117$_2$, B-146, and C-121 on Holm Land and collection M-115 on Amdrup Land.

Description. This small obese species has an endothyroid juvenarium of about 2 volutions followed by about 6 planispiral whorls and

Measurements of specimens of *Profusulinella priscoidea* shown on Plate 3.

	Volution	Fig. 10	Fig. 11	Fig. 9
Radius vector....	0	.02 mm	.03 mm	.04 mm
	1	.03	.04	.07
	2	.07	.07	.11
	3	.12	.13	.15
	4	.20	.22	.25
	5	.34	.35	.40
	6	.50	.51	.51
	7	.70	..	.70
Half length.....	1	.05 mm	.07 mm	.06 mm
	2	.09	.10	.11
	3	.18	.15	.19
	4	.30	.30	.35
	5	.45	.51	.70
	6	.67	.82	.85
	7	.90	..	1.00
Form ratio.....	1	1.7	1.7	.9
	2	1 3	1.4	1.0
	3	1.5	1.2	1.3
	4	1.5	1.4	1.4
	5	1.3	1.5	1.8
	6	1.3	1.6	1.7
	7	1.3	..	1.4
Tunnel angle.....	1	20°	15°	30°
	2	20	20	30
	3	25	20	30
	4	25	25	28
	5	27	30	24
	6	35	..	22
	7	..	..	..
Wall thickness...	0	.01 mm	.01 mm	.01 mm
	1	.01	.01	.01
	2	.02	.01	.02
	3	.02	.02	.02
	4	.03	.03	.03
	5	.02	.04	.02
	6	.03	.04	.03
	7	.03	..	.03

reaches a length of 2.0 mm and a diameter of 1.4 mm. The juvenarium is askew; succeeding whorls are rather loosely coiled; the lateral slopes are convex and the poles are bluntly rounded.

The proloculus is only about 20 microns in outside diameter and the spiral wall is very thin, increasing gradually from a thickness of 10 microns in the first whorl to about 30 microns in the seventh volution. It consists of three well differentiated layers. The tunnel is narrow and is bounded by rather prominent but narrow chomata. The septa are thin and are planar except for very slight irregular folds near the poles in the outer volutions. Secondary deposits commonly thicken the edges of the septa around the tunnel but are lacking elsewhere.

Discussion. Our specimens from northeast Greenland compare closely in size, shape, and internal features with the type specimens which are from zone C_2^2 of the Moscovian Series at the Samara Bend of the Volga River, U.S.S.R. (RAUSER-CHERNOUSSOVA, 1938, p. 102, pl. 2, figs. 1—3), but are very slightly smaller in corresponding volutions. *P. ovata* RAUSER-CHERNOUSSOVA (1938) from the same zone at the Samara Bend is smaller and less obese. *Profusulinella decora* THOMPSON from the Muddy Springs group in the Hueco Mountains, west Texas, is closely similar but somewhat more elongate at all stages of growth.

Occurrence. Our specimens are all from the lowest unit of the Lower Marine group where they are associated with *Paraeofusulina triangulifórmis*, *Pseudostaffella greenlandica* and *Fusulinella eopulchra*.

Profusulinella cf. *P. regia* THOMPSON.

Pl. 3, figs. 13—16.

Profusulinella regia THOMPSON, 1948, Kansas Univ., Paleont. Contr., Protozoa, art. 1, p. 83, pl. 1, fig. 1, pl. 27, figs. 7, 8, pl. 30, figs. 8—19.

Material studied. Fourteen thin sections from collections B-130, A-117, Holm Land, and L-30, Amdrup Land, lower part of the Lower Marine Group; early Moscovian (early Desmoinesian), Middle Carboniferous (Pennsylvanian).

Description. This small subglobose species is loosely coiled and commonly reaches a length of 2.4 mm and a diameter of 1.8 mm in 7 volutions.

The proloculus is of medium size (about 60 microns in outside diameter), and the first volution is spheroidal with umbilicate poles. Later volutions are high and become more elongate, reaching a form ratio of 1.6 in the third or fourth volution. The poles are broadly rounded and the outline of the test in thin section is elliptical (Pl. 3, figs. 14, 15).

The wall is composed of three layers and is thin, commonly reaching only 20 microns in thickness in the sixth volution, but it may reach 40 microns in some specimens.

The septa are nearly planar across the entire front of the chambers, but in places are gently folded in the polar extremities.

The wide tunnel is well defined by low asymmetrical chomata which reach to one-half chamber height and extend as far as the last half of the terminal volution (Pl. 3, fig. 14). Axial deposists and other secondary deposits are lacking.

Measurements of specimens of *Profusulinella* cf. *P. regia* shown in Plate 3.

	Volution	Fig. 14	Fig. 15
Radius vector....	0	.03 mm	.05 mm
	1	.06	.08
	2	.11	.14
	3	.20	.21
	4	.35	.34
	5	.48	.49
	6	.70	.70
	7	..	.90?
Half length.....	1	.05 mm	.09 mm
	2	.17	.15
	3	.32	.30
	4	.55	.55
	5	.85	.80
	6	1.20	1.10
	7	..	1.15
Form ratio.....	1	.8	1.1
	2	1.5	1.1
	3	1.6	1.4
	4	1.6	1.6
	5	1.8	1.6
	6	1.7	1.6
	7	..	1.3?
Tunnel angle.....	1	30°	25°
	2	30	26
	3	35	32
	4	40	40
	5	..	40
	6	..	..
	7	..	..
Wall thickness...	0	.01 mm	.02 mm
	1	.02	.02
	2	.02	.02
	3	.02	.03
	4	.03	.04
	5	.02	.04
	6	.02	.04
	7	..	.04

Discussion. Figure 15 of plate 3 indicates the planeness of the septa normal to this species. In figure 16 and in the last half volution of figure 14 septa cross the slice repeatedly chiefly because their course is not strictly meridional. These are mostly not septal loops due to folding though there is a variable amount of folding near the poles of the outer whorls.

It is surprising to find a western American species in a faunal assemblage in Greenland that is closely allied to that of the Moscow Basin and is otherwise quite distinct from that of the interior of North America, and we suspect that the form in Greenland may be a homeomorph of *P. regia*. If there is any difference it appears to be that the spiral wall in the Greenland shells is slightly thicker than in those figured by THOMPSON.

This species is very close to *P. decora* THOMPSON in size, shape, and development of internal features. Some of the figured specimens of *P. decora* have an endothyroid juvenarium and none such have been found in *P. regia*, but microspheric shells of this sort are to be expected in any fusuline species.

P. ovata RAUSER-CHERNOUSSOVA (1938) and *P. subovata* SAFONOVA (1951), both from lower Moscovian beds in the Moscow Basin are smaller in corresponding volutions than *P. regia*.

Occurrence. This species occurs in the middle part of the Lower Marine group in northeast Greenland (collections B-130 and A-117 in Holm Land and L-30 in Amdrup Land). The types of *P. regia* were from upper part of the Green Canyon group (Atokan Series) in the Hueco Mountains of West Texas. The most closely similar species in the Moscow Basin occur in the lower and middle Moscovian.

Fusulinella MÖLLER, 1877.

Fusulinella MÖLLER, 1877, Neues Jahrbuch, p. 144; 1878, Acad. Imp. Sci. St. Petersbourg, Mem., Ser. 7, v. 25, No. 9, p. 101—104.

Generotype. *Fusulinella bocki* MÖLLER, 1878.

Diagnosis. Shells small, fusiform; spiral wall of four layers, tectum, diaphanotheca, and inner and outer tectoria; septa nearly plane across the middle of the shell but gently and somewhat irregularly folded in the polar regions; tunnel narrow; chomata massive and high; microspheric shells with an endothyroid juvenarium coiled oblique to the axis of later whorls; megalospheric shells planispiral throughout.

Discussion. In his original diagnosis of this genus in 1877, MÖLLER stated that he knew only a single species, which was not mentioned by name. In 1878 he discussed the genus more fully and described the type

species, *F. bocki*. At this time MÖLLER seems to have mistaken the diaphanotheca for an open space between the tectum and the inner tectorium since he referred to it as a "Zwischenraum".

Fusulinella resembles *Fusulina* in having a four-layered wall but is generally smaller and more thickly fusiform; it is undoubtedly ancestral to *Fusulina* which is distinguished by more intense septal folding and is normally of larger size. *Fusulinella* is characteristic of the lower part of the Moscovian in the U.S.S.R. and the lower part of the Desmoinesian Series in the U.S.A. and has not been recorded in higher Pennsylvanian rocks.

Pseudofusulinella THOMPSON (1951) of the early Permian of western North America and the Orient very closely resembles *Fusulinella* in all respects except the structure of its spiral wall which includes only two layers. It is probably a direct descendent of *Fusulinella* and has specialized in the reduction and loss of tectoria. Secondary deposits on the contrary, take the form of slight axial filling in some of the chambers.

Profusulinella RAUSER-CHERNOUSSOVA and BELJAEV (1936) also closely resembles *Fusulinella* but differs in having a three-layered spiral wall consisting of tectum and inner and outer tectoria. It normally occurs lower in the section than *Fusulinella*.

It appears probable that *Profusulinella*, *Fusulinella*, and *Pseudofusulinella* form a lineal genetic series; in the first, the wall consists of tectum and tectoria; in the second a diaphanotheca is clearly differentiated and the wall consists of four layers; in the last the tectoria have disappeared and the wall consists of only two layers, tectum and diaphanotheca.

Fusulinella eopulchra RAUSER-CHERNOUSSOVA.

Pl. 4, figs. 1—5.

Fusulinella eopulchra RAUSER-CHERNOUSSOVA, 1951, Middle Carboniferous fusulinids of the Russian Platform and adjacent Regions: Handbook and guide. U.S.S.R. Akad. Nauk., Inst. Geol. Nauk., Minist. Petrol. Prosp. p. 235, pl. 35, figs. 5—8.

Material studied. Five thin sections from collections O-116, three thin sections from B-130, four thin sections from B-116, lower part of the Lower Marine group, Holm Land; and sixteen thin sections from collection F_1-238b, middle part of the Lower Marine group.

Description. A small species attaining a length of about 3 mm and a diameter of 1.8, and consisting of about 6 volutions. It is obese in the middle, its lateral slopes gently concave, and its polar extremities subacutely rounded.

All studied specimens are megalospheric and planispiral throughout. The proloculi range from 100 to 160 microns in diameter. The first volution is very low but the whorls expand gradually to maturity.

The spiral wall includes four layers, a tectum, a thin diaphanotheca, a well developed outer tectorium and a sporadically developed inner tectorium. The septa are plane except in the polar extremities where they are irregularly folded.

The tunnel is of moderate width (tunnel angle about 20°) and is bordered by massive, nearly symmetrical chomata which are about half as high as the volution. Secondary deposits heavily coat the septa near the tunnel and may line some of the chambers in the axial zone.

Measurements of specimens of *Fusulinella eopulchra* shown on Plate 4.

	Volution	Fig. 2	Fig. 3	Fig. 5
Radius vector....	0	.08 mm	.05 mm	.06 mm
	1	.14	.10	.10
	2	.23	.19	.18
	3	.35	.30	.31
	4	.50	.44	.48
	5	.72	.62	.70
	6	.91	.82	.
Half length.....	1	.20 mm	.18 mm	.15 mm
	2	.27	.38	.35
	3	.55	.60	.60
	4	.90	.80	.80
	5	1.15	.95	1,20
	6	1.55	1.25?	..
Form ratio.....	1	1.4	1.8	1.5
	2	1.2	2.0	1.9
	3	1.6	2.0	2.0
	4	1.8	1.8	1.7
	5	2.2	1.5	1.7
	6	1.7	1.5	.
Tunnel angle.....	1	20°	20°	20°
	2	20	20	20
	3	20	25	20
	4	20	30	25
	5	30	25	..
Wall thickness...	0	.01 mm	.01 mm	.01 mm
	1	.02	.02	.03
	3	.05	.03	.04
	4	.02	.03	.04
	5	.05	.03	.03
	6	.02	.03	..

Discussion. This species is smaller and shorter than *F. pulchra* Rauser-Chernoussova and Beljaev (1938). Its pointed poles, high chambers, nearly flat septa, strong chomata, and shape separate it from other described species.

Occurrence. This species occurs in the lower part of the Lower Marine group in northeast Greenland where it is associated with *Profusulinella priscoidea*, and *P.* cf. *regia*, and in the middle part where it is associated with *Pseudostaffella sphaeroidea*. In the Moscow Basin it occurs in the Mjatchkovian Stage of the Moscovian.

Fusulina FISCHER, 1829.

Fusulina paradistenta SAFONOVA.

Pl. 4, figs. 13—17.

Fusulina paradistenta SAFONOVA, in RAUSER-CHERNOUSSOVA, et al., 1951, Middle Carboniferous fusulinids of the Russian Platform and adjacent regions: Handbook and guide; U.S.S.R. Akad. Nauk., Inst. Geol. Sci., Minist. Petrol. Prosp., p. 291, pl. 48, figs. 3—4.

