LEIDSE GEOLOGISCHE MEDEDELINGEN
DEEL 34 – 12-5-1965

CARBONIFEROUS FUSULINIDS FROM THE CANTABRIAN MOUNTAINS (SPAIN)

BY

A. C. VAN GINKEL

ABSTRACT

Fusulinid faunas from various locations spread throughout the Cantabrian mountains are described as belonging to about 180 species including 17 new species and 11 new subspecies of 18 genera. The latter are *Staffella* (with 3 new species), *Parastaffella* (with 3 new species and 2 new subspecies), *Millerella*, *Ozawainella* (with 2 new species), *Pseudostaffella*, *Schubertella*, *Fusiella*, *Profusulinella* (with 1 new species and 3 new subspecies), *Aljutovella* (with 1 new species), *Hemifusulina*, *Beedeina* (with 1 new species and 1 new subspecies), *Verella*, *Eofusulina* (with 1 new species), *Fusulina* (with 2 new species and 1 new subspecies), *Hidaella* (with 1 new subspecies), *Fusulinella* (with 3 new species and 3 new subspecies), *Obsoletes* and *Protriticites*. The faunas are closely comparable with those of the Eurasian continent, notably of Russia; not only in the species and genera but also in their chronological sequence. The assemblage zones have been subdivided into subzones and subdivisions:

Assemblage Zones	Subzones	Subdivisions
Protriticites		
		B 3
	B	B 2
Fusulinella	A	B 1
	B	
Profusulinella	A	
Millerella	Ps. antiqua	

The subdivisions and subzones are considered to be only significant for this region where they have facilitated the correlation of many sections. These correlations have been almost invariably confirmed by Rácz from his studies of algal floras, and have enabled a synthesis of the general sedimentary history of the Carboniferous Period here.

The correlation of the NW European and Russian stages through the Donetz Basin, presented at Heerlen in 1958 is different from that derived from the Spanish floras and faunas. Despite shortcomings in some stratigraphic data the palaeontological identifications are valid and the difference in correlations must be considered significant. This forces the conclusion that some process possibly that of different rates of evolution, existed during this time.

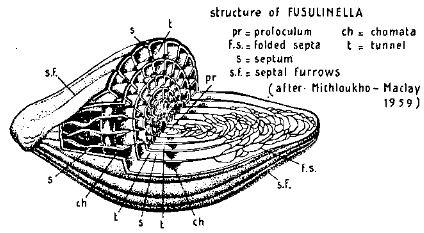
CONTENTS

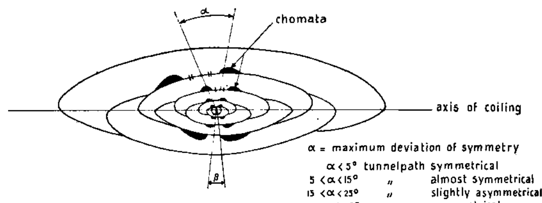
PART I. SYSTEMATIC PALAEONTOLOGY OF SPANISH FUSULINID FAUNAS

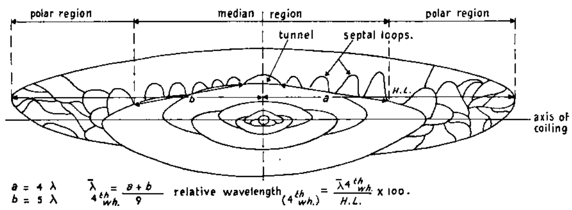
PART II. SPANISH CARBONIFEROUS FUSULINIDS AND THEIR SIGNIFICANCE FOR CORRELATION PURPOSES

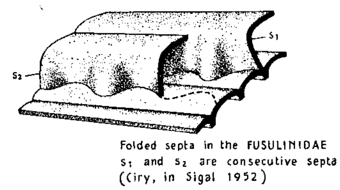
PART I

SYSTEMATIC PALAEONTOLOGY OF SPANISH FUSULINID FAUNAS

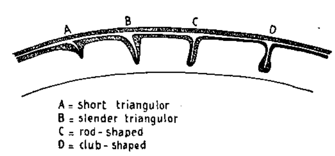


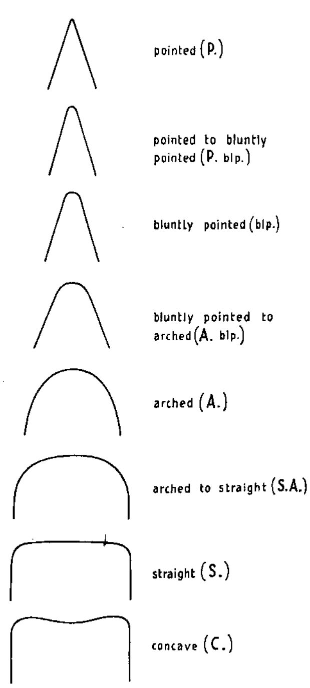






SHAPE		F.r.	PERIPHERY	LATERAL SIDES	POLES
Discoïdal		< 1	arched to pointed	perpendicular to axis, straght	—
Lenticular		< 1	pointed to bluntly pointed	convex	protruding sometimes with slight umbilical cavities or flat
Rhomboïdal		< 1	pointed to bluntly pointed	straight	protruding
Nautiloïd		< 1	arched	convex	with umbilical cavities.
Staffelloïd		± 1	arched straight concave	—	with umbilical cavities or flat
Oval		> 1	broadly arched	convex	rounded (obtuse)
Short fusiform Fusiform Elongate fusiform		< 1.75 1.75 < Fr < 2.50 > 2.50	arched	convex to hearly straight	pointed to bluntly pointed
Inflated fusiform		> 1	arched	concavo-convex	bluntly pointed
Rhomboïdal Elongate rhomboïdal		< 2.00 > 2.00	pointed or bluntly pointed	straight	pointed
Inflated rhomboïdal		> 1	pointed or narrowly arched	concave	pointed to bluntly pointed
Short cylindrical Cylindrical Elongate cylindrical		< 1.75 1.75 < Fr < 3.50 > 3.50	—	parallel to axis, straight	rounded (obtuse)





I. INTRODUCTION

Since the early fifties the Geological Institute of Leiden University has been carrying out a systematic program of mapping the southern slopes of the Palaeozoic core of the Asturo-Cantabrian Mountains (NW Spain).

Early field parties were impressed by the intricate tectonic patterns but also by the abundance of fossils of many different groups of animals. It became evident that a reconstruction of the geological history could be achieved only by close coordination of structural and palaeontological data. This held more especially for the unravelling of the geological history during the Carboniferous because notably during this period intermittant orogenic movements (Variscan phases) caused intricate and rapidly changing sedimentary patterns whose mutual relations could hardly be evaluated without biostratigraphic zoning.

Fusulinid and algal faunas proved to be extremely useful for this purpose. Both groups occur in abundant quantities in numerous localities and both were subject to rapid evolution.

Therefore it is the primary aim of this paper to provide the means of a fairly precise dating of geological events during the Carboniferous Period by establishing the description of the succession of fusulinid faunas from various regions of the Cantabrian Mountain Chain. The systematic description of the fusulinid faunas has been dealt with in Part I where the verbal descriptions are supported by statistics of measured characters as well as the usual set of photographic plates (at end of paper). Part II shows how these faunas have been used in the stratigraphic correlations established together with a discussion of the divergence of long-distance correlations for various other fossils when compared with the fusulinid faunas in NW Spain.

Method of description

The general morphology of the Fusulinidae has been very adequately dealt with in a number of textbooks(e.g. Dunbar in Cushman, 1955; Sigal in Piveteau, 1952; Pokorny, 1958; Thompson in Moore, 1964). These accounts are perfectly adequate for the purpose of this paper and no special comments are necessary. However, no method of describing fusulinid species has yet been universally accepted. Various authors differ, for example, in the number of paratypes they consider sufficient quite apart from the parameters selected for measurement and the choice of graphical or numerical presentation. The increase in synonymous species attendant on this lack of systematic treatment has become very evident during the study of the Spanish faunas. Apparently homogeneous assemblages could often be referred to several species following the type descriptions.

It is not the purpose of this paper to present a discussion of the fundamental considerations in measuring and describing fusulinid species. Such a study has been undertaken by Mr. J. L. Cutbill (written comm.). The present writer has largely followed the instructive paper of Dunbar and Henbest (1942) in selecting some of the most usual modes of presentation of information. However, a special effort has also been made to try and express certain characters, usually presented in a loose subjective sense (i.e. tightness of spire, intensity of septal folding, regularity of the tunnel-path), with numerical values.

The following characters were determined for various assemblages:

a) Number of whorls.
b) Radius of the proloculum (R.v. 0). This is half the outside diameter.
c) Radius vector (R.v.). It was measured from the centre of the proloculum to the tectum of each consecutive whorl.
d) Half-length for each consecutive whorl.
e) Form ratio (F.r.) for each consecutive whorl. The form ratio was determined as the proportion of half-length and radius vector. This ratio is somewhat smaller than the length-diameter ratio (L/D).
f) Tightness of the spire. This character is here expressed in the percentage increase of the radius vector for each consecutive whorl (G.r.) (e.g. G.r. $1 \rightarrow 2 = \frac{R.v.2}{R.v.1} \times 100$ etc.)
g) Thickness and structure of wall (W.th.) for each consecutive whorl. This thickness was determined as the sum of layers which make up the wall, measured in the equatorial plane.
h) Height of chomata (Ch.h.). The proportion of the height of the chomata and the corresponding height of chambers was determined for each consecutive half-whorl. It was measured only when the chomata were sectioned approximately in the middle between a pair of septa. The relative width was determined as the proportion of the actual width and the maximum possible extension (i.e. to the poles).
i) Angle of the tunnel (T.a.). The angle of the tunnel was measured in each consecutive whorl as subtended at the centre of the proloculum from the edges of the chomata along the outer lines of the tunnel.
j) Regularity of the tunnel-path. The shift of the tunnel-path in a specimen during growth was expressed as the maximum angle as subtended at the centre of the proloculum from the middle of the tunnel of each consecutive whorl (fig. 1, p. 4). It is obvious, however, that the visual impression of asymmetry is controlled not only by this maximum angle but depends also on the width of the tunnel.
k) Septal folding. Folding may be irregular or regular, intense or weak, high or low. It is rather difficult to transform these subjective statements into numerical values. With regard to the intensity of folding the relative wavelength in the central half of a whorl may be calculated (fig. 1, p. 4). The height of the folding may be expressed as the ratio of the height of septal loops to the height of the corresponding chambers.
l) Number of septa (S.c.) for each consecutive whorl.
m) Shape of specimens. Again statements with respect to overall shape, the shape of septa in sagittal sections, the angularity of the periphery and poles as well as the curvature of the lateral sides in axial sections are necessarily very subjective. fig. 1 shows how the terms for these characters of shape have been used in this paper.

Measurements of the radius of the proloculum, radius vector and thickness of the wall are all expressed in microns unless otherwise indicated.

Taxonomy

It has not been the purpose of the present study to examine the phylogenetical relations between fusulinid genera or species. Yet questions of taxonomical nature could not always be avoided and a choice between often quite diverging opinions had to be made. Questions regarding the systematics of fusulinids arose when it had to be decided whether some species had to be referred to one particular genus or another depending on the author followed.

The genus *Parastaffella* Rauser-Chernoussova, 1948, is accepted although in a more restricted sense than it has been used by Russian palaeontologists. For instance, species of the group *pseudosphaeroidea* Dutk. are here referred to the genus *Staffella* Ozawa, 1925, which has priority over the closely related genus *Parastaffella*. It is realized that a distinction between both genera is often difficult to make in faunas from Bashkirian strata of NW Spain. Although *Parastaffella* is a typonym of *Pseudoendothyra* Mikhailov, (genotype of both is *Fusulinella struvii* Moeller) usage of the latter genus may lead to confusion since the lectotype chosen by Mikhailov apparently is a transverse section (*Fusulinella struvii* Moeller, 1879, fig. 4a) which shows a three-layered wall and therefore could also belong to the genus *Millerella*.

The present writer is reluctant to accept the genera *Eostaffella* Rauser-Chernoussova (1948), *Novella* Grozdilova *et* Lebedeva (1950), *Seminovella* Rauser-Chernoussova (1951), *Pseudonovella* Kireeva (1949) and *Paramillerella* Thompson (1951).

Provisionally all species assigned to these genera are referred here to the genus *Millerella* Thompson, 1942. The distinction between *Millerella* and *Eostaffella*, for example, resting merely on the base of the respective evolute or involute state of whorls does violence to systematics since, at least for our Spanish faunas this procedure often separates closely related species and brings together those who often are not. However, a study wholly dedicated to these primitive group of fusulinid species may have already been published in the U.S.S.R. without coming to this author's attention. The old groups *Pseudostaffella sphaeroidea* (Moeller) and *Profusulinella librovitchi* (Dutk.) are still used in this paper for species belonging to the more modern genera *Neostaffella* Mikloucho-Maclay, 1959 and *Taitzehoella* Sheng respectively.

The separation of a Carboniferous genus *Eoschubertella* Thompson, 1937 from an Upper Carboniferous and Permian genus *Schubertella* Staff *et* Wedekind, 1910 as advocated by Thompson (1937) is not adopted in the present paper since it is rarely possible to recognize the four-layered wall which should characterize *Eoschubertella* and should distinguish it from the two-layered wall of *Schubertella*. It is doubted whether species usually referred to *Aljutovella* Rauser-Chernoussova, 1951 should be considered as mutually closely related. Judging from illustrations of described species the impression is gained that this genus might be polyphyletic, originating from various species of *Profusulinella* during a very large part of the total span of time of the latter genus.

Putrya (1956) introduced the genus *Dutkevichella* for relatively elongate species of *Hemifusulina* Moeller, 1877 which did not show pores penetrating the wall. Apparently Russian authors still prefer to assign such species to *Hemifusulina* Moeller an attitude which has been followed by this author.

The present writer closely agrees with the opinions expressed by Ishii (1958) in his study on the systematics of fusulinid genera. The evolution of fusulinid faunas in NW Spain indeed supports the arguments Ishii put forward for the re-establishment of the genus *Beedeina* Galloway, 1933. Unlike Ishii the present writer recognizes the genus *Eofusulina* Rauser-Chernoussova, 1951 as well as the subgenus *Eofusulina* (*Paraeofusulina*) Putrya, 1956. In Spain this genus is very useful for stratigraphic purposes which implies that it could be distinguished from its successor *Fusulina* Fischer de Waldheim, 1829 without serious difficulty.

The establishment of the evolutionary lineage *Verella-Eofusulina-Fusulina* by Rauser-Chernoussova is considered to be an important achievement and is confirmed by evidence from NW Spain. The present writer is of the opinion that *Akiyoshiella* Toriyama, 1953 and *Eofusulina* Rauser-Chernoussova, 1951 are generically not separable. Provisionally the former genus is considered to be a subgenus of the latter.

The suppression of the genus *Pseudotriticites* Putrya by Rjazanov (1958a) is here followed and the species previously referred to the former (van Ginkel, 1959) is now provisionally placed in *Beedeina*.

II. SYSTEMATIC DESCRIPTIONS

Family FUSULINIDAE Moeller, 1878
Subfamily STAFFELLINAE Miklouсho-Maklai, 1949

Genus STAFFELLA Ozawa, 1925

Ozawa, Y., On the classification of Fusulinidae. Imp. Univ. Tokyo, Coll. Sci., Journ. Tokyo, Japan, 1925, Vol. 45, art. 4, p. 24.

Thompson, M. L., New genera of Pennsylvanian fusulinids. Am. Journ. Sci., New Haven, Conn., 1942, Vol. 240, p. 407.

Staffella rabanalensis sp. nov.

Pl. I Figs. 1–7

Type specimen: Specimen 1(2) (Pl. I, Fig. 3) is designated as the holotype.
Locality: P 23.

Description:		
	Radius vector:	405–545
	Form ratio:	0,70–0,88
	Number of whorls:	5–6

Umbilical depressions absent or shallow; sometimes slightly umbonate; whorls completely involute, percentages of angularity of periphery from 1st to 6th volution for 5 specimens respectively:

S.	—	—	10	—	—	—
S. (A.)	—	—	—	—	—	—
A.	75	30	10	80	90	100
A. (blp)	—	—	50	—	10	—
blp.	25	30	10	10	—	—
P. (blp)	—	—	10	—	—	—
P.	—	40	10	10	—	—

Chomata extend to poles in inner 4–5 whorls; relative height ranges from 0.25 to 0.50; steep or gentle slopes at the tunnel side.

Wall with yellow-brown or brown colour; differentiation indistinct; locallay an outer translucent and an inner more dense layer is sometimes observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	
Specimen: 27	30	73	129	241	381	527		
6	26	77	133	179	255	357	510	
2 (2)	21	—	155	246	380	545		R.v.
2 (1)	21	60	110	187	268	408		
1	—	60	129	195	297	442	—	
Av.:	24.5	67	131	210	316	456	—	
			76	87	58	38		
			78	35	43	40	43	
			—	59	54	43		G.r.
			83	69	43	52		
			114	51	52	49		
Av.:			88	60	50	44	—	
		0.44	0.61	0.75	0.76	0.88		
		0.44	0.55	0.71	0.75	0.83	0.80	
		—	0.63	0.75	0.80	0.80		F.r.
		0.36	0.59	0.64	0.73	0.79		
		0.46	0.52	0.65	0.77	0.69	—	
Av.:		0.42	0.58	0.70	0.76	0.80	—	

Remarks: A conspicuous character of this species is the relatively high chomata. In this respect it points to *St. moelleri* Ozawa and *St. yobarensis* Ozawa. The absence of umbilical depressions or even the slight umbonate state in some specimens [cf. specimen 2(1)] is a character which they also share with *St. yobarensis*. A single specimen (specimen 27) is not unlike *St. lata* (Grozd. *et* Leb.) although the latter species has a more pointed periphery. For comparison measurements are given of what are considered the most allied species:

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	L/D
St. moelleri Ozawa (acc. to Ozawa)	6–7	77	680	0.79
(acc. to Toriyama)	6	87–159	700–1000	0.60–0.80
St. yobarensis Ozawa				
(acc. to Ozawa)	4–4.5	41–50	310	0.80–1.00
(acc. to Toriyama)	4–5.5	50–120	480–750	0.80
St. lata Grozd. *et* Leb.	4–5	18	730–960	0.66–0.87
St. rabanalensis sp. nov.	5–6	42–60	480–720	0.70–0.93

Staffella ex gr. *expansa* Thompson, 1947

Pl. I Figs. 8–10

Locality: L 25.

Description: Radius vector: 630–765
Form ratio: 0,60–0.67
Number of whorls: 6–6.5

Umbilical depressions shallow to moderately deep; whorls completely involute; percentages of angularity of periphery for 3 specimens from 1st to 6th volution respectively:

S.	—	33	33	—	—	—
S. (A.)	—	—	—	—	—	—
A.	100	50	50	83	83	80
A (blp.)	—	—	—	17	17	20
blp.	—	17	—	—	—	—
P (blp.)	—	—	—	—	—	—
P.	—	—	17	—	—	—

Chomata extend to poles in inner 5.5–6.5 whorls; relative height usually between 0.20 and 0.40; steep or gentle slopes at the tunnel side.

Wall with a yellow-brown colour; occasionally a thin lower-tectorium locally visible; coarse mural pores frequently observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 12	28	60	114	181	272	382	552	629	
17	24	56	105	196	289	442	663	765	R.v.
35	20	52	110	187	323	493	663		
Av.:	25	61	112	191	302	460	626		
		89	58	50	40	44			
		88	86	47	53	50			G.r.
		112	70	73	53	34			
Av.:		85	70	59	51	43			
		0.50	0.55	0.77	0.75	0.67	0.65	0.61	
		0.58	0.82	0.70	0.76	0.81	0.69	0.67	F.r.
		0.50	0.67	0.70	0.59	0.57	0.60		
Av.:		0.53	0.68	0.72	0.70	0.68	0.65		

Remarks: The present species resembles *Staffella moelleri* Ozawa, *St. volimiensis* (Grozd. *et* Leb.), *St. powwowensis* Thomp., *St. depressa* Thomp., *St. affixa* Grozd. *et* Leb., *St. akagoensis* Tor. and *St. expansa* Thomp. It seems probable, however, that it is conspecific with none of the above mentioned species. It might be closer to *St. moelleri* Ozawa than to any of the other mentioned species.

Staffella cf. *moelleri* Ozawa, 1925 b

Pl. I Figs. 11–20
Pl. II Figs. 1–10

Locality: L 16.

Description: Radius vector: 425–765
Form ratio: 0.57–0.84
Number of whorls: 6–8

Shallow umbilical depressions; whorls completely involute throughout growth; percentages of angularity of periphery for 13 specimens from 1st to 8th volution respectively:

S.	8	4	—	4	—	7	—	—
S. (A.)	—	8	8	4	5	—	—	—
A.	69	42	19	37	72	86	100	100
A. (blp.)	11	23	23	42	9	7	—	—
blp.	—	15	42	13	14	—	—	—
P (blp.)	4	8	8	—	—	—	—	—
P.	8	—	—	—	—	—	—	—

Spirotheca smooth; 8th whorl, however, sometimes with well marked septal furrows; septa perpendicular to wall or, more frequently, forwardly inclined; in inner whorls they arcuate anteriorly.

Chomata extend to poles in inner 4.5–5.5 whorls; relative height mostly between 0.25 and 0.35; steep or gentle slopes at the tunnel side.

Wall with a yellow-brown, brown-grey to light grey colour; differentiation of wall often difficult to observe; occasionally a thin less translucent inner lining (lower-tectorium) is seen below the diaphanotheca; coarse mural pores sometimes present.

Measurements: See Table 1.

Remarks: This species might possibly be conspecific with *St. moelleri* Ozawa. To prove this assumption a restudy of the latter species, giving ample information on its variation, would be required. For comparison measurements of the present specimens and the single figured specimen of Ozawa are given below.

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	L/D
Ozawa's specimen [lectotype (designated by Toriyama in 1958)]:	6–7	77	680	0.79
Spanish specimens:	6–8	40–68	390–640	0.62–0.90

These figures suggest that our Spanish form is of microspheric type in comparison with Ozawa's species. Some specimens in our assemblage resemble *St. expansa* Thomp. (e.g. specimens 30, 33, 36) although their form ratio is somewhat greater. Specimen 20 (5) is somewhat similar to *St. akagoensis* Tor., although this species seems to have lower chomata, and *St. affixa* Grozd. *et* Leb.

Staffella cf. *moelleri* Ozawa
(2nd assemblage)

Pl. II Figs. 11–12

Locality: P 99.

Description: Associated with *St. mochaensis* sp. nov. our collection yielded two specimens which seem to belong to another species of this genus. They have many features in common with *St. moelleri* Ozawa.

Volutions wholly involute; umbilical depressions low; periphery arched, bluntly pointed or pointed in inner 3.5 whorls and arched in subsequent whorls.

Relative height of chomata varies from 0.25 to 0.40; they extend to poles in inner 4.5–5.5 whorls.

The lenticular juvenarium not at angle to subsequent whorls.

Wall structure not different from the associated *St. mochaensis* sp. nov.

Measurements:

	Wh.n.	0	1	2	3	4	5	6		7	
Specimen:	18	—	95	166	255	357	493	646		824	R.v.
	23	32	86	159	255	353	493	705	799		
				74	54	40	38	31	28		
				85	60	38	40	43			G.r.
			—	—	0.52	0.64	0.72	0.72		0.70	F.r.
			0.45	0.57	0.62	0.60	0.71	0.66	0.67		

Remarks: The general dimensions of this species correspond to those given by Ozawa for *St. moelleri*. A well founded comparison cannot be given since the description and figuration of Ozawa's species is rather brief to the modern standards.

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	L/D
St. moelleri Ozawa (acc. to Ozawa)	6–7	77	680	0.79
St. cf. *moelleri* (2nd assemblage)	6.5–7	64	650–700	0.72–0.75

An important difference with *St. moelleri* Ozawa is the state of the juvenarium. According to the single figure of Ozawa even the innermost whorls have an arched periphery whereas in the present species they are clearly angular. In this respect there is an obvious resemblance with the much larger *St. leei* Dutk. *Staffella* cf. *moelleri* (1st assemblage) has a smaller radius vector for corresponding whorls.

Staffella breimeri sp. nov.

Pl. III Figs. 1–15
Pl. IV Figs. 1–15
Pl. V Figs. 1–7

Type specimen: Specimen 35 (1) (Pl. III, Fig. 6) is designated as the holotype.
Locality: L 25.
Description: Radius vector: 365–815
Form ratio: 0.64–0.88
Number of whorls: 5.5–7

Umbilical depressions low (specimen 29 (2)) to deep (specimen 1); whorls completely involute up to and including the 4.5 whorl, in subsequent whorls sometimes partly evolute; percentages of angularity of periphery for 25 specimens from 1st to 6th whorl respectively:

S.	11	17	29	33	29	22
S. (A).	4	8	17	33	36	61
A.	79	48	42	31	36	17
A. (blp.)	4	15	8	2	—	—
blp.	2	8	4	—	—	—
P. (blp.)	—	2	—	—	—	—
P.	—	2	—	—	—	—

Spirotheca essentially smooth in all whorls; septa somewhat forwardly curved in inner 2 whorls, in subsequent whorls generally perpendicular to spirotheca.

Chomata extend to poles in inner 3.5–6 whorls; asymmetric or subsymmetric (dome-shaped or rectangular) in subsequent whorls; relative height generally between 0.20 and 0.30; steep or gentle slopes at the tunnel side.

Axis of coiling maintains original position throughout growth in the majority of specimens; occasionally, however, innermost whorl at slight angle to subsequent whorls.

Wall with brown to yellow-brown colour in thin section (day-light); composed of a well developed diaphanotheca and a locally present thin lower-tectorium; upper-tectorium absent; coarse pores frequently observed, especially in outer whorls.

Measurements: See Table 2.

Remarks: This sample from locality L 25 was crowded with specimens of this apparently new species. Although widely different specimens were encountered they were all linked by transitional forms suggesting the presence of a single population. It is interesting to note that the variation is so wide that it would lead to the description of at least three different species when we take into consideration the minor differences which nowadays justify the introduction of new names.

This species belongs to the group of *St. pseudosphaeroidea* Dutk. It is most similar to *St. deformica* (Grozd. *et* Leb.) and *St. raja* (Grozd. *et* Leb.). In certain respects some individuals resemble *St. pseudosphaeroidea* Dutk. Closely related species are probably also *St. fraudulenta* (Raus.) and *St. keltmensis* (Raus.). The latter two species, however, show no tendency towards evolute whorls whereas *St. breimeri* often has partly evolute outer whorls at maturity. As for *St. deformica* and *St. raja*, these species are apparently not as variable as the Spanish species as is shown by the measurements given below. The single illustration by which each species is represented suggests that the outer whorls are always partly evolute.

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	Form ratio
St. breimeri sp. nov.	5.5–7	38–78	380–860	0.69–0.93
St. pseudosphaeroidea	4–5 (6)	80–130	520–1150	0.83–1.06
St. deformica	6.5	?	390	0.84
St. raja	6–7	56	460–540	0.69–0.74

Staffella cf. *pseudosphaeroidea* Dutkevitch, 1934 a
(1st–3rd assemblage)
Pl. V Figs. 8–11

Locality: Specimens closely similar to *St. pseudosphaeroidea* Dutk. were encountered at the following localities:
Arbejal; Río Pisuerga; Palencia (Loc. P 63) (1st assemblage)
Perapertú; Río Pisuerga; Palencia (Loc. P 70) (2nd assemblage)
Mesao Limestone Member; Río Cea; León (Loc. L 11) (3rd assemblage)

Description: Unfortunately we have only one or two specimens of each assemblage available. These specimens, however, are very similar to each other for which reason they are presented together.

Volutions completely involute; umbilical depressions very shallow; periphery arched or arched to bluntly pointed in inner 3–4 whorls, arched or straight in subsequent whorls.

Chomata extend to poles in inner 4 whorls (Loc. L 11; P 70); relative height moderate.

Measurements:

	Wh.n.	0	1	2	3	4		5	6	
	Specimen									
Loc. P 63	23	—	86	150	212	340	442			
Loc. P 70	3	26	64	103	185	272		374	450	R.v.
	11	—	54	95	155	230		323	501	
Loc. L 11	20	26	64	120	210	293		412	586	

75	41	60			
60	79	47	37	20	G.r.
76	64	48	41	55	
87	75	40	41	42	

0.42	0.67	0.84	1.00	0.79			
0.57	0.63	0.65	0.81		0.82	0.89	F.r.
0.56	0.50	0.61	0.81		0.92	0.93	
0.45	0.56	0.74	0.83		0.79	0.83	

Remarks: These specimens are very close to *St. pseudosphaeroidea* Dutk. Other similar species are probably *St. fraudulenta* (Raus.) and *St. keltmensis* (Raus.). For comparison we list some important parameters of *St. ex gr. pseudosphaeroidea* from the Piedras Luengas Limestone Member and *St. pseudosphaeroidea* Dutk.

	No. of Wh.	Diam. Prol.	R.v. 4th wh.
Staffella cf. *pseudosphaeroidea* Dutk. (1st assemblage)	4.5	—	340
Staffella cf. *pseudosphaeroidea* Dutk. (2nd, 3rd assemblages)	6	52	230–295
Staffella ex gr. *pseudosphaeroidea* Dutk. (Piedras Luengas Lst. Member)	7–8	30–58	190–325
Staffella pseudosphaeroidea Dutk. (original description)	4–5 (6)	80–130	app. 430–560

Staffella ex gr. *pseudosphaeroidea* Dutkevitch

Pl. VI Figs. 1–11

Locality: P 1.

Description: Radius vector: 610–920
Form ratio: 0.77–0.87
Number of whorls: 7–8

Umbilical depressions shallow [specimen 117(1)] or, more frequently, fairly well developed; whorls completely involute throughout growth; percentages of angularity of periphery for 7 specimens from 1st to 7th whorl respectively:

S.	15	—	14	14	7	23	37
S. (A.)	—	15	7	14	43	46	38
A.	70	47	29	50	50	31	25
A. (blp.)	15	38	22	22	—	—	—
blp.	—	—	21	—	—	—	—
P. (blp.)	—	—	—	—	—	—	—
P.	—	—	7	—	—	—	—

Spirotheca essentially smooth in first 7–7.5 whorls; last whorls with septal grooves clearly marked; occasionally also inner 2–2.5 whorls show well marked septal grooves; in this juvenile stage septa often curved becoming straight and generally perpendicular to the wall in later growth stages.

Because of the rather strong recrystallization of wall and chomata, which made it difficult to distinguish between both, the width of chomata is difficult to determine; it seems that they extend to the poles in inner 3.5–6 whorls; steep or gentle slopes at the tunnel side.

Wall shows a light-brown or brown colour in thin section (day-light); it consists of a thick primary layer (diaphanotheca) and scattered deposits of lower-tectorium which are somewhat darker and generally thin with respect to the diaphanotheca; upper-tectorium absent; indistinct mural pores in outer whorls.

Measurements: See Table 3.

Remarks: The present species seems to have a close affinity to *Staffella pseudosphaeroidea* Dutk. and apparently only differs in the more microspheric state as compared with the species of Dutkevitch. Ross and Dunbar (1962) described from Greenland a similar species which was classified as *Pseudostaffella ? pseudosphaeroidea* (Dutk.) and which in this respect apparently takes an intermediate position to our form and *St. pseudosphaeroidea* of Dutkevitch, as follows from the table below.

	No. of Wh.	Diam. Prol.	R.v. 4th wh.
St. pseudosphaeroidea of Dutkevitch	4–5 (rarely up to 6)	80–130	appr. 430–560
specimens from Greenland	6	40–60	270–300
specimens from Spain	7–8	30–58	190–325

Staffella powwowensis Thomp. has a rounder periphery ,smaller form ratio and somewhat lower chomata.

Staffella lacunosa Dunb. has a larger form ratio, higher number of septa in each whorl, thicker wall and lower chomata.

Other somewhat similar species are *Staffella fraudulenta* (Raus.) and *Staffella keltmensis* (Raus.). A specimen most similar to our form has been figured by Grozdilova and Lebedeva (1954, pl. XVI, fig. 1) and referred to *Parastaffella* aff. *keltmensis* Raus.

Staffella mochaensis sp. nov.

Pl. VII Figs. 1–7
Pl. VIII Figs. 1–9
Pl. IX Fig. 1

Type specimen: Specimen 6 (2) (Pl. VII, Fig. 7) is designated as the holotype.
Locality: P 99.
Description: Radius vector: 475–1275
Form ratio: 0.75–0.93
Number of whorls: 4.5–8

Umbilical depressions absent (e.g. specimens 26(2), 7) to deep (e.g. specimen 15); whorls completely involute possibly with exception of 1st whorl; polar extremities sometimes just touch in last whorl (e.g. specimen 15); percentages of angularity of periphery for 9 specimens from 1st to 7th whorl respectively:

S.	6	—	—	—	24	30	50
S. (A.)	—	—	6	10	18	31	33
A.	77	24	33	90	58	39	17
A. (blp.)	6	—	10	—	—	—	—
blp.	—	18	34	—	—	—	—
P. (blp.)	—	24	6	—	—	—	—
P.	11	34	11	—	—	—	—

Spirotheca smooth up to and including 6th whorl, septal grooves often clearly marked in subsequent whorls; septa sometimes somewhat forwardly curved in inner whorls, in outer whorls either perpendicular to wall or forwardly inclined.

Chomata extend to poles in inner 3.5–5 whorls, in subsequent whorls still very broad and generally asymmetric; relative height generally between 0.25 and 0.40; steep or gentle slopes at the tunnel side.

Axis of coiling maintains original position throughout growth in the majority of specimens; in an exceptional case innermost whorls coiled at a slight angle to subsequent whorls.

Wall with a yellow-brown, brown to brown-grey colour; except for chomata, secondary deposits probably absent; coarse pores were sometimes observed, they are at all means less distinct than those observed in *Staffella breimeri* sp. nov.

Measurements: See Table 4.
Remarks: It is considered that this species is on the verge of giving rise to other species. We may distinguish a small form with about 4.5 whorls of which the inner 2–3 whorls are highly angular [specimens 12 (2) and 26 (2)], a large form with 8 whorls and generally more rounded inner whorls and a typical form which is intermediate in its characters. *Staffella mochaensis* sp. nov. belongs to the group of *St. pseudosphaeroidea* Dutk. For comparison measurements are given of some more or less similar species:

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	L/D
St. mochaensis sp. nov.	4.5–8	44–72	600–850	0.80–1.00
St. pseudosphaeroidea	4–5 (6)	80–130	520–1150	0.83–1.06
St. lacunosa	8	< 100	370	(0.70–1.00)?
St. powwowensis	6–8.5	58	530	0.70–0.80

St. lacunosa Dunb. has much weaker chomata, which holds good also for *St. powwowensis* Thomp. Moreover, this latter species also has a rounded periphery in outer whorls in contrast with the often straight periphery of the present species. *Staffella breimeri* sp. nov. has a smaller maximum number of volutions, smaller maximum diameter which diameter is also slightly smaller for corresponding whorls, smaller maximum form ratio, a somewhat lower average height of the chomata, a slightly different development of the angularity of the periphery and often partly evolute outer whorls.

Staffella sp. 1

Pl. IX Figs. 2–4

Locality: P 70.

Description: Radius vector: 400–730
Form ratio: 0.53–0.76
Number of whorls: 6–7.5

Umbonate; involute throughout growth; percentages of angularity of the periphery for 3 specimens from 1st to 6th whorl respectively:

S.	—	—	33	—	33	—
S. (A.)	—	—	—	—	—	—
A.	100	50	—	—	17	—
A. (blp.)	—	17	17	33	—	50
blp.	—	17	17	34	17	—
P. (blp.)	—	16	33	33	33	50
P.	—	—	—	—	—	—

Chomata extend to poles throughout growth; relative height varies from 0.30 to 0.55; steep or gentle slopes at the tunnel side.

The apparently homogeneous wall has a yellow-brown to brown colour; tectoria probably absent; mural pores not observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	8	
Specimen: 27	23	73	153	230	315	408	510	680 731		
24	17	39	82	170	213	310 391				R.v.
44	13	34	77	153	221	289	400			
Av.:	18	49	104	184	250	336	455	—		
		110	50	37	30	25	33			
		111	107	25	45					G.r.
		125	112	44	31	38				
Av.:		115	90	35	35	31	—			
		0.59	0.61	0.59	0.61	0.60	0.55	0.51 0.53		
		0.56	0.68	0.70	0.80	0.74 0.70				F.r.
		—	—	0.69	0.73	0.76				
Av.:		0.57	0.64	0.66	0.71	0.70	—	—		

Remarks: To the author's knowledge there has not yet been described from the Carboniferous a species of this genus which is more than remotely similar to the present form. Only from Permian strata a number of species are known, which belong to the subgenus *Nankinella* particularly *St.* (*N.*) ex gr. *deprati* (Yabe) and *St.* (*N.*) ex gr. *inflata* (Colani), which are similar in some respects. These Permian species differ mainly by their larger dimensions. Unfortunately we have only three specimens, which is considered insufficient to introduce a new name. Specimen 27 is the most typical; specimens 24 and 44 suggest that there is probably a close relation to *St. rabanalensis* sp. nov.)

Staffella sp. 2
Pl. IX Fig. 5

Associated with *Staffella mochaensis* sp. nov. (San Cristóbal Formation; Loc. P 99) a single specimen was encountered which belongs to the group *Staffella pseudosphaeroidea* Dutk. and is very similar to *St. raja* (Grozd. *et* Leb.) and *St. deformica* (Grozd. *et* Leb.)

Staffella? sp. 3
Pl. IX Fig. 6

From the Cotarazo Limestone Member (Loc. P 40) of the Corisa Formation (Río Pisuerga; Palencia) we got a single specimen of a species which is probably new.

This specimen has approximately 6–7 volutions, is completely involute and has moderately developed umbilical depressions in the outer whorls. In contrast to typical species of the genus *Staffella,* this species shows an angular periphery not only in the inner whorls but throughout growth. In this respect as well as the concave lateral sides in the outer whorls and the small form ratio (= 0.48; 6–7th whorl), it resembles some species belonging to the genus *Parastaffella.* The extremely large size of our specimen (a radius vector of approximately 1200; 6–7th whorl) is equalled only by *Parastaffella grandis* Put. The latter species also conforms in general shape. The clear yellow-brownish colour of the recrystallized wall in our Spanish specimen is similar to typical species of the genus *Staffella* including the genotype. Igô (1957; p. 183; pl. III, fig. 20) described and figured a specimen which although much smaller has essentially the same generic characters.

Genus PARASTAFFELLA Rauser-Chernoussova, 1948

Rauser-Chernoussova, D. M., Contributions to the foraminiferal fauna of the Carboniferous deposits of central Kazakhstan. Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Trudy, Moscow, 1948, Fasc. 66, Geol. Ser., No. 21, pp. 13, 14.

Parastaffella vlerki sp. nov.
Pl. IX Figs. 7–18
Pl. X Figs. 1–35

Type specimen: Specimen 6(1) (Pl. IX, Fig. 15) is designated as the holotype.
Locality: P 1.

Description:	Radius vector:	295–710
	Form ratio:	0.25–0.56
	Number of whorls:	4.5–6

Umbilical depressions generally deep at maturity; whorls involute in inner 4 whorls, involute or evolute in 4.5–5th whorl, always evolute in subsequent whorls; lateral sides straight or convex in inner 3 whorls; occasionally slightly concave in subsequent whorls; percentages of angularity of periphery for 35 specimens from 1st to 6th whorl respectively:

S. (A.)	—	1	4	3	2	—
A.	94	63	7	9	18	42
A. (blp.)	3	21	27	13	10	14
blp.	3	13	36	35	30	14
P. (blp.)	—	1	13	19	15	30
P.	—	1	13	21	25	—

Spirotheca essentially smooth in inner 4–5 whorls; septal grooves clearly marked in subsequent whorls.

Septa rod or club-shaped in all whorls; curved or forwardly inclined.

Chomata extend to poles in inner whorls; if volutions become evolute, they generally extend to the line formed by contact of two subsequent volutions; low to fairly high.

Wall consists of four layers; diaphanotheca nearly always clearly visible, generally as thick or thicker than upper or lower-tectorium; thickness of tectoria fairly inconstant; spirotheca as a whole has a dark-brown colour (thin section; day-light).

Measurements: See Table 5.

Remarks: Parastaffella vlerki sp. nov. belongs to the group of *Parastaffella composita* Dutk. One of the most important characters of our species is the great variation in its distinctive characters such as radius vector, form ratio, degree of overlap of whorls, angularity of periphery, height of chomata, etc. This might perhaps point to favourable environmental conditions, a possibility supported by the rock sample which was crowded with individuals of this assemblage. Although widely different specimens were encountered they are all linked by transitional forms suggesting the presence of a single population. The present new species may be compared with *P. composita* Dutk. (specimens 2, 15, 40, 93, 136), *P. poststruvei* Raus. (specimens 15, 38, 42A, 43, 49, 93, 103, 136), *P. umbonata* Raus. (specimens 40, 42A, 93, 132), *P. holmensis* Ross *et* Dunb. and *P. pritonensis* Grozd. *et* Leb. (specimens 3, 14, 15, 117). The three first mentioned species are reported to have never more than 5 volutions as against up to 6 in the present species. *P. holmensis* and the similar species *P. pritonensis* are wholly involute or volutions are just in contact whereas a large number of specimens with partly evolute outer whorls were encountered in the Spanish assemblage. Differences here mentioned do not claim to be complete, but only serve to bring out distinctions quickly.

Parastaffella hispaniae sp. nov.

Pl. X Figs. 36–41

Pl. XI Figs. 1–17

Type specimen: Specimen 6(2) (Pl. XI, Fig. 5) is designated as the holotype.

Locality: P. 23.

Description: Radius vector: 385–731

Form ratio: 0.30–0.60

Number of whorls: 4.5–6

Umbilical depressions in adult specimens highly variable, generally moderately deep; slender evolute specimens with very deep umbilical depressions occur whereas on the other hand in specimen 9, a more staffelloid-shaped specimen, umbilici are practically absent; whorls involute in inner 4 whorls, involute or partly evolute in 4.5–6th whorl; lateral sides straight or convex in inner 2.5 whorls, sometimes concave in subsequent whorls; percentages of angularity of periphery for 21 specimens from 1st to 6th whorl respectively:

A.	100	43	7	7	12	(—)
A. (blp.)	—	14	2	2	8	(—)
blp.	—	36	29	19	16	(33)
P. (blp.)	—	5	19	12	8	(33)
P.	—	2	43	60	56	(34)

Chomata low to extremely high; on an average about half the height of chamber lumen; always extending to poles in inner whorls; in outer whorls width highly variable.

Wall consists of four layers; in some specimens, diaphanotheca difficult to observe; spirotheca as a whole shows a dark-brown or dark brown-grey colour (thin section; day-light).

Measurements: See Table 6.

Remarks: Remarks made on the variability and the mode of occurrence of *Parastaffella vlerki* sp. nov. hold good for *Parastaffella hispaniae* sp. nov. as well. The present species differs from *P. vlerki* by its generally more angular periphery, slightly less evolute state of outer whorls, somewhat greater radius vector for corresponding whorls, a slightly larger form ratio at maturity, on an average somewhat higher chomata, and a slightly different composition of the wall; this wall is more greyish and the diaphanotheca is not always as clearly visible as in *P. vlerki*. *P. hispaniae* as well as *P. vlerki* may be compared with some species of the group of *P. composita* Dutk. especially with *P. pritonensis* Grozd. *et* Leb. and *P. holmensis* Ross *et* Dunb. (specimens 9, 17, 25) or with *P. umbonata* Raus. [specimens 2, 24, 28(1)]. The present species, however, contains also individuals which might be compared with species of the group *P. preobrajenskyi* (Dutk.) e.g. *P. timanica* Raus. and *P. bradyi* (Moell.) [specimens 26, 28(2)] or of the group of *P. subrhomboides* Raus. e.g. *P. jazvensis* Grozd. *et* Leb. [specimens 15, 17(1)].

Parastaffella bradyi (Moeller, 1878) subsp. *cantabrica* subsp. nov.

Pl. XI Figs. 18–26

Type specimen: Specimen 20 (Pl. XI, Fig. 19) is designated as the holotype.

Locality: P 70.

Description: Radius vector: 365–715
Form ratio: 0.49–0.60
Number of whorls: 5–6

Whorls completely involute throughout growth; umbilical depressions shallow or absent; lateral sides in general straight or convex; sometimes, however, slightly concave in 5–6th whorl; percentages of angularity of periphery for 8 specimens from 1st to 6th whorl respectively:

A.	100	69	31	13	9	50
A. (blp.)	—	31	19	13	27	—
blp.	—	—	50	60	55	50
P. (blp.)	—	—	—	7	9	—
P.	—	—	—	7	—	—

Spirotheca smooth in inner 4 whorls; in subsequent whorls septal grooves generally clearly marked; septa straight and forwardly inclined or curved.

Chomata reach poles in inner 3?–5 whorls; moderately high to high, relative height generally between 0.30 and 0.50; steep or gentle slopes at the tunnel side.

The somewhat recrystallized state and coarse texture of the wall, typical for the Staffellinae, is in some specimens more heavily expressed in inner whorls than in the outer ones; we sometimes observe that the wall shows a clear yellow-brown colour in inner whorls and a somewhat darker grey-brown or brown colour in outer whorls; protheca fairly dark coloured and rarely showing differentiation i.e. diaphanotheca and a more dense layer below it; lower-tectorium either thin and locally developed or absent at all; upper-tectorium absent; mural pores not observed; thickness of wall measured in three specimens: 13–15μ (4th wh.), 15–26 μ (5th wh.) and 17 μ (6th wh.).

Measurements: See Table 7.

Remarks: In as much as Moeller's figures of *P. bradyi* permit a comparison this species resembles our present form very much. Especially shape and height of the chomata and the general outline of the test are closely similar. *P. bradyi* (Moell.) differs from its subspecies *cantabrica* in having a greater diameter for corresponding whorls, a thicker and better differentiated wall and presumably a slightly higher maximum number of volutions.

Parastaffella cf. *preobrajenskyi* (Dutkevitch, 1934 a)

Pl. XI Fig. 27

Locality: L 25.

Description: The single specimen present of this species has weak umbilical depressions and is wholly involute; periphery arched in inner 1.5 whorl and bluntly pointed in subsequent whorls; lateral sides convex or straight.

Relative height of chomata varies between 0.20 and 0.30; they extend to poles in inner 3 whorls; steep or gentle slopes at the tunnel side.

Wall has a brown-grey colour and shows a well defined diaphanotheca; lower-tectorium rudimentary if present.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 41		23		64		142		280		425	R.v.
					120		97		52		G.r.
				0.53		0.62		0.50		0.50	F.r.

Remarks: Except for the somewhat smaller proloculum and the possibly slightly lower chomata of the present species, there is a very close resemblance to *P. preobrajenskyi* (Dutk.).

Parastaffella cf. *timanica* Rauser-Chernoussova, 1951

Pl. XII Figs. 1–4

Localities: L 16, L 353, P 63.

Description: The here described and figured specimens are from three different localities.

Periphery rounded in inner 1–2.5 whorls; beyond 4th whorl often pointed; whorls completely involute; polar extremities of last whorl in mature specimens just in contact; shallow to moderately deep umbilical depressions in outer whorls; lateral sides straight or convex in inner 3–4.5 whorls, straight or concave in subsequent whorls.

Chomata extend to poles in inner 3–5 whorls; relative height varies between 0.20 and 0.40.

Wall yellow-brownish coloured and in this respect similar to *Staffella*; not over 26μ in thickness; differentiation indistinct; pores often easily distinguishable.

Measuerements:

	Wh.n.	0	1	2	3	4	5	6	
	specimen:								
Loc. L 16	34	30	92	204	302	493	731		
Loc. L 353	25	24	64	123	217	382	608		R.v.
	26 (3)	21	60	110	193	304	385		
Loc. P 63	33	28	63	118	203	300	490	610	
			122	48	63	48			
			90	76	76	59			G.r.
			83	75	58				
			87	72	47	63			
			0.40	0.51	0.58	0.54	0.49		
			0.57	0.56	0.59	0.56	0.48		
			0.50	0.53	0.52	0.55	0.51		F.r.
			0.48	0.46	0.48	0.50	0.51	0.44	

Remarks: As far as may be judged from illustrations of *Parastaffella timanica* Raus. our specimens seem to differ only in the sometimes concave lateral sides in outer whorls and the slightly greater persistance of a rounded periphery in inner whorls.

Parastaffella ex gr. *mathildae* (Dutkevitch, 1934 a)

Pl. XII Figs. 5–7

Locality: P 54.

Description: Whorls completely involute with shallow umbilical depressions; in inner 1.5–3 whorls periphery rounded or almost straight, in subsequent whorls more or less pointed; lateral sides straight or convex.

Chomata generally low and often indistinct.

Wall consists of a tectum and a less dense lower layer; spirotheca light-grey coloured in thin section (day-light).

Measurements:

	Wh.n.	0	1	2	3	4	
Specimen: 10 (1)		32	103	168	297	493	R.v.
10 (2)		28	105	195	328		
				62–86	68–77	66	G.r.
			—	0.49	0.51	0.48	F.r.
			0.34	0.39	0.43		

Remarks: This species belongs without any doubt to the group of *Parastaffella mathildae* (Dutk.). Within this group it is similar to *P. mathildae* and *P. ivanovi* (Dutk.). However, both species have a larger proloculum and a larger diameter for corresponding whorls. Form ratio of *P. mathildae* slightly smaller, of *P. ivanovi* slightly greater than form ratio of the present specimens.

Parastaffella sp. 1

Pl. XII Fig. 8

Locality: P 94.

Description: We have only one specimen of this species at our disposal, which we nevertheless describe since it is from the Escapa Formation (= Caliza de Montaña). This formation, near the base of the Carboniferous, yielded only few and badly preserved fusulinids because of the recrystallized and partly dolomitized state of the rock.

The specimen which has 5.5 whorls is wholly involute and has only very shallow umbilical depressions; lateral sides convex or straight; periphery bluntly pointed or arched to bluntly pointed in 2nd–5th whorl, arched in last half whorl.

Chomata most probably quite low.

Wall has a grey or light-grey colour; because of recrystallization especially in inner whorls nothing can be said about its composition.

Measurements:

Wh.n.	0	1	2	3	4	5	6	
	—	77	170	323	433	705 799		R.v.
			121	90	34	63		G.r.
		—	0.55	0.41	0.47	0.49 0.51		F.r.

Remarks: The most conspicuous character of this specimen is its large radius vector in comparison with the relatively few number of volutions. It is similar to some extent to species of the group of *Parastaffella preobrajenskyi* (Dutk.) e.g. *P. timanica* Raus. On the other hand there also is a certain similarity to *Staffella* ex gr. *expansa* Thomp. [cf. *St. expansa* Thomp., *St. akagoensis* Tor. (inner whorls)]. However, the greyish colour of the wall as well as the angular periphery in the penultimate whorl of the present specimen are considered more characteristic for *Parastaffella*.

Parastaffella sp. 2

Pl. XII Figs. 9–10

Locality: P 76.

Description: Whorls involute or polar ends just touch at their margins, in subsequent whorls sometimes slightly evolute; periphery rounded in inner 2 whorls, rounded or bluntly pointed up to and including 3rd–4th whorl, pointed in subsequent whorls; sometimes umbonate (specimen 17) or with shallow or moderately deep umbilical depressions (specimen 10); lateral sides convex in inner whorls, perfectly straight in outer whorls.

Chomata extremely low and of moderate width.

Wall has a light-grey colour, is relatively thin and seems to consist of a protheca only; chomata dark-grey, contrasting strongly with the translucent protheca.

Measurements:

Wh.n.	0	1	2	3	4	5	6	
Specimen: 17	35	73	120	204	323	493		R.v.
10	27	90	140	219	331	510	680	
		55–65	57–70	51–58	53–54			G.r.
		0.62	0.71	0.63	0.63	0.55		F.r.
		0.38	0.50	0.51	0.47	0.42	0.33	

Remarks: Although the different shapes and the difference in form ratios suggest that the two specimens might belong to different species, the comparable radius vector, mode of coiling as well as the state of chomata strongly favours the opposite view. This species is probably related to *Parastaffella propinqua* Viss. var. *angulata* Raus. (cf. our specimen 17). Other more remotely similar species are *Parastaffella plummeri* (Thomp.) and *Parastaffella luminosa* Gan. (cf. our specimen 10).

Parastaffella sp. 3

Pl. XII Figs. 11–13

Locality: L 353.

Description: Polar ends just touch in inner 1–3 whorls and slightly overlap in subsequent whorls; umbilical depressions shallow or absent; number of volutions up to five; periphery arched in inner 1–1.5 whorls, bluntly pointed in 1.5–3.5 whorl and pointed in 4–5th whorl; lateral sides straight or slightly convex in inner 2.5–3.5 whorls, straight or slightly concave in subsequent whorls.

Chomata extend to poles in inner 3.5–4.5 whorls; relative height between 0.20 and 0.45.

Wall shows indistinct differentiation; mural pores were observed; light grey-brown colour.

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 26 (1)	—	56		102		221		408		671	R.v.
26 (2)	22	57		102		183		323		544	
			82		116		85		65		G.r.
			79		79		77		68		
		—		0.66		0.50		0.44		0.35	F.r.
		0.57		0.46		0.45		0.42		0.34	

Remarks: The present species is to some extent similar to *Parastaffella plummeri* (Thomp.) (cf. Thompson, 1947, pl. 32, fig. 14). Differences are the slightly higher number of volutions, the apparently less well developed chomata and the somewhat greater form ratio of *Parastaffella plummeri.*

Parastaffella sp. 4

Pl. XII Fig. 14

Locality: L 11.

Description: The single specimen has 6 volutions, is wholly involute in inner whorls whereas in outer whorls axial ends just touch; periphery rounded in inner 2.5 whorls and bluntly pointed or bluntly pointed to pointed in 3.5–6th whorl; lateral sides straight or, in 6th whorl, straight or slightly concave; inner 3 whorls without polar concavities, in subsequent whorls umbilical depressions moderately developed.

Chomata probably extend to poles in all whorls; height quite variable, ranges from moderately high to absent as may be observed in the same chamber at both sides of the median plane (pseudochomata?).

Tunnel very well visible and clearly very low and broad in outer whorls.

Wall has a *Staffella*-like yellow-brownish colour; its composition could not be determined.

Measurements:

Wh.n.	0	1		2		3		4		5		6	
Specimen: 16	—	56		99		172		268		425		646	R.v.
			77		74		56		59		52		G.r.
		0.54		0.51		0.45		0.48		0.46		0.42	F..r

Remarks: This species is considered to be more related to *Parastaffella plummeri* (Thomp.) than to any other hitherto described species of this genus. It differs from *P. plummeri* by its somewhat more slender outline and perhaps somewhat higher chomata.

Parastaffella sp. 5

Pl. XII Figs. 15–16

Locality: P 10.

Description: These two rather badly preserved specimens which perhaps even belong to two different species are nevertheless described here since they are from one of our youngest foraminiferal containing limestones.

In inner 5 whorls wholly involute or whorls just contact at their margins, subsequent whorls sometimes slightly evolute; umbilical depressions shallow; periphery arched in inner two whorls, in subsequent whorls more or less pointed (specimen 17) or arched to bluntly pointed (specimen 4); lateral sides straight or convex.

Chomata low or of moderate height; proper judgement fails because of the quite recrystallized state of wall and chomata. This thorough recrystallization probably is the reason that protheca and secondary deposits show an almost equal density.

Wall light-brown coloured, its composition could not be determined.

Measurements:

Wh.n.	0	1	2	3	4	5	6	
Specimen: 4	25	68	127	204	289	425	552	R.v.
17	—	102	161	263	374	552	663	
			58–87	60–63	41–42	47–48	30	G.r.
		0.50	0.50	—	—	—	0.42	F.r.
		—	0.34	0.39	0.43	0.45	0.44	

Parastaffella? irinovkensis (Leont., 1951)* subsp. *kanisi* subsp. nov.

Pl. XII Figs. 17–23

Synonymy: 1956, *Pseudostaffella? mölleri* (Ozawa). — van Ginkel in Kanis, J., Leidse Geol. Med., Deel 21, p. 402, fig. 15, specimen G.

Type specimen: Specimen 32 (Pl. XII, Fig. 19) is designated as the holotype.

Locality: P 63.

Description:

Radius vector:	323–595
Form ratio:	0.47–0.61
Number of whorls:	5–6

Umbilical depressions absent or very broad and shallow; volutions normally involute, last whorl sometimes partly evolute; percentages of angularity of the periphery for 5 specimens from 1st to 6th volution respectively:

S.	—	10	10	—	—	—
S. (A.)	—	—	20	20	—	—
A.	100	90	70	80	88	100
A. (blp.)	—	—	—	—	12	—

* In Rauser-Chernoussova *et. al.*, 1951

Spirotheca essentially smooth in inner 4–5.5 whorls, septal grooves slightly marked in subsequent whorls; septa may be triangular in inner 4–4.5 whorls, rod-shaped in outer whorls; perpendicular to the wall, curved or forwardly inclined.

Relative height of chomata in 2.5–4.5 whorl usually ranges from 0.20 to 0.45; in 5–5.5 whorl from zero to 0.38; they are moderately wide; yet it seems that, at least in outer whorls, they do not extend to the poles; commonly gentle slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; average and range of maximum deviation of symmetry respectively 17° and 10°–22° (N = 5); tunnel angle from 3rd to 5.5 whorl ranges from 22° to 37°.

Axis either maintains same position throughout growth or inner 1–2 whorls at an angle to subsequent whorls.

Wall typically light-grey coloured. As far as it could be determined in our present material, the wall is composed of a relatively thin protheca covered on both sides by tectoria; the difference in density between protheca and tectoria is weak; in outer whorls we sometimes observe that the protheca consists of a tectum and a less dense inner layer (diaphanotheca); thickness of wall in 3rd–6th whorl varies from 15μ to 29 μ.

Measurements: See Table 8.

Remarks: In 1951 Leontovitch* described the new species *Pseudostaffella irinovkensis*. The present subspecies differs by its less depressed umbilical region, a somewhat greater radius vector for corresponding whorls, less volutions and slightly less septa for each whorl. This writer is inclined to believe that the Spanish form is more related to *Parastaffella* than to *Pseudostaffella*. Particularly the light-grey coloured wall, the fairly low chomata and the occasionally somewhat pointed periphery in the last whorl point to typical *Parastaffella's* from older strata of this region (Sierra del Brezo). The resemblance with *Pseudostaffella* is considered to be caused by convergence.

Parastaffella? carmenesensis sp. nov.

Pl. XIII Figs. 1—8

Type specimen: Specimen 31 (Pl. XIII, Fig. 3) is designated as the holotype.

Locality: L 25.

Description:

Radius vector:	610–820
Form ratio:	0.50–0.63
Number of whorls:	6–7

Umbilical region convex, flat (specimen 37), to moderately depressed; whorls completely involute in inner 4?–6 whorls; percentages of angularity of periphery for 8 specimens from 1st to 6th whorl respectively:

S.	12	19	—	6	—	—
S. (A.)	6	19	—	—	—	—
A.	82	50	38	12	19	—
A. (blp.)	—	—	19	19	12	27
blp.	—	12	31	44	19	36
P. (blp.)	—		—	—	31	9
P.	—	—	12	19	19	28

* In Rauser-Chernoussova *et al.*, 1951.

Lateral sides straight or convex in inner 3.5–6 whorls, in subsequent whorls straight or concave.

Chomata extend to poles in inner 3–5 whorls; relative height generally between 0.20 and 0.35; steep or gentle slopes at the tunnel side; asymmetric, in 5.5–7th whorl sometimes subsymmetric or symmetric.

Wall has a light-brown or yellow-brown colour, corresponding with the wall of species of *Staffella* in this sample; it is composed of a clear diaphanotheca and a more opaque lower-tectorium; lower-tectorium sometimes locally absent, relatively thin; mural pores frequently observed; chomata generally somewhat more opaque than spirotheca and brown or rather grey coloured; in the latter case in clear contrast to the yellow-brown wall.

Measurements: See Table 9.

Remarks: The present species occurs in association with *Staffella breimeri* sp. nov. and *St.* ex gr. *expansa* Thomp. This association added to the *Staffella*-type wall (light-brown or yellow-brown colour in thin section (day-light)), which corresponds in every respect with the wall of *St. breimeri* and *St.* ex gr. *expansa*, sufficiently proves the close affinity between *P.? carmenesensis* sp. nov. and the genus *Staffella*. However, the pointed periphery, concave lateral sides in combination with the relatively small form ratio are characters which prevail in *Parastaffella*. This species is considered to be a relatively late off-shoot of the *Staffella* branch and related to *St.* ex gr. *expansa* e.g. *St. expansa* Thomp. and *St. depressa* Thomp.

Parastaffella? sp.

Pl. XIII Figs. 9–12

Locality: P 99.

Description:

Radius vector:	645–800
Form ratio:	0.46–0.63
Number of whorls:	5.5–6

Umbilical depressions shallow to moderately deep; specimen 24 probably umbonate; whorls wholly involute; lateral sides convex or straight; percentages of angularity of periphery for 4 specimens from 1st to 6th whorl respectively:

A.	63	14	—	12	—	—
A. (blp.)	12	28	12	13	25	20
blp.	25	43	50	38	50	20
P. (blp.)	—	15	38	37	13	40
P.	—	—	—	—	12	20

Chomata extend to poles in inner 4–5 whorls; steep or gentle slopes at the tunnel side; relative height varies mostly from 0.25 to 0.45.

Wall has a yellow-brown, brown or light brown-grey colour which is the same as observed in the associated *Staffella mochaensis* sp. nov.; tectoria generally absent; lower-tectorium locally observed in specimen 26; mural pores indistinct probably due to recrystallization.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen:	25	—	85	170	259	391	595 646		
	26	24	85	153	259	408	612 799		
	24	—	85	166	255	391	595 723		R.v.
	7	—	68	136	238	365	527	782	
Av.:		—	81	156	253	389	582	—	
			100	52	51	52			
			80	69	57	50			G.r.
			95	54	53	52			
			100	75	54	44	48		
Av.:			94	62	54	50	—		
			0.50	0.50	0.52	0.67	0.57 0.63		
			0.52	0.58	0.62	0.62	0.60 0.54		F.r.
			0.45	0.46	0.62	0.63	0.67 0.56		
			—	0.72	0.68	0.56	0.53	0.46	
Av.:			0.49	0.56	0.61	0.62	0.59	—	

Remarks: The present species was encountered in a sample crowded with representatives of the subfamily Staffellinae (*St. mochaensis* sp. nov.; *St.* ex gr. *expansa*). Since colour and composition of the wall of *Parastaffella?* sp. is closely comparable with that of the above-mentioned species, presumably there is a close affinity between the present species and the genus *Staffella.* However, general outline as well as small form ratio rather point to typical *Parastaffella.* Provisionally we consider this and comparable forms to belong to *Parastaffella,* being late off-branches of *Staffella.* Differences with the stratigraphically much older but rather similar *Parastaffella? carmenesensis* sp. nov. are tabulated below:

	No. of Wh.	Diam. Prol.	R.v. 4th wh.	R.v.	F.r.
P.? carmenesensis	6–7	44–56	260–430	610–820	0.50–0.63
P.? sp.	5.5–6	48	365–410	645–800	0.46–0.63

Parastaffella? sp. has also somewhat higher chomata, a more angular periphery in inner whorls and always completely involute outer whorls.

Subfamily OZAWAINELLINAE Thompson et Foster, 1937

Genus MILLERELLA Thompson, 1942

Thompson, M. L., New genera of Pennsylvanian fusulinids. Am. Journ. Sci., New Haven, Conn., 1942, Vol. 240, p. 407.

Millerella breviscula (Ganelina, 1951)

Pl. XIII Fig. 13

Locality: P 54.

Description: Outer whorl partially evolute, inner whorls probably just contact in axial region; axial region flat; lateral sides parallel; periphery rounded throughout growth. Probably planispiral coiling. Supplementary deposits absent. Wall differentiation not observed. Clearly defined dark shadows in axial area.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 27 (1)		—	32		71		129	R.v.
				120		82		G.r.
			0.73		0.62		0.33	F.r.

Pl. XIII Figs. 14–15

Locality: L 16.
Description: Whorls partially evolute or just in contact at their margins; axial region flat; lateral sides parallel; periphery rounded throughout growth. Essentially planispiral. Wall differentiation not observed. Clearly defined dark shadows in axial area

Measurements:

	Wh.n.	0	1		2	
Specimen: 23 (4)		15	30		60	R.v.
22 (1)		15	34		73	
				100–113		G.r.
			0.57		0.37	F.r.
			0.59		0.43	

Pl. XIII Figs. 16–19

Locality: L 24.
Description: Whorls slightly evolute or just in contact at their margins; axial region flat or very slightly concave; parallel to subparallel sides in axial section; periphery rounded throughout growth. Planispiral coiling. Supplementary deposits absent. Wall differentiation not observed. Clearly defined dark shadows in axial area.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 25 (1)		11	39		73			
28		12	30		64			R.v.
22		13	34		69	112		
6		15	38		69		118	
R.:				82–114		—		G.r.
Av.:				96		72		
			0.39		0.29			
			—		0.37			F.r.
			—		0.44	0.28		
			0.46		0.34		0.31	

Remarks: (with respect to specimens of this species from Locs. P. 54, L 16 and L 24).
The present species is easily identified with *Millerella breviscula* (Gan.). Ganelina did not point out differences with the apparently very similar *M. minutissima* (Raus.). However, Rauser-Chernoussova in her description of *M. minutissima* does not mention presence of dark shadows in the polar area which characterize *M. breviscula* as well as our specimens. Other species presumably closely related to *M. breviscula* (Gan.) are *M. mediocris* (Viss.), *M. prisca* (Raus.) and *M. lenticula* (Grozd. *et* Leb.).

Millerella cf. *breviscula*

Pl. XIII Fig. 20

Locality: P 76.

Description: Margins of 2nd whorl in polar area just touch, 3rd whorl slightly evolute; axial region flat; lateral sides parallel; periphery rounded throughout growth. First whorl coiled at large angle (90°) to subsequent whorls. Supplementary deposits absent. Faint indication of dark shadows in axial area.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 13		13	39		86		145	R.v.
				120		70		G.r.
			0.39		0.42		0.31	F.r.

Remarks: The present specimen is related to species of the group *M. parva* (Moell.) as well as to species of the group *M. mediocris* (Viss.). Species showing many characters in common and belonging to the group *M. parva* are (in decreasing order of resemblance) *M. prisca* (Raus.), *M. tantilla* (Gan.), *M. parva* (Moell.), *M. parva* var. *shamordini* (Raus.) and *M. paraparva* (Gan.).
Our specimen differs from *M. breviscula* (Gan.) (ex gr. *M. mediocris*) by its slightly larger diameter, fainter shadows in the axial area and its relatively somewhat thicker wall. Moreover, a shift in the axis of coiling has not been reported in *M. breviscula* (Gan.).

Millerella cf. *varvariensis* (Brazhnikova *et* Potievskaja, 1948)

Pl. XIII Figs. 21–22

Locality: P 76.

Description: Whorls slightly overlap or just in contact at the umbilical area; slightly umbilicate; lateral slopes straight or convex; periphery rounded in inner 2 whorls, subrounded or bluntly pointed in 3.5–4th whorl. First whorl at small or medium angle to subsequent whorls. Supplementary deposits (chomata) moderately developed (for this genus). Wall not differentiated.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 7 (2)	13	47		95		168	224		R.v.
14 (2)	11	40		74		130		200	
			85–100		75–77		—		G.r.
		0.50		0.46		0.40	0.32		F.r.
		0.48		0.45		0.44		0.39	

Remarks: These specimens might be conspecific with *M. varvariensis* (Brazhn. *et* Pot.) or with its variety *grandis* (Brazhn.). The illustration of this species in the original publication, however, does not permit comparison. For this reason it may well be possible that our specimens are actually closer to *M. pseudostruvei* (Raus. *et* Belj.) especially to its varieties *angusta* (Kir.) [cf. specimen 7(2)] and *chomatifera* (Kir.) [cf. specimen 14(2)]. Other species similar to some degree are *M. transita* (Kir.) and *M. postmosquensis* var. *acutiformis* (Kir.). More remotely comparable are the Lower Carboniferous (Viséan) *M. constricta* (Gan.) and *M. pressula* Gan. They are, moreover, not unlike some North American species as for instance *M. chesterensis* Cooper.

Millerella cf. *parastruvei* (Rauser-Chernoussova, 1948)

Pl. XIII Figs. 23–24

Locality: P 54.

Description: First whorl may be evolute, subsequent whorls involute; polar region flat or very slightly depressed, degree of concavity of umbilicus unequal at opposite sides; lateral sides straight or, more commonly, convex; periphery rounded in inner 2 whorls, rounded or subrounded in 3rd–4th whorl. Axis of coiling maintains original position. Secondary deposits (discontinuous chomata) weakly developed. At some places in outer whorls of mature specimens wall shows a tectum and a less dense lower layer.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 22 (1)	—	64		146		230		408	R.v.
22 (2)	30	54		129		263	306		
			127–140		58–104		78		G.r.
		0.67		0.54		0.52		0.48	F.r.
		—		0.47		0.39	0.42		

Remarks: These specimens correspond with *M. parastruvei* (Raus.) in all essential characters yet the diameter of the Spanish specimens seems to be slightly larger for corresponding volutions.

Millerella cf. *mosquensis* (Viss., 1948*) var. *acuta* (Rauser-Chernoussova, 1948)

Pl. XIII Figs. 25–26

Locality: P 54.

Description: Inner 2 whorls just in contact at their margins, subsequent whorls slightly overlap; axial region flat or depressed in inner 2 whorls and raised in outer 2 whorls; lateral sides straight or convex; periphery arched or arched to flat in inner 2 whorls, arched or bluntly pointed in 3–3.5 whorl. First whorl at an angle to subsequent whorls. Supplementary deposits (discontinuous chomata) moderately developed. Wall weakly differentiated, consisting of a tectum and a lower less dense layer.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 28 (2)		—		—		119		221	289		R.v.
17 (1)		—		80		129		214	272		
					61		65–86				G.r.
				—		0.57		0.46	0.47		F.r.
				0.46		0.55		0.56	0.45		

Remarks: The two specimens described above are almost equally similar to *M. mosquensis* and its varieties *acuta* (Raus.) and *sublata* (Gan.) as to the North American species *M. ampla* (Thomp.). Yet our specimens are probably somewhat closer related to *M. mosquensis*. They differ from *M. mosquensis* (Viss.) and its varieties mainly by the umbonate state of the pole region and the perhaps slightly better developed secondary deposits. *M. ampla* differs in having slightly more volutions, a more regularly and symmetrically coiled shell and slightly better (continuous?) developed chomata. Other less similar species are *M. ikensis* (Viss.), *M. proikensis* (Raus.) and *M. parastruvei* (Raus.).

Millerella cf. *pseudostruvei* (Rauser-Chernoussova *et* Beljaev, 1936)

Pl. XIV Fig. 1

Locality: P 54.

Description: Inner 3.5 whorls just in contact at their margins, 4th whorl slightly evolute; axial region probably flat in early whorls, gradually becoming depressed in subsequent whorls; lateral sides straight or convex; periphery rounded or rounded to straight in inner 2.5 whorls, subrounded in 3rd–4th whorl. First whorl at large (90°) angle to subsequent whorls. Supplementary deposits (discontinuous? chomata) weakly developed to almost absent. Locally a tectum is sometimes observed.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 27 (1)		15		47		70		120		198	R.v.
					49		71		65		G.r.
				0.47		0.53		0.50		0.41	F.r.

* In Rauser-Chernoussova *et. al.*, 1948.

Remarks: This specimen might be conspecific with *M. pseudostruvei* (Raus *et* Belj.). The only difference is the perhaps slightly larger diameter for corresponding whorls in our specimen. *M. varvariensis* (Brazhn. *et* Pot.) might be somewhat similar as well. *M. postmosquensis* (Kir.) and its variety *acutiformis* (Kir.) differ in having better developed secondary deposits and a usually stable axis of coiling.

Millerella cf. *pseudostruvei* (Raus. *et* Belj., 1936) var. *angusta* (Kireeva, 1951*)

Pl. XIV Figs. 2–5

Locality: P 1.

Description: Opposite whorls merely in contact at their margins or slightly evolute, last half whorl occasionally more highly evolute (specimen 28); inner whorls with clearly depressed (specimens 37, 60) or with flattened to even slightly raised axial regions [specimens 83(1), 28], outer whorls with flat or shallowly depressed (wide) axial areas; lateral slopes straight or convex; periphery generally rounded or subrounded in outer whorls, occasionally bluntly pointed; in inner whorls straight to rounded (specimen 60) or from rounded to bluntly pointed (specimens 28, 37); shape of early whorls in one specimen angular linguiform with portion of whorl near suture inflated (specimen 37); this points possibly to a close relation with *M. variabilis* (Raus.). Axis of coiling often not wholly stable (specimen 60); first whorl sometimes at an angle to subsequent whorls [specimen 83(1)]; final half whorl may be highly asymmetric with respect to the median plane of the previous whorl (specimens 60, 28); axis of specimen 37 on the contrary maintains original position throughout growth. Supplementary deposits (chomata) either hardly developed (specimen 60), or of moderate width and height (specimen 37).

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 28	—	50		82		135		217	
37	21	47		86		138		189	R.v.
83 (1)	19	45		77		119	145		
60	18	41		65		108		211	
R.:			58–82		55–67		38–96		G.r.
Av.:			69		62		65		
		0.47		0.38		0.39		0.39	
		0.50		0.40		0.39		0.34	F.r.
		0.57		0.55		0.43	0.41		
		0.58		0.50		0.46		0.31	

Remarks: The present specimens definitely belong to *M.* ex gr. *pseudostruvei* (sensu Rauser-Chernoussova *et al.*, 1951). Within this group of species *M. pseudostruvei* (Raus. *et* Belj.) var. *angusta* (Kir.) is considered to be most closely allied. This variety differs by its slightly larger diameter for corresponding whorls; mature individuals measure 0.37 mm to 0.45 mm (Kireeva, 1951) whereas our specimens vary between 0.30 mm and 0.37 mm. Yet Kireeva states that occasionally smaller forms may occur which apparently were included in this variety. A second distinction may be the slightly

* In Rauser-Chernoussova *et. al.*, 1951.

smaller proloculum and the more frequent plectogyroid state of the juvenarium. Moreover, the angular linguiform inner whorls in some specimens (specimen 37) was not reported to occur in Kireeva's variety. *M. pseudostruvei* (Raus. *et* Belj.) forma *minima* (Kir.) contains slightly less (2.5–3.5) volutions (3.5–4 in the present specimens) Specimen 37 resembles to some degree *M. variabilis* (See above) and *M. zelleri* Cooper. Both species, the latter in particular, have a smaller diameter for corresponding whorls. Specimen 28 is not unlike those specimens of *M. mixta* (Raus.) transitional to *M. mutabilis* (Raus.). This species, however, has more volutions, a smaller proloculum and better developed chomata.

Millerella acuta (Grozdilova *et* Lebedeva, 1950)

Pl. XIV Figs. 6–7

Locality: P 63.

Description: Margins of opposite whorls are just in contact or slightly overlap; axial region flat or very slightly raised, occasionally with shallow umbilical depressions; lateral sides straight or slightly convex; periphery rounded in 1st whorl, from rounded to bluntly pointed in 2nd whorl, from bluntly pointed to pointed in 3rd whorl. Axis of coiling almost stable during growth. Supplementary deposits (chomata) weakly or moderately developed (for this genus); low but relatively wide. Wall differentiation not observed.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 4		21	56		107		219	
9		18	52		118		150	R.v.
6		23	52		90		168	
R.:				75–127		27–104		G.r.
Av.:				98		72		
			0.42		0.42		0.29	
			0.47		0.39		0.39	F.r.
			0.48		0.43		0.34	

Remarks: Except for the more umbonate state of the inner whorls in our specimens, all characters correspond with *M. acuta* (Grozd. *et* Leb.).

Pl. XIV Fig. 8

Locality: L 16.

Description: Margins of whorls just in contact or whorls slightly evolute; umbilical depressions broad and shallow; lateral slopes straight or slightly convex; periphery rounded in innermost whorl, from subrounded to subangular in subsequent whorls. Axis of coiling not wholly stable during growth. Supplementary deposits weakly developed. Wall differentiation not observed.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 3 (2)		23	56		112		206	R.v.
				100		85		G.r.
			0.48		0.39		0.27	F.r.

Remarks: The single specimen we have, perfectly fits the original description of *M. acuta*. In our specimen the periphery (3rd wh.) is slightly more rounded as compared with the periphery in description and illustrations of *M. acuta*. The somewhat rounded to angular linguiform inner whorls with the portion of whorl near the suture inflated is similar to *M. variabilis* (Raus.).

Pl. XIV Figs. 9–11

Locality: P 1.

Description: Margins of opposite whorls just in contact or whorls slightly evolute; umbilical depressions well expressed; lateral slopes straight or convex; periphery rounded (1st wh.), from rounded to bluntly angular (2nd wh.), from subrounded to subangular (3rd wh.). Supplementary deposits weakly (specimen 60) or moderately (specimen 73) developed. Axis of coiling not wholly stable during growth. Tunnel crescentic, about two times as wide as high in last whorl (specimen 60). Wall differentiation not observed.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen:	73	21	58		99		172	185		
	115	20	47		88		159			R.v.
	60	24	56		112		189			
R.:				70–100		69–83				G.r.
Av.:				85		75				
			0.44		0.35		0.34	0.32		
			0.50		0.39		0.35			F.r.
			0.62		0.42		0.32			

Millerella cf. *acuta* (Grozdilova *et* Lebedeva)

(1st assemblage)

Pl. XIV Figs. 12–15

Locality: L 16.

Description: Margins of opposite whorls just contact in axial area; moderate degree of concavity of the umbilicus; lateral sides straight or convex in inner 3 whorls, straight or concave in last half whorl (3.5 wh.); periphery changes from rounded or subrounded (1st–2nd wh.) to bluntly pointed or pointed (2.5–3.5 wh.). Axis of coiling maintains approximately original position throughout shell. Supplementary deposits (continuous? chomata) rather weakly developed for this genus, low but relatively broad. Wall differentiation not observed.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 3 (1)	25	52		99		175	226		
16 (1)	25	51		92		148	224		R.v.
16 (4)	23	49		99		181			
16 (2)	21	47		95		172			
R.:			83–100		60–83				G.r.
Av.:			94		75				
		0.50		0.41		0.37	0.34		
		0.51		0.47		0.39	0.36		F.r.
		0.52		0.37		0.32			
		0.52		0.36		0.35			

Remarks: This species is without doubt very close to *M. acuta* (Grozd. *et* Leb.). The only difference seems to be a slightly larger L/D ratio (0.30–0.38 in *M. acuta* to 0.36–0.44 in the present specimens). Other somewhat similar species are *M. dogbendensis* (Stew.), *M. lepidaeformis* (Kir.), *M. donbassica* (Kir.) and *M. mutabilis* var. *postera* (Kir.). Linguiform inner whorls less common as compared with assemblages from Loc. P 1 and Loc. L 16 [specimen 3(2)].

(2nd assemblage)

Pl. XIV Figs. 16–17

Locality: L 16.

Description: Slightly evolute or margins of opposite whorls just contact in axial area; umbilical depressions shallow [specimen 37(3)] or rather deep (specimen 9); lateral sides straight or convex; periphery changes from rounded or subrounded (inner 1.5 wh.) to rounded or bluntly pointed (2nd–3rd wh.). First whorl may be at a small angle to subsequent whorls [specimen 37(3)]. Chomata moderately developed, broad, of medium height. Wall differentiation not observed.

Measurements:

Wh.n.	0	1		2		3	
Specimen: 9	25	60		107		181	R.v.
37 (3)	20	50		89		145	
			78–79		62–68		G.r.
		0.39		0.32		0.35	F.r.
		0.50		0.42		0.35	

Remarks: The two specimens here described might belong to the same population as specimens from this locality referred respectively to *M. acuta* and *M.* cf. *acuta*. The few specimens we have do not permit to judge whether the observed differences are actually due to variability within a single population. Apart from this consideration specimens 9 and 37(3) have characters which not only point to *M. acuta* (size) but also to *M. exilus* (Grozd. *et* Leb.) (rounded periphery). Both species seem to be closely related.

Millerella acuta (Grozd. *et* Leb., 1950) forma *nana* (Kireeva, 1949)

Pl. XIV Figs. 18–20

Locality: P 1.

Description: Margins of opposite whorls just in contact, very slightly involute or evolute; axial region flat (inner 2–3 whs.), shallow umbilical depressions observed in last whorl; lateral slopes straight or convex; periphery rounded (inner 2 whs.), subrounded or bluntly pointed (subsequent whorls). Axis of coiling almost stable, first half whorl sometimes at slight angle to subsequent whorls. Supplementary deposits indistinct. Wall structure generally homogeneous, yet locally a tectum and a less dense lower layer were sometimes observed.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen: 66		20	46		73		135			R.v.
83 (2)		14	30		58		112	176		
				59–93		85–93				G.r.
			0.38		0.42		0.31			F.r.
			0.57		0.48		0.46	0.30		

Remarks: These specimens are considered to be closely allied with or identical to the smaller sized forms of *M. acuta* (Grozd. *et* Leb.). They were described by Kireeva (1949) as *M. acuta* forma *nana.*

Pl. XIV Figs. 21–22

Locality: P 38.

Description: Whorls slightly involute [very little overlap (specimen 107)] or evolute (specimen 138); axial region with broad and relatively shallow umbilical depressions in outer whorls; lateral slopes straight or slightly convex; periphery rounded or angular in inner 1–2 whorls, subrounded or subangular in 2nd–3rd whorl. Axis of coiling not stable (cf. specimen 138). Supplementary deposits weakly developed. Wall differentiation indistinct.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 138		19	45		77		150	R.v.
107		15	34		71		148	
				71–106		94–109		G.r.
			0.48		0.29		0.25	F.r.
			0.56		0.42		0.32	

Remarks: Specimens might correspond to *M. acuta* forma *nana* (Kir.). Unfortunately, Kireeva's description leaves us in some doubt as to the actual nature of this form. A difference with *M. acuta* forma *nana* (Kir.) is probably the "*Pseudonovella*"-like type of growth of our specimen 138. This character brings to mind species like *M. irregularis* (Kir.), *M. carbonica* (Grozd. *et* Leb.) and *M. keltmensis* (Raus.) although these species are different in a number of other characters. *M. compressa* (Brazhn.) differs by its involute manner of coiling. Inner whorls sometimes show a linguiform outline which is reminiscent of *M. variabilis* (Raus.).

Millerella acuta (Grozd. *et* Leb., 1950) var. *lata* (Kireeva, 1949)

Pl. XIV Fig. 23

Locality: A 7.

Description: Whorls just contact at their margins or slightly overlap; axial region almost flat; lateral slopes straight or convex; periphery rounded or subrounded (1st–2nd wh.), subrounded or bluntly pointed (3–3.5 wh.). Axis of coiling almost stable. Supplementary deposits (discontinuous chomata) weakly developed. Wall differentiation not observed.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 5		17		39		64		112	150		R.v.
					64		75				G.r.
				0.47		0.45		0.44	0.43		F.r.

Millerella compressa (Brazhnikova, 1951)

Pl. XIV Figs. 24–27

Locality: A 3.

Description: Margins of opposite whorls either just in contact or whorls evolute; umbilical area slightly depressed; lateral sides straight or convex; periphery rounded or subrounded in inner 2 whorls, from rounded to bluntly pointed in subsequent whorls. Slight but rather frequent shifts of the axis may occur. Supplementary deposits absent or weakly developed. Wall differentiation not observed.

Measurement:s

	Wh.n.	0		1		2		3		4	
Specimen: 18 (2)		10		24		47		90			
7 (1)		13		39		56		103			R.v.
25 (2)		16		39		69		120			
8		14		30		60		103	125		
R.:					44–100		71–90				G.r.
Av.:					80		80				
				0.59		0.45		0.33			
				0.33		0.35		0.31			F.r.
				0.44		0.38		0.30			
				0.50		0.46		0.42	0.38		

Remarks: The specimens here described are wholly similar to *Millerella compressa* (Brazhn.) as described and illustrated by Putrya (1956). There is no reason to believe that they are different from Brazhnikova's specimens but comparison is hampered by inadequate quality of reproductions in the original publication. Our specimen 8 is less typical and constitutes a transitional form to *M. depressa* (Put.).

Millerella cf. *compressa* (Brazhnikova)

Pl. XIV Fig. 28

Locality: P 70.

Description: Inner 2 whorls probably slightly evolute, margins of 3rd whorl just contact in axial area; moderately umbilicate; straight or convex lateral sides; periphery rounded (1st wh.), bluntly pointed to subangular (2–2.5 wh.) and again rounded (3rd wh.). First whorl at slight angle to subsequent whorls. Chomata of medium height and width, probably discontinuous. Wall differentiation not observed.

Measurements:

	Wh.n.	0		1		2		3	
Specimen: 8		19		39		80		163	R.v.
					101		105		G.r.
				0.50		0.38		0.32	F.r.

Remarks: This specimen is provisionally referred to *M. compressa*. It differs from this species in having a larger proloculum, slightly larger diameter as well as a slightly greater form ratio. In these characters it is closer to *M. exilus* (Grozd. *et* Leb.). It differs from *M. aperta* (Grozd. *et* Leb.) and *M. carbonica* (Grozd. *et* Leb.) by a more evolute coiling of both these species. The linguiform 2nd whorl points to a possible relation with *M. variabilis* (Raus.).

Millerella mutabilis (Rauser-Chernoussova, 1951)

Pl. XIV Fig. 29

Locality: P 1.

Description: Whorls slightly overlap or margins just in contact; axial region essentially flat; lateral slopes straight or convex; periphery rounded or subrounded in inner 2 whorls, subrounded or subangular in subsequent whorls. Axis of coiling not stable, last whorls asymmetrical in axial section. Chomata variable, generally of moderate width and height, probably discontinuous. Structure of wall homogeneous.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 35		14		34		82		142		241	R.v.
					137		74		70		G.r.
				0.62		0.47		0.41		0.31	F.r.

Remarks: This specimen definitely belongs to *M. mutabilis* (Raus.). The diameter of our specimen is somewhat larger than of specimens from the Moscow basin but probably corresponds to measurements of specimens from more northern areas in the U.S.S.R. (cf. Rauser-Chernoussova *et al.*, 1951).

Millerella cf. *mutabilis* (Rauser-Chernoussova)

Pl. XIV Figs. 30–32

Locality: L 16.

Description: Whorls normally slightly involute, sometimes margins merely in contact; axial regions commonly flat or very slightly raised, sometimes with shallow umbilical depressions; lateral slopes in inner whorls straight or convex, last whorl often with concave slopes at one side and convex slopes at the other side of the axial plane and consequently asymmetric in outline [specimen 14(2)]; periphery rather variable, varying from acute to rounded. Axis of coiling not wholly stable but deviations to only a few degrees. Chomata quite variable, either low or of medium height, either extending almost to the poles or very narrow. Wall structure homogeneous.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 14 (2)	18	42		77		142	176		
12	12	40		73		123	160		R.v.
21 (2)	15	34		70		120		183	
R.:			83–103		68–83				
Av.:			90		74		52		G.r.
		0.46		0.44		0.39	0.33		
		0.40		0.38		0.37	0.36		F.r.
		0.63		0.52		0.45		0.39	

Remarks: The present specimens are best compared with *M. mutabilis* (Raus.). The Spanish forms differ in having fewer whorls (3.5–4 whs. as against 4–4.5 whs.), a slightly larger proloculum and a larger diameter for corresponding whorls.

Pl. XIV Figs. 33–34

Locality: P 1.

Description: Margins of inner 1–2 whorls merely in contact, subsequent whorls overlap very slightly; axial region normally flat, occasionally showing very shallow umbilical depressions; lateral slopes convex or straight; periphery rounded (1st wh.) from subrounded to subangular (subsequent whorls). Axis of coiling almost stable, equatorial plane may shift somewhat (cf. specimen 83 from 3rd to 4th whorl). Secondary deposits weakly developed. Wall structure inconspicuous, locally a tectum is sometimes observed.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen:	68	27	47		90		170	181		R.v.
	83	19	37		65		108		181	
				76–91		67–88		68		G.r.
			0.59		0.48		0.37	0.40		F.r.
			0.53		0.53		0.46		0.29	

Remarks: Specimen 35 [Loc. P 1 (= *M. mutabilis*)] and the here described specimens from the same locality might belong to a single population. The latter specimens, however, differ from typical *M. mutabilis* (Raus.) in having a larger proloculum and somewhat less volutions (3.5–4 whs. as against 4–4.5 whs. in *M. mutabilis*). In this respect they resemble *M. mutabilis* var. *postera* (Kir.).

Millerella cf. *mutabilis* (Raus., 1951) var. *postera* (Kireeva, 1949)

Pl. XIV Fig. 35

Locality: A 7.

Description: Involute throughout growth with possible exception of 1st whorl; umbilical region flat; lateral slopes straight or convex; periphery rounded or bluntly pointed up to the 1st whorl, angular in subsequent whorls (2nd–3rd wh.). Axis of coiling not wholly stable but deviations of symmetry not very conspicuous. Asymmetric outline of last whorls, a character fairly typical for *M. mutabilis*, is evident in this specimen. Wall structure homogeneous.

Measurements:

	Wh.n.	0	1		2		3	
Specimen:	4	19	54		102		190	R.v.
				89		86		G.r.
			0.40		0.34		0.29	F.r.

Remarks: Although we are inclined to refer this specimen to *M. mutabilis* var. *postera* (Kir.) we cannot exclude the possibility that it is more allied to *M. lepidaeformis* var. *minima* (Kir.). Another somewhat similar species is *M. dogbendensis* (Stew.). See also *M.* ex gr. *acuta* et *mutabilis* from the Perapertú Formation (Loc. P 70).

Millerella variabilis (Rauser-Chernoussova, 1951)

Pl. XIV Figs. 36–38

Locality: P 1.

Description: Whorls generally slightly evolute, occasionally margins of opposite whorls just in contact; umbilical depressions shallow, relatively broad if present, often better expressed in early whorls (specimen 64 = juvenile specimen); degree of concavity of umbilicus generally unequal at opposite sides; lateral slopes straight or convex; periphery rounded (1st wh.) rounded or subangular (2nd wh.) from rounded to bluntly pointed (3rd–4th wh.). Axis of coiling not stable, although shifts only amount to a few degrees. Supplementary deposits (discontinuous chomata) weakly developed, of moderate width and generally low. Wall either not differentiated or sometimes with tectum and less dense lower layer.

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 55 (1)	17	37		65		108		155	—		
55 (2)	18	43		69		107		140			R.v.
64	18	37		62		108					
R.:			60–76		56–72		30–44				G.r.
Av.:			69		65		37				
		—		0.47		0.38		0.36			
		0.55		0.50		0.40		0.37			F.r.
		0.53		0.45		0.40					

Remarks: The present specimens correspond very well to the original description o *M. variabilis* (Raus.).

Millerella cf. *carbonica* (Grozdilova *et* Lebeveda, 1950)

Pl. XIV Figs. 39–40

Locality: P 1.

Description: Volutions evolute; beyond 1st–2nd whorl umbilical depressions generally deep and relatively wide, inner 1–2 whorls with nearly flat axial region; lateral sides straight or convex, commonly straight in outer whorls; periphery rounded in inner 2 whorls, from rounded to bluntly pointed in subsequent whorls. First whorl often at a slight angle to subsequent whorls. Chomata either low (specimen 56) or of moderate height (specimen 29), relative width highly variable. Wall structure homogeneous, fairly coarse texture gives the wall a somewhat lighter grey colour than is usual for this genus.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 29	23	51		96		155			R.v.
56	20	47		75		138		194	
			60–88		61–83		41		G.r.
		0.43		0.38		0.35			F.r.
		0.50		0.54		0.47		0.42	

Remarks: Except for a slightly different L/D ratio, our specimens are quite similar to those described and figured by Grozdilova and Lebedeva (1950).

Millerella exilus (Grozdilova *et* Lebedeva, 1950)

Pl. XIV Figs. 41–48

Locality: P 1.

Description: Margins of opposite whorls in contact, slightly evolute or –rarely– involute; axial region often flat in inner 1–2.5 whorls, slightly to moderately depressed in subsequent whorls; lateral slopes commonly convex, occasionally straight; periphery rounded (1st wh.), from rounded to bluntly pointed (subsequent whorls). Axis of coiling not wholly stable, first whorl sometimes at a slight angle to subsequent whorls (specimen 59), last half whorl may show different overlap at both sides of the equatorial plane [specimens 99(3), 119]. Chomata probably discontinuous, poorly developed if present, low and relatively broad. Wall not differentiated.

Measurements:

	Wh.n.	0	1		2		3		4	
Form 1										
Specimen:	59	15	47		86		129			
	119	18	39		73		114			R.v.
	99 (3)	18	37		67		107	155		
R.:				82–87		50–61				G.r.
Av.:				84		56				
			0.24		0.37		0.40			
			0.22		0.47		0.38			F.r.
			0.53		0.50		0.44	0.37		
Form 2										
Specimen:	123 (1)	19	43		67		123	146		R.v.
	2	19	39		82		120			
R.:				55–111		47–84				G.r.
			0.50		0.39		0.35	0.37		F.r.
			0.50		0.37		0.41			
Form 3										
Specimen:	15 (1)	16	52		84		125			
	15 (2)	19	43		71		146			R.v.
	99 (2)	16	30		60		99	133		
R.:				63–100		49–106				G.r.
Av.:				76		73				
			0.42		0.38		0.36			
			0.45		0.48		0.37			F.r.
			0.61		0.46		0.39	0.32		

Remarks: We encountered a large number of fairly small specimens from this locality which are believed to belong to a single population, although extreme variants differ considerably from each other (cf. form 1, 2 and 3). The possibility that they belong to early growthstages of one or more species cannot ruled out with certainty. On the other hand the description of *M. exilus* as given by Grozdilova and Lebedeva fits almost all our specimens.

Millerella monstrosa (Kireeva), 1949
Pl. XIV Figs. 49–50

Locality: P 1.

Description: Margins of opposite whorls just in contact at the umbilical area or whorls slightly evolute; axial region flat (1st–2nd wh.) or depressed (2nd–3rd wh.); lateral slopes generally convex; periphery rounded or subrounded. Axis of coiling not wholly stable, first whorl sometimes at a slight angle to subsequent whorls. Chomata distinct but weakly developed. Wall structure homogeneous.

Measurements:

Wh.n.	0	2		2		3	
Specimen: 94	15	34		54		90	R.v.
24	16	32		56		86	
			56–73		48–68		G.r.
		0.50		0.48		0.40	F.r.
		0.43		0.38		0.37	

Remarks: These specimens may be identified with *M. monstrosa* (Kir.). This species is one out of a number rather similar species e.g. *M. minutissima* (Raus.), *M. parva* (Moell.), *M. lenticula* (Grozd. *et* Leb.), *M. exilus* (Grozd. *et* Leb.) etc.

Millerella cf. *donbassica* (Kireeva 1949),
Pl. XIV Figs. 51–54

Locality: P 1.

Description: Margins of inner 1–3 whorls just touch in the axial area, subsequent whorls slightly involute; state of axial area varies from clearly depressed (specimen 82) over flat (specimen 20) to very slightly raised and with slight umbilical concavities sometimes (spec'men 6); lateral slopes straight or convex, occasionally slightly concave (specimen 82); periphery rounded or subrounded (inner 1.5 wh.), subrounded or bluntly pointed (2nd wh.), from bluntly pointed to angular (subsequent whorls). Axis of coiling not wholly stable (shifts of only a few degrees); first whorl may be at a very slight angle to subsequent whorls. Chomata generally low, occasionally of medium height, often relatively wide. Differentiation of wall indistinct.

Measurements:

Wh.n.	0	1		2		3	4	
Form 1								
Specimen: 82	26	56		108		202		
20	26	58		112		189	224	R.v.
6	23	60		112		206		
R.:			86–93		69–88			G.r.
Av.:			90		81			
		0.58		0.44		0.36		
		0.52		0.42		0.42	0.36	F.r.
		0.50		0.48		0.40		
Form 2								
Specimen: 89	25	65		129		198		R.v.
			100		53			G.r.
		0.60		0.45		0.50		F.r.

Remarks:

Form 1: These specimens are thought to be closely allied to *Millerella donbassica* (Kir.). Unfortunately description and illustration of this species do not permit the evaluation of differences with our forms. Our specimens might have a slightly larger diameter for corresponding whorls. Other, less similar, but probably related species are: *M. acuta* (Grozd. *et* Leb.), *M. lepidaeformis* (Kir.) and *M. dogbendensis* (Stew.). A related assemblage was found in San Emilliano (Loc. L 16) [i.e. *M.* cf. *acuta,* specimen 3(1)].

Form 2: Specimen 89 might belong to the same assemblage as specimens described as "Form 1". Another possibility is that it is more closely allied to *M. lepidaeformis* (Kir.) which species is apparently closely similar to *M. donbassica* (Kir.). This similarity was not explicitly mentioned by Kireeva but it follows from descriptions and illustrations of both species. The present specimen differs from *M. lepidaeformis* by its slightly larger L/D ratio (= 0.50) in which respect it comes closer to *M. donbassica.* On the other hand, the large diameter and the less angular periphery indicate a closer relation to *M. lepidaeformis.* Other somewhat similar species are *M. parastruvei* var. *chusovensis* (Kir.) and *M. postmosquensis* var. *acutiformis* (Kir.).

Millerella cf. *acutissima* (Kireeva, 1949)

Pl. XIV Figs. 55–56

Locality: A 3.

Description: Margins of opposite whorls either just in contact at the umbilical region or whorls slightly evolute [inner whorls, specimen 16(2)]; margins of opposite whorls just in contact or slightly involute [outer whorls, specimen 16(2) and 56(1)]; axial region somewhat raised and with very weakly expressed umbilical depressions, inner whorls may be clearly umbilicate [specimen 16(2)]; lateral sides convex or straight (inner 2.5 whs.), essentially straight (2.5–3.5 wh.); periphery rounded (innermost whorl), rounded or bluntly pointed (1.5–2.5 wh.), pointed (3–3.5 wh.). Axis of coiling maintains original position throughout growth. Chomata low or of medium height; in inner whorls relatively wide. Tunnel semicircular; its width two times height or less. Differentiation of wall not observed.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 16 (2)	10	32		60		122	200		R.v.
56 (1)	10	32		68		142	215		
			88–112		103–109				G.r.
		0.53		0.45		0.38	0.26		F.r.
		0.53		0.47		0.33	0.28		

Remarks: These specimens belong without any doubt to the group *M. acuta* et *mutabilis* (sensu Rauser-Chernoussova *et al.,* 1951). They show superficial resemblance to *M. acutissima* (Kir.) from which species they apparently differ only by their more lenticular and somewhat less acute inner whorls as compared to the original illustration of Kireeva's species. It is possible that in fact *M. mutabilis* (Raus.) is still closer allied than *M. acutissima* (Kir.). *M. mutabilis*, however, has more whorls, smaller diameter for corresponding whorls and a larger L/D ratio (this holds good for specimens of the Moscow basin; those of more northern areas of the U.S.S.R. seem to differ even less in recorded characters).

Pl. XIV Fig. 57

Locality: P 82.

Description: Inner 3 whorls slightly evolute or margins just in contact in axial area, 4th whorl slightly evolute; shallow and relatively broad umbilical depressions; lateral sides convex or straight in inner 2 whorls, straight or very slightly concave in subsequent whorls; periphery rounded or bluntly pointed in inner 2 whorls, angular in subsequent whorls. Axis of coiling not wholly stable; chomata of medium height or low, relatively wide. Tectum locally observed.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen: 8		16	43		86		172		272	R.v.
				100		100		58		G.r.
			0.40		0.33		0.27		0.26	F.r.

Remarks: The present specimen is without any doubt very close to *M. acutissima* (Kir.); yet the somewhat larger size prevents us to refer it to this species. Very similar is also *M. pressa* Thomp. and *M. bella* (Kir.). The latter species might be a synonym of the former.

Millerella spinulosa (Grozdilova *et* Lebedeva, 1960)

Pl. XIV Fig. 58

Locality: A 3.

Description: Margins of whorls just in contact at the umbilical region; axial region flat (1st–2nd wh.) or with very shallow umbilical depressions (3rd wh.); lateral slopes straight or convex (1st–2nd wh.), straight or concave (3rd wh.); periphery rounded or subrounded (inner 1.5 whorls), angular or subangular (2nd–3rd wh.). First whorl at a very slight angle to subsequent whorls. Chomata of medium height; wide, probably extending to poles in inner 2.5–3 whorls. Differentiation of wall not observed. Tunnel about two times as wide as high; semicircular or crescentic.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 43		13	41		100		180	R.v.
				144		80		G.r.
			0.50		0.35		0.28	F.r.

Remarks: There is hardly any doubt that specimen 43 belongs to *Millerella spinulosa* (Grozd. *et* Leb.). The latter species, however, should have a weakly defined diaphanotheca, whereas our specimen shows no differentiation whatsoever. This differentiation of the wall probably has been the reason why Grozdilova and Lebedeva referred this species to the genus *Ozawainella*. In our opinion the sum of characters of this species points rather to *Millerella*.

Millerella cf. *samarica* Reitlinger, 1961
Pl. XIV Fig. 59

Locality: A 3.
Description: Whorls either just in contact in polar area or slightly evolute (1–3.5 wh.); umbilical depressions broad and relatively shallow; lateral sides essentially straight in outer whorls; periphery rounded in inner 2 whorls, gradually becoming pointed in last half whorl (3.5 wh.). Inner 2 whorls at a very slight angle to subsequent whorls. Secondary deposits weakly developed in inner 2.5 whorls but distinct in 3–3.5 whorl. Tunnel arcuate, nearly as high as wide. Wall differentiation not observed.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen: 16 (1)		15	34		73		163	241		R.v.
				112		124				G.r.
			0.47		0.38		0.28	0.25		F.r.

Remarks: This specimen is considered to be close to *Millerella samarica* Reitl., *M. keltmensis* (Raus.), *M. acuta* (Grozd. *et* Leb.), *M. carbonica* (Grozd. *et* Leb.) and perhaps *M. mutabilis* var. *rjasanensis* (Raus.). Unfortunately, we have only a single specimen which makes it difficult to refer it to any of the above mentioned species in particular.

Millerella ex gr. *protvae* (Rauser-Chernoussova, 1948)
Pl. XIV Figs. 60–61

Locality: P 76.
Description: Coiling involute throughout shell; axial region flat (1st–3rd wh.) or slightly depressed (2nd–4th wh.); lateral sides convex; periphery rounded in inner 3.5 whorls, nearly flat in 4th whorl. Axis of coiling not stable; 1st whorl at a large (90°) angle to the 2nd whorl which on its turn may be at an angle to subsequent whorl(s). Supplementary deposits (discontinuous chomata) distinctly developed. Wall clearly composed of a tectum and a less dense and thicker layer below it.

Measurements:

	Wh.n.	0	1		2		3	4	
Specimen: 11 (1)		13	43		73		120	172	R.v.
11 (2)		14	39		77		129		
				70–100		65–67			G.r.
			—		0.76		0.77	0.97	F.r.
			—		0.58		0.60		

Remarks: We have provissonally referred these specimens to *Millerella*. However, it would not have been a serious error if we had them referred to *Pseudostaffella* ex gr. *variabilis* (sensu Reitlinger, 1961). Whether the inclusion of these species of the group *protvae* in *Millerella* is preferable to their reference to the genus *Pseudostaffella* is open to discussion. Most similar species are: *Millerella? protvae* (Raus.), *M. tujmasensis* (Viss.), *M. mira* (Raus.), *Pseudostaffella variabilis* Reitl. and *Ps. minor* Raus.

Millerella ex gr. *ikensis* (Vissarionova, 1948*)

Pl. XIV Figs. 62–67
Pl. XV Figs. 1–8

Locality: L 24.

Description:

Radius vector:	170–323
Form ratio:	0.38–0.51
Number of whorls:	4–5.5

First whorl slightly evolute or margins just in contact at polar regions, subsequent whorls clearly involute; axial region flat in inner 1–3 whorls and clearly raised (umbonate) with (specimens 23, 14) or without (specimen 7) shallow umbilical depressions; lateral slopes straight or slightly convex in inner 2.5–4 whorls, straight or slightly concave in subsequent whorls; percentages of angularity of periphery for 15 specimens from 1st to 5th whorls is respectively:

A.	95	55	17	—	—
A. (blp.)	5	28	30	—	—
blp.	—	13	34	28	25
P. (blp.)	—	8	13	38	25
P.	—	—	6	34	50

Sagittal sections with smooth spirotheca except for the 1st whorl which shows inflated chambers; septa arcuate anteriorly; number of septa in 2 specimens from 1st to 3rd whorl respectively: 6—7, 10–12, 14–17.

Axis of coiling either maintains original position throughout shell or slightly shifts in inner 1–2 whorls.

Supplementary deposits (chomata) well developed for this genus; moderately high; in outer whorls of mature specimens often extending more than half distance from tunnel to poles.

Wall in outer whorls of mature specimens generally consists of a tectum and a thicker and less dense layer above and below the tectum.

Measurements: See Table 10.

Remarks: The species described above is most similar to species from Viséan and lowermost Namurian strata assigned to the group of *M. ikensis* (Viss.) [e.g. *M. ikensis* (Viss.), *M. ikensis* var. *tenebrosa* (Viss.) and *M. raguchensis* (Gan.)]. Also *M. grandis* (Kir.) from a higher stratigraphic level (C_2^5) is somewhat similar. The present highly variable species shows two distinct types which are linked by transitional forms. Thus specimen 23 shows more "millerelloid" characters (loose coiling, chomata of moderate width, somewhat rounded periphery, initial wall differentiation) than specimen 7 which is more similar to early species of *Ozawainella* (e.g. *O. aurora* Grozd. et Leb.) showing broad, ribbon-like chomata, sharply angular periphery, tight coiling and better wall differentiation.

* In Rauser-Chernoussova *et. al.*, 1948.

Pl. XV Fig. 9

Locality: P 97.

Description: Whorls involute; axial region clearly raised, especially in last (3rd) volution; lateral sides essentially straight in inner 2 whorls, last whorl slightly asymmetrical with concave to slightly convex lateral slopes; periphery rounded in 1st whorl, becoming sharply angular in last whorl. Axis of coiling maintains original position throughout growth with possible exception of innermost half whorl. Relative height of chomata moderate; they extend to poles. Wall not differentiatied.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 1		11	38		83		182	R.v.
				118		119		G.r.
			0.47		0.44		0.39	F.r.

Remarks: The single specimen we encountered at this locality is closer to *Millerella ljudmilae* (Raus.) than to any other described species. Our specimen, however, shows a nearly rhomboidal outline whereas *M. ljudmilae* is subrhomboidal (a more flattened polar area) in axial section. Other closely related species are probably *M. lepida* (Grozd. *et* Leb.) and *M. proikensis* (Raus.).

Pl. XV Fig. 10

Locality: P 63.

Description: Whorls involute; raised axial region; lateral sides essentially straight or convex; periphery changes from rounded (1st wh.), bluntly pointed to pointed (2–2.5 wh.) to rounded to bluntly pointed (3rd wh.). Innermost whorl probably coiled at small angle to subsequent whorls. Secondary deposits (chomata) well developed, of medium height and extending to or near poles. Differentiation of wall indistinct.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 8 (1)		24	67		142		193	R.v.
				112		39		G.r.
			0.45		0.45		0.60	F.r.

Remarks: Of all described species *M. ljudmilae* (Raus.) seems to be most closely allied to our specimen. According to Rauser's description and reproductions, this species differs by its more microspheric state (i.e. more volutions, smaller diameter for corresponding volutions, and smaller proloculum).

Millerella ex gr. *parva* (Moeller, 1879)

Pl. XV Figs. 11–15

Locality: L 24.

Descriptions: Whorls either just in contact at the axial region or evolute; axial region flat or with shallow and relatively broad umbilical depressions; lateral sides generally convex; periphery rounded or subrounded. Inner 1–2 whorls sometimes coiled at a variable (up to 90°) angle to subsequent whorls. Supplementary deposits absent or inconspicuous. Sagittal sections show a smooth spirotheca; septa almost perpendicular to the wall. Wall homogeneous.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen:	9 (1)	10		34		56		84	89		
	9 (2)	11		34		60		101			R.v.
	9 (3)	13		30		56		99			
	9 (4)	15		47		81					
R.:					63–86		50–77				G.r.
Av.:					74		65				
				—		0.38		0.40	0.42		
				—		0.54		0.40			F.r.
				0.50		0.46		0.37			
				0.45		0.43					

Remarks: Closely similar to but not identical with the present species are *M. parva* (Moell.), *M. parva* var. *shamordini* (Raus.), *M. paraparva* (Gan.), *M. prisca* var. *butinae* (Gan.), *M. pressula* Gan., *M. minutissima* (Raus.) and *M. exilus* (Grozd. *et* Leb.). Of species described from North America *M. tortula* Zeller and *M. zelleri* Cooper seem to be most closely related to our species.

Pl. XV Figs. 16–17

Locality: P 1.

Description: Margins of opposite whorls merely in contact in axial region or slightly overlap; axial region flat, sometimes with shallow and narrow umbilical depressions; lateral slopes convex; periphery rounded (inner 2 whs.), rounded or subrounded (subsequent whorls). Inner 0.5–1.5 whorls generally at a large angle to subsequent whorls. Chomata wide and fairly low. Wall homogeneous.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen:	42A	23		56		102	133				R.v.
	73	24		45		86		133	161		
					82–90		55				G.r.
				—		0.42	0.53				F.r.
				0.71		0.55		0.56	0.57		

Remarks: According to original illustrations of *M. parva* (Moell.) and *M. cooperi* Zeller, these species have weaker developed secondary deposits. *M. prisca* (Raus.) has a slightly larger diameter for corresponding whorls, generally a slightly smaller L/D ratio and weaker developed secondary deposits. *M. prisca* var. *ovoidea* (Raus.) has more volutions (3.5–4 occasionally up to 5) and a smaller proloculum. Axis of inner whorls is only at a slight angle to subsequent whorls. *M. kasakhstanica* (Raus.) is partially evolute in mature specimens and has a somewhat smaller L/D ratio as well as slightly more volutions. *M. exilus* (Grozd. *et* Leb.) shows better expressed umbilical depressions, weaker developed secondary deposits and a somewhat smaller L/D ratio.

Millerella ex gr. *evoluta* (Grozdilova *et* Lebedeva, 1950)

Pl. XV Figs. 18–20

Locality: A 3.

Description: Volutions clearly evolute; axial area flat; lateral sides straight and parallel; periphery varies from rounded to subangular. Inner 1–2 whorls may be at a varying (up to 90°) angle to subsequent whorls. Supplementary deposits inconspicuous. Wall homogeneous.

Measurements:

	Wh.n.	0	1		2		3		4		5	
Specimen:	42	—	21		47		73		129		206	
	56	7.5	19		34		61		—	163		R.v.
	25 (1)	15	34		63		109					
R.:				79–138		55–79						G.r.
Av.:				101		69		77		60		
							0.30			0.17	0.15	F.r.

Remarks: This group contains a number of species which Russian authors generally refer to the genus *Novella* Grozdilova *et* Lebedeva (genotype: *N. evoluta* Grozd. *et* Leb.). These species are characterized by an evolute coiling almost throughout growth and a very small L/D ratio. Supplementary deposits present. It contains the species *M. primitiva* (Raus.), *M. manukalovae* (Brazhn.), *M. evoluta* var. *mosquensis* (Raus.), *M. intermedia* (Raus.) and *M. discoidea* Igô.

Millerella ex gr. *acuta* et *mutabilis* (Rauser-Chernoussova, 1951)

Pl. XV Figs. 21–28

Localities: P 76, P 54.

Description: Margins of inner 1–2 whorls commonly just in contact, subsequent whorls clearly involute; axial area normally flat or raised, shallow umbilical depressions often present; lateral sides straight or convex in inner 2–3 whorls, straight or slightly concave in subsequent whorls; periphery rounded or subrounded in inner 2 whorls, from rounded to angular in 2nd to 3rd whorl, from bluntly pointed to angular in 3rd to 4th whorl. Axis of coiling maintains original position throughout growth;

equatorial plane sometimes slightly shifted in a lateral direction in the outer whorl of mature specimens (this means that the shell is not exactly planispiral) (e.g. specimens 9(3), 18). Chomata of moderate height or low, occasionally fairly wide and almost extending to poles. Wall differentiation (tectum and less dense thicker lower layer) often observed in mature specimens.

Measurements:

Wh.n.	0	1	1–2	2	2–3	3	3–4	4	
Loc. P 76									
Specimen: 14 (1)	15	38		64		111			
12 (1)	13	39		68		120		208	
19 (1)	13	39		67		133	182		R.v.
18	—	43		82		159		297	
12 (2)	13	30		60		92		193	
7 (1)	21	52		90		193			
Av.:	15	40		72		135		233	
R.:			68–100		54–114		73–109		G.r.
Av.:			80		85		90		
		0.40		0.45		0.47			
		0.36		0.41		0.47		0.43	
		0.46		0.45		0.42	0.42		F.r.
		0.45		0.50		0.43		0.31	
		0.43		0.49		0.42			
		0.47		0.50		0.34			
Av.:		0.43		0.47		0.42		0.37	
Loc. P 54									
Specimen: 6	20	47		86		146	221		R.v.
			82		70				G.r.
		0.48		0.50		0.50	0.42		F.r.

Remarks: These specimens are referred to a group of species closely allied with *M. mutabilis* (Raus.). However, in many respects they are also similar to species belonging to the group of *M. ikensis* (Viss.) notably *M. proikensis* var. *mstaensis* (Gan.), which differs amongst other things by its larger L/D ratio. Other somewhat similar species (of *M.* ex gr. *acuta* et *mutabilis*) are *M. lepida* (Grozd. *et* Leb.), *M. mutabilis* (Raus.) and in less degree *M. dogbendensis* (Stew.). Unlike our specimens, *M. lepida* has an angular periphery in a very early stage of growth. *M. mutabilis* has a somewhat smaller L/D ratio, a slightly smaller diameter for corresponding whorls and slightly more volutions.

Pl. XV Figs. 29–30

Locality: P 70.

Description: Margins of inner 1–2 whorls merely in contact; subsequent whorls slightly involute; axial area flat with or without small umbilical depressions (1st–2nd wh.), flat or slightly raised (2nd–3rd wh.); lateral slopes straight or convex; periphery rounded (1st wh.) from rounded to bluntly pointed (1st–2nd wh.) from subrounded to subangular (2nd–3rd wh.). First half whorl may be at a slight angle to subsequent whorls [specimen 22(1)]; equatorial plane sometimes slightly shifted in a lateral direction [specimen 22(1)]. Chomata weakly to moderately developed. Differentiation of wall not observed.

Measurements:

	Wh.n. 0	1		2		3	
Specimen: 22 (1)	19	48		92		180	R.v.
41	21	47		82		155	
			73–92		90–96		G.r.
		0.44		0.41		0.34	F.r.
		0.50		0.45		0.42	

Remarks: These specimens are considered to be closely allied with *M. lepidaeformis* var. *minima* (Kir.) or perhaps even more with *M. mutabilis* especially its variety *postera* (Kir.). According to Kireeva the latter variety has a slightly smaller L/D ratio and a somewhat larger diameter. More remotely similar are *M. acuta* (Grozd. *et* Leb.) and *M. dogbendensis* (Stew.).

Pl. XV Figs. 31–35

Locality: A 3.

Description: Margins of 1st whorl merely in contact or evolute, subsequent whorls involute; axial region flat (1st–2nd wh.) or slightly raised (2nd–3rd wh.), umbilical depressions hardly developed; lateral slopes straight or convex in inner 1.5–2 whorls; convex, straight or slightly concave in subsequent whorls; periphery rounded or subrounded (1st wh.), from rounded to bluntly pointed (1st–2nd wh.), from subrounded to angular (2nd–3rd wh.), from bluntly pointed to angular (3.5 wh.). Axis of coiling usually maintains original position throughout growth, sometimes 1st whorl at slight angle to subsequent whorls (specimen 41). Chomata usually wide, sometimes extending to poles; of medium height. Wall homogeneous.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 6 (1)	14	39		86		172			
6 (2)	11	24		56		99	146		
7 (2)	14	35		64	90				R.v.
41	13	30		56		99			
27	13	30		60		112			
Av.:	13	32		64		120			
R.:			83–136		77–100				G.r.
Av.:			105		85				
		0.39		0.40		0.35			
		0.55		0.54		0.46	0.37		
		0.46		0.49	0.47				F.r.
		0.46		0.46		0.41			
		0.43		0.50		0.42			
Av.:		0.46		0.48		0.41			

Remarks: Most similar species are *M. acuta* var. *lata* (Kir.), *M. lepidaeformis* var. *minima* (Kir.), *M. korobcheevi* (Raus.), *M. depressa* (Put.) and *M. donbassica* (Kir.). *M. acuta* var. *lata* (Kir.) has about the same diameter for corresponding whorls; the inner whorls, however, show a rounder periphery; chomata are more weakly developed; number of volutions is slightly lower. *M. lepidaeformis* var. *minima* (Kir.) should have, according to original description, either weak pseudochomata (2nd wh.) or no secondary deposits at all. *M. korobcheevi* (Raus.) has more acute inner whorls, a slightly smaller L/D ratio and more volutions. *M. depressa* (Put.) has a smaller diameter for corresponding whorls, apparently less developed secondary deposits and a more depressed axial region. *M. donbassica* (Kir.) has a larger diameter for corresponding whorls.

Pl. XV Figs. 36–37

Locality: P 10.

Description: Margins of inner 2.5 whorls (specimen 13) or inner 3 whorls (specimen 32) merely in contact, subsequent whorls (3–3.5 whorl in specimen 13) slightly involute; axial region in inner 2–2,5 whorls usually somewhat depressed, essentially flat with sometimes faint umbilical concavities in subsequent whorls; lateral sides straight or convex; periphery rounded or subrounded (1st wh.), from rounded to angular (1st–3rd wh.), from bluntly pointed to angular (3–3.5 wh.). Axis of coiling essentially constant, last half whorl sometimes slightly asymmetric (specimen 13). Chomata probably discontinuous, weakly developed; inconspicuous (specimen 13) or narrow and of medium height to low (specimen 32). Locally a differentiation of wall in tectum and less dense lower layer may be observed.

Measurements:

	Wh.n.	0	1	2	3	4	
Specimen: 13		20	43	90	142	194	R.v.
32		25	56	116	226		
				107–110	57–86		G.r.
			—	0.40	0.38	0.37	F.r.
			0.41	0.37	0.27		

Remarks: It is believed that both specimens belong to a single species notwithstanding the larger L/D ratio, the slightly smaller diameter and the somewhat higher number of volutions of specimen 13. *M. mutabilis* var. *postera* (Kir.) is considered to be the nearest ally. The more slender specimen (specimen 32) may be compared also with *M. acutissima* (Kir.); specimen 13 on the other hand is somewhat similar to *M. donbassica* (Kir.).

Millerella sp. 1

Pl. XV Fig. 38

Locality: P 95.

Description: Margins of inner 3 whorls just in contact or coiling slightly evolute; subsequent whorl involute; inner whorls with umbilical depressions, outer whorl with an almost flat axial area; lateral slopes straight or convex; periphery rounded (inner 2 whorls), bluntly pointed to subangular (2nd–3rd wh.), subrounded (4th wh.). Axis of coiling almost stable. Supplementary deposits (discontinuous chomata) weakly developed; narrow and fairly low. Wall differentiation indistinct.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 17		19		45		82		150	243		R.v.
					81		84				G.r.
				0.43		0.37		0.36	0.34		F.r.

Remarks: At first glance there is a certain resemblance with some specimens of *M. bigemmicula* Igô. The present specimen differs by its slightly larger diameter for corresponding whorls, (yet just within the range of *M. bigemmicula*) and by its less clearly expressed umbilical depressions at maturity. Moreover, inner whorls are less tightly coiled and on the whole possess a smaller form ratio. The state of these inner (3) whorls indicates a possible close relationship to species like *M. carbonica* (Grozd. *et* Leb.), *M. elegantula* (Raus.) and *M. acuta* (Grozd. *et* Leb.) although our specimen certainly does not belong to any of these species.

Millerella sp. 2

Pl. XV Fig. 39

Locality: L 16.

Description: Whorls highly evolute; umbilical depressions very shallow or absent; lateral sides straight (3rd–4th wh.) or convex; periphery rounded or flat. Axis of coiling not stable. Supplementary deposits inconspicuous. Differentiation of wall not observed.

Measurements:

	Wh.n.	0		1		2		3		4	
Specimen: 22 (4)		17		42		72		109		175	R.v.
					71		51		61		G.r.
				0.47		0.37		0.33		0.23	F.r.

Remarks: Probably close to a number of species referred by Russian authors to one of the (sub-) genera *Novella*, *Seminovella* and *Pseudonovella*.

Millerella sp. 3

Pl. XV Figs. 40–41

Locality: L 25.

Description: Margins of inner 2–2.5 whorls just in contact at the umbilical region, subsequent whorls slightly overlap; axial region flat or slightly depressed; lateral sides normally convex, occasionally straight; periphery rounded or subangular (inner 1.5 whs.), from rounded to bluntly pointed (subsequent whorls). First whorls may be at a small angle to subsequent whorls. Supplementary deposits (chomata) well developed, extending approximately to poles in some whorls and of moderate height. Wall structure homogeneous.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 34		17	66		127		159	R.v.
11		20	47		105	144		
				92–123		83		G.r.
			0.53		0.47		0.42	F.r.
			0.50		0.41	0.39		

Remarks: These specimens are best compared with *M. prisca* var. *ovoidea* (Raus.), *M. transita* (Kir.), *M. postmosquensis* var. *acutiformis* (Kir.) and *M. varvariensis* (Brazhn. *et* Pot.). The first variety has a slightly smaller diameter and four instead of three whorls in mature individuals. These differences hold equally good for *M. transita* (Kir.). The second variety, *M. postmosquensis* var. *acutiformis*, shows better developed umbilical depressions; outer whorls of this variety just in contact whereas our specimens are involute at maturity; moreover L/D ratio varies from 0.50 to 0.58 according to figures in text (yet one of the two illustrated specimens (holotype) gives a value below the lower limit and thus conforms to the *L*/D ratio of our specimens). *M. varvariensis* has more whorls and a somewhat smaller diameter for corresponding whorls. Its umbilici are usually better developed.

Millerella sp. 4

Pl. XV Figs. 42–43

Locality: P 63.

Description: Margins of inner 1–1.5 whorl merely in contact, subsequent whorls involute; axial region essentially flat in inner 2 whorls, slightly raised in subsequent whorls; lateral slopes convex or straight, sometimes slightly concave; periphery rounded or subrounded in inner 2 whorls, from rounded to bluntly pointed in subsequent whorls. Axis of coiling maintains original position throughout growth. Chomata usually low and of moderate width. Wall locally differentiated; it shows tectum and a less dense, lower layer.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 8 (2)		17	39		82		138	R.v.
				111		68		G.r.
			0.44		0.47		0.52	F.r.

Remarks: Millerella informa (Kir.) and *M. amabilis* (Grozd. *et* Leb.) are considered to be most close to the specimen described above.

Millerella sp. 5

Pl. XV Figs. 44–45

Locality: P 1.

Description: Margins of first whorl just in contact, subsequent whorls slightly overlap; axial region essentially flat in inner 1–2 whorls, slightly raised in 2nd–3rd whorl; lateral slopes straight or convex. Axis of coiling almost stable. Supplementary deposits (discontinuous chomata) moderately developed, a tendency to dark shadows in the axial region is observed. Wall homogeneous.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 30 (2)		20	47		88		151	R.v.
43		22	43		95		181	
				86–120		71–91		G.r.
			0.45		0.49		0.44	F.r.
			0.60		0.45		0.44	

Remarks: The specimens described above are evidently closely related to *M. advena* (Thomp.) and its variety *ampla* (Thomp.) as well as to *M. dogbendensis* (Stew.). Both species, however, have more volutions; the L/D ratio of our specimens is intermediate between the ratios for *M. dogbendensis* and *M. advena*; diameter of 3rd whorl corresponds approximately with measurements of *M. dogbendensis* and *M. advena* var. *ampla.*

Millerella sp. 6

Pl. XV Figs. 46–49

Locality: P 1.

Description: Evolute or margins merely in contact (1st–2nd wh.), involute (2nd–3rd wh.); axial region flat or depressed in inner 2 whorls, flat or slightly raised in 3rd whorl and with or without small umbilical depressions; lateral sides straight or convex, in the outer whorl usually straight; periphery rounded or subrounded (1st wh.), from rounded to bluntly pointed (1.5–2.5 wh.), subrounded or bluntly pointed (3rd wh.). Axis of coiling not wholly stable, inner 1–2 whorls at variable angle to subsequent whorls (specimens 12, 126). Supplementary deposits moderately developed; generally wide and of medium height. Wall homogeneous.

Measurements:

	Wh.n.	0	1		2		3	
Specimen: 40		21	45		86		157	
97		30	73		112		172	R.v.
126		21	47		90		161	
12		17	52		86		155	
R.:				53–91		54–82		G.r.
Av.:				80		72		
			0.48		0.50		0.49	
			0.53		0.54		0.45	
			0.50		0.45		0.48	F.r.
			—		0.42	0.53		

Remarks: The present specimens are probably best compared with *M. prisca* var. *ovoidea* (Raus.). They differ from that variety in having fewer whorls and a somewhat larger diameter for corresponding whorls. The same differences serve to distinguish these specimens from the nearly equally close *M. advena* Thomp. Other less similar species are *M. prisca* (Raus.), *M. cooperi* Zell. and *M. postmosquensis* forma *fraudulenta* (Kir.).

Millerella sp. 7

Pl. XV Figs. 50–52

Locality: P 1.

Description: Margins of whorls merely in contact or whorls partly evolute; axial region clearly depressed, sometimes this is already distinctly observed in the 2nd whorl (e.g. specimen 98); lateral sides essentially straight or convex, occasionally very slightly concave in adult specimens; periphery rounded (inner 1.5 whs,), from rounded or flat to bluntly pointed (2–2.5 wh.), from subrounded to pointed (subsequent whorls). Inner 1–2 whorls with axis of coiling at a highly variable angle (up to 90°) to subsequent whorls. Chomata of moderate height but more often low or indistinct, width ranging from narrow to nearly to poles. Wall structure indistinct, apparently homogeneous; often much less dense than the secondary deposits.

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 98	19	41		71		114	181				
15 (3)	19	45		73		125	159				R.v.
55 (3)	15	28		49		81		121	145		
R.:			62–75		61–71						G.r.
Av.:			70		66		41				
		0.47		0.42		0.42	0.37				
		0.67		0.56		0.52	0.38				F.r.
		—		0.65		0.47		0.42	0.34		

Remarks: If the assumption is correct that the three specimens described above belong to a single population, than variability of shape is reminiscent of *M. bigemmicula* Igô. This species, however, has a larger radius vector for corresponding whorls. Specimens 15(3) and 55(3) suggest a narrow relationship respectively to *M. postmosquensis* var. *acutiformis* (Kir.) and *M. elegantula* (Raus.) (cf. Rauser-Chernoussova *et al.*, 1951, pl. 2, fig. 8).

Millerella? sp.

Pl. XV Fig. 53

Locality: P 54.

Description: Inner 2 whorls probably slightly evolute or perhaps merely in contact at their margins; subsequent whorls just in contact or slightly involute; axial area moderately depressed; lateral sides essentially straight; periphery rounded in inner 2 whorls, from subrounded to bluntly pointed (3rd wh.), from bluntly pointed to subangular (3.5–4.5 wh.). Axis of coiling maintains original position throughout growth. Supplementary deposits (chomata) prominent (for *Millerella*), fairly high and almost extending to poles. A first differentiation of wall may be observed; we may distinguish a tectum and a less dense lower layer which locally is less dense than the secondary deposits.

Measurements:

Wh.n.	0		1		2		3		4		5	
Specimen: 5	—		77		150		254		421	450		R.v.
				94		69		66				G.r.
			—		—		—		0.37	0.34		F.r.

Remarks: This specimen is of large size compared with other known species of *Millerella*. In this respect it is to some degree comparable with certain specimens of *Millerella* from Lower Carboniferous strata e.g. *M. ikensis* (Viss.), *M. mosquensis* var. *attenta* (Gan.), *M. pespicabila* (Grozd. *et* Leb.). The large size added to the well-developed ribbon-shaped chomata indicate a, perhaps, still closer affinity to *Ozawainella.* The latter genus moreover is known to originate in strata of about this age (lower to middle part of Bashkirian, e.g. *O. umbonata* Brazhn. *et* Pot.).

Genus OZAWAINELLA Thompson, 1935

Thompson, M. L., The fusulinid genus *Staffella* in America. Journ. Pal., Menasha, Wis., U.S.A., 1935, Vol. 9, No. 2, p. 114.

Ozawainella leonensis sp. nov.

Pl. XV Figs. 54–60

Type specimen: Specimen 34 (Pl. XV, Fig. 55) is designated as the holotype.
Locality: L 24.

Description:

Radius vector:	305–565
Form ratio:	0.41–0.62
Number of whorls:	5.5–6.5

Lateral sides essentially straight, slightly concavo-convex lateral sides may be observed beyond the 4th whorl; broadly convex to flat polar regions, sometimes with shallow umbilical depressions; percentages of angularity of periphery for 7 specimens from 1st–6th whorl respectively:

A.	10	54	—	7	—	10
A. (blp.)	—	8	7	7	7	—
blp.	—	31	43	29	15	—
P. (blp.)	—	7	14	7	16	—
P.	—	—	36	50	62	90

Chomata extend to poles in inner 3–6 whorls, still very broad in subsequent whorls; of medium height with respect to chamber lumen, relative height between 0.30 and 0.50; in last half whorl of mature specimens (6–6.5 wh.) low or absent.

Wall with tectum and a lower less dense layer which has same density as secondary deposits above tectum.

Measurements: See Table 11.

Remarks: A striking character of this species is its considerable variability especially with regard to the L/D ratio, the state of periphery as well as the axial region. In mature specimens the L/D ratio varies from 0.48 to 0.64. The periphery may vary from rounded or bluntly pointed (specimen 26) to sharply angular often with a very pronounced keel (specimens 29(2), 20, 8). Umbilical depressions sometimes absent [specimen 29(2)] or clearly present (specimen 20). The umbilical depressions seem to correlate with the smaller L/D ratio. Due to this great variability there are many known species of *Ozawainella* which resemble some particular specimen of the present assemblage. Thus similar and probably closely allied species are:

O. loerentheyi Raus. which differs in having slightly fewer whorls, somewhat higher chomata and a distinct diaphanotheca.

O. mosquensis Raus. which differs in having fewer whorls, on average a somewhat smaller L/D ratio and a larger diameter for corresponding whorls.

O. kurachovensis Man. which differs in having fewer whorls, convex lateral slopes and apparently no keel.

O. kumpani Raus. (description of this species is rather wanting) which might differ by a larger maximum diameter as well as a larger diameter for corresponding whorls and possibly on average a somewhat smaller L/D ratio.

O. crassiformis Put. shows inconspicuous umbilical depressions, periphery apparently never keeled, slightly more whorls and a much greater lower limit of the L/D ratio.

O. pseudotingi Put. is more clearly rhombic in outline.

O. paratingi Man. differs in having lower and more narrow chomata as well as a larger diameter for corresponding whorls.

O. tingi (Lee) (cf. our specimen 26) differs in having on average a slightly larger L/D ratio as well as a somewhat smaller maximum diameter; moreover, presence of umbilical depressions or a keeled periphery were not reported to occur in this species.

Ozawainella brazhnikovae sp. nov.

Pl. XV Figs. 61–62

Type specimen: Holotype of *Ozawainella umbonata* Brazhnikova *et* Potievskaja (Brazhnikova and Potievskaja, 1948, pp. 93, 94, slide 312, pl. V, fig. 19).

Locality: P 63.

Description:	Radius vector:	295–510
	Form ratio:	0.18–0.32
	Number of whorls:	4–4.5

Inner 1–2 whorls with straight or convex lateral sides, subsequent whorls with straight or concavo-convex lateral sides; polar regions either flat or with broad and shallow umbilical depressions; periphery arched in inner 1–1.5 whorl, sharply angular beyond the 2.5 whorl.

Chomata extend to poles in inner 4 whorls or throughout growth; maximum relative height about 0.50.

Wall with tectum and lower less dense layer which has about same density as chomata.

Measurements:

	Wh.n.	0	1	2	3	4	5	
Specimen:	4	—	39	84	173	297	510	R.v.
	7	—	—	107	194	297		
			117	80–105	54–73			G.r.
			0.50	0.39	0.35	0.28	0.18	F.r.
			—	0.36	0.32	0.32		

Remarks: The specimens described above are referred to *Ozawainella umbonata* Brazhn. *et* Pot. This species, however, is a junior homonym of *Ozawainella umbonata* Put. *et* Leont. In this paper, the binomen *Ozawainella brazhnikovae* is introduced for *Ozawainella umbonata* Brazhn. *et* Pot.

Ozawainella adducta Manukalova, 1950 b

Pl. XVI Fig. 1

Locality: P 4.

Description: Straight or very slightly concavo-convex lateral sides; polar regions flat or slightly convex in early whorls, broad and shallow umbilical depressions at maturity; last whorl partly evolute; periphery angular to bluntly angular at maturity.

Chomata extend to poles in inner 4.5 whorls and attain a height of at least half chamber lumen; the 5–5.5 whorl still with fairly high and broad chomata; in the 6th whorl, however, they are much reduced, cover only 0.25–0.50 of lateral slopes and are less than half the height of chambers.

Tectum distinct at most places; a less dense layer below the tectum has same density as secondary deposits above tectum.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen:	3	—	54	112	200	328	565	901	R.v.
			107	79	64	72	59		G.r.
			—	—	0.46	0.39	0.29	0.22	F.r.

Remarks: The single specimen which this locality yielded belongs without any doubt to the group of *O. nikitovkensis* (Brazhn.). Within this group the species *O. adducta* Man. and *O. praestellae* Raus. are considered closely allied if not identical to the present specimen. The latter species is perhaps a synonym of the former.

O. krasnodonica Man. is somewhat similar as well but differs in having a larger L/D ratio, straight lateral sides and possibly somewhat lower chomata.

O. stellae Man. has fewer whorls (4.5–5.5), nearly parallel sides and also different shaped chomata.

O. nikitovkensis (Brazhn.) corresponds in its dimensions and L/D ratio but differs in its straight or slightly convex lateral sides and less clearly expressed keel.

Ozawainella cf. *leei* Putrya*.

Pl. XVI Figs. 2–7

Locality: P 22–3.

Description: Radius vector: 320–630
Form ratio: 0.32–0.45
Number of whorls: 5.5–6.5

Straight or weakly convex lateral sides in inner 2.5–3 whorls, subsequent whorls with straight or slightly concavo-convex lateral sides; broadly convex to almost flat polar regions with occasionally shallow umbilical depressions; percentages of angularity of periphery for 8 specimens from 1st to 7th whorl respectively:

A.	94	44	6	—	—	—	—
A. (blp.)	—	12	6	—	6	—	—
blp.	6	38	25	—	—	—	—
P. (blp.)	—	6	19	6	—	12	—
P.	—	—	44	94	94	88	100

Chomata extend to poles in inner 4.5–6 whorls; relative height immediately lateral to the tunnel varies from 0.40–0.65 (N = 42); height generally increases from 1st to 4th or 5th whorl and decreases in subsequent whorls.

Tectum and a less dense lower layer frequently observed; the lower layer has about same density as upper-tectorium or chomata; some specimens show no differentiation of wall.

Measurements: See Table 12.

Remarks: The species which is considered to be most closely related to the present specimens is *O. leei* Put. This species apparently differs mainly by its slightly larger L/D ratio which varies from 0.42 to 0.50 whereas the variation in the present species is from 0.37 to 0.43. The species described by Putrya and the specimens described above differ also in size of proloculum which is somewhat larger in *O. leei.* With regard to the L/D ratio our specimens are on average intermediate between *O. leei* and *O. angulata* (Col.). This intermediate position holds good for a number of other characters as well. For this reason we have some difficulty in choosing one or the other; yet *O. leei* might be somewhat more closely allied. *O. angulata* differs by its generally slightly smaller L/D ratio, a closed umbilical region (our specimens often show small umbilical depressions) and lower chomata. *O. laxa* Grozd. *et* Leb. is also closely similar. This species differs by its slightly greater L/D ratio and its apparently more highly concave lateral sides at maturity.

Ozawainella cf. *krasnokamski* Safonova, 1951** var. *kirovi* Dalmatskaja, 1961

Pl. XVI Figs. 8–11

Locality: A 7.

Description: Radius vector: 230–425
Form ratio: 0.32–0.45
Number of whorls: 6–7

*The orginal description of *O leei* Putrya has not been available to the present writer.

**In Rauser-Chernoussova *et. al.*, 1951.

Lateral sides straight or convex in inner 4 whorls, straight or very slightly concavo-convex in subsequent whorls; polar regions narrowly to broadly convex in inner 4–5 whorls, from 4–7th whorl weakly to moderately developed umbilical depressions present; percentages of angularity of periphery for 4 specimens from 1st–7th whorl respectively:

A.	88	50	12	—	—	—	—
A. (blp.)	12	25	38	—	—	—	—
blp.	—	25	25	57	17	12	—
P. (blp.)	—	—	25	29	17	—	—
P.	—	—	—	14	66	88	100

Chomata probably extend to poles in 6.5 whorls, in last half whorl of specimens with 7 whorls often still fairly wide; relative height of chomata varies between 0.30 and 0.45.

Well preserved specimens may show wall with tectum.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 22	19	45	77	120	181	272			
21	13	26	53	90	142	217	297	391	R.v.
17	11	26	57	99	146	224	310	425	
16	10	23	45	73	120	172	228		

R.:	71–121	56–74	50–65	43–53	33–38	31–37	G.r.
Av.:	99	66	55	50	36	34	

0.38	0.44	0.43	0.46	0.38			
0.46	0.55	0.48	0.45	0.48	0.44	0.39	F.r.
0.50	0.42	0.41	0.44	0.38	0.39	0.32	
0.48	0.50	0.41	0.43	0.47	0.45		

Remarks: The specimens here described are closely similar to the variety *kirovi* Dalm. of *O. krasnokamski* Saf. They differ only in the still smaller L/D ratio (0.35–0.36 in 7th whorl) as well as in the somewhat smaller diameter (0.74 mm in 7th whorl).

Ozawainella cf. *vozhgalica* Safonova, 1951*

Pl. XVI Fig. 12

Locality: A 3.

Description: Lateral sides convex in inner 2–2.5 whorls, concavo-convex at maturity; polar regions with moderately developed umbilical depressions; periphery arched (1st wh.) arched or arched to bluntly pointed (2nd wh.) bluntly pointed or sub-angular (3rd wh.) angular (3.5–5th wh.).

Chomata extend to poles almost throughout growth (inner 5 whorls); relative height lateral to the tunnel is 0.25–0.50; in 5.5 whorl chomata poorly developed.

Differentiation of wall not observed.

* In Rauser-Chernoussova *et al.*, 1951.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen: 46		11	34	64	122	239	340	—	R.v.
				87	90	95	42		G.r.
			0.50	0.50	0.46	0.43	0.40		F.r.

Remarks: The single specimen present is best compared with *O. vozhgalica* Saf. The only difference is apparently a slightly fewer number of whorls in this specimen as compared with *O. vozhgalica.* However, the specimen might still be immature. Other almost equally similar species are *O. mosquensis* Raus. and *O. laxa* Grozd. *et* Leb. The former has a slightly larger L/D ratio and diameter for corresponding whorls; the latter shows less developed umbilical depressions as well as a somewhat greater L/D ratio. Closely allied is also *O. paracompressa* Grozd. *et* Leb. which differs only in having a somewhat larger diameter for corresponding whorls. The systematic position of the specimen here described is considered to be intermediate between this species and *O. vozhgalica* Saf.

Ozawainella ex gr. *tingi* (Lee, 1937)

Pl. XVI Figs. 13–14

Locality: A 3.

Description: Radius vector: 240–325
Form ratio: 0.50–0.53
Number of whorls: 5–6

Essentially straight lateral sides, occasionally concavo-convex or convex; broadly convex to convex polar regions, umbilical depressions absent; periphery arched (inner 1–1.5 wh.), bluntly pointed or arched to bluntly pointed (1.5–2.5 wh.), arched to bluntly pointed, bluntly pointed or angular (3–5.5 wh.).

Chomata extend to poles throughout growth; relative height immediately lateral to the tunnel does not exceed 0.40.

Wall homogeneous.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen: 14		13	35	65	108	156	244		R.v.
37		13	41	79	128	190	265	300	
R.:				86–93	62–66	44–48	39–56		G.r.
Av.:				90	64	46	48		
			0.57	0.56	0.52	0.56	0.50		F.r.
			0.52	0.58	0.56	0.54	0.52	—	

Remarks: The present specimens are definitely closely related to a number of mutually very similar rhombic species. They are here grouped under *O. tingi* (Lee) which is among the first described of these rhombic species. Closely similar species to our specimens are:

O. tingi (Lee) which differs in having more whorls (6.5) and possibly a slightly larger L/D ratio.

O. pseudotingi Put. which differs in having a larger diameter for corresponding whorls [0.56–0.68 as against 0.48–0.60 (5–5.5 whorl)], larger proloculum and possibly somewhat better developed chomata.

O. facoides Man. which species possibly has a flat or even slightly depressed axial region, a maximum of 6.5 whorls, apparently a slightly more slender shell as well as a somewhat smaller diameter for corresponding whorls (no original data were available).

O. donbassensis Raus. which differs in having a slightly smaller L/D ratio and somewhat fewer whorls.

Ozawainella sp. 1

Pl. XVI Figs. 15–16

Locality: A 8.

Description: Lateral sides straight or convex in inner 2–3.5 whorls, straight to very slightly concavo-convex in subsequent whorls; polar regions with weak to moderately developed umbilical depressions; periphery arched (0.5–1.5 wh.) from angular to arched (1–2.5 wh.) and angular (3rd–6th wh.).

Chomata either extend to poles throughout growth (specimen 19; 5 whorls) or extend to poles in inner 5.5 whorls (specimen 25; 6 whorls); relative height increases during growth, attains a maximum of slightly over half the chamber lumen in 4.5–5th whorl and decreases to about 0.30 in 5.5–6th whorl.

Differentiation of wall indistinct; 4th whorl of specimen 19 shows tectum, a lower less dense layer and possibly also a lower-tectorium; secondary deposits above tectum show about same density as layer below tectum.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen:	25	24	69	153	246	378	501	697	R.v.
	19	19	59	103	183	306	442		R.v.
			75–122	61–78	53–67	33–44	39		G.r.
			0.41	0.44	0.45	0.38	0.43	0.32	F.r.
			0.40	0.46	0.42	0.39	0.36		

Remarks: The present specimens resemble *O. vozhgalica* Saf. somewhat closely. This species differs, however, by its greater L/D ratio (0.41–0.51 as against 0.34–0.38 in our specimens). Other probably related species although less similar than *O. vozhgalica* are *O. kumpani* Raus., *O. angulata* (Col.), *O. laxa* Grozd. *et* Leb., *O. pseudoangulata* (Put.), *O. leei* Put., *O. mosquensis* Raus. and *O. umbonoplicata* Put. All these species except for *O. angulata* and *O. umbonoplicata* have a larger L/D ratio. Moreover, the keeled and pointed periphery, clearly present in our specimens, is absent in *O. pseudoangulata*, *O. leei*, *O. angulata*, *O. umbonoplicata* and to some degree also in *O. mosquensis*. *O. angulata* differs moreover in having lower chomata and no umbilici and *O. umbonoplicata* in the more evolute state of its whorls at maturity.

Ozawainella sp. 2

Pl. XVI Figs. 17–21

Locality: L 353.

Description:

	Radius vector	430–480
	Form ratio:	0.35–0.40
	Number of whorls:	4.5–5

Lateral sides straight or convex in inner 2 whorls; straight, slightly convex or slightly concavo-convex in subsequent whorls; polar regions broadly convex, flat or with shallow umbilical depressions; periphery arched (1st wh.), pointed (beyond 2nd wh.).

Chomata extend to poles in inner 4 whorls; width in subsequent whorls varies from 1/3 this distance (along lateral slopes) to almost to the poles; relative height varies between 0.30 and 0.50.

Wall with tectum and lower less dense layer, which has about same density as the upper-tectorium; lower-tectorium absent.

Measurements:

Wh.n.	0	1	2	3	4	5	
Specimen: 28	26	54	112	187	297	433	
21	—	56	116	215	340	—	
7	22	58	125	195	—		R.v.
14	21	54	116	215	331	476	
26	15	39	80	151	219	—	
R.:	15–26	39–58	80–125	151–215	219–340	433–476	
Av.:	21	52	110	193	297	454	
R.:		106–115	56–89	46–59	44–46		G.r.
Av.:		110	76	54	45		
28		0.44	0.48	0.48	0.43	0.39	F.r.
21		0.62	0.43	0.45	0.46		
7		7	12	16			
14		7	13	15	19	25	S.c.
26		7	13	14	17		

Remarks: Species which are considered most allied to the specimens described above are *Ozawainella vozhgalica* Saf., *O. mosquensis* Raus., *O. paracompressa* Grozd. *et* Leb., *O. edita* Man. and *O. laxa* Grozd. *et* Leb. Some differences appear in the table below:

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	ibid. 5th wh.	L/D
O. vozhgalica	5.5–6.5	20–40	360–490	600–730	0.41–0.51
O. mosquensis	4.5–6	37	550	800	0.45–0.55
O. paracompressa	4.5–5	25–26	510–900	730–1010	0.41–0.44
O. edita	4.5–5	—	470–610	800–960 (4.5 wh.)	0.31
O. laxa	5.5	29	460–540	570–770	0.44–0.46
Spanish specimens	4–5	30–52	390–640	800–900	0.42

The pronounced keel in our axial sections strongly points to *O. vozhgalica.* However, this species differs in a number of other characters. *O. edita* and, in less degree, also *O. paracompressa* apparently have lower chomata.

Genus PSEUDOSTAFFELLA Thompson, 1942

Thompson, M. L., New genera of Pennsylvanian fusulinids. Amer. Journ. Sci., New Haven, Conn., 1942, Vol. 240, No. 6, p. 407.

Pseudostaffella antiqua (Dutkevitch, 1934 b)

Pl XVI Figs. 22–23

Locality: P 76.

Description: The two axial sections present show indistinct umbilical depressions and are wholly involute; periphery arched in inner 3 whorls and arched or straight to arched in subsequent whorls.

Chomata more similar to those of certain species of *Schubertella* than to the chomata of the large and more specialized species of *Pseudostaffella*; asymmetric; broad and moderately high or high, relative height in 3.5–4.5 whorl varies from 0.40 to 0.50; gentle or perpendicular slopes at the tunnel side.

Tunnel path almost symmetric; tunnel angle in 3rd and 4th whorl 12–15° and 20–21° respectively.

Inner 2–2.5 whorls coiled at a large angle to subsequent whorls.

Composition of wall rather indistinct, probably consisting of a protheca and secondary deposits (chomata and? tectoria); in outer whorls protheca indistinctly differentiated in tectum and lower less dense layer; this latter layer of about same density as the secondary deposits.

Measurements:

	Wh.n.	0	1		2		3		4	5	
Specimen:	24 (1)	10	35		62		86		151	194	R.v.
	24 (2)	18	49		84		119		204	246	
				77		39		75			G.r.
				71		41		71			
			—		—		1.02		0.91 0.95		F.r.
			—		—		—		0.87 0.91		

Pl. XVI Figs. 24–25

Locality: L 24.

Description: Wholly involute; umbilical depressions absent; periphery arched in inner 2.5–3.5 whorls and straight or arched to straight in subsequent whorls; a sagittal section shows a smooth spirotheca and short triangular septa in inner 3 whorls, triangular or rod-shaped septa in the 4th whorl.

Chomata similar to those of many species of *Schubertella;* asymmetric or symmetric; of medium height and width in 2–3.5 whorl, height between 1/3 and 1/2 of chamber lumen; generally steep slopes at the tunnel side.

Inner 2–2.5 whorls at an angle to subsequent whorls.

Locally spirotheca shows presence of a tectum; secondary deposits of same density as layer below tectum.

Measurements:

Wh.n.	0	1		2		3		4	
Ax. Sag.									
Specimen: 13 (1)	21	51		90		125		176	
3	16	60		92		129	185		R.v.
13 (2)	18	56		101		163	215		
			76		39		58		
			54		40				G.r.
			81		62				
		—		0.67		0.96		0.98	F.r.
		0.52		0.79		1.02	0.87		
13 (1)		8		9		9		13	W.th.
13 (2)		11		11		11	12		

Remarks: The possibility cannot be excluded that the above described specimens, here compared with *Ps. antiqua,* in reality are juvenile individuals of *Ps.* ex gr. *gorskyi* (1st assemblage) found in association with the present specimens.

Pseudostaffella cf. *antiqua* (Dutk.) var. *grandis* Shlykova

Pl. XVI Fig. 26

Locality: P 54.

Description: Unfortunately we possess only two central-oblique sections of this species which we nevertheless mention and describe since they occur in one of the stratigraphically lowest fusulinid containing limestones.

Periphery probably arched in all whorls.

Chomata low as compared with other species of *Pseudostaffella;* sometimes quite narrow and subsymmetric.

Tunnel angle in 4th whorl about 30° which is a fairly large value for the genus *Pseudostaffella.*

Inner 1–2 whorls coiled at an angle to subsequent whorls.

Locally protheca clearly consists of a dark outer layer (tectum) and a less dense inner layer; presence of tectoria doubtful.

Measurements:

Wh.n.	0	1	2	3	4		5	
Specimen: 13	27	69	95	196				R.v.
17	22	65	138	221	357	408		

Form ratio of adult specimens probably varies between 0.90 and 1.00.

Remarks: The resemblance of the present species with *Pseudostaffella antiqua* var. *grandis* Shlyk. as figured by Rauser-Chernoussova (1951; pl. V; fig. 7) and Grozdilova and Lebedeva (1960; pl. XV; fig. 3) is quite obvious. Unfortunately, the original description of Shlykova was not at the writer's disposal. Apparently *Ps. antiqua* var. *grandis* Shlyk. has more volutions and a smaller diameter for corresponding whorls than our Spanish form (Rauser-Chernoussova *et al.*, 1951; Grozdilova and Lebedeva, 1960). It seems, however, that in these respects the illustration presented by Rauser-Chernoussova corresponds to the present specimens.

Pseudostaffella ex gr. *antiqua* (Dutkevitch)

Pl. XVI Figs. 27–28

Locality: P 76.

Description: The two axial sections present show weak umbilical depressions and are wholly involute; periphery probably arched in inner 1.5 whorls; arched, straight to arched in 2nd–4th whorl; arched in 4.5–5th whorl.

Chomata more similar to those of certain species of *Schubertella* than to the chomata of the larger and more specialized species of *Pseudostaffella;* wide but, at least in outer whorls, not extending to poles; relative height in 2nd–4th whorl varies from 0.30 to 0.50, they may be absent or low in the 4.5 whorl; generally sleep slopes at the tunnel side.

Tunnel path almost symmetric; tunnel angle in 3rd and 4th whorl respectively 13–24° and 20–24°.

Inner 1–2.5 whorls coiled at a large angle to subsequent whorls.

In outer whorls protheca clearly differentiated in a tectum and a less dense lower layer; this latter layer locally somewhat less dense than the chomata; presence of tectoria doubtful.

Measurements:

	Wh.n.	0	1		2		3		4	5	
Specimen:	2	25	72		128		208		325	374	R.v.
	17	28	69		112		183		259		
				78		63		56			G.r.
				62		63		42			
			—		—		0.95		0.92	0.98	F.r.
			0.53		0.88		0.86		0.93		

Remarks: The present species definitely belongs to the group of *Ps. antiqua* (Dutk.). It is somewhat larger than *Ps. antiqua* and may be identical with either *Ps. antiqua* var. *posterior* Saf. or *Ps. antiqua* var. *grandis* Shlyk. Unfortunately the original description of the latter variety was not available to this writer. To a certain extent it corresponds also with *Ps. kanumai* Igô. The latter species is clearly transitional to *Profusulinella* (cf. *Profusulinella bona* Grozd. *et* Leb.).

Pseudostaffella ex gr. *variabilis* Reitlinger, 1961

Pl. XVI Fig. 29

Locality: L 25.

Description: The single specimen present is wholly involute and has flat umbilical regions; periphery arched in inner 2.5 whorls and straight to arched in the 3rd whorl.

Chomata asymmetric or symmetric; wide or narrow; low, relative height between 0.20 and 0.30. Inner 1.5 whorls coiled at large angle to subsequent whorls.

Wall indistinctly differentiated.

Measurements:

	Wh.n. 0		1		2		3	
Specimen: 26	17		49		99		163	R.v.
				100		65		G.r.
			—		0.74		0.71	F.r.

Remarks: Pseudostaffella variabilis Reitl. is most similar to the above described specimen. Other somewhat similar species equally belonging to *Ps.* ex gr. *variabilis* are *Ps. primitiva* Reitl. and *Ps. minor* Raus. There is apparently also a close relation to some species of the group *Millerella? protvae* (Raus.) as well as to species of the group *Schubertella obscura* Lee *et* Chen (cf. *Sch. obscura* var. *mosquensis* Raus.).

Pseudostaffella cf. *needhami* Thompson, 1942

Pl. XVI Fig. 30

Locality: L 353.

Description: The single specimen of this species present shows slight umbilical depressions and is wholly involute; periphery arched (1–1.5 wh.), straight (2–2.5 wh.) or straight to arched (3–3.5 wh.).

Chomata high and extending to poles; from 2nd to 3.5 whorl relative height varies from 0.35 to 0.55; steep (perpendicular) or gentle slopes at the tunnel side.

Tunnel angle from 1st to 3rd whorl 14°, 25° and 22° respectively.

Inner 2 whorls coiled at a small angle (25°) to subsequent whorls.

Wall of three layers i.e. tectum, upper-tectorium and a layer below the tectum which shows same density as upper-tectorium.

Measurements:

	Wh.n. 0	1	2	3	4	
Specimen: 20	31	79	119	220	284	R.v.
		0.72	0.81	0.83		F.r.

Remarks: Also *Ps. hollingsworthi* (Thomp.) resembles our species to a large measure. It differs in having a somewhat more narrowly rounded periphery.

Pseudostaffella ex gr. *gorskyi* (Dutkevitch) *

(1st assemblage)

Pl. XVI Figs. 31–32

Locality: L 24.

Description: Umbilical depressions weakly developed; volutions completely involute; periphery arched in inner 3 whorls, flat in 4.5–5.5 whorl and again arched or flat to arched in 6th–7th whorl.

Chomata extend to poles in inner 3 whorls, starting with 4th whorl narrow and symmetric or subsymmetric; relative height ranges from 0.40 to 0.55 in 2–6.5 whorl,

* In Grozdilova and Lebedeva, 1950.

decreases to 0.25 in 7th whorl; steep (often perpendicular) or gentle slopes at the tunnel side.

Tunnel path almost symmetric; maximum deviation of symmetry about 10°; tunnel angle from 3rd–6th whorl respectively 26°, 21°, 26° and 23°.

Inner 2 whorls at a large angle to subsequent whorls.

Wall composed of a tectum and a less dense lower layer; this latter layer is about as dense as the secondary deposits.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	7	
	Ax.	Sag.								
Specimen:	1	—	59	94	144	217	323	450	557	R.v.
	33	21	54	103	174	280	408	557		
				57	55	50	49	39	24	G.r.
				92	69	61	45	36		
			—	0.77	1.06	1.00	1.01	0.92	0.89	F.r.
			?	10	14	19	?	23		S.c.

Remarks: Within this group the present species seems to be most closely related to *Ps. gorskyi* (Dutk.) and the microspheres of *Ps. subquadrata* Grozd. *et* Leb. A difference with respect to these species is the more microspherical state, i.e. smaller proloculum and higher number of whorls, of the Spanish specimens.

Pseudostaffella ex gr. *gorskyi* (Dutkevitch)
(2nd assemblage)

Pl. XVI Figs. 33–34

Pl. XVII Figs. 1–5

Synonymy: 1882, *Fusulinella sphaeroidea* Moeller. – Barrois, Ch., Mém. Soc. Géol. du Nord, Tome II, p. 297, pl. XVI, fig. 1.

Locality: A 3.

Description: *macrospheres*

Radius vector:	355–420
Form ratio:	1.10 (4th wh.)
Number of whorls:	4–4.5

Umbilical depressions distinct; wholly involute; percentages of angularity for 5 specimens from 1st to 5th volution respectively:

S.	—	90	100	100	100
S. (A.)	20	—	—	—	—
A.	80	10	—	—	—

Chomata extend to poles in inner 2.5–4 whorls; rectangular in outer whorls and with steep (often perpendicular) slopes at the tunnel side.

Tunnel path almost symmetric; average and range of maximum deviation of symmetry respectively 9° and 5–13° (N = 5).

Axis maintains original position throughout growth, occasionally axis in first half whorl at a slight angle to subsequent whorls.

Wall consists of three layers; tectum, upper-tectorium and a layer below the tectum which has the same density as the upper-tectorium and which probably is homologous with the diaphanotheca.

microspheres

Radius vector:	430–675 (5.5 wh.)
Form ratio:	0.96–0.99 (5.5 wh.)
Number of whorls:	5.5–6

Umbilical depressions slightly or moderately developed; wholly involute; percentages of angularity for 3 specimens from 1st to 6th volution respectively:

C.	—	—	—	—	25	—
S.	—	34	34	66	75	100
S. (A.)	—	16	66	17	—	—
A.	100	50	—	17	—	—

Chomata extend to poles in inner 3.5–4.5 whorls; sometimes rectangular; generally steep slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; tunnel sometimes very wide and low in last whorl; maximum deviation of symmetry ranges from 6° to 19°, on average 14° (N = 3).

Axis of 1st whorl at a large angle to subsequent whorls.

Wall structure does not differ from that of macrospheres.

Measurements: See Table 13.

Remarks: The present species belongs without any doubt to the group of *Ps. gorskyi* in the sense of Rauser-Chernoussova (Rauser-Chernoussova *et al.* 1951, p. 104).

We may distinguish in our material specimens with a large proloculum and few whorls as well as specimens with a small proloculