CARBONIFEROUS AND PERMIAN FUSULINIDAE FROM SPITSBERGEN

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ABSTRACT. The collections of several expeditions to Spitsbergen have been examined and seventeen species (none new) of Fusulinidae are described from horizons ranging from Middle Carboniferous to Lower Permian. These identifications form the basis of stratigraphical work published elsewhere and here briefly summarized. Previous records of Fusulinidae from Spitsbergen are re-examined.

INTRODUCTION

THIS description of the fusulinids collected by various expeditions to Spitsbergen follows the account of the geology of the area visited by the Cambridge Expedition 1949, as given by Gee, Harland, and McWhae (1952) and by Forbes, Harland, and Hughes (1958). The stratigraphical nomenclature of these authors is summarized in text-fig. 1. It is regretted that No. 13 (1958) of the Trav. Inst. géol. U.R.S.S., with an important series of papers on the fusulinids of the *Schwagerina* horizon, has come to notice too late to receive the consideration it deserves.

All specimens are deposited in the Sedgwick Museum, Cambridge. Locations and horizons are detailed in the Appendix.

Previous work on Fusulinids from Spitsbergen. Goës (1884) identified *Fusulina cylindrica* in material collected by Nathorst and de Geer in 1882 from Tempelfjorden, evidently from the Mid Wordiekammen Limestones. Chernyshev, quoted by Nathorst (1910), pointed out that these fusulinids were not *F. cylindrica*.

Schellwien (1908) described the common fusulinid of the Mid Wordiekammen Limestones as *Fusulina arctica*; he also records doubtfully identifiable *F. anderssoni* presumably also from the Mid Wordiekammen Limestones. His material was from Templet, Gipshuken, and Billefjorden; all these are localities in the area (Gee *et al.*, pl. 1) from which most of the present material has been collected.

Staff and Wedekind (1910) elaborated Schellwien's work. They transferred Schellwien's species to *Schellwienia*, refigured and redescribed *Schellwienia arctica*, and figured *S. anderssoni* for the first time. They also described a new species, *Schubertella transitoria*, making it the type of their new genus, *Schubertella*. They mention *Schellwienia* cf. *verneuili* (v. Möller) and *S.* cf. *exigua* Staff as occurring in Spitsbergen. Horizons and localities are not accurately defined.

Ozawa (1925*a*) figured and remarked on some '*Fusulinella*-like forms which seem to be congeneric with *Schubertella*', occurring with '*Fusulina*' and '*Staffella*' (i.e. *Ozawainella*) in some Carboniferous limestone from Spitsbergen. This material evidently includes *Fusiella*, *Profusulinella*, or *Fusulinella*, and this was for many years the only record of Moscovian fusulinids from Spitsbergen.

Thompson (1937) redescribed *Schubertella transitoria*, restricting it to the microspheric form of Staff and Wedekind, basing his redescription on material from the Middle Wordiekammen Limestones of Tempelfjorden; he identified and figured *Schwagerina anderssoni* (Schellwien)? and *Schwagerina*? *arctica* (Schellwien) also from this horizon.

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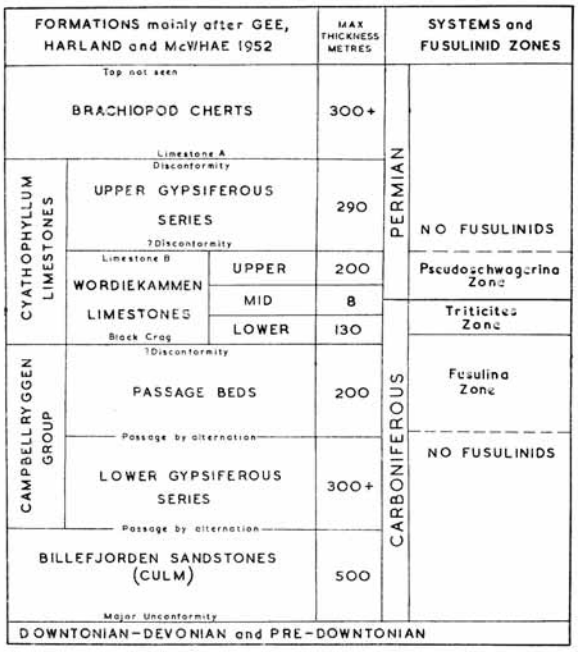
Baker, Forbes, and Holland (1952) mention indeterminable fusulinids from Kapp Scania near the entrance to Isfjorden. Forbes, Harland, and Hughes (1958) give faunal lists of which the fusulinid identifications are substantiated and somewhat extended by the descriptions given here, which also supersede the 'very precursory' identifications by H. C. Wang in Gee *et al.*, based on a small part of the material here studied (see Appendix).

Descriptive procedure. The rocks containing the fusulinids here studied are too well cemented for the usual methods of disintegration, so that attention has been focused on



TEXT-FIG. 1. Summary of Permian and Carboniferous stratigraphy of Central Vestspitsbergen.

those samples with fusulinids sufficiently abundant to give all necessary orientated sections in a reasonably small number of slices.

Genera are mostly used in the sense of Dunbar (in Cushman 1948), which is in accordance with well-established practice. Specific descriptions and remarks are here given to substantiate my use of the names used; they are based solely on my own specimens; type material has not been re-examined. For economy of space, dimensions have been tabulated (Table 1). The synonymy given for each species comprises only the references actually checked by me; where such references are given by Rauzer *et al.* 1951 they are omitted from both Synonymy and Bibliography.

SYSTEMATIC DESCRIPTIONS

Family FUSULINIDAE Möller emend. Dunbar
Subfamily FUSULININAE Rhumbler emend. Dunbar and Henbest
Genus PSEUDOSTAFFELLA Thompson
Pseudostaffella cf. *antiqua* (Dutkevich)

Plate 30, figs. 3–9

Cf. 1934 *Staffella antiqua* Dutkevich, p. 35, text-figs. 1–3 (trans. Ellis and Messina).
Cf. 1951 *Pseudostaffella antiqua* (Dutkevich); Rauzer *et al.*, p. 97, pl. 5, fig. 6.

Description. Small, globular, or with well-rounded periphery and slightly umbilicate poles. First two whorls coiled at right angles to later whorls. Septa slightly spiralled towards the poles. Chomata rather weak; tunnel angle variable, usually about 27°.

Remarks. P. antiqua (Dutkevich) s.s. is slightly smaller in all dimensions and may lack the well-marked endothyroid juvenarium of my material. Of other species few are so nearly spherical; *P. hollingsworthi* (Thompson) is similar but has a larger proloculus and more septa per whorl; *P. needhami* Thompson (type of this genus) is rather smaller in most dimensions but with larger proloculum and more rectangular outline in axial sections. Of Russian species described by Rauzer *et al.* (1951) *P. paracompressa* is very similar, but not quite so globular.

Pseudostaffella sphaeroidea (Möller)

Plate 30, figs. 10–13

1878 *Fusulinella sphaeroidea* (Ehrenberg); Möller, pp. 107–11, pl. 5, figs. 4*a–e*, pl. 15, figs. 1*a–b*.
1927 *Staffella sphaeroidea* (Möller); Lee, pp. 13–16, pl. 1, fig. 1; pl. 2, figs. 8–11.
1930 *Staffella sphaeroidea* Möller; Lee, Chen, and Chu, pp. 114, 115, pl. 6, fig. 26.
1930 *Staffella parasphaeroidea* Lee and Chen; Lee, Chen, and Chu, pp. 115, 116, pl. 6, figs. 27, 28.
1932 *Staffella sphaeroidea* (Möller); de Terra, p. 157, pl. 15, figs. 21, 22.
1951 *Pseudostaffella sphaeroidea* (Ehrenberg); Rauzer *et al.*, p. 128, pl. 9, figs. 3–5.

Description. Large for this genus, cylindrical, yielding axial sections nearly square. First two whorls more or less oblique to the later whorls. Chomata strong, tunnel angle narrow, about 19°.

Remarks. My material includes only two axial sections, and equatorials seem to differ from Möller's description in having as many as twenty-four (rather than twenty) septa

EXPLANATION OF PLATE 30

All figures magnified ×25.

Figs. 1–2. *Ozawainella spp.* 1, Black Crag, Lower Wordiekammen Limestones; sample F 30. 2, Passage Beds; sample T 11.
Figs. 3–9. *Pseudostaffella* cf. *antiqua* (Dutkevich). Passage Beds; sample F 51.
Figs. 10–13. *Pseudostaffella sphaeroidea* Möller. Passage Beds; sample T 11.
Figs. 14–15. *Wedekindellina spp.* 14, Probably Black Crag, Lower Wordiekammen Limestones; sample R 64. 15, Black Crag, Lower Wordiekammen Limestones; sample F 30.
Figs. 16–19. *Profusulinella* cf. *pararhomboides* Rauzer *et al.* Passage Beds; sample F 83.
Figs. 20–23. *Fusulinella eopulchra* Rauzer. Passage Beds; sample S 48.

in the fourth whorl and in being rather smaller (diameters up to 1·53 mm. rather than 1·81 mm.). Lee, Chen, and Chu (1930) distinguish *S. parasphaeroidea* as yielding axial sections subcircular not quadrate, as in Möller's species from which it also differs in being rather larger and in occurring at a slightly higher horizon. I find less than specific difference between these forms; specimens from station T 11 show variation sufficient to cover both. *Fusulinella quadrata* Deprat (1913) is similar to *P. sphaeroidea* and is included by Lee (1927) as a synonym, but to judge from Deprat's figures it differs in having weaker chomata. Other similar large species of *Pseudostaffella* are described by Rauzer *et al.* (1951).

Genus OZAWAINELLA Thompson

Ozawainella spp.

Plate 30, figs. 1, 2

Remarks. Specimens are few, and the absence of any good axial section renders specific identification impossible. It is quite likely that more than one species is present; contrast, for example, the crescentic tunnel in Pl. 30, fig. 1, with the D-section tunnel in Pl. 30, fig. 2. Comparable Russian species from the Middle and Upper Carboniferous are figured and described by Rauzer *et al.* (1951). Some at least of my material might be referred to *Parastaffella* Rauzer (Coogan 1958; Rauzer *et al.* 1951), but this genus would seem to be synonymous, at least in part, with *Ozawainella.*

Genus FUSULINELLA Möller

Fusulinella bocki Möller

Plate 31, figs. 1–3

1878 *Fusulinella bocki* Möller, pp. 104–7; pl. 5, figs. 3*a–g*; pl. 14, figs. 1–4.
1925*b* *Fusulinella bocki* Möller; Ozawa, pp. 17–18, pl. 3, figs. 7, 9, 10.
1927 *Neofusulinella bocki* (Möller); Lee, Chen, and Chu, pp. 121–2, pl. 8, figs. 8–15; pl. 9, figs. 1–9.
1932 *Fusulinella bocki* Möller; de Terra, p. 156, pl. 15, fig. 23.
1951 *Fusulinella bocki* Möller subsp. *timanica* Rauzer *in* Rauzer *et al.*, p. 220, pl. 31, fig. 10, pl. 32, fig. 1.

Description. Stoutly fusiform tapering convexly to bluntly pointed poles. Septa more or less plane for a short distance about the equator, but much convoluted at the poles. Chomata strong, tunnel narrow but expanding gradually, tunnel angle increasing from about 15° in the earlier whorls to 35° or 45° in the fifth and sixth.

Remarks. My material agrees well with Möller's and Lee's descriptions; of the Russian subspecies described by Rauzer *et al.* (1951) it is nearest to subsp. *timanica* but includes rather larger specimens besides more slender ones much resembling *F. bocki* s.s.

Fusulinella eopulchra Rauzer-Chernousova

Plate 30, figs. 20–23

1951 *Fusulinella eopulchra* Rauzer; in Rauzer *et al.*, p. 235, pl. 35, figs. 5–8.

Description. Stout and fusiform with concave flanks sloping from a convex equatorial

region to bluntly pointed poles. Septa smooth except at the poles, where they are fluted forming regular chamberlets. Chomata high and narrow, tunnel narrow about 15° tunnel angle throughout.

Remarks. The above description is based on six equatorial or central oblique and two axial sections all from station S 48; other samples have yielded a few oblique sections only. My specimens are generally rather larger than would be strictly conformable with Rauzer's description. Similar species are *F. librovitchi* Dutkevich and *F. cadyi* Thompson, both smaller and with endothyroid juvenaria which are not present in my material. *F. itoi* Ozawa is also small, while *F. devexa* Thompson has more whorls and is more slender. *F. pulchra* Rauzer is closely similar but rather more slender.

Fusulinella usvae Dutkevich

Plate 31, figs. 4–8

1932 *Fusulinella usvae* Dutkevich, p. 15.
?1954 *Pseudofusulinella utahensis* Thompson and Bissell *in* Thompson, p. 34.

Description. Fusiform with moderately pointed poles, axis commonly bent at the proloculum, flanks forming a slightly to markedly concave slope from near the equator to near the poles. In the outermost whorl the spirotheca consists of an outer thin, dark tectum and an inner thick, clear diaphanotheca which is perforate like a keriotheca. To these primary layers which together total about 0·028 mm. there is added in the inner whorls a thick outer tectorium and perhaps an indistinct thin inner tectorium. The keriothecal nature of the diaphanotheca is not well seen in the inner whorls, probably owing to blocking of the pores by secondary calcite, or to recrystallization during fossilization. Chomata high and generally narrow, tunnel narrow and rather sinuous, tunnel angle expanding gradually to about 26°. Secondary deposits present near the axis but not strongly developed.

Remarks. The assignment of this material to *Fusulinella* rather than to *Wearingella*, *Wedekindellina*, or *Fusulina* rests on the probable presence of an inner tectorium, the rather inflated form, the septa not folded except at the poles, and the weakness of secondary axial deposits.

The genus *Pseudofusulinella* Thompson (1951) includes forms from the *Pseudoschwagerina* zone which are similar to my material, especially in having a perforate spirotheca. It seems to me, however, that *Pseudofusulinella* should not be separated from *Fusulinella*. Thompson remarks on the similarity between the two genera and bases his separation on the presence of axial deposits in *Pseudofusulinella* and on the nature of the spirotheca. But pores have been described in the spirotheca of *Fusulinella* (Dunbar and Skinner, 1937, interpreting earlier work), and the presence of axial deposits is not in itself of generic importance.

EXPLANATION OF PLATE 31

All figures magnified ×25.

Figs. 1–3. *Fusulinella bocki* Möller. Passage Beds; sample B 372.

Figs. 4–8. *Fusulinella usvae* Dutkevich. 4–5, Upper Wordiekammen Limestones; sample S 91. 6–8 Lower Wordiekammen Limestones; sample 201.

Similar species of *Fusulinella* are discussed under *F. eopulchra*. *Wearingella bailkeyi* Thompson, Verville, and Bissell, 1950, has a very similar gross appearance but is stated to lack an inner tectorium. *Pseudofusulinella utahensis* is closely similar but rather stouter in proportion to its length.

Genus PROFUSULINELLA Rauzer *et al.*

Remarks. Dunbar *in* Cushman (1948) considered *Profusulinella* to be a junior subjective synonym of *Fusiella* Lee and Chen, both genera being based on small fusulinids with similar wall structure and from similar horizons. Thompson (1948) cites the smaller size, more elongate form, and presence of axial fillings as distinguishing *Fusiella* from *Profusulinella*, and he is here followed in conformity with current Russian practice for the species considered; but if the numerous Russian and American species now known do form a continuous series, all should evidently be placed in *Fusiella*.

Profusulinella cf. *pararhomboides* Rauzer *et al.*

Plate 30, figs. 16–19

Cf. 1951 *Profusulinella pararhomboides* Rauzer and Belyaev *in* Rauzer *et al.*, p. 172, pl. 17, fig. 3.
Cf. 1948 *Profusulinella pararhomboides* Rauzer and Belyaev; Thompson, p. 39, pl. 6, fig. 2.

Description. Fusiform, tapering evenly to bluntly pointed poles, or barrel-shaped with broadly rounded poles. First two whorls usually oblique to axis of later whorls. Septa plane for most of their length, with irregular folding at the extreme poles. Chomata moderately strong, tunnel angle variable, 10°–15°, expanding to 30° or 40° in the fourth whorl or up to 66° in the fifth.

Remarks. My material differs from *P. pararhomboides* in having a greater tendency to rounded ends and smaller prolocula; the spirotheca is also rather thicker.

Genus WEDEKINDELLINA Dunbar and Henbest

Wedekindellina spp.

Plate 30, figs. 14, 15

Remarks. Sections are few and poor, and no axial sections have been obtained. Pl. 30, fig. 15 closely resembles *W. euthysepta* (Henbest), the type species of the genus figured by Thompson (1948), and *W. dutkevichi* Rauzer and Belyaev figured by Rauzer *et al.* (1936; 1951) is also a possible identification.

Genus SCHUBERTELLA Staff and Wedekind

1910 *Schubertella* Staff and Wedekind, p. 121, pl. 4, figs. 7, 8.
1937 *Schubertella* Thompson, p. 120 (including *Eoschubertelle* Thompson, p. 123).

Remarks. My specimens are too few or, in some cases, too poorly preserved to say here what species are present. Material from the Mid Wordiekammen Limestones comprises only the two individuals in Sample 140 identified by Wang as *S. transitoria* Staff and Wedekind. These oblique sections agree fairly well with the original description by Staff

and Wedekind (1910), but are rather larger in all dimensions than the larger of their two figured specimens. Thompson (1937) redescribed *S. transitoria* on the basis of material evidently from the Mid Wordiekammen Limestones and he may well be right in suspecting that the magnification of Staff and Wedekind's figures is less than they say. He is more likely to be wrong in suggesting that the figures (which are drawings) are composite, since the authors state that by good luck they found their two well-orientated sections in one slice.

S. transitoria was described by Staff and Wedekind from an unspecified horizon or locality in Spitsbergen. Thompson's material is not from accurately located horizons or localities and the originals should therefore be re-examined before Thompson's 'topotypes' are accepted as such and before his restriction of the species to 'forms with small prolocula' is accepted.

Genus EOFUSULINA Rauzer, *in* Rauzer *et al.*, 1951

Eofusulina cf. *triangula* (Rauzer and Belyaev)

Plate 32, figs. 1, 2

Cf. 1951 *Eofusulina triangula* (Rauzer and Belyaev); Rauzer *et al.*, p. 269, pl. 43, figs. 1, 2.
Cf. 1958 *Eofusulina triangula* (Rauzer and Belyaev); Coogan, p. 307, text-figs. 2, 6.

Description. Slender and biconical with pointed or slightly rounded poles, axis often bent at the proloculum. Septa deeply and regularly folded forming chamberlets over the whole length. Chomata weak or quite absent. Tunnel wide, tunnel angle increasing from 51° to 71°.

Remarks. Specimens are few but attain a larger size, with larger prolocula and more septa per whorl than is given in the published descriptions. The spirotheca is thin but the fine structure is not seen.

Subfamily SCHWAGERININAE Dunbar and Henbest

Genus TRITICITES Girty

Triticites arcticus (Schellwien)

Plate 32, figs. 10–17

1908 *Fusulina arctica* Schellwien, pp. 173–4, pl. 16, figs. 3–9.
1910 *Schellwienia arctica* (Schellwien); Staff and Wedekind, pp. 115–18, pl. 4, figs. 4–6.
1938 *Triticites arcticus* Schellwien; Rauzer, pp. 115–17, pl. 4, figs. 5, 6.

Description. Moderately slender, the flanks curving evenly convex from equator to slightly rounded poles. Septa deeply folded, generally irregular but sometimes in part regular. Septal pores present but not often seen. Tunnel angle irregular, increasing from

EXPLANATION OF PLATE 32

All figures magnified × 10.

Figs. 1–2. *Eofusulina* cf. *triangula* (Rauzer and Belyaev). Passage Beds; sample T 11.

Figs. 3–5. *Quasifusulina longissima* (Möller) s.l. Passage Beds; sample B 372.

Figs. 6–9. *Triticites* cf. *osagensis* Newell, Lower Wordiekammen Limestones. 6–7, Sample S 88 (location not known). 8–9, Sample LM 12.

Figs. 10–17. *Triticites arcticus* (Schellwien). Mid Wordiekammen Limestones. 10–11, Sample LM 5. 12–13, Sample S 29. 14, Sample S 50. 15–17, Sample S 90, pieces 1, 2.

about 30° in the inner whorls to as much as 50° or 73° in the fifth or sixth whorl. Chomata present in at least the first three whorls. Secondary axial deposits weak or absent.

Remarks. The above description is based on specimens from S 90 pieces 1, 2, which have been investigated in rather more detail than other samples. It seems that the Schwagerinids in these samples are best considered as belonging to one single, highly variable, advanced species, *Triticites arcticus*. No *Schwagerina* species is clearly separable though small specimens may resemble *Schwagerina anderssoni*. This is the conclusion also reached by Schellwien (1908, p. 193) who distinguishes *S. anderssoni* as having more septa in the fourth whorl and more regular septal folding; *S. anderssoni* is described below, and the close similarity of size and axial ratio is seen in Table 1.

The relationship and possible synonymy of *T. arcticus* with '*Fusulina*' *alpina* Schellwien needs further investigation; Staff and Wedekind (1910, p. 118) separate these species on very slight grounds.

Triticites cf. *osagensis* Newell

Plate 32, figs. 6–9

Cf. 1934 *Triticites osagensis* Newell, pp. 423–4, pl. 52, figs. 4*a–f*, pl. 52, fig. 4.
1950 *Triticites* (*Triticites*) *ohioensis* Rozovskaya [*non* Thompson], pp. 22–23, pl. 4, figs. 12–22.

Description. Elongate fusiform, large individuals being especially slender, with bluntly rounded poles. Septa irregularly fluted over the whole length, forming chamberlets and perforated by numerous septal pores, especially near the poles. Chomata weak, and almost obsolete by the outer whorl. Tunnel angle about 20° in the inner whorls expanding widely especially in the outer whorl to about 90° or as much as 105° in one specimen.

Remarks. T. ohioensis of Rozovskaya differs from Thompson's species in having a rather larger proloculum, rather stouter form, seemingly coarser alveolar structure in the inner whorls, and more strongly folded septa. (See Dunbar and Henbest 1942, for an extended account of Thompson's species.)

Of other American species *T. osagensis* Newell agrees quite well with my material and the Russian, but is more slender and has a minute proloculum.

Of other Russian species described by Rozovskaya *T.* (*Rauserites*) *variabilis* is nearest my material but, at least in well-grown specimens, it has a stouter form.

The rapid expansion of the tunnel in the last whorl, which is characteristic of this group of *Triticites*, is very well seen in my material.

This species differs from *T. arcticus* (see above) in having generally a smaller proloculum, a more slender form, very irregular septal fluting, and very numerous large septal pores.

Genus SCHWAGERINA Möller 1877

Type species *Borelis princeps* Ehrenberg

1936 *Schwagerina* Dunbar and Skinner, p. 85.
1948 *Schwagerina* Dunbar *in* Cushman, p. 157.

Remarks. Usage of the name *Schwagerina* is confused. Dunbar *in* Cushman (1948) and

Thompson (1948) use it in slightly different senses; Dunbar keeps *Pseudofusulina* Dunbar and Skinner in synonymy, but Thompson separates it. The usage of recent Russian authors (e.g. Rauzer and Belyaev 1938; Rauzer and Shcherbovich 1949; Rozovskaya 1952) would include the species described below, in *Pseudofusulina*, understanding *Schwagerina* in a sense roughly equivalent to *Paraschwagerina* Dunbar and Skinner. Opinion 213 of the International Commission on Zoological Nomenclature (1954) has, it is to be hoped, stabilized *Schwagerina* in Dunbar and Skinner's sense, as here used.

Schwagerina princeps (Ehrenberg) Dunbar and Skinner

Plate 33, figs. 8–11

1908 *Fusulina krotowi* Schellwien, pp. 190–2, pl. 20, figs. 1–10.
1932 *Schwagerina princeps* (Ehrenberg); de Terra, pp. 155–6, pl. 15, figs. 27–28.
1936 *Schwagerina princeps* (Ehrenberg); Dunbar and Skinner, pp. 86–87, pl. 10, figs. 1–11.

Description. Stout and fusiform, the flanks forming convex slopes to the pointed poles. Chomata weak or nearly absent especially in the outer whorls; tunnel narrow and wandering slightly in an irregular manner with tunnel angle expanding slightly to about 27°.

Remarks. My specimens are few from each sample, but the axial sections are plainly of this species. Comparison with Dunbar and Skinner's redescription of the types shows that my specimens are generally about one whorl larger, rather more elongate, and perhaps with more septa per whorl in the outer whorls. They agree better with Schellwien's *F. krotowi*, which Dunbar and Skinner cite as a synonym of *S. princeps*. See Rauzer and Belyaev (1938) for several species which may be synonyms.

Schwagerina anderssoni (Schellwien)

Plate 33, figs. 1–4; cf. Plate 33, figs. 5–7

1908 *Fusulina anderssoni* Schwellwien, pp. 192–3 (no figures).
1910 *Schellwienia anderssoni* (Schellwien); Staff and Wedekind, pp. 119–20, pl. 3, figs. 1–5.
1927 *Schellwienia anderssoni* (Schellwien); Lee, pp. 57–59, pl. 7, figs. 11–13.
1934 *Pseudofusulina anderssoni* (Schellwien); Chen, pp. 60–62, pl. 4, fig. 20, pl. 5, fig. 15.
1936 *Pseudofusulina anderssoni* (Schellwien); Rauzer *et al.*, pp. 195–7, pl. 4, figs. 1, 2.
1937 *Schwagerina anderssoni* (Schellwien); Thompson, pl. 20, fig. 11.

Description. Fusiform with straight or convex lateral slopes and bluntly pointed poles.

EXPLANATION OF PLATE 33

All figures magnified × 10.

Figs. 1–4. *Schwagerina anderssoni* (Schellwien). Mid Wordiekammen Limestones; sample 140.

Figs. 5–7. *Schwagerina* cf. *anderssoni* (Schellwien). Mid Wordiekammen Limestones; sample S 90, piece 3.

Figs. 8–11. *Schwagerina princeps* (Ehrenberg) Dunbar and Skinner. Upper Wordiekammen Limestones. 8–9, Sample S 91. 10–11, Sample S 10.

Figs. 12–15. *Schwagerina* cf. *emaciata* (Beede). Upper Wordiekammen Limestones. 12–14, Sample 210–14. 15, Sample S 10.

Figs. 16–18. *Schwagerina schwageriniformis* (Rauzer *et al*). Upper Wordiekammen Limestones. 16–17, Sample S 30. 18, Sample S 92.

Figs. 19–20. ?*Parafusulina lutugini* (Schellwien). Upper Wordiekammen Limestones; sample S 32.

Septal folds typically high, narrow, and regular with incipient cuniculi. Septal pores not seen. Tunnel angle increasing throughout to an average maximum about 54° in the last whorl. Chomata present, axial deposits well developed.

Remarks. The above description is based on material from sample 140 which comprised one piece of rock only. Samples 130, 139 nominally from the same place yield only *Triticites arcticus*, which differs in having septal folding less regular and less intense, tunnel generally expanding more in the last whorl, slightly larger proloculum, axial deposits quite or nearly absent, and septal pores present. The few *Triticites sp.* present in sample 140 seem to differ from *T. arcticus* in being more slender, with thinner spirotheca and septal folding quite irregular, features which also give a clear differentiation from *Schwagerina anderssoni.*

S. cf. *anderssoni* from sample S 90, piece 3, is in most respects identical with *S. anderssoni* as here described but is rather smaller and more slender; see Table 1.

Schwagerina cf. *emaciata* (Beede)

Plate 33, figs. 12–15

Cf. 1927 *Fusulina emaciata* Beede; Dunbar and Condra, p. 116, pl. 10, figs. 1–3.
Cf. 1937 *Schwagerina emaciata* Beede; Dunbar and Skinner, p. 633, pl. 56, figs. 1–12.

Description. Small and moderately stout with lateral slopes usually straight but sometimes convex; poles rounded or bluntly pointed. Septal folding moderately deep and regular; septal pores not seen. Tunnel angle 30°–57°, average 42°, expanding slowly throughout growth to this value. Chomata present but generally in first four whorls only. Secondary axial deposits generally absent, and never well developed.

Remarks. The dimensions in Table 1 are based on Sample 210–4, specimens in other samples being few but similar. This species is distinguished from others occurring in Spitsbergen by a combination of small size, rather slender habit, and absence of secondary axial deposits. It differs from *S. emaciata* s.s. in being slightly smaller and with a somewhat wider tunnel angle; *S. emaciata* v. *jarillaensis* Needham 1937 is closely similar but has less strongly fluted septa. *S. patens* Dunbar and Newell 1946, *S. providens* Thompson and Hazzard 1946, *S. vervillei* Thompson 1954 are all similar but rather larger, though still small compared to most members of this genus.

Schwagerina schwageriniformis (Rauzer *et al.*)

Plate 33, figs. 16–18

1936 *Pseudofusulina schwageriniformis* Rauzer *et al.*, pp. 198–200, 224, pl. 4, figs. 3–6, pl. 5, fig. 1.

Description. Stout and fusiform with more or less rounded poles and convex rounded flanks. Tunnel angle 23°–44°, average 33°. Axial deposits absent. Chomata absent or nearly so.

Remarks. My individuals are generally smaller than the types, but the largest agree very well.

Genus PARAFUSULINA Dunbar and Skinner
? *Parafusulina lutugini* (Schellwien)

Plate 33, figs. 19–20

?1908 *Fusulina lutugini*, Schellwien, pp. 177–8, pl. 17, figs. 2, 3, 7, 8, 12–14.
?1908 *Fusulina verneuli* (Möller), Schellwien, *partim* (i.e. slender specimens).
?1935 *Pseudofusulina lutugini* (Schellwien); Rauzer, pp. 142–5, pl. 1, figs. 1–5.
?1939 *Parafusulina lutugini* Likharev, p. 40, pl. 3, figs. 6, 7.

Description. Cylindrical with rounded poles. Septal folds rather low but regular. Cuniculi not clearly seen. Tunnel angle 41°, 42° in two axial sections. Chomata present, at least in the earlier whorls. Axial deposits absent or weak.

Remarks. My material comprises few individuals, and I have not seen clearly the generically characteristic cuniculi formed by deep septal folding. The subcylindrical form and minute proloculum are characteristic, but both specific and generic identification must remain doubtful for the present.

Dunbar (1946) quotes Rauzer as having found cuniculi absent in this species, but Likharev must presumably have observed them since he places the species in *Parafusulina*. The matter evidently requires closer investigation.

Parafusulina alaskensis Dunbar 1946 is similar and may be a synonym, if *P. lutugini* is rightly placed in *Parafusulina*. *P. kattaensis* (Schwager) and *P. subtensa* Chernyshev are similar but have larger prolocula (Dunbar 1946). '*Schellwienia*' *granumavenae* Roemer is a *Schwagerina* species very similar to *P. lutugini*, and considered by Ozawa 1927 to be a senior synonym of it.

Genus QUASIFUSULINA Chen
Quasifusulina longissima (Möller) s.l.

Plate 32, figs. 3–5

1878 *Fusulina longissima* Möller, pp. 59–64, pl. 1, fig. 4; pl. 2, figs. 1*a–c*; pl. 7, figs. 1*a–d*.
1908 *Fusulina longissima* Möller; Schellwien, pp. 163–5, pl. 13, figs. 14–20.
1927 *Schellwienia longissima* Möller; Lee, pp. 111–18; pl. 19, figs. 11–14; pl. 20–21, pl. 22, figs. 1–5.
1934 *Quasifusulina longissima* (Möller); Chen, pp. 92–93, pl. 5, figs. 6–9.

Description. Fusiform, nearly cylindrical. Septal folds forming regular chamberlets. Tunnel angle 18° expanding to about 40° in the outer whorls. Chomata present, not well seen. Secondary axial deposits well developed.

Remarks. The fine structure of the spirotheca is indistinctly seen, but seems to have the pores described by Chen, and by Dunbar *in* Cushman 1948; it is rather thick for this species. The gross appearance of the shell agrees well with Schellwien's description and figures; my specimens are more slender than most of those figured by Chen. The material is too scanty for varietal identification to be attempted here.

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TABLE 1

All dimensions are in millimetres. The 'Axial Ratio' quoted is the ratio Length: Diameter.

		Pseudostaffella cf. *antiqua*	*Pseudostaffella sphaeroidea*	*Fusulinella bocki*	*Fusulinella eopulchra*	*Fusulinella usvae*	*Profusulinella pararhombiodes*	*Eofusulina triangula*	*Quasifusulina longissima*
Sections measured	Axial	11	2	3	1	3	3	2	2
	Other	6	11	5	8	7	7	4	4
Proloc. diam.	Range	0·03–0·05	0·05–0·09	0·06–0·15	0·12–0·20	0·06–0·19	0·05–0·10	0·20–0·30	0·28–0·44
	Av.	0·04	0·07	0·11	0·15	0·13	0·07	0·25	0·37
Length	Range	0·44–0·76	1·10–1·20	3·30–4·10	2·03–2·76	2·86–6·02	0·84–1·88	2·92–8·20	5·40–8·10
	Av.	0·57		3·83		4·65			
Diameter	Range	0·56–0·84	0·68–1·53	1·29–2·31	0·90–1·55	1·17–1·97	0·50–1·00	0·60–1·80	1·40–1·61
	Av.	0·66	1·08	1·67	1·16	1·70			
Axial ratio	Range	0·68–1·00	0·90–0·95	1·80–2·00	1·97	2·64–3·06	1·70–1·90	4·90–4·95	3·84–5·10
	Av.	0·86	0·93						
No. of whorls		4–5½	5–8½	4–5½	4–6	6–8½	4–5½	2–4½	4–5½
Spirotheca max. thickness		0·15–0·30	0·02–0·04	0·05–0·09	0·02 (apx.)	0·03–0·06	0·01–0·03	0·02–0·03	0·03

		Triticites arcticus	*Triticites* cf. *osagensis*	*Schwagerina princeps*	*Schwagerina anderssoni*	*Schwagerina* cf. *anderssoni*	*Schwagerina schwageriniformis*	*Schwagerina* cf. *emaciata*	?*Parafusulina lutugini*
Sections measured	Axial	12	9	8	12	17	11	7	2
	Other	10	10	7	10	10	7	5	5
Proloc. diam.	Range	0·15–0·32	0·18–0·28	0·07–0·17	0·16–0·24	0·12–0·21	0·13–0·23	0·07–0·12	0·12–0·22
	Av.	0·25	0·24	0·09	0·20	0·17	0·18	0·09	0·14
Length	Range	3·42–8·80	3·0–10·24	3·46–5·90	3·42–7·22	2·90–6·92	4·94–7·40	2·74–5·28	6·66–9·28
	Av.	5·90	7·10	4·59	5·52	4·95	6·58	4·20	7·94
Diameter	Range	1·14–2·71	0·91–2·67	1·72–3·48	1·50–2·54	1·01–2·10	2·34–3·54	1·23–1·97	1·75–2·22
	Av.	2·03	2·50	2·39	1·97	1·45	2·95	1·57	1·97
Axial ratio	Range	2·71–3·27	3·30–4·30	1·54–2·12	2·28–3·45	2·76–4·16	1·93–2·77	2·45–3·20	3·40–4·18
	Av.	2·90	3·77	1·79	2·75	3·35	2·52	2·69	3·69
No. of whorls		4–6	3–6	6–8	5–6½	4½–6½	4½–7	5–6½	5–8
Spirotheca max. thickness		0·06–0·10	0·05–0·08	0·07–0·12	0·06–0·10	0·05–0·07	0·08–0·13	0·07–0·09	0·06–0·09

APPENDIX

List of samples and faunas

(*a*) Samples collected in 1938, including the material identified by Wang *in* Gee *et al.*, table 3.

75–79, 81, 100. Gee *et al.*, table 3 column c, and pl. 2, Section H 740 ft. above base of Black Crag; Upper Wordiekammen Limestones. *Schwagerina schwageriniformis*, including specimens ident. Wang as *Triticites secalicus*, misprinted as *Triticites secularis*.

139. Gee *et al.*, table 3 column 1, and pl. 2, Section H 400 ft. above base of Black Crag; Mid Wordiekammen Limestones. See also sample 140. *Triticites arcticus*, including specimens ident. Wang as *Schwagerina anders*[*s*]*oni*.

140. Location and horizon nominally the same as samples 139 above. *Schwagerina anderssoni*, including specimens ident. Wang as *Schwagerina arctica*, and as *Schwagerina anders*[*s*]*oni*. *Schubertella sp.*, ident. Wang as *Schubertella transitoria*.

184. Gee *et al.*, table 3 'Watsondalen 1', Mid Wordiekammen Limestones. *Triticites arcticus*?, including specimens ident. Wang as *Schwagerina anders*[*s*]*oni*. Insufficient for certain identification.

201. Gee *et al.*, table 3 column 1, and pl. 2, Section I Campbellryggen south-west spur 110 ft. above base of Black Crag; Lower Wordiekammen Limestones. *Fusulinella usvae*, ident. Wang (but not sectioned by him) as *Schwagerina* cf. *arctica*.

210–14. Gee *et al.*, table 3 Tyrellfjellet, north spur, Middle, 560 ft. above base of Black Crag; Upper Wordiekammen Limestones. *Schubertella sp.* Not seen by Wang. *Schwagerina* cf. *emaciata*, including specimens ident. Wang as *Schwagerina anders*[*s*]*oni*, and as *Schwagerina arctica*.

215. Gee *et al.*, table 3 Tyrellfjellet, north spur, Lower, 370 ft. above base of Black Crag; ?Upper Wordiekammen Limestones. ?*Triticites arcticus*, ill-preserved material including specimens ident. Wang as *Schwagerina arctica*.

286 Gee *et al.*, table 3 and pl. 2, Section D, Campbellryggen north-east spur. Lower 740 ft. above base of Black Crag; Upper Wordiekammen Limestones. ?*Schwagerina princeps* and *Schwagerina sp.*, ill-preserved material including specimens ident. Wang as *Schwagerina arctica*.

(*b*) Samples collected after 1938 and not seen by Wang. Place names and locations refer to Gee *et al.*, pl. 1, unless otherwise stated.

B 372. To the north of mid-Chydeniusbreen above Raudryggen, about 20 miles north-east of the area shown by Gee *et al.*, pl. 1. Passage Beds. *Fusulinella bocki*, *Wedekindellina sp*?, *Quasifusulina longissima*, s. l.

F 30. Highest exposed bed of massive limestone, just below rubbly limestone; east spur of Ferrierfjellet, Black Crag, Lower Wordiekammen Limestones. *Ozawainella sp.*, *Wedekindellina sp.*

F 36. Near base of 45 ft. massive grey crag-forming limestone, i.e., about 20 ft. above highest gypsum; north side of Urmstonfjellet; lat. 78° 37·5′ N., long. 17° 10′ E. Passage Beds. *Pseudostaffella sphaeroidea*, *Ozawainella sp.*

F 51. Lower part of 11 ft. grey limestone with base 33 ft. above unconformity at base of Carboniferous; spur of Minkinfjellet; lat. 78° 38′ N., long. 17° 22′ E. Passage Beds. *Pseudostaffella* cf. *antiqua*.

F 83. 4 ft. carious limestone with base 186 ft. above top of bed containing F 51. Passage Beds. *Profusulinella* cf. *pararhomboides*.

F 85. Near base of 10 ft. dark limestones, with base 15 ft. above F 83. Passage Beds. ?*Ozawainella sp.*, *Fusulinella eopulchra*, *Profusulinella pararhomboides*, *Pseudostaffella sphaeroidea*.

LM 5. Black bituminous limestone; stream section below Burn Murdochbreen; Mid Wordiekammen Limestones. *Triticites arcticus*.

LM 12. Black bituminous limestone, about 40 ft. stratigraphic thickness below LM 5. Lower Wordiekammen Limestones. *Schubertella sp.*, *Triticites* cf. *osagensis*.

R 64. Massive grey limestone; about 1½ km. south of fault outcrop on shore between Anservika and Phantomodden. ?Black Crag. ?*Pseudostaffella sphaeroidea*, *Ozawainella sp.*, *Fusulinella eopulchra*? *Wedekindellina sp.*

S 10. Black limestone with shale partings. Gee *et al.*, pl. 3. Section N, 410 ft. above base of Black Crag. Upper Wordiekammen Limestones. *Schwagerina princeps*, *Schwagerina* cf. *emaciata*, *Schubertella sp.*

S 29. 10 ft. Black fusuline limestone above scree. Gee *et al.*, pl. 2, Section J, 420 ft. above base of Black Crag. Mid Wordiekammen Limestones. *Triticites arcticus.*

S 30. Pale grey-brown siliceous limestone at asterisk 200 ft., above S 29. Upper Wordiekammen Limestone. *Schubertella sp., Schwagerina schwageriniformis.*

S 32. Pale-grey limestone with fusulinids partly silicified, asterisk 130 ft. above S 30. Upper Wordiekammen Limestones. ?*Parafusulina lutugini.*

S 41. Black fusulinid limestone 20 ft. thick base about 620 ft. above base of Black Crag; near summit of Wordiekammen; lat. 78° 41·5′ N., long. 16° 41·5′ E. Mid Wordiekammen Limestones. *Triticites arcticus.*

S 43. Grey limestone 30 ft. thick to summit of hill above S 41. Upper Wordiekammen Limestones. *Schwagerina princeps, Schwagerina anderssoni, Schwagerina* cf. *emaciata*?

S 48. 5 ft. black limestone, base at 600 ft. below base of Black Crag south-east flank of De Geerfjellet; lat. 78° 41·5′ N., long. 16° 50′ E. Passage Beds. *Fusulinella eopulchra.*

S 50. Black limestone at summit of De Geerfjellet, 360 ft. above base of Black Crag, point marked 1022. Mid Wordiekammen Limestones. *Triticites arcticus.*

S 66. 10 ft. grey porcellanous limestone, base 400 ft. above base of Black Crag. Gee *et al.*, pl. 3 and text-fig. 3, Section L. Lower Wordiekammen Limestones. *Triticites* cf. *osagensis, Schubertella sp.*

S 67. 5 ft. black limestone base 57 ft. above S 68. Mid Wordiekammen Limestones. *Triticites arcticus.*

S 85. 70 ft. massive grey bedded limestone, lower part of Limestone B, Upper Wordiekammen Limestones; lat. 78° 31·5′ N., long. 16° 30·5′ E. ?*Schwagerina princeps.*

S 90. 26 ft. black carbonaceous fusulina limestone, base 363 ft. above base of Black Crag, 9th bed up in Singleton's Campbellryggen North Section, Gee *et al.*, p. 328. Mid Wordiekammen Limestones. The sample comprises several pieces of which three have been examined: Pieces 1 and 2. *Triticites arcticus.* Abundant. Piece 3. *Schwagerina* cf. *anderssoni, Fusulinella usvae.*

S 91. 30 ft. limestone including 3 ft. flinty bed at the top, base 459 ft. above base of Black Crag. 11th bed up in Singleton's section, see S 90. Upper Wordiekammen Limestones. *Schwagerina princeps, Fusulinella usvae.*

S 92. 9 ft. limestone below main cliff, base about 600 ft. above base of Black Crag, included in thick fossiliferous limestone cliff (Limestone B) of Singleton's section, see S 90. Upper Wordiekammen Limestones. *Schwagerina schwageriniformis.*

T 11. 10 ft. limestone, top 400 ft. below base of Black Crag; lat. 78° 44·2′ N., long. 17° 5′ E. Passage Beds. *Pseudostaffella sphaeroidea, Ozawainella sp., Eofusulina* cf. *triangula, Fusulinella eopulchra*?

REFERENCES

BAKER, B. H., FORBES, C. L. and HOLLAND, M. F. W. 1952. Fossiliferous strata at Kapp Scania, Daudmannsøyra, Vestspitsbergen. *Geol. Mag.* **89,** 303–4.

CHEN, S. 1934. Fusulinidae of South China, Part. 1. *Palaeont. Sinica,* (B) **4** (2), 1–185, pl. 1–16.

COOGAN, A. H. 1958. Russian fusulinid genera. *J. Paleont.* **32,** 304–11.

CUSHMAN, J. A. 1948. *Foraminifera—their classification and economic use.* Fourth edition. Harvard Univ. Press, Cambridge, Mass.

DEPRAT, J. 1913. Étude des Fusulinidés de Chine et d'Indochine et classification des calcaires à Fusilines (2e mémoire). Les Fusulinidés des calcaires Carbonifériens et Permiens du Tonkin, du Laos et du Nord-Annam. *Mém. Serv. géol. Indoch.* (2) **1,** 1–76, pl. 1–14.

DUNBAR, C. O. and CONDRA, G. E. 1927. The Fusulinidae of the Pennsylvanian system in Nebraska. *Nebraska geol. Surv. Bull.* **2** (second series), 1–130, pl. 1–15.

DUNBAR, C. O. and SKINNER, J. W. 1936. Schwagerina versus Pseudoschwagerina and Paraschwagerina. *J. Paleont.* **10,** 83–91.

—— —— 1937. The Permian Fusulinidae of Texas. The geology of Texas. **3** (2). *Univ. Texas Bull.* **3701,** 517–825, pl. 42–81.

—— 1940. The Type Permian: its classification and correlation. *Bull. Amer. Ass. Petrol. Geol.* **24,** 237–81.

DUNBAR, C. O. and HENBEST, L. G. 1942. Pennsylvanian Fusulinidae of Illinois. *Bull. Illinois geol. Surv.* **61,** 1–218, pl. 1–23.

DUNBAR, C. O. 1946. Parafusulina from the Permian of Alaska. *Amer. Mus. Novit.* **1325,** 1–4.

DUNBAR, C. O. and NEWELL, N. D. 1946. Marine Early Permian of the Central Andes and its fusuline faunas. Parts 1 and 2. *Amer. J. Sci.* **244,** 377–402, 457–91, pl. 1–12.

DUTKEVICH, G. A. 1932. Geological investigations in the Eastern part of the Chusovski oil-bearing region. *Trans. geol. Oil Inst., Moscow*, A, **30,** 1–72.

—— 1934. Sur la stratigraphie du Carbonifère moyen de l'Oural. Ibid., A, **55,** 1–41.

FORBES, C. L., HARLAND, W. B. and HUGHES, N. F. 1958. Palaeontological evidence for the age of the Carboniferous and Permian rocks of Central Vestspitsbergen. *Geol. Mag.* **95,** 465–90.

FREBOLD, H. 1951. Geologie des Barentsschelfes. *Abh. dtsch. Akad. Wiss. Berl. Kl. Math. Nat. Jahrg.* 1950 Nr. 2, 1–156.

GEE, E. R., HARLAND, W. B. and MCWHAE, J. R. H. 1952. Geology of Central Vestspitsbergen: Pts. 1 and 2. *Trans. roy. Soc. Edinb.* **62,** 2 (9), 299–354, pl. 1–7.

GOËS, A. 1884. Om Fusulina cylindrica Fischer från Spetsbergen. *Öfvers. Vetensk Akad. Förh., Stockh., Årg.* **40** (8), 29–35.

GROZDILOVA, L. P. 1938. Fusulinidae of oil bearing limestones of Ishimbaevo district (Ural). *Trans. geol. Oil Inst., Moscow*, A, **101,** 90–192.

LEE, J. S. 1927. Fusulinidae of North China. *Palaeont. Sinica*, (B) **4** (1), 1–123, pl. 1–24.

LEE, J. S., CHEN, S. and CHU, S. 1930. Huanglung Limestone and its fauna. *Mem. Res. Inst. Geol., Shanghai*, **9,** 85–143, pl. 2–15.

LIKHAREV, B. K. 1939. Atlas of the leading forms of the fossil faunas of the U.S.S.R. **6,** Permian. *Central Geol. Prosp. Inst., Leningrad.*

MÖLLER, V. VON. 1878. Die spiral-gewunden Foraminiferen des russischen Kohlenkalkes. *Mém. Acad. Sci. St. Pétersb.* (7) **25** (9) 1–147, pl. 1–15.

NATHORST, A. G. 1910. Beiträge zur Geologie der Bäreninsel, Spitsbergens, und des Konig-Karl-Landes. *Bull. geol. Instn. Univ. Uppsala*, **10,** 261–415, pl. 14–15.

NEEDHAM, C. E. 1937. Some New Mexico Fusulinidae. *Bull. N. Mex. Sch. Min.* **14,** 1–88, pl. 1–12.

NEWELL, N. D. 1934. Some mid-Pennsylvanian invertebrates from Kansas and Oklahoma. 1. Fusulinidae, Brachiopoda. *J. Paleont.* **8,** 422–32, pl. 52–55.

NEWELL, N. D., CHRONIC, J. and ROBERTS, T. G. 1953. Upper Palaeozoic of Peru. *Mem. geol. Soc. Amer.* **58,** 1–276, pl. 1–44.

OZAWA, Y. 1925*a*. On the classification of the Fusulinidae. *J. Coll. Sci. Tokyo*, **45** (4), 1–26, pl. 1–4.

—— 1925*b*. Paleontological and stratigraphical studies on the Permo-Carboniferous limestone of Nagato. Part. 2, Paleontology. Ibid., **45** (6), 1–90, pl. 1–14.

—— 1927. Stratigraphic studies of the Fusulina Limestone of Akasaka, Province of Mino. *J. Fac. Sci. Tokyo Univ.* Section 2, **2** (3), 121–64, pl. 34–46.

RAUZER-CHERNOUSOVA, D. M. 1935. On the Lower Permian age of the sediments with Pseudofusulina lutugini (Schellwien) on the Western slopes of the Urals. *Bull. Soc. Nat. Moscou*, **43** (Sect. Géol. 13), 129–54, pl. 1–2.

RAUZER-CHERNOUSOVA, D. M., BELYAEV, G. M. and REĬTLINGER, E. 1936. The Upper Palaeozoic Foraminirfera of Petschoraland. *Trud. polyar. Komiss.* **28,** 159–232, pl. 1–6.

—— 1938. The Upper Palaeozoic Foraminifera of the Samara Bend. *Trav. Inst. géol. U.R.S.S.* **7,** 69–167, pl. 1–9.

RAUZER-CHERNOUSOVA, D. M. and BELYAEV, G. M. 1938. On some fusulinids of the Schwagerina Horizon (the group of Pseudo-fusulina uralica Krotow). Ibid. 169–96, pl. 1–2.

RAUZER-CHERNOUSOVA, D. M. and SHCHERBOVICH, S. F. 1949. Schwagerininae from the European Part of the U.S.S.R. Ibid. 105 (geol. 35), 61–117, pl. 1–12. [C.E.D.P. trans. 749.]

RAUZER-CHERNOUSOVA, D. M., KIREEVA, G. D., LEONTOVICH, G. E., GRŸZLOVA, N. D., SAFONOVA, T. P. and CHERNOVA, E. I. 1951. Middle Carboniferous Fusulinids of the Russian Platform and adjacent regions. *Acad. Sci. U.S.S.R. Inst. geol. Sci. Ministry of Petroleum Exploration of the U.S.S.R.*, Moscow.

ROZOVSKAYA, S. E. 1950. The genus Triticites its subdivision and stratigraphical significance. *Trav. Inst. paléozool. Acad. Sci. U.R.S.S.* **24,** 1–78, pl. 1–10.

—— 1952. Fusulinidae of the Upper Carboniferous and the Lower Permian of the Southern Urals. Ibid. **40,** 3–50, 6 pls.

SCHELLWIEN, E. 1908. Monographie der Fusulinen. 1. Die Fusulinen des russich-arktischen Meeresgebietes. *Palaeontographica*, **55,** 145–94, pl. 13–20.

SEMIKHATOVA, S. V. (as SEMICHATOV, S. V.) 1936. Upper and Lower Boundary of the Middle Carboniferous Moscovian Stage. *Amer. J. Sci.* (5) **32,** 222–33.

STAFF, H. and WEDEKIND, R. 1910. Der Oberkarbone Foraminiferensapropelit Spitzbergens. *Bull. geol. Inst. Univ. Uppsala*, **10,** 81–123, pl. 2–4.

DE TERRA, H. 1932. *Wissenschaftliche Ergebnisse der Dr. Trinkler'schen Zentralasien Expedition.* 2. *Geologische Forschungen im westlichen K'un Lun und Karakorum Himalaya.* Berlin.

THOMPSON, M. L., 1937. Fusulinids of the subfamily Schubertellinae. *J. Paleont.* **11,** 118–25, pl. 22.

THOMPSON, M. L. and HAZZARD, J. C. 1946. *In* Thompson, M. L., Wheeler, H. E. and Hazzard, J. C. Permian fusulinids of California. *Mem. geol. Soc. Amer.* **17,** 1–77, pl. 1–18.

—— 1948. Studies of American Fusulinids. *Univ. Kansas Paleont. Contr.* **4** (Protozoa 1), 1–184, pl. 1–38.

THOMPSON, M. L., VERVILLE, G. J. and BISSELL, H. J. 1950. Pennsylvanian Fusulinids of the south-central Wasatch Mountains, Utah. *J. Paleont.* **24,** 430–65, pl. 57–64.

—— 1951. New genera of Fusulinid foraminifera. *Contr. Cushman Fdn.*, **2,** 115–19, pl. 13–14.

—— 1954. American Wolfcampian Fusulinids. *Univ. Kansas Paleont. Contr.* **14** (Protozoa 5), 1–226, pl. 1–52.

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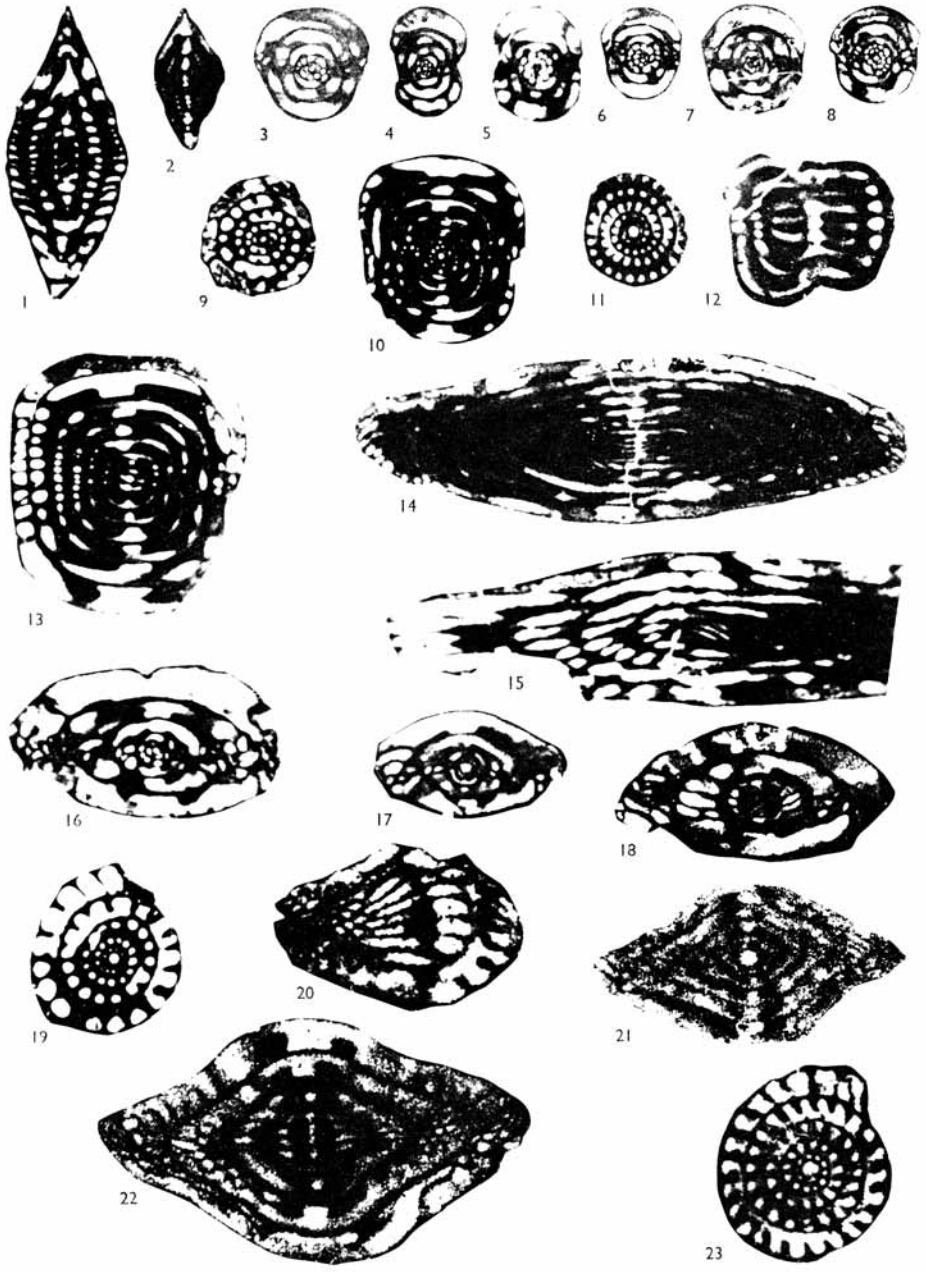
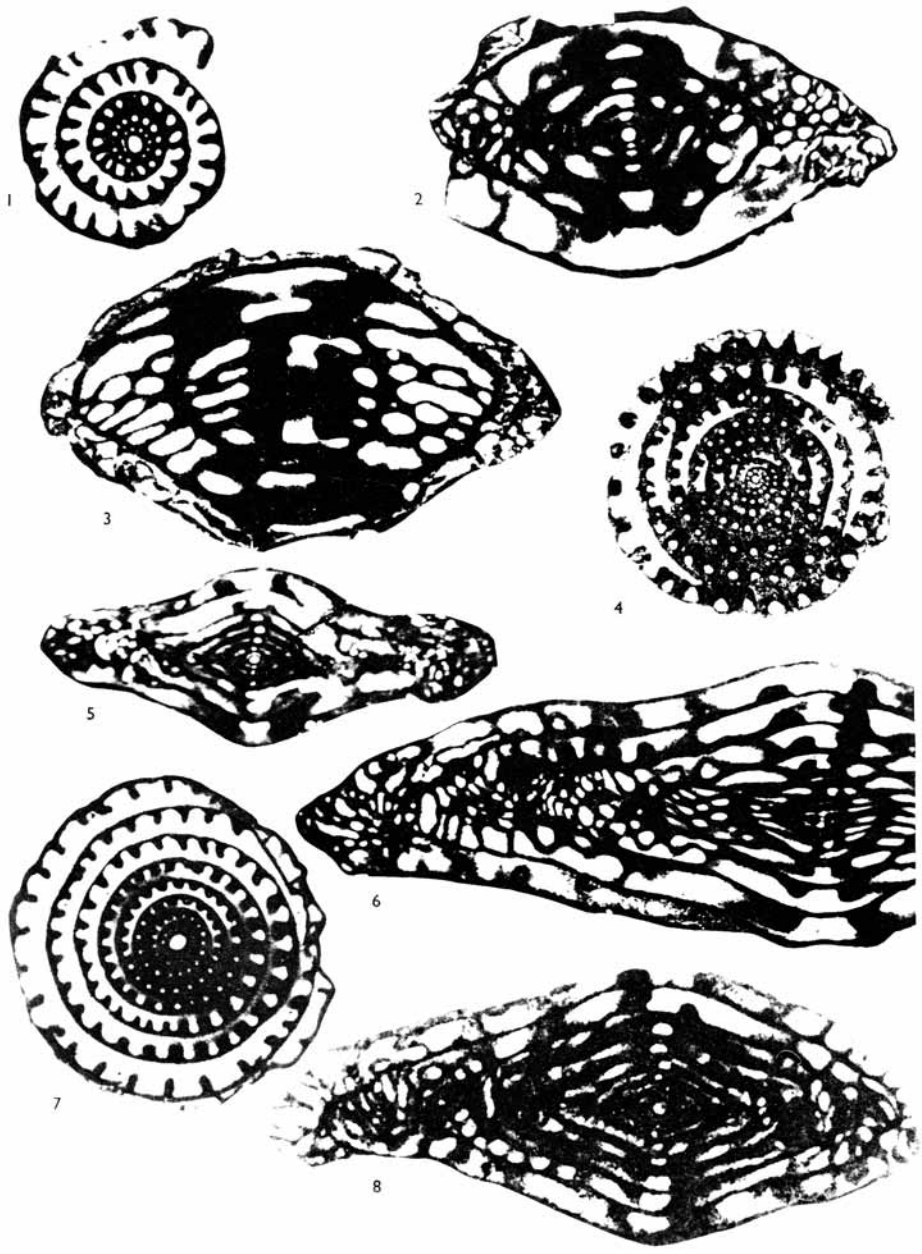
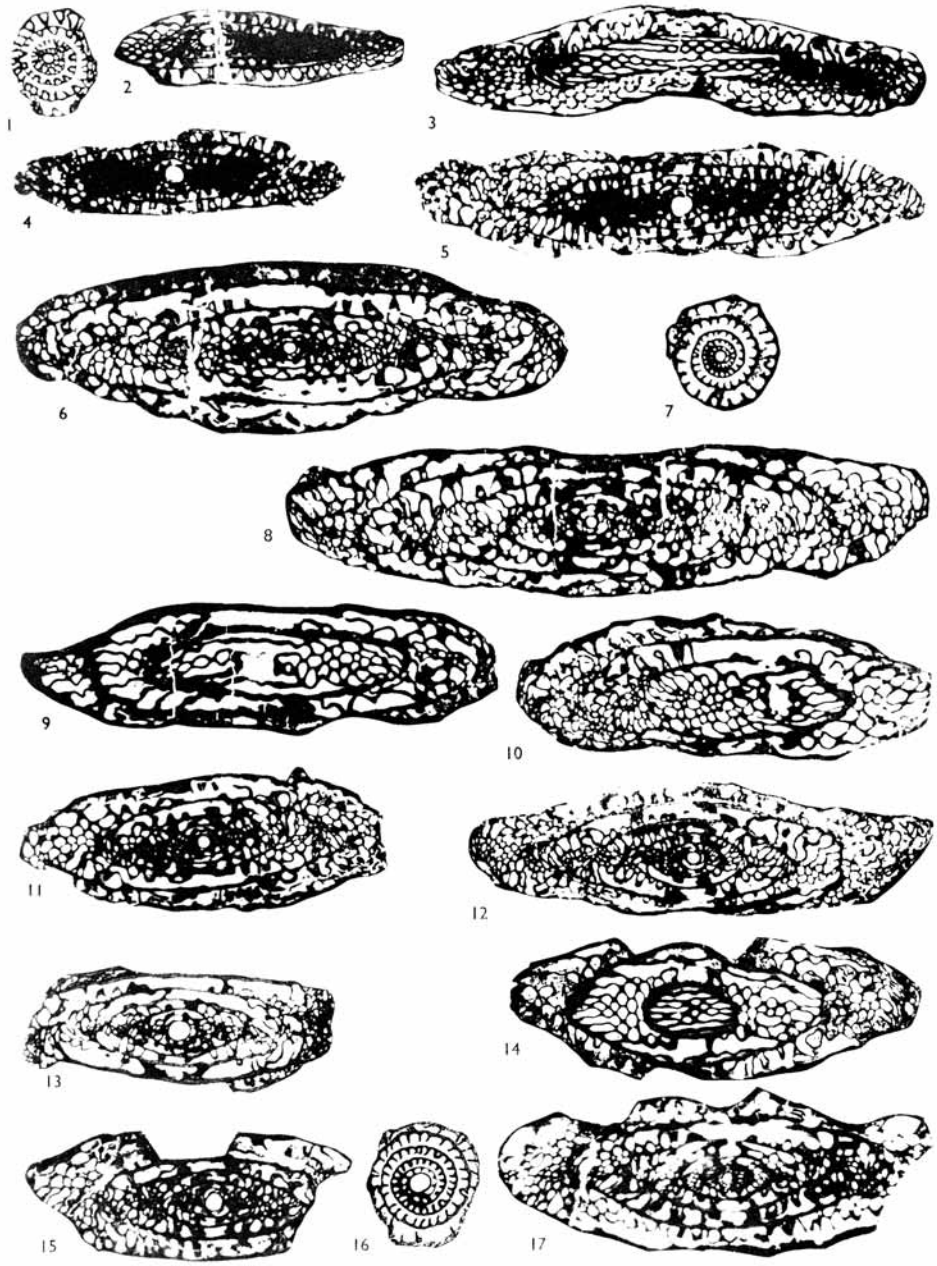


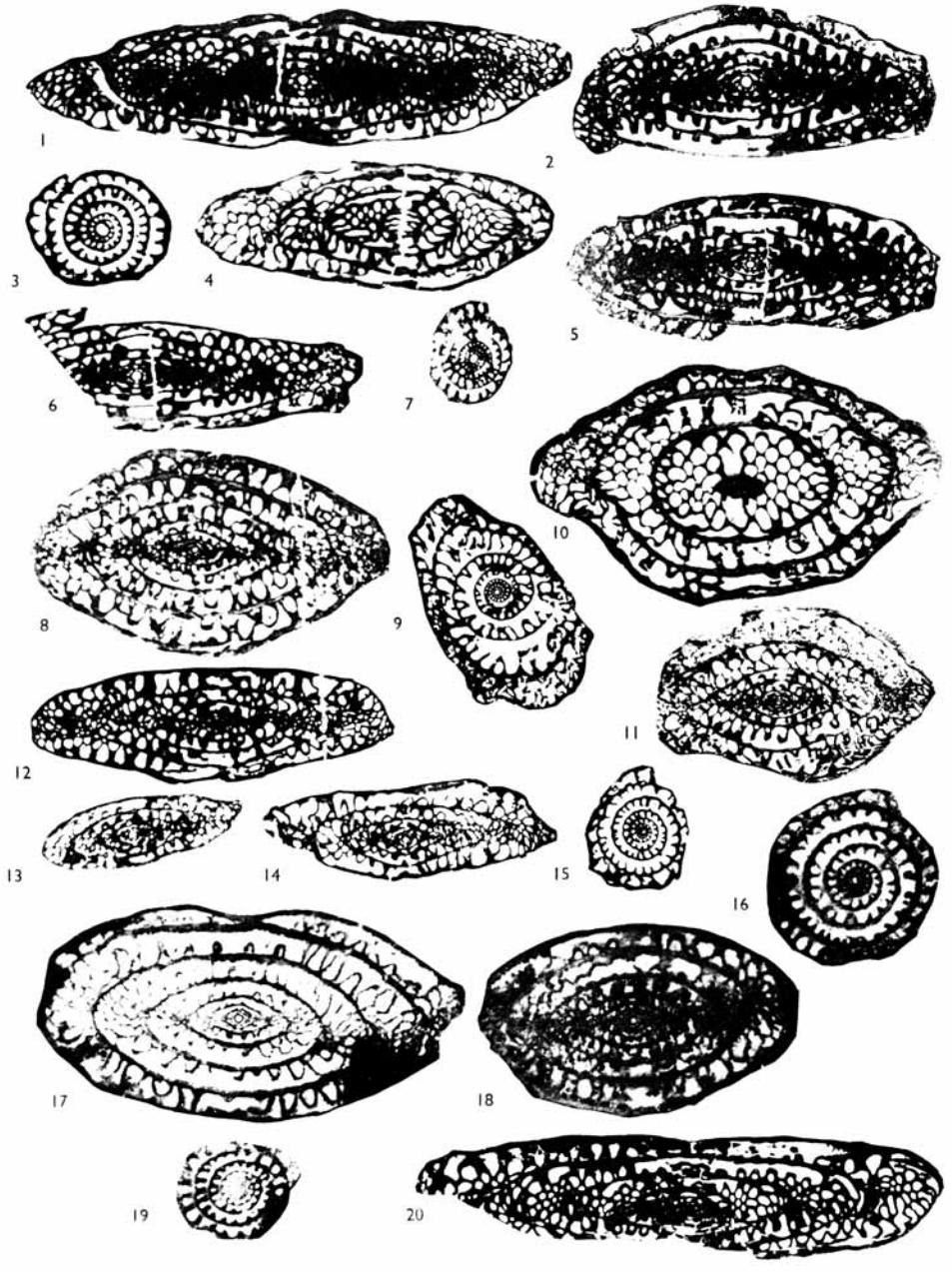
FORBES, *Fusulinidae from Spitzbergen*, x25.



FORBES, *Fusulinidae from Spitzbergen*, x25.



FORBES, *Fusulinidae from Spitzbergen*, x10.



FORBES, *Fusulinidae from Spitzbergen*, x10.