Material studied. Five thin sections from collections A-126 and N-132, Mallemukfjæld, Holm Land.

Description. This robust species commonly reaches a length of 4 to 5 mm and a diameter of 3 mm in eight volutions. The subacute poles and globose mid portion of the test are noteworthy.

The proloculus is large (up to 180 microns), and the first 2 or 3 volutions are low. Succeeding volutions gradually increase in height so that in the eighth volution the chambers are 0.3 mm high. The obese central portion of the shell narrows abruptly to the subangular poles leaving the lateral slopes slightly concave.

The wall is composed of four distinct layers. The tectum and diaphanotheca are thin and they separate the two thick, dark tectorial layers. The wall increases only slightly in thickness in succeeding volutions. The tectoria, however, thin markedly toward the poles.

The septa are fluted into high regular folds across the entire chamber.

The tunnel is narrow and of nearly constant width throughout the test (tunnel angle 15°—20°), and may deviate irregularly out of the mid plane of the test (Pl. 4, fig. 16). High symmetrical chomata border the tunnel in all but the last volution. They commonly are two thirds the height of the chambers. Locally secondary deposits coat the septa, making them appear massive.

Discussion. Specimens of *Fusulina paradistenta* from northeast Greenland compare closely with the type specimens described by SAFONOVA (1951) from the upper Moscovian of Timan. *F. paradistenta* differs from *F. girtyi* (DUNBAR and CONDRA) and *F. tumidus* ALEXANDER in having less folded septa, lesser secondary deposits, fewer volutions, and smaller size. *F. curta* THOMPSON, from Utah, is closely similar to *F. paradistenta* but is slightly more globose.

Measurements of specimens of *Fusulina paradistensa* shown on Plate 4.

	Volution	Fig. 15	Fig. 16
Radius vector....	0	.09 mm	.09 mm
	1	.16	.16
	2	.25	.25
	3	.37	.36
	4	.51	.55
	5	.70	.72
	6	.95	.95
	7	1.20	1.20
	8	1.50	..
Half length.....	1	.35 mm	.27 mm
	2	.51	.50
	3	.70	.60
	4	.95	.85
	5	1.20	1.05
	6	1.51	1.50
	7	2.00	1.80
	8	2.50?	..
Form ratio.....	1	2.2	1.7
	2	2.0	2.0
	3	1.9	1.7
	4	1.9	1.5
	5	1.7	1.5
	6	1.6	1.6
	7	1.7	1.5
	8	1.7	..
Tunnel angle.....	1	20°	15°
	2	20	15
	3	18	15
	4	18	15
	5	18	17
	6	18	17
	7	17	..
Wall thickness...	0	.01 mm	.02 mm
	1	.01	.03
	2	.02	.03
	3	.02	.03
	4	.03	.03
	5	.03	.03
	6	.03	.03
	7	.06	.02
	8	.04?	..

Occurrence. In both collections A-126 and N-132 this species is associated with *Pseudostaffella sphaeroidea*, *P. greenlandica* and abundant *Wedekindellina doutkevichi* in the upper part of the Lower Marine group.

The species was described from the upper part of the Moscovian Series Padolsk and Mjachkova Stages in the Timan Uplands and other localities on the Russian Platform.

Fusulina sp. A.

Pl. 3, fig. 17.

Material studied. Six thin sections from collection A-117, near the middle of the Lower Marine group, Holm Land; and in pebbles in collection F_2-148 from the lower part of the Upper Marine group, Amdrup Land.

Description. Small fusiform tests of this species have six volutions and commonly reach 3 mm in length and 1.1 mm in diameter.

The proloculus is small (100 microns in outside diameter), and the early volutions are low and elongate. Succeeding volutions gradually increase in height and length to reach a form ratio of 2.5 mm in the sixth volution. The poles are subacute and the test is fusiform throughout (Pl. 3, fig. 17).

The wall is composed of a tectum, diaphanotheca, and inner and outer tectoria. The wall thickens from 10 microns in the proloculus to 30 microns in the fifth volution.

The septa display high regular folds across the entire front of the chambers.

The tunnel is of medium width (tunnel angle about 25°), and follows a straight path in the mid plane of the test. High, symmetrical chomata which border the tunnel reach to one-half the height of the chambers between septa. Axial deposits are lacking (Pl 3, fig. 17).

Measurements of the specimens of *Fusulina* sp. A. shown as figure 17 on Plate 3.

Volution	Radius vector	Half length	Form ratio	Tunnel angle	Wall thickness
0	.05 mm	. .	. .	. .	.01 mm
1	.08	.15 mm	1.9	25°	.02
2	.15	.35	2.3	25	.03
3	.26	.55	2.1	25	.03
4	.42	1.05	2.5	25	.03
5	.55	1.50	2.7	.	.03

Remarks. *Fusulina* sp. A. is similar to a number of Desmoinesian and Moscovian species from North America and eastern Asia. It has nearly the same size and shape per volution as the Desmoinesian species *Fusulina leei* SKINNER (1931) from Oklahoma, Iowa (THOMPSON, 1934) and Illinois (DUNBAE and HENBEST, 1942). *F. weintzi* VERVILLE, THOMPSON, and LOKKE (1956) is larger and lacks the massive chomata which

are distinctive of *Fusulina* sp. A. *F. rockymontana* ROTH and SKINNER, McCOY formation of Colorado, is perhaps the most similar described species in having strong chomata, strongly folded septa, and similar size per volution comparable to those features of *Fusulina* sp. A.

Wedekindellina DUNBAR and HENBEST, 1930.

Wedekindella DUNBAR and HENBEST, 1930, Amer. Jour. Sci., v. 20, p. 362.
— 1933, Cushman Lab. Foraminiferal Research, Special Publ. No. 4, p. 134.

Generotype. *Fusulinella euthysepta* (HENBEST), 1928.

Diagnosis. Shells small and very slender, tapering to acute poles; volutions numbering about 8 to 10, low and closely coiled; spiral wall consisting of four layers as in *Fusulinella*; septa numerous and almost plane except for gentle and irregular folds near the ends of the outer whorls; tunnel narrow; chomata well developed but slender; axial filling massive in the end zones of all but the last one or two volutions.

Discussion. *Waeringella* THOMPSON (1942), resembles *Wedekindellina* in size and shape but has rather conspicuous septal folds and lacks appreciable axial filling. *Wedekindellina* is widespread in the middle part of the Desmoinesian Series and *Waeringella* occurs much higher, in the upper part of the Pennsylvanian System. *Waeringella* is probably a specialized descendant of *Wedekindellina*.

Wedekindellina dutkevichi RAUSER-CHERNOUSSOVA and BELJAEV

Pl. 4, figs. 6—12.

Wedekindellina dutkevichi RAUSER-CHERNOUSSOVA and BELJAEV, 1936, Akad. Nauk., S.S.S.R., Poliarnaia Komissa, fasc. 28, p. 183, 185.

RAUSER-CHERNOUSSOVA, BELJAEV, and REITLINGER, 1940, Neftianyi geologo-razvedochnyi Institut, Trudy, fasc. 7, p. 21, 72.

RAUSER-CHERNOUSSOVA, et al., 1951, Srednekamennougolnye fuzulinidy russkoi platformy i sopredelnykh oblastei. Spravochnik-opredelitel, Akad. Nauk., S.S.S.R., p. 239, pl. 36, figs. 8, 9.

? *Wedekindella* sp. FORBES, 1960, Paleontology, v. 2, Pt. 2, p. 215, pl. 30, figs. 14, 15.

Material studied. Many thin sections from collections A-324, A-126, N-130, N-132, upper part of the Lower Marine group, Holm Land and in collection F_2-148, a cobble from the lower part of the Upper Marine group, Amdrup Land.

Description. This small, elongate species commonly reaches 3.6 mm in length and 0.8 mm in diameter in six to seven volutions. The size, fusiform shape of the test, and small asymmetrical chomata are characteristic features.

The proloculus is small (about 100 microns in outside diameter), and the volutions are low throughout the test. The chambers are elongate

Measurements of specimens of *Wedekindellina dutkevichi* shown on Plate 4.

	Volution	Fig. 8	Fig. 7	Fig. 11
Radius vector....	0	.05 mm	.05 mm	.05 mm
	1	.09	.07	.07
	2	.12	.11	.11
	3	.18	.17	.18
	4	.24	.24	.25
	5	.30	.34	.34
	6	.40	..	.45
	7	..	..	.60
Half length.....	1	.25 mm	.25 mm	.20 mm
	2	.55	.40	.30
	3	.90	.55	.45
	4	1.20	.85	.60
	5	1.35	1.70	1.20
	6	1.82	..	1.60
	7	..	..	..
Form ratio.....	1	2.8	3.6	2.9
	2	4.6	3.6	2.8
	3	5.0	3.2	2.5
	4	5.0	3.6	2.4
	5	4.5	5.0	3.5
	6	4.6	..	3.5
	7	..	..	..
Tunnel angle.....	1	25°	30°	25°
	2	25	30	25
	3	20	30	25
	4	25	30	30
	5	40	30	25
	6	..	..	30
Wall thickness...	0	.01 mm	.02 mm	.01 mm
	1	.01	.02	.01
	2	.01	.02	.01
	3	.02	.02	.01
	4	.03	.01	.01
	5	.02	.02	.02
	6	..	..	.02
	7	..	..	.02

and the form ratio commonly increases from about 3.0 in the first volution to 4 or 5 in the fifth or sixth volution. The test is fusiform in early volutions and becomes subcylindrical in later volutions. The poles are subacute.

The thin wall is composed of a tectum and a diaphanotheca over the tunnel near the mid plane of the test, but towards the poles an outer tectorium is common and an inner tectorium is sporadically distributed.

The septa are planar across the chambers except for minor undulations at the polar extremities. Heavy, dark secondary coatings on the septa give them a dense appearance in thin sections.

The tunnel angle gradually increases from about 25 degrees in the first volution to 30 or 40 degrees in the fifth volution. Low asymmetrical chomata border the tunnel in all but the last volution. Secondary deposits heavily coat the septa throughout the test and fill the axial region of early volutions.

Discussion. As noted by RAUSER-CHERNOUSSOVA, BELJAEV, and REITLINGER (1940), this species is more slender and elongate than others known from the U.S.S.R. but it may prove to be identical with *W. uralica* var. *longa* DOUTKEVITCH which was described from the western flank of the Urals. The latter was not adequately described and figured, but appears not to be so elongate and not to have such massive axial deposits. *W. dutkevichi* resembles *W. euthysepta* HENBEST and *W. henbesti* SKINNER but is more slender and has a wider tunnel and more massive axial deposite than either.

Occurrence. This species was described from the upper part of the Moscovian Stage in the region of the Samara Bend of the Volga River. In northeast Greenland it is common in the upper part of the Lower Marine group (Collections A-124, A-126, N-130, N-132) in Holm Land. In Amdrup Land it was found only in a boulder (Collection F_2-148_a) embedded in the lower part of the Upper Marine group and its associated fauna clearly proves that the boulder was derived from the underlying Lower Marine group.

Taitzehoella SHENG, 1951.

Taitzehoella SHENG, 1951, Geol. Soc. China, Bull. v. 31, p. 79—83; 1958, Palaeontologia Sinica, Whole Number 143, N. ser. B, No. 7, p. 25—26, 83—84.

Generotype. *Taitzehoella taitzehoensis* SHENG, 1951.

Diagnosis. Shells minute, thickly fusiform with concave lateral slopes and acutely pointed poles, having an endothyroid juvenarium of about two volutions followed by several fusiform whorls. Spirotheca very thin, composed of two layers, a tectum and a more transluscent inner layer (diaphanotheca). Septa plane except for slight twisting near the poles in the outer volutions. Tunnel narrow. Chomata massive but narrow. Axial filling very weak or absent.

Discussion. This genus resembles *Profusulinella* in shape but is generally smaller and has concave instead of convex lateral slopes, and more acute poles; it differs also in having a two-layered wall, lacking

tectoria. Two species are known from the Penchi Series (Moscovian) of Sheng King Province in southern Manchuria, and one from the upper part af the Moscovian Stage in the Chussovaya River valley in the western slope of the Urals. Our collections extend the range of the latter species into northeast Greenland.

Taitzehoella librovitchi (DOUTKEVITCH).

Pl. 5, figs. 1—7.

Fusulinella librovitchi DOUTKEVITCH, 1934, Petrol. Geol. Prosp. Inst. Trudy, Ser. A, v. 36, p. 43, 81, pl. 5, figs. 1—5;

— GORSKY, et al., 1939, Central Geol. Prosp. Inst., v. 5, p. 36, pl. 2, figs. 1—3.

Material studied. Six axial and one tangential section from collections N-130 and A-126 in Holm Land and many from a pebble (collection F_2-138b) in the lower part of the Upper Marine group of Amdrup Land.

Description. A minute species having an endothyroid juvenarium followed by about 6 fusiform volutions, attaining a length of about 2.0 mm and an equatorial diameter of about 1.0 mm. The middle of the shell is obese, the lateral slopes somewhat concave and the polar extremities acutely pointed.

The proloculus is only about 40 microns in outside diameter and the juvenarium, consisting of 1 to 2 volutions of bead-like chambers, is coiled askew to the axis of later whorls. Following the first or second fusiform volution the shell assumes a form ratio of about 2 which is maintained with little change to maturity.

The spiral wall is very thin, reaching a thickness of about 50 microns in the last volution, and is composed of only 2 layers, a tectum and an inner layer, without tectoria.

Septa are thin and plane except for irregular folds near the ends of the outer volutions. The tunnel maintains a nearly constant tunnel angle of about 20°, and is bounded by high but narrow and nearly symmetrical chomata. The tunnel normally is about half as high as the whorl.

Discussion. Our specimens agree very closely with the type of *T. librovitchi* DOUTKEVITCH and with specimens figured by SHENG (1951) from southern Manchuria.

Occurrence. The species was described from the Moscovian (zone C_2^2) in the western slope of the Urals and the Manchurian occurrence is in the same zone. Our specimens, from collections N-130 and A-126 are in the upper zone of the Lower Marine group of Holm Land where they are associated with *Pseudostaffella sphaeroidea*, *Wedekindellina doutkevichi*, and *Fusulina paradistensa*.

Measurements of specimens of *Taitzehoella librovitchi* shown on Plate 5.

	Volution	Fig. 2	Fig. 6	Fig. 7
Radius vector....	0	.02 mm	.02 mm	.03 mm
	1	.03	.04	.04
	2	.06	.06	.05
	3	.10	.09	.10
	4	.15	.15	.16
	5	.25	.24	.24
	6	.34	.44	.47
	7	.48	..	..
Half length.....	1	.05 mm	.04 mm	.04 mm
	2	.07	.05	.05
	3	.16	.15	.10
	4	.26	.30	.20
	5	.40	.45	.35
	6	.70	.80	.60
	7	1.00	..	.75
Form ratio.....	1	1.6	1.0	1.0
	2	1.1	1.2	1.0
	3	1.7	1.7	1.0
	4	1.7	2.0	1.2
	5	1.7	1.9	1.5
	6	2.1	1.8	1.6
	7	2.1	..	..
Tunnel angle.....	1	20°	25°	25°
	2	20	25	30
	3	22	30	30
	4	22	30	25
	5	22	20	25
	6	22	20	30
	7	..	..	..
Wall thickness...	0	.01 mm	.008 mm	.01 mm
	1	.01	.01	.01
	2	.01	.01	.01
	3	.01	.02	.02
	4	.02	.01	.02
	5	.03	.02	.02
	6	.03	.02	.03
	7	.05	.03	.03

Eofusulina *(Paraeofusulina)* PUTRJA, 1956.

Eofusulina (Paraeofusulina) PUTRJA, 1956, Mikrofauna S.S.S.R., Sbornik 8, Trudy Neft. Nauchno-Issled. Geol.-Razved. Instituta, N.S., v. 98, p. 458.

Subgenerotype. *P. trianguliformis* PUTRJA, 1956.

Diagnosis. Shell small and slender, tapering to acute poles; volutions few; spiral wall very thin, comprised of tectum and a single

more transluscent layer that appears to be homologous with the diaphanotheca of *Fusulina*; septa strongly folded from end to end, even in the early volutions; tunnel low; chomata limited to the first one or two volutions where they are slender and low.

Discussion. In size and shape this genus resembles *Wedekindellina* from which it is readily distinguished, however, in axial section by its septal folding, its simpler wall, and the lack of chomata and axial filling.

In 1956 PUTRJA subdivided *Eofusulina* into two subgenera, *Eofusulina* (*Eofusulina*) and *Eofusulina* (*Paraeofusulina*). The types of the former have a relatively very large proloculus, consist of only about 3 volutions, have intense septal folding even in the first volution, and lack axial deposits; the types of the second have about 5 volutions, have smaller proloculi, have slight septal folding in the first two volutions and have conspicuous axial filling.

Verella DALMATSKAIA (1951) was distinguished from *Eofusulina* (lata) on the basis that its septa are nearly plane in all but the outer whorl and that it has considerable axial filling. It appears to be very similar to *Paraeofusulina* but perhaps more primitive.

Paraeofusulina trianguliformis PUTRJA, 1956.

Pl. 5, figs. 8—12.

Eofusulina (Paraeofusulina) trianguliformis PUTRJA, 1956, *In* RAUSER-CHERNOUSSOVA, D.M. et al., Mikrofauna S.S.S.R., Sbornik 8, Trudy Neft. Nauchno-Issled. Geol.-Razved. Inst. n.s. v. 98, p. 458—459, pl. 15, figs. 7, 8.

COOGAN, A. H., 1958, Jour. Paleontology, v. 32, p. 307.

Material studied. Forty seven thin sections from collections B-122, B-123, B-126, B-146, and O-116 in Holm Land, and M-115, M-168 and No. 152 in Amdrup Land.

Description. A slender, elongate-fusiform species consisting of about 5 volutions and attaining a length of about 5 mm and an equatorial diameter of 1.0 to 1.2 mm. The polar extremities are neatly rounded. The proloculus is relatively large, ranging from 100 to 160 microns in outside diameter. The whorls are low and closely coiled and the wall is very thin, increasing gradually from a thickness of about 10 microns in the first volution to 30 microns in the fifth. It is composed of two layers, the tectum and an inner protheca (whose structure is not well preserved in our specimens).

The septa are nearly plane in the first volution but considerably folded in the second and strongly folded from end to end in later whorls so that high septal loops are conspicuous in axial sections. The tunnel is rather wide and low, the tunnel angle ranging commonly up to 40° and rarely up to 60° or more. Rudimentary chomata are present on the

Measurements of specimens of *Paraeofusulina trianguliformis* shown on Plate 5.

	Volution	Fig. 10	Fig. 9	Fig. 11	Fig. 12
Radius vector....	0	.08 mm	.08 mm	.06 mm	.05 mm
	1	.12	.10	.09	.08
	2	.15	.17	.19	.13
	3	.35	.30	.25	.20
	4	.52	.50	.43	.35
	5	..	..	.60	.55
Half length.....	1	.15 mm	.30 mm	.12 mm	.35 mm
	2	.80	.75	.45	.80
	3	1.90	1.40	1.10	1.65
	4	2.40	2.40	1.90	2.20
	5	..	..	2.45	3.0
Form ratio.....	1	1.2	3.0	1.3	4.4
	2	5.3	4.4	2.4	6.1
	3	5.5	4.7	4.4	8.3
	4	4.6	4.8	4.4	6.3
	5	..	..	4.1	5.5
Tunnel angle.....	1	70°	20°	30°	20°
	2	55	40	40	26
	3	60	40	40	40
	4	..	..	45	40
	5	..	..	..	..
Wall thickness ...	0	.01 mm	.01 mm	.01 mm	.01 mm
	1	.01	.01	.01	.01
	2	.02	.01	.01	.01
	3	.02	.02	.02	.02
	4	.03	.02	.02	.02
	5	..	..	.03	.03

outside of the proloculus and may be present in the first and second volution but are lacking in later whorls. Secondary deposits commonly coat the septa, and may largely fill the chambers in the end zones of the inner whorls.

Discussion. Our specimens agree very closely with the types of the species and are unlike any other described fusulines. The slender shape, very thin wall, intensely folded septa, and conspicuous axial filling are distinctive.

Eofusulina triangularis Rauser-Chernoussova, Beljaev, and Reitlinger (1936) has fewer volutions, is more convex at the middle and more pointed at the poles, and lacks axial filling.

Occurrence. The types of this species are from the upper part of the Moscovian Series in the Donetz Basin, U.S.S.R. In northeast Green-

land the species is common in the lower third of the Lower Marine group of both Holm Land and Amdrup Land where it is associated with *Pseudostaffella greenlandica* and *Profusulinella priscoidea.*

Pseudofusulina DUNBAR and SKINNER.

Pseudofusulina DUNBAR and SKINNER, 1931, New fusulinid genera from the Permian of West Texas, Am. Jour. Sci., v. 22, p. 252—258.

Generotype. *Pseudofusulina huecoensis* DUNBAR and SKINNER, 1931.

Diagnosis. Elongate fusiform to subcylindrical species in which the volutions expand gradually. Spiral wall composed of tectum and a relatively thick, coarsely alveolar keriotheca. The septa are strongly folded throughout and the tips of opposed folds in adjacent septa commonly meet. The tunnel is low and commonly broad. Slender chomata appear in the early whorls of primitive species but are discontinuous or lacking in the later volutions and may be virtually lacking even in the earliest whorls in advanced species.

Discussion. Elongate shells of this type form a large complex of species showing virtually all gradations from the obese and subglobular form of *Schwagerina*, through more elongate fusiform shells to those that are subcylindrical. Although the generotypes of *Schwagerina* and *Pseudofusulina* differ greatly, no satisfactory basis is yet known for placing some of the intermediate species. In general the septal folding is somewhat less intense and more irregular in *Pseudofusulina* and the spiral wall is somewhat thicker. The volutions are also more loosely coiled in some, but not in all, species of *Pseudofusulina.* Some species of this genus possess a very thin false wall (phrenotheca) separating the outer and inner portions of each volution and suggesting that the shell at maturity was only partly filled with protoplasm.

The pseudofusulines rather obviously developed out of *Triticites* about the beginning of Permian time, and several of the early species are intermediate in structure having rather weaker and more irregular septal folds than is typical of *Pseudofusulina* and possessing distinct, though narrow, chomata in several of the inner whorls. For species in this stage of development ROZOVSKAYA (1949, 1952) proposed the genus *Daixina.* But since the evolution from *Triticites* to *Pseudofusulina* was progressive and gradual this genus can at best be distinguished on a rather arbitrary basis. Such species have commonly been referred by some students to *Triticites* and by others to *Pseudofusulina.*

Rugosofusulina is undoubtedly a specialized offshoot from *Pseudofusulina* from which it differs only in the crenation of its spiral wall. In the transitional species this feature appears irregularly in different

parts of the shell, the rest of the surface being normal, whereas in more specialized and younger species the crenation is general and conspicuous. Restudy of the type species of *Pseudofusulina* by SKINNER and WILDE and by the writers reveals that it shows crenation in places. Thus it is difficult at best to separate the two genera, and *Rugosofusulina* may best be regarded as a subgenus of *Pseudofusulina*.

Pseudofusulina (Daixina) amdrupensis ROSS and DUNBAR, n. sp.

Pl. 6, figs. 14—16.

Material studied. Seventeen axial sections from collection F_2-115 and No. 134, both at Kap Jungerson.

Description. A rather large, elongate-fusiform species with neatly to bluntly rounded poles, consisting of 4 to 5 loosely coiled volutions and attaining a length of about 9.5 mm and a thickness of 2.7 mm.

The proloculus is spheroidal and of medium size (180 to 240 microns in outside diameter). The first volution is low and short but succeeding whorls increase rather rapidly in height and in length until the form ratio reaches about 3.5 in the fifth. The spiral wall is thick, about 130 microns thick in the outer whorls, and consists of tectum and coarsely alveolar keriotheca. In axial sections the outline of the wall is uneven but is not crenate.

The septa show rather strong but irregular septal folds, but the ratio of the depth of the folds to the distance between septa is such that the opposed folds of adjacent septa do not meet across the middle of the shell and in axial sections septal loops may appear prominent or almost absent near the middle, depending on whether the slice is close to a septum or midway between septa. The tunnel is low and well defined, and very narrow chomata border the tunnel in the first 2 or 3 volutions but are discontinuous or obsolete in later whorls. Except for irregular local coating on the septa, secondary deposits are lacking.

Discussion. This species is similar to *Daixina ruzhencevi* and *D. sokensis* (RAUSER-CHERNOUSSOVA) but differs in having a more elongate test. *D. crispa* ROZOVSKAYA, *D. baituganensis* (RAUSER-CHERNOUSSOVA) and *D. magna* (ROZOVSKAYA) are smaller and have more tightly coiled shells. *D. privilegiata* ROZOVSKAYA has a smaller, more closely coiled shell and a larger form ratio.

Occurrence. This species is abundant in two collections from southeastern Amdrup Land (Collections No. 134 and F_2-115, both from Cape Jungerson). Collection F_2-115 is located about 300 feet above the base of Nielsen's Profile section F_2 and about the same distance above the base of the Upper Marine group. Collection No. 134 was not located in

Measurements of specimens of *Paixina amdrupensis* shown on Plate 6.

	Volution	Fig. 14	Fig. 16	Fig. 15
Radius vector....	0	.09 mm	.16 mm	.12 mm
	1	.19	.30	.20
	2	.35	.60	.41
	3	.65	1.00	.80
	4	1.10	1.50	1.05
	5	1.50?	..	1.35
Half length.....	1	.20 mm	.50 mm	.40 mm
	2	.70	1.90	.85
	3	1.75	3.30	1.90
	4	2.85	4.90	4.00
	5	3.90?	..	5.50?
Form ratio.....	1	1.1	1.7	2.0
	2	2.0	3.2	2.1
	3	2.7	3.3	2.4
	4	2.5	3.3	3.8
	5	2.6	..	4.0?
Tunnel angle.....	1	40°	35°	35°
	2	40	40	35
	3	45	55	35
	4	..	..	..
Wall thickness...	0	.02 mm	.03 mm	.03 mm
	1	.02	.03	.03
	2	.07	.04	.07
	3	.10	.12	.10
	4	.11	.12	.10
	5	.13	..	.12

the section but may have come from the same horizon. Although many sections were cut, no other fusuline species was found in either of these collections.

Species of this general stage of evolution, transitional from *Triticites* to *Pseudofusulina*, are found chiefly in the uppermost part of the Upper Carboniferous and especially in the basal part of the Permian.

Pseudofusulina (Rugosofusulina) RAUSER-CHERNOUSSOVA, 1937.

Rugosofusulina RAUSER-CHERNOUSSOVA, 1937, *Rugosofusulina*, a new genus of fusulinids. Studies in Micropaleontology. Moscow University, v. 1, fasc. 1, p. 9—26.

Generotype. *Fusulina prisca* EHRENBERG emend. MÖLLER, 1878.

Discussion. *Rugofusulina* was proposed by RAUSER-CHERNOUSSOVA to embrace species of the tribe of *Pseudofusulina* in which the spiral wall appears crenate in thin sections. Since sections have this appearance

regardless of their orientation, it is evident that the crenation is due to small rounded elevations and that on the surface these appear as blister-like elevations rather than rugae. They involve both tectum and keriotheca.

This appears to represent a specialization within the tribe of *Pseudofusulina* that eventually became distinct, but in many of the early species the crenation is rather weak and is sporadic in its appearance, being limited to irregular patches of the wall. The generotype, *Fusulina prisca*, appears to be one of the early and transitional species, and restudy of the generotype of *Pseudofusulina* by SKINNER and WILDE and by the writers reveals that it also shows at least sporadic crenation. It now appears that it will be difficult to separate such species into the two genera and we are inclined to regard *Rugosofusulina* as no more than a subgenus of *Pseudofusulina* and possibly a direct synonym.

Pseudofusulina (Rugosofusulina) arctica (SCHELLWIEN).

Pl. 6, figs. 1—7.

Fusulina arctica SCHELLIWIEN, 1908, Paleontographica, v. 55, p. 173, pl. 16, figs. 3—9.

Triticites articus RAUSER-CHERNOUSSOVA, 1938, U.S.S.R. Akad. Nauk., Geol. Inst. Trudy, v. 7, p. 115, pl. 4, figs. 4—6;

— ROZOVSKAYA, 1958, ibid., v. 13, p. 90, pl. 4, figs. 10—11.

Material studied. Thirty-six thin sections from collections E-131.5, E-138, E-139, on the north side of Maagefjæld, Holm Land and from collection F_2-X at Kap Jungersen, Amdrup Land.

Description. This fusiform species commonly reaches 6 to 7 mm in length and 2 mm in diameter in 6 volutions. The test is loosely coiled and axial deposits are rare.

The proloculus is small (150 to 200 microns in outside diameter) and the initial volutions are low. The poles are subacute to acutely rounded. The succeeding volutions become elongate, and form ratios of 3.0 or greater are common.

The wall is thin and is composed of a thin tectum and a thin, finely alveolar, keriotheca. In some specimens, much of the wall is crenulated (Pl. 6, fig. 5), whereas in others only the tectum is appreciably crenulated (Pl. 6, fig. 4).

The tunnel is of medium width in much of the test (the tunnel angle being about 30°) but it increases abruptly to 50 degrees in the penultimate whorl. The path of the tunnel is nearly straight, but it may deviate out of the mid plane of the test. Rudimentary chomata girth the proloculus, and pseudochomata, occurring as thickenings at the base of the septa, are common throughout the first three volutions. Only one of our specimens (Pl. 6, fig. 4), displays axial deposits and these are only of small extent.

Measurements of specimens of *Rugosofusulina arctica* shown on Plate 6.

	Volution	Fig. 5	Fig. 4	Fig. 2
Radius vector....	0	.07 mm	.09 mm	.10 mm
	1	.15	.14	.15
	2	.20	.21	.24
	3	.35	.33	.38
	4	.60	.51	.58
	5	.90	.83	.79
	6	..	1.10	1.00
Half length.....	1	.20 mm	.15 mm	.25 mm
	2	.40	.40	.60
	3	.75	.80	.85
	4	2.30	1.50	1.35
	5	3.50	2.00	2.00
	6	..	3.10	3.10
Form ratio.....	1	1.3	1.1	1.7
	2	2.0	1.9	2.5
	3	2.1	2.4	2.2
	4	3.8	3.0	2.5
	5	3.9	2.4	2.5
	6	..	2.8	3.1
Tunnel angle.....	1	30°	30°	25°
	2	30	25	25
	3	30	30	25
	4	55	30	50
	5	..	50	?
	6	..	..	..
Wall thickness...	0	.01 mm	.01 mm	.01 mm
	1	.01	.01	.02
	2	.02	.02	.04
	3	.03	.02	.05
	4	.04	.07	.07
	5	.07	.08	.08
	6	..	.07	.08

Discussion. Our specimens from northeast Greenland compare favorably with the type specimens figured by SCHELLWIEN (1908, pl. 16, figs. 3—9). The northeast Greenland specimens exhibit a wide range of morphological variation, not only in the rate of inflation of the chambers but also in the variations in wall thickness. However, an even greater amount of variation is known in other species such as *Schwagerina nelsoni* DUNBAR and SKINNER and *S. hawkinsi* DUNBAR and SKINNER.

P. (R.) arctica belongs to a group of species which are marginal between advanced species of *Triticites* and well differentiated species of *Pseudofusulina*. As these northeast Greenland specimens have a marked,

but sporadically displayed, crenulation of the wall and as crenulations are displayed in the wall of the type species of *Pseudofusulina*, *P. huecoensis* DUNBAR and SKINNER, *P. (R.) artica* is placed in the subgenus *Pseudofusulina*.

P. (R.) arctica is closely similar to *P. prisca* (MÖLLER), the type species of *Rugosofusulina* RAUSER-CHERNOUSSOVA (1938). *Tricitites rossicus* (SCHELLWIEN) is more elongate but compares closely with several of the northeast Greenland specimens (Pl. 6, figs. 2, 6, 7). *P. gregaria* (LEE) and its several subspecies are similar in many aspects, but they have lower chambers and appreciable axial deposits. These species are of Late Carboniferous age, most occurring in the zone C_3B and C_3C (ROZOVSKAYA, 1958, p. 61) of the Samara Bend region, southern Ural Mountains, and are comparable in evolutionary development to many Virgilian species (Late Pennsylvanian) in North America. In northeast Greenland this fauna apparently occupies a zone about 100 meters thick whereas in the Southern Urals the similar faunas range through about 130 meters.

Occurrence. *R. arctica* was described by SHELLWIEN from Spitzbergen. He stated it to occur abundantly at Temple Mt. and his figured types were from that locality; but he identified it also from Cape Duner on Bear Island where it was associated with "*Schwagerina princeps*" [= *Pseudoschwagerina*] and other fusulines from which he concluded that it was of the age of the "Cora beds" or the "Schwagerinakalk" of Russia, ie., of beds now included in the Sakmarian Stage at the base of the Permian.

In northeast Greenland it is common in the lower part of the Upper Marine group (Collections E-131.5, E-138 and E-139 in Holm Land and F_2-X in Amdrup Land). In collection E-138 it occurs with *Pseudoschwagerina pavlovi* and *Schubertella transitoria*.

Pseudofusulina (Rugosofusulina) sp. A.

Pl. 7, figs. 2–4.

Material studied. We have but two axial sections of this species, one each from collections 191 and 112 in the southeast corner of Amdrup Land. We have searched in vain for additional specimens.

Description. A rather small slender fusiform species of 7 to 8 volutions of which the first 4 or 5 are very low and closely coiled. A shell of 8 volutions has a length of 5.4 mm and a thickness of 1.9 mm.

The proloculus is minute (80 to 120 microns in outside diameter) and the spiral wall of the first several volutions is very thin, increasing gradually in the outer volutions. In the specimen shown as figure 2 of plate 7 the wall is only about 30 microns thick in the 6th volution but

Measurements of specimens of *Rugosofusulina* sp. A shown on Plate 7.

	Volution	Fig. 2	Fig. 4
Radius vector ...	0	.04 mm	.06 mm
	1	.06	.10
	2	.10	.16
	3	.14	.23
	4	.22	.42
	5	.33	.51
	6	.49	.70
	7	.70	..
	8	1.10	..
Half length.....	1	.09 mm	.15 mm
	2	.22	.40
	3	.40	.80
	4	.70	1.20
	5	1.30	..
	6	2.00	..
	7	2.80	..
	8	3.60?	..
Form ratio	1	1.3	1.3
	2	2.2	2.5
	3	2.9	3.5
	4	3.2	2.9
	5	3.9	..
	6	4.1	..
	7	4.0	..
	8	3.9	..
Tunnel angle	1	30°	30°
	2	30	30
	3	30	30
	4	30	30
	5	30	..
	6	40	..
	7	..	..
Wall thickness...	0	.01 mm	.01 mm
	1	.01	.01
	2	.01	.01
	3	.02	.01
	4	.03	.02
	5	.04	.03
	6	.05	.03
	7	.06	..
	8	.09	..

it is about 90 microns thick in the eight volution of figure 4. The wall consists of tectum and rather finely alveolar keriotheca and is rather strongly crenate (Pl. 7, fig. 3). The septa show rather strong but irregular folds

even in the early whorls. The tunnel is low and slit-like, the tunnel angle ranging from 30 to 40 degrees, and the path of the tunnel varies somewhat irregularly from the sagittal plane. Very slender chomata are present in the early whorls where they clearly define the tunnel, but are lacking in the outer whorls. Rather massive axial deposits are present in the end zones of the inner whorls.

Discussion. Superficially these shells resemble *Rugosofusulina prisca* MÖLLER (1878) in size and shape and in having a crenate wall, but they differ markedly in having numerous tightly coiled early whorls and in having heavy axial deposits.

Occurrence. Both of our specimens occur in collections that were picked up as loose pieces on the surface (Collection 191 from Henrik Kröyer's Islets off the coast from Sophus Müller's Naze and collection 112 at Cape Jungerson, both in Amdrup Land. Neither can be located exactly in the section but they evidently came from the lower part of the Upper Marine group and are of Early Permian (Sakmarian) age. In collection 191 the specimen was associated with *Pseudoschwagerina pavlovi.*

Monodiexodina SOSNINA, 1956.

Monodiexodina SOSNINA, 1956, in Kiparisova, editor, contributions to Paleontology—new families and genera: Vsesriuzny Nauchno—Issled. Geol. Inst., Mininsterstva Geologii i Okhrany Nedr SSSR, n.s. Paleontologiia, v. 12, p. 24–29, pl. 5, figs. 2–5, pl. 7, fig. 1.

COOGAN, 1958, Jour. Paleontology, v. 32, p. 310.

Generotype. *Fusulina wanneri* var. *sutschania* DUTKEVITCH (1934).

Diagnosis. Shells large, elongate, and subcylindrical with numerous low volutions. Wall consisting of tectum and a finely alveolar keriotheca. Septa strongly and regularly folded near their lower margin but nearly plane in their upper half so that in axial sections the septal loops are low. In the outer volutions of the more advanced species the folds of adjacent septa may overlap and be resorbed at the tip to form cuniculi. The tunnel is rather wide. Very slender chomata commonly occur in the first 2 or 3 volutions but are lacking in later whorls. Axial deposits are normally conspicuous and, in the end zones, commonly completely fill the chambers in all but the last two whorls, but are lacking across the mid part of the shell.

Discussion. A number of early Permian species fall neatly into this genus. Examples are *Fusulina wanneri* SCHUBERT, *Schwagerina linearis* DUNBAR and SKINNER, *Schwagerina prolongada* BERRY and *S. paralinearis* THORSTEINSSEN. In as much as cuniculi begin to appear in the outer volution of some specimens this genus represents a stage of evolution near the transition from *Pseudofusulina* to *Parafusulina* but

their distinctive low septal folds and heavy axial filling suggest they represent a specialized offshoot of *Pseudofusulina*.

Monodiexodina cf. *paralinearis* (THORSTEINSSON), 1960.

Pl. 7, fig. 1.

Schwagerina paralinearis THORSTEINSSON, 1960, Geol. Surv. Canada Mem. 309, p. 24, pl. 4, figs. 1–8.

Discussion. We have 3 incomplete sections of this species from collection 209, the best of which is figured. Unfortunately it is incomplete at both ends. The shell was undoubtedly much longer than our figure suggests. The collection consisted of a small piece of light grey porous limestone which we have reduced to small bits in the search for more and better specimens.

Our specimens agree with THORSTEINSSON's species in size and proportions so far as they are revealed, in the small and very thin walled proloculus, the thinness of the spiral wall in the early volutions, and in the low septal folds. Our specimens show no appreciable axial filling but such deposits are highly variable in the figured types of *M. paralinearis*.

Collection 209 is labeled "Sophus Müllers Næs, Amdrup Land" but cannot be located in the section. As explained on page 10 M.o.G. bd. 167 nr. 4 the horizon is that of profile E and the lower part of F_2, low in the Upper Marine group. This genus is widespread in Wolfcampian formations in both North and South America and collection 209 is undoubtedly of early Permian age.

Measurements of specimen of *Monodiexonida* cf. *paralinearis* shown as Figure 1, Plate 7.

Volution	Radius vector	Half length	Form ratio	Tunnel angle	Wall thickness
0	.06 mm	...	..	..	.01 mm
1	.10	.19 mm	1.9	50°	.01
2	.20	.40	2.0	50	.02
3	.30	.90	3.0	50	.03
4	.48	1.40	3.0	60	.05
4	.68	2.50	3.7	?	.06
6	.90	3.50	5.5	..	.06

Schwagerina MÖLLER, 1877 [non 1878]; emend. DUNBAR and SKINNER 1936.

Schwagerina MÖLLER, 1877, Neues Jarbuch, p. 139–146; DUNBAR and SKINNER, 1936, Jour. Paleont., v. 10, p. 83–91; DUNBAR, 1958, Jour. Paleont., v. 36, p. 1019–1021.

Generotype. *Borelis princeps* EHRENBERG, 1842.

Diagnosis. Tests thickly fusiform to subglobose, with numerous regularly expanding volutions. Wall consisting of tectum and keriotheca. Septa regularly and strongly folded from pole to pole, the tips of opposed folds meeting to subdivide the lower part of the meridional chambers into chamberlets. Chomata rudimentary in the early whorls of primitive species but lacking in the outer whorls, and completely lacking at all stages of growth in advanced species.

Discussion. As redefined by DUNBAR and SKINNER (1936) the genus *Schwagerina* includes a great complex of species ranging in shape from thickly fusiform to elongate fusiform and to subcylindrical. It will probably be subdivided eventually into several generic lines. DUNBAR and SKINNER (1931) had proposed the genus *Pseudofusulina* for elongate fusiform or subcylindrical species with *P. huecoensis* DUNBAR and SKINNER as generotype, and in 1936 they considered this to be a synonym of *Schwagerina*. However, in as much as the generotype of *Schwagerina* was a short, obese species, there is a growing tendency to recognize both *Schwagerina* and *Pseudofusulina* even though the wide range of shape among species makes it difficult to draw a sharp boundary between them. Other genera have also been erected in recent years to embrace some of the elongate species. Of these *Monodiexodina* SOSNINA (1956) is distinguished by its low septal folds and massive axial filling. *Rugosofusulina* RAUSER-CHERNOUSSOVA (1937) is distinguished by its spiral wall flexed into small blister-like mounds. *Daixina* ROZOVSKAYA (1937) will embrace small species that are in a transitional stage between *Triticites* and *Pseudosfusulina*, having more irregular and weaker septal folds than is normal in *Pseudofusulina*, and possessing chomata in several of the early whorls.

Much confusion exists in the literature over the nature of *Schwagerina*. When MÖLLER proposed the genus in 1877 he intended it to include the thickly fusiform or globose fusulines, and designated as its type *Borelis princeps* EHRENBERG, a species for which thin sections had not been described. In 1878 he redescribed the genus and illustrated it with thin sections of a species from China (*Schwagerina Moelleri* RAUSER-CHERNOUSSOVA, 1936) which he supposed to be the same as *B. princeps*. This species had nearly plain septa and showed a tightly coiled juvenarium followed by rapid and rather abrupt inflation to high and loosely coiled volutions. This ontogenetic change soon came to be regarded as the distinctive feature of the genus *Schwagerina*. In 1936, however, DUNBAR and SKINNER published a study of the original types of *Borelis princeps*, showing that this species had strongly and regularly folded septa and that the volutions increased gradually in heights. Accordingly they redefined *Schwagerina* in accordance with its generotype and pro-

posed *Pseudoschwagerina* for the inflated shells. This has since been widely accepted, though over the strong protest of RAUSER-CHERNOUSSOVA (1936 and 1956). Opinion 213 of the International Commission on Zoological Nomenclature (1954) officially fixed the generotype of *Schwagerina* as *Borelis princeps* EHRENBERG, and confirmed the interpretation of DUNBAR and SKINNER. The matter was reviewed by DUNBAR in 1958.

Schwagerina krotowi (SCHELLWIEN) 1908.

Pl. 6, figs. 8–13.

Fusulina krotowi SCHELLWIEN, 1908, Palaeontographica, v. 55, p. 190, pl. 20, figs. 1–10.

Pseudofusulina krotowi (SCHELLWIEN), RAUSER-CHERNOUSSOVA, 1938, U.S.S.R. Akad. Nauk., Geol. Inst. Trudy, v. 7, p. 143, pl. 9, figs. 1, 2.

Pseudofusulina krotowi var. *nux* RAUSER-CHERNOUSSOVA, 1938, Ibid., pl. 9, figs. 3, 4.

Schellwienia krotowi (SCHELLWIEN), OZAWA, 1925, Journ. Coll. Sci., Imp. Univ. Tokyo, v. 45, art. 6, p. 27, pl. 7, figs. 5, 6;

— RAUSER-CHERNOUSSOVA and SCHERBOVNY, 1958, U.S.S.R. Akad. Nauk., Geol. Inst. Trudy, v. 13, p. 38, pl. 13, figs. 3–8.

Pseudofusulina krotowi var. *sphaeroidea* RAUSER-CHERNOUSSOVA, 1938, Ibid., v. 7, p. 146, pl. 9, figs. 5–7;

— RAUSER-CHERNOUSSOVA and SCHERBOVNY, 1958, Ibid., v. 13, p. 39, pl. 3, figs. 9–11.

Material studied. Four axial sections from collection 214b on Henrik Kröyer Islets, and 2 sections from collection 178a at Sophus Müller Næs, both in Amdrup Land.

Description. A small, thickly fusiform species having 6 or 7 volutions and attaining a diameter of about 3.6 mm in the seventh volution and a length of about 7.0 mm. The shells are evenly convex across the middle and the polar extremities are rather acutely rounded. Not uncommonly the poles are slightly extended in the later whorls so that the outer part of the lateral slopes is slightly concave.

Of our specimens those shown as figures 10 to 13 have only about 5 volutions and are considered to be immature but sections 10 to 12 are well oriented to show the shape of the shell. Our specimens of figures 8 and 9 are somewhat oblique, as was Schellwien's original figure 1 and in these the length is foreshortened, making the shell appear more gibbous than it actually was. The first volution has a very thin wall, and is low and subspherical, but subsequent volutions increase gradually in height and the form ratio increases to about 2 in the fifth volution.

The spiral wall consists of tectum and finely alveolar keriotheca and increases gradually from a thickness of about 20 microns in the first volution to 120 microns in the seventh.

Septal folds are somewhat irregular but strong and high in all volutions. The tunnel is moderately narrow, the tunnel angle being commonly

30° or less. Rudimentary chomata appear on the walls of the proloculus and in the first and second volutions, but are obsolete thereafter. Slight secondary deposits appear locally on the septal folds of some of the immature whorls but are never conspicuous.

Measurements of *Schwagerina krotowi* specimens shown on Plate 6.

	Volution	Fig. 10	Fig. 11	Fig. 12
Radius vector ...	0	.08 mm	.07 mm	.05 mm
	1	.11	.12	.10
	2	.19	.22	.15
	3	.38	.34	.30
	4	.60	.55	.44
	5	.95	.80	1.00
	6	..	1.15	
Half length.....	1	.20 mm	.10 mm	.15 mm
	2	.45	.20	.30
	3	.75	.60	.50
	4	1.30	1.00	.80
	5	1.90	1.80	1.40
	6	..	2.10	?
Form ratio	1	1.8	0.8	1.5
	2	2.3	1.1	2.0
	3	2.0	1.8	1.6
	4	2.2	1.8	1.8
	5	2.0	2.3	2.1
	6	..	1.8	..
Tunnel angle	1	35°	20°	20°
	2	40	22	22
	3	40	22	22
	4	35	25	22
	5	..	35	25
	6	..	..	..
Wall thickness ...	0	.02 mm	.02 mm	.02 mm
	1	.02	.02	.02
	2	.04	.03	.02
	3	.06	.04	.03
	4	.06	.06	.06
	5	.12	.09	.07
	6	..	.11	.07

Discussion. This species belongs to the group of *Schwagerina princeps* (EHRENBERG) but that species is shorter and more globular and has more regularly folded septa. *S. bona* ROZOASKAYA (1958) is much larger.

Occurrence. SCHELLWIEN's types came from several localities, all in the "Schwagerinakalk" of the U.S.S.R., ie. in beds now generally classified as Sakmarian (basal Permian). In our collection 178a it is associated with *Pseudoschwagerina pavlovi.*

Our collection 214 is from a loose block on the mainland of Amdrup Land opposite Henrik Kröyer Holme, and collection 178a is labeled "Sophus Müllers Næs, Amdrup Land". These beds are believed to be low in the Upper Marine group since they are associated with *Pseudoschwagerina pavlovi.*

Pseudoschwagerina DUNBAR and SKINNER, 1936.

DUNBAR and SKINNER, 1936, *Schwagerina* versus *Pseudoschwagerina* and *Paraschwagerina.* Jour. Paleont., v. 10, p. 83–91. Dunbar, Carl O., 1958, on the validity of *Schwagerina* and *Pseudoschwagerina,* Jour. Paleont., v. 32, p. 1019–1021.

Generotype. *Schwagerina uddeni* BEEDE and KNIKER, 1924.

Diagnosis. Shells large and thickly fusiform to subglobose or even subspherical, consisting of several volutions. The first 2 to 3 or 4 volutions are low and tightly coiled forming a conspicuous juvenarium following which the whorls rapidly become high and inflated. The spiral wall is relatively thin and consists of a tectum and a well defined keriotheca. The septa are widely spaced and simple, being nearly plane except near the poles in the outer volutions where a variable degree of irregular septal folding commonly occurs. The tunnel is relatively low and narrow. Very slender chomata generally occur in the juvenarium but are discontinuous or lacking in the inflated whorls.

Discussion. *Pseudoschwagerina* is distinguished by its relatively simple septa and especially by the abrupt ontogenetic change from tightly coiled juvenile whorls to very high and inflated later whorls. The final whorl generally declines to lesser height than the penultimate one and this clearly indicates maturity of the shell. The genus is widely distributed and with possibly a few exceptions is confined to the Sakmarian Stage in Eurasia and its equivalents, the Wolfcampian, of North and South America for which it serves as the most characteristic zone fossil.

A subgenus *Zellia* was distinguished by KAHLER and KAHLER (1937) to include certain Eurasian species with relatively thick spiral wall and septa, and by very abundant and rather coarse septal pores.

Paraschwagerina resembles *Pseudoschwagerina* in size and shape, and in possessing a tightly coiled juvenarium, but it is distinguished by having very strongly and regularly folded septa, even in the early whorls, and normally has a slender elongate juvenarium. It appears that *Pseudo-*

schwagerina developed out of *Triticites* whereas *Paraschwagerina* developed out of *Pseudofusulina.*

For the relation of *Pseudoschwagerina* to *Schwagerina* see our discussion of the latter.

Pseudoschwagerina pavlovi (RAUSER-CHERNOUSSOVA).

Pl. 7, figs. 5–11.

Schwagerina pavlovi RAUSER-CHERNOUSSOVA, 1938, U.S.S.R. Akad. Nauk., Paleont. Inst. Trudy, v. 7, p. 127, 158, pl. 6, figs. 6, 7.

— RAUSER-CHERNOUSSOVA, 1959, Ibid., v. 13, p. 46, pl. 5, figs. 4, 5.

Material studied. Twelve thin sections from collection E-138 in Holm Land and from 178a (float from Sophus Müller Næs), and collection 191 and 169, Henrik Kröyer Holme, Amdrup Land.

Description. A subspherical species having a tightly coiled juvenarium followed by about 5 very high, inflated whorls. It attains an equatorial diameter of about 6 mm and a polar diameter of 8 mm. The axial profile is correctly shown by figs. 5 and 11.

The proloculus is very small (commonly less than 70 microns in diameter), and the juvenarium consists of 2 to 3 very thin walled and tightly coiled volutions. In the inflated whorls the wall is thin, increasing gradually from about 10 microns in the first to 40 microns in the fifth. Where thin its structure is indistinct, but in the outer volutions it clearly consists of tectum and a finely alveolar keriotheca. As is common in this genus the final whorl is somewhat lower than the penultimate.

The septa are very thin and are nearly plane except in the end zone where a variable amount of small irregular septal folding is evident. The tunnel is low and slit-like. In the juvenile whorls it is bordered by very slender chomata but in the last 3 or 4 volutions chomata are lacking and it is commonly impossible to define the tunnel or measure the tunnel angle in thin sections.

Discussion. Our specimens from northeast Greenland agree closely with the types of this species which are from the Samara Bend in the U.S.S.R. *P. pavlovi* differs from several other species described from that region in having more septal folds in the polar region, in being extended into slight knobs at the polar extremities, and in having higher, more inflated whorls. *P. ciceroides* RAUSER-CHERNOUSSOVA is larger in corresponding volutions and lacks polar knobs. *P. carniolica* KAHLER and KAHLER (1937) is similar in many features and may be identical with *P. pavlovi.* This species differs from similar American species in having a minute, thin-walled juvenarium and in having its slender chomata reaching well into the early inflated whorls.

Measurements of specimens of *Pseudoschwagerina pavlovi* shown on Plate 7

	Volution	Fig. 4	Fig. 7	Fig. 8	Fig. 9
Radius vector ...	0	0.035 mm	0.04 mm	0.04 mm	..
	1	.07	.07	.10	..
	2	.12	.12	.20	.17 mm
	3	.20	.20	.20	.34
	4	.37	.35	.75	.60
	5	.82	.67	1.15	1.10
	6	1.50	1.30	1.85	1.70
	7	2.07	2.20	..	2.35
	8	2.45	2.60	..	2.80
Half length.....	1	.14 mm	.10 mm	.15 mm	..
	2	.25	.22	.30	..
	3	.35	.32	.55	12
	4	.55	.55	1.00	15
	5	.95	.95	1.40	18
	6	1.70	1.45	2.20	17
	7	2.50	2.00	..	25
	8	3.10	2.50	..	32
Form ratio	1	2.0	1.4	1.5	
	2	2.1	1.8	1.5	
	3	1.8	1.6	1.8	
	4	1.5	1.6	1.3	
	5	1.2	1.4	1.2	
	6	1.1	1.1	1.2	
	7	1.2	1.1	..	
	8	1.3	1.0	..	
Tunnel angle	1	25°	30°	25°	
	2	25	30	35	
	3	25	30	30	
	4	32	30	25	
	5	30	30	..	
	6	30	25	..	
	7	..	30	..	
	8	..		..	
Wall thickness...	0	0.01 mm	0.01 mm	0.01 mm	..
	1	.02	.02	.02	..
	3	.02	.02	.04	0.02 mm
	3	.03	.03	.05	.02
	4	.03	.05	.06	.02
	5	04	.05	.10	.03
	6	.05	.08	..	.05
	7	.13	.09	..	.11
	8	.15	.10	..	.15

no. of septa

Occurrence. This species was described from the early Permian (Sakmarian) beds in Petschoraland on the west flank of the northern Urals. In northeast Greenland it is abundant in collection E-138 in Holm Land where it is associated with many specimens of *Rugosofusulina arctica*. It was found by KOCH and WEGENER in loose blocks at Sophus Müller's Næs in Amdrup Land (Collections 169 and 178a), and in collections 191 and 214 on Henrik Kröyer Holme several miles off shore. In collections 169 and E-138 it is associated with *Schubertella transitoria*, and in collection 214 with *Schwagerina krotowi*, and in collection 191 with both *Schubertella transitoria* and *Schwagerina krotowi*.

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Færdig fra trykkeriet 20. juni 1962.

PLATES

Plate 1.

Figs. 1–7. *Ozawainella mosquensis* Rauser-Chernoussova; Lower Marine Group, Holm Land.

1, 2, 7. Axial sections from Collection A-124; 1. ×10, 2. ×40, 7. ×40.
3, 5. Slightly oblique sections from Collection N-132, ×40.
4. Axial section from Collection B-119, ×40.
6. Axial section from section from Collection N-132, ×40.

Figs. 8–13. *Pseudostaffella greenlandica* sp. nov., Lower Marine Group, Holm Land.

8. Axial section from Collection B-119, ×40.
9, 10. Holotype axial section from Collection A-126, the wall structure is well shown in the upper left part of figure 9; 9. ×40, 10. ×10.
11. Axial section from Collection B-124, ×40.
12. Axial section from Collection A-126, ×40.
13. Axial section from Collection B-117_2, ×40.

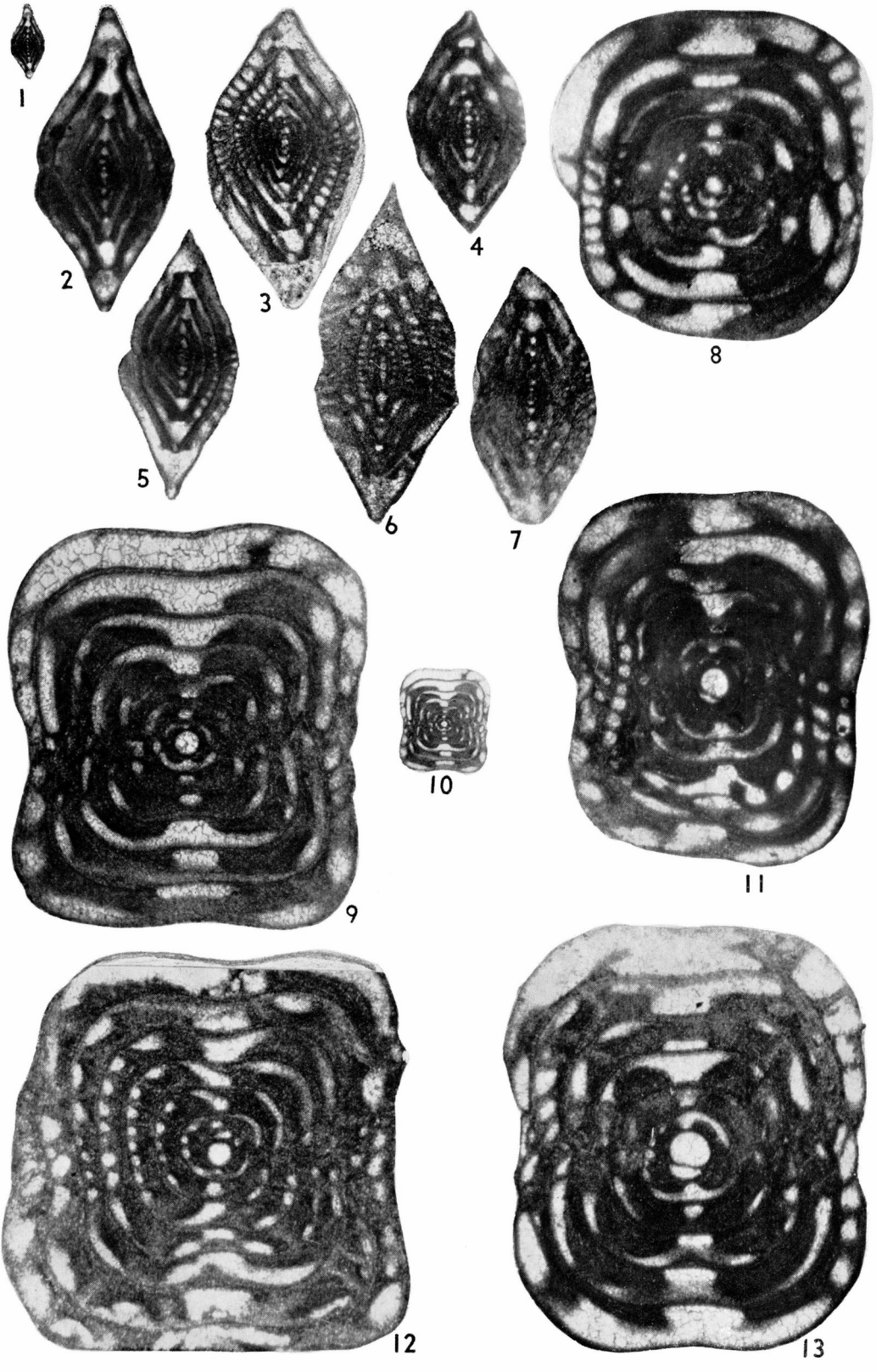
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Plate 2.

All X 40 except fig. 2 which is $\times 10$.

Figs. 1–8. *Pseudostaffella? pseudosphaeroides* (DOUTKEVITCH); Lower part of Lower Marine Group, Holm Land.

1–7. Axial sections from Collection O-127_4.
8. Axial section from Collection B-117_1.

Figs. 9–12. *Pseudostaffella sphaeroidea* (EHRENBERG); Upper part of the Lower Marine Group, Holm Land.

9–12. Axial sections from Collection N-132.

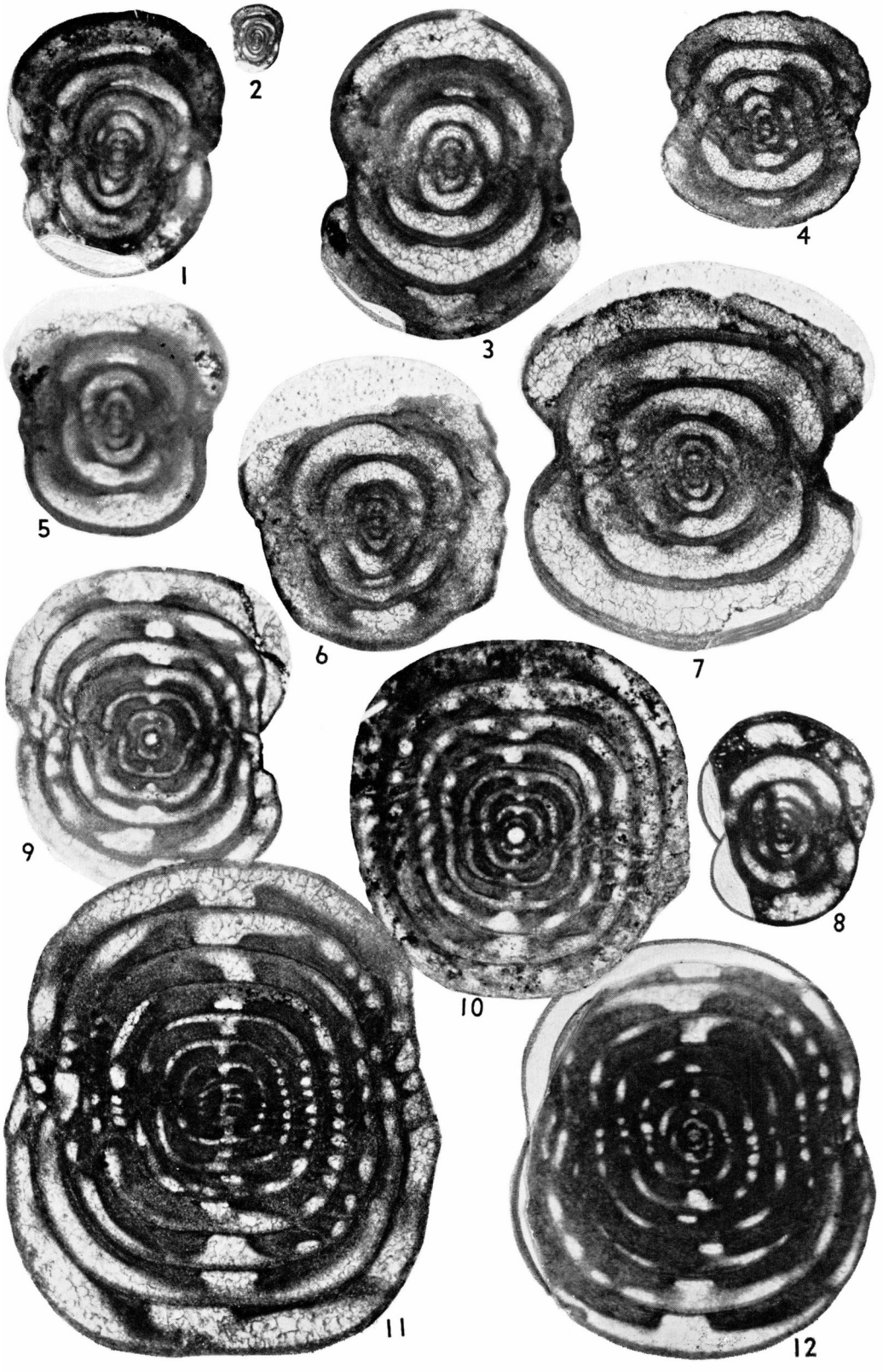
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Plate 3.

Figs. 1–6. *Parastaffella holmensis* sp. nov.; Lower part of the Lower Marine Group, Holm Land.

1, 2. Axial section of holotype from Collection B-117$_1$; 1. ×10, 2. ×40.
3, 5–6. Axial section of paratypes from Collection B-117$_1$, ×40.
4. Saggital section of paratype from Collection B-117$_1$ ×40.

Figs. 7A–7D. *Parastaffella nielseni* sp. nov.; Lower part of the Lower Marine Group, Holm Land.

7A. Axial section of holotype from Collection B-117$_1$; ×40.
7B, 7C. Axial sections of paratypes from Collection B-117$_1$; ×40.
7D. Saggital section of paratype from Collection B-117$_1$; ×40.

Figs. 8–12. *Profusulinella priscoidea* RAUSER-CHERNOUSSOVA; Lower part of the Lower Marine Group, Holm Land.

8, 9. Axial section from Collection B-116; 8. ×10, 9. ×20.
10, 11. Axial sections from Collection C-121, ×20.
12. Axial section from Collection B-122, ×20.

Figs. 13–16. *Profusulinella* cf. *P. regia* THOMPSON; Lower part of the Lower Marine Group, Holm Land and Amdrup Land.

13, 14. Axial section from Collection B-130, Holm Land; 13. ×10, 14. ×20.
15, 16. Axial sections from Collection L-30 Amdrup Land; ×20.

Fig. 17. *Fusulina* sp. A., Cobble imbedded in the lower part of the Upper Marine Group, Amdrup Land; Axial section from Collection F$_2$-148, ×20.

Fig. 18. *Profusulinella priscoidea*? RAUSER-CHERNOUSSOVA, Lower part of the Lower Marine Group, Holm Land; Axial section of juvenile specimen from Collection O-127$_4$, ×40.

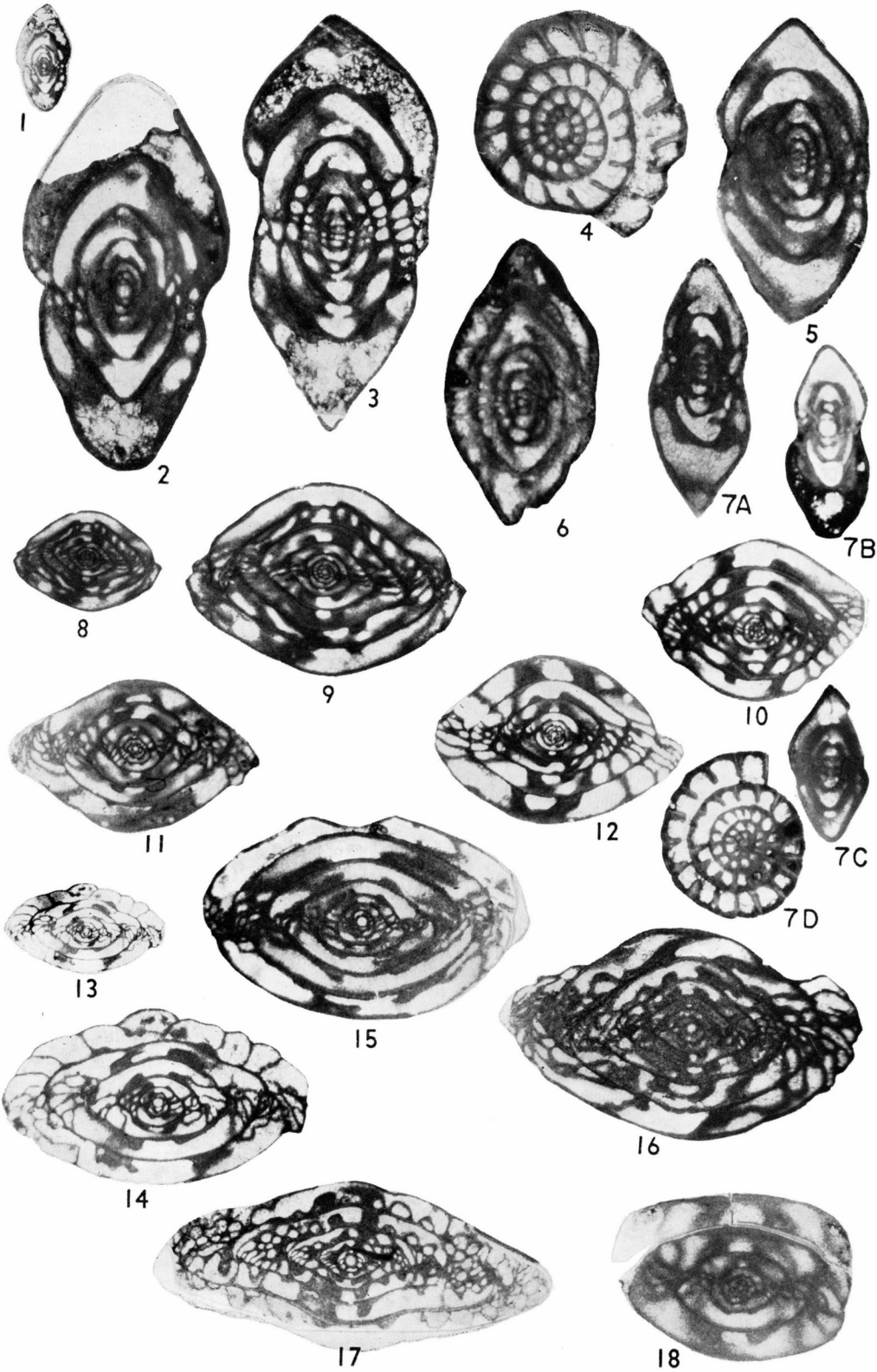
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Plate 4.

Figs. 1-5. *Fusulinella eopulchra* Rauser-Chernoussova; Lower part of the Lower Marine Group, Holm Land.

1, 2, 5. Axial sections from Collection O-116, 1. ×10, 2, 5. ×20.
3. Axial section from Collection B-130, ×20.
4. Saggital section from Collection B-116, ×20.

Figs. 6–12. *Wedekindellina dutkevichi* Rauser-Chernoussova and Beljaev; Upper part of the Lower Marine Group, Holm Land.

6, 7. Axial section from Collection N-130; 6. ×10, 7. ×20.
8. Axial section from Collection A-124, ×20.
9. Axial section from Collection A-126, ×20.
10, 11. Axial sections from Collection N-132, ×20.
12. Saggital section from cobble imbedded in the lower part of the Upper Marine Group, Amdrup Land, Collection F_2-148, ×20.

Figs. 13–17. *Fusulina paradistenta* Safonova; Upper part of the Lower Marine Group, Holm Land.

13. Oblique section from Collection N-132, ×20.
14, 15, 16. Axial sections from Collection A-126; 14. ×10, 15. ×20, 16. ×20.
17. Saggital section from Collection N-132, ×20.

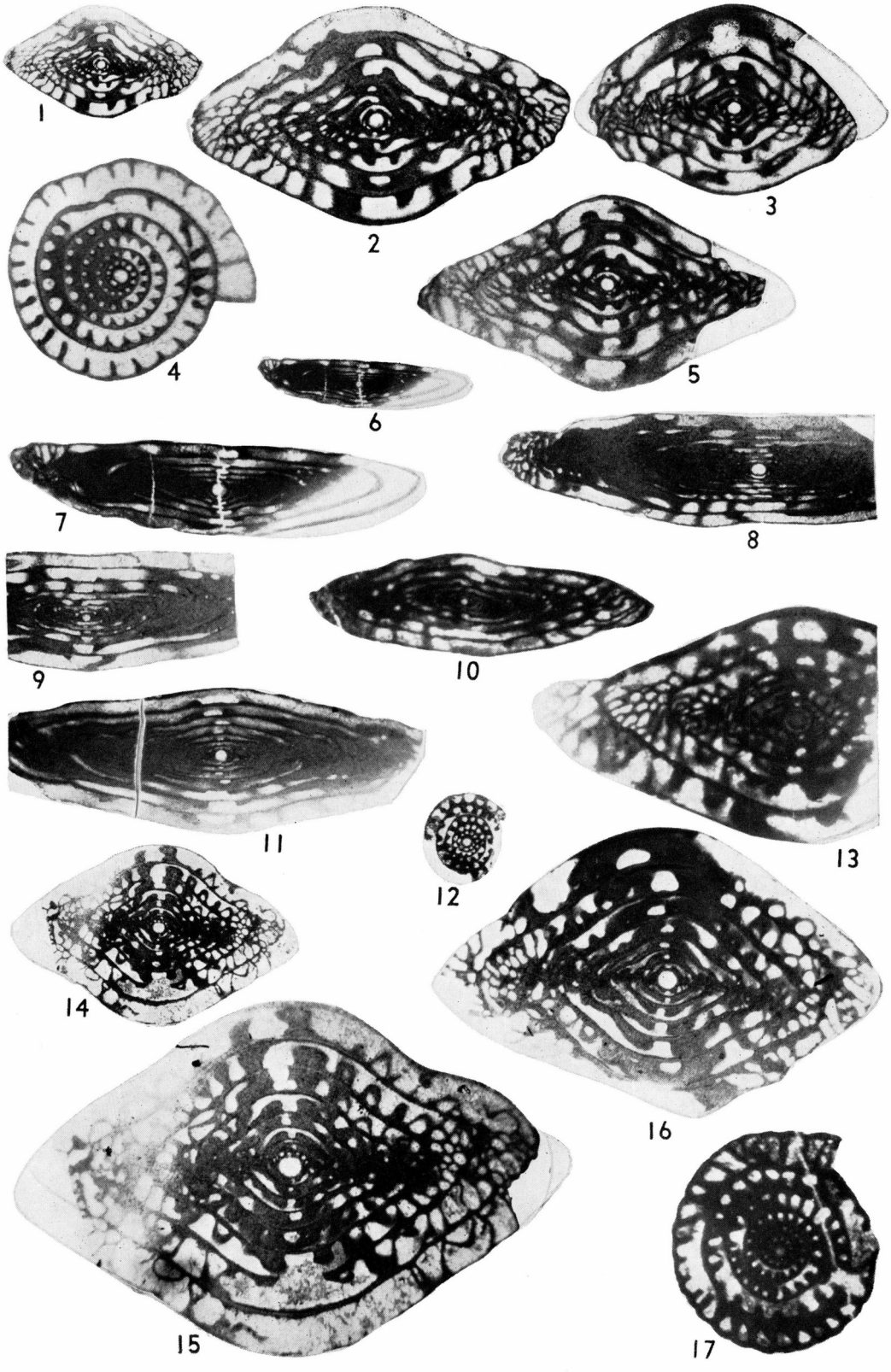
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Plate 5.

Figs. 1–7. *Taitzehoella librovitchi* (DOUTKEVITCH); Upper part of the Lower Marine Group, Holm Land.

1–4, 6, 7. Axial sections from Collection N-132; 1. ×20, 3. ×10, others ×40.
5. Tangential section from Collection N-132 showing thickening of chomata at the septa, ×40.

Figs. 8–12. *Paraeofusulina trianguliformis* (PUTRJA); Lower part of the Lower Marine Group, Holm Land.

8, 9, 10. Axial sections from Collection B-122; 8. ×10, 9, 10. ×20.
11, 12. Axial sections from Collection B-146, ×20.

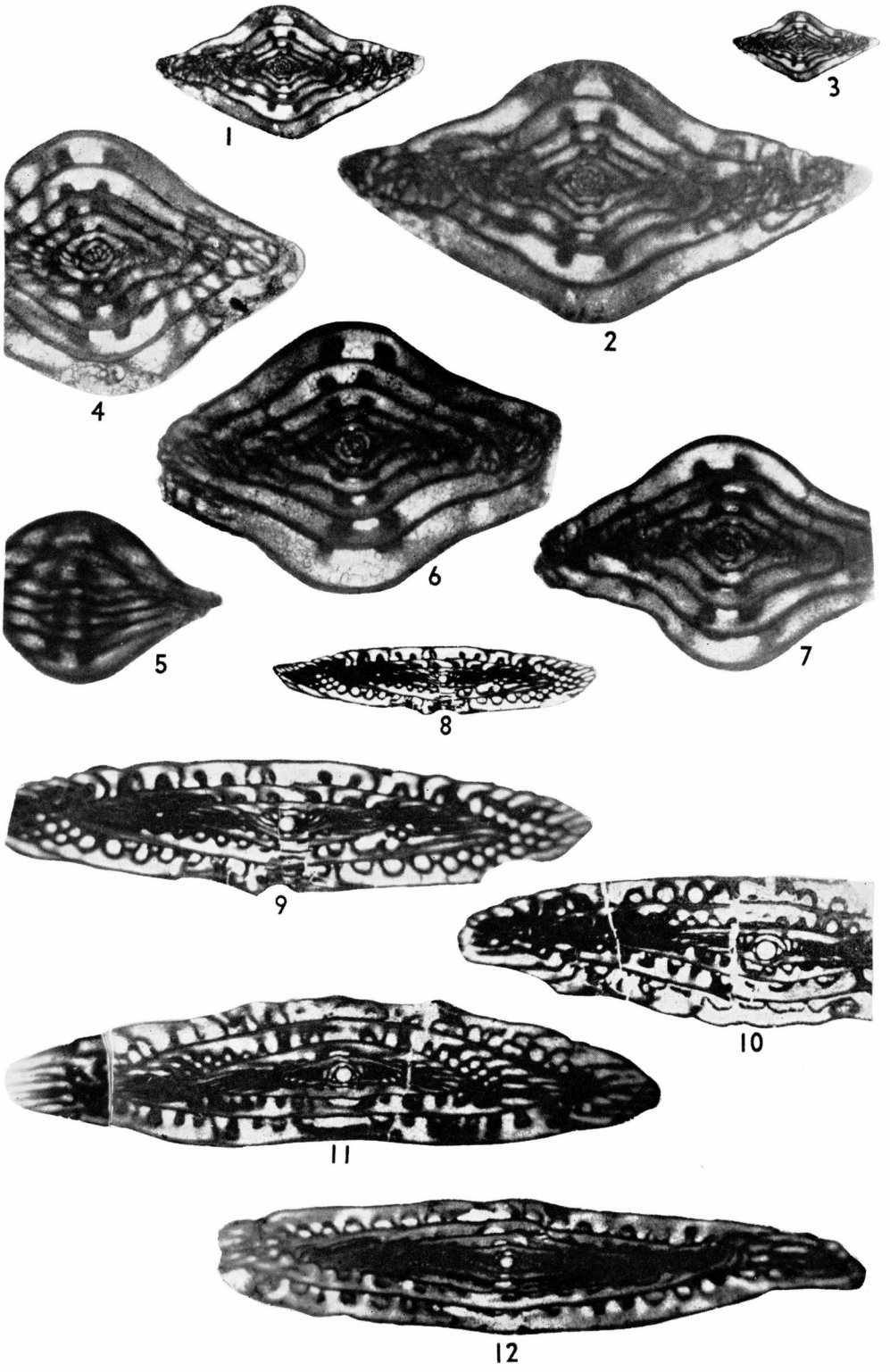
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Plate 6.

All figures ×10.

Figs. 1–7. *Pseudofusulina (Rugosofusulina) arctica* (SCHELLWIEN); Lower part of the Upper Marine Group, Holm Land and Amdrup Land.

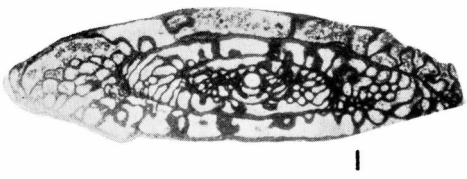
1. Axial section from Collection E-139.
2, 4. Axial sections from Collection E-138.
3, 5. Axial sections from Collection E-131 $^1/_2$.
6, 7. Axial sections from Collection F_2-X.

Figs. 8–13. *Schwagerina krotowi* (SCHELLWIEN); Float probably from lower part of the Upper Marine Group, Amdrup Land.

8, 9. Slightly oblique sections from Collection 178a, Sophus Müller Næs.
10, 11, 12. Axial sections from Collection 214b, Mainland opposite Henrik Kröyer Holme.
13. Tangential section from Collection 214b, Mainland opposite Henrik Kröyer Holme.

Figs. 14–16. *Pseudofusulina (Daixina) amdrupensis* sp. nov.; Lower part of the Upper Marine Group, Amdrup Land.

14, 15. Axial sections of paratypes from Collection F_2-115.
16. Axial section of holotype from Collection F_2-115.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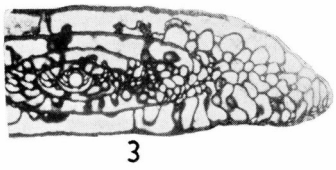
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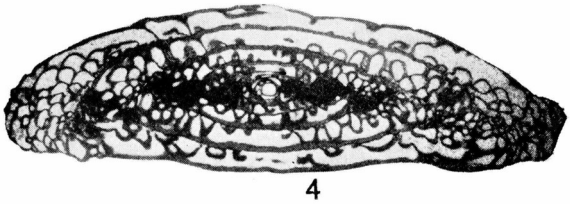
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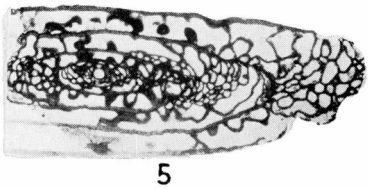
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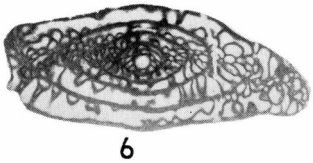
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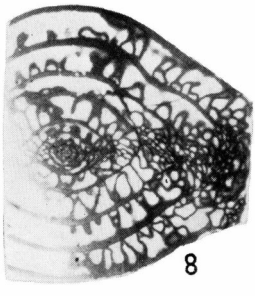
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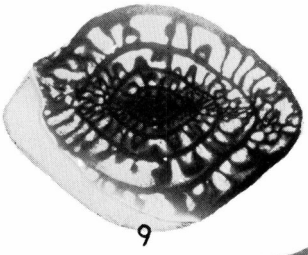
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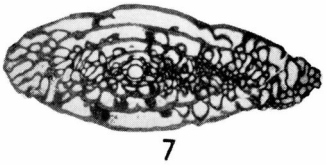
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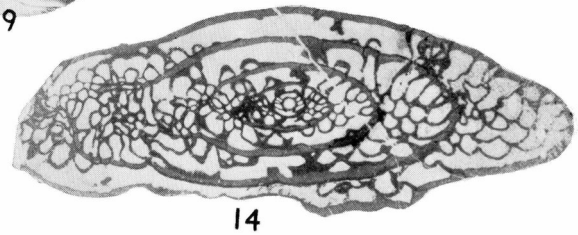
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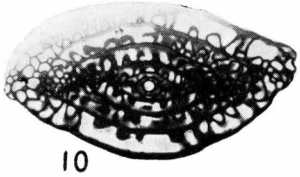
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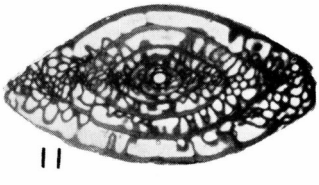
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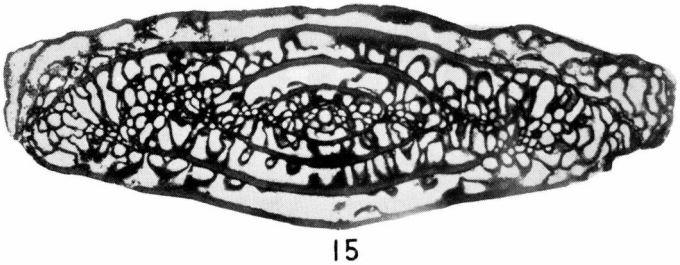
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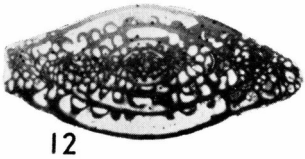
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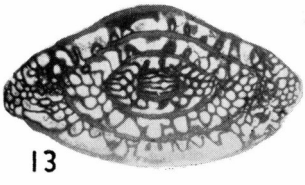
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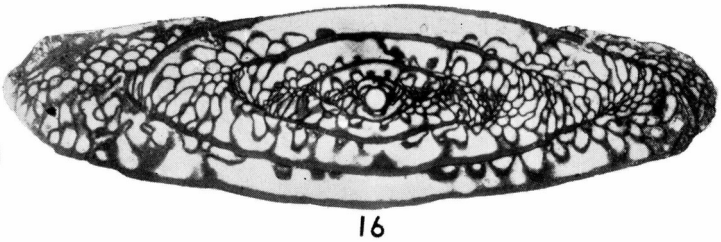
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Plate 7.

Fig. 1. *Monodiexodina* sp. A; Float, probably from the lower part of the Upper Marine Group, Amdrup Land, ×10.

Figs. 2, 3, 4. *Pseudofusulina (Rugosofusulina)* sp. A; Float probably from the lower part of the Upper Marine Group, Amdrup Land.

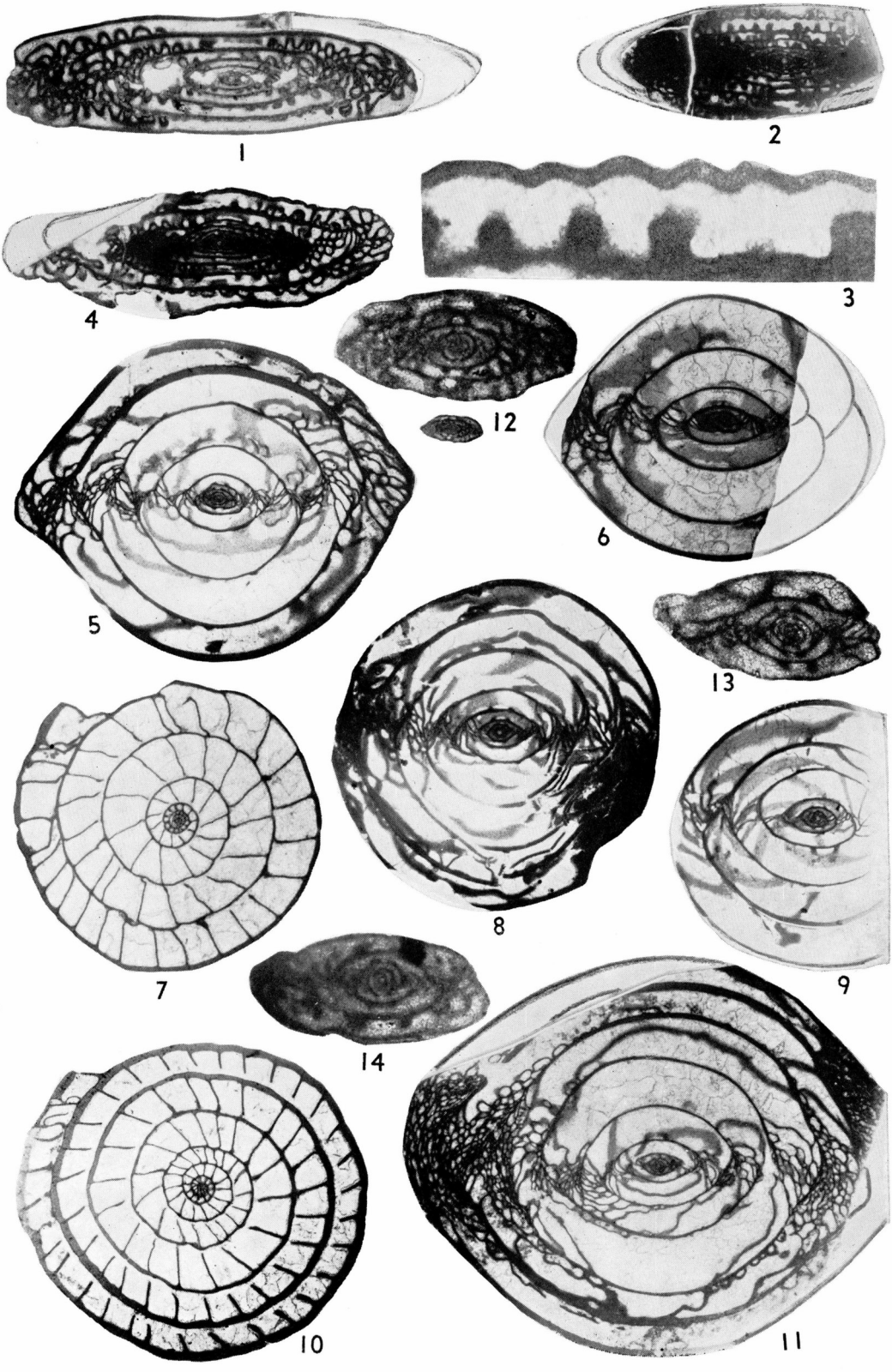
2. Axial section from Collection 112, Float? from Kap Jungersen. ×10.
3. Enlarged view of a portion of fig. 2 showing crenulation in the wall, ×50.
4. Axial section from Collection 191, Float from Henrik Kröyer Holme, ×10.

Figs. 5–11. *Pseudoschwagerina pavlovi* RAUSER-CHERNOUSSOVA; Float probably from lower part of the Upper Marine Group, Amdrup Land, ×10.

5–7, 11 Three axial and one saggital section from Collection 191, Henrik Kröyer Holme.
8, 9. Axial sections from Collection 214b, Mainland opposite Henrik Kröyer Holme.
10. Saggital section from Collection 178a, Sophus Müller Næs.

Figs. 12, 13, 14. *Schubertella transitoria* STAFF and WEDEKIND; Upper Marine Group, Amdrup Land.

12, 14. Axial sections from Collection 169, ×40 and ×10.
13. Axial section from Collection E-138, ×40.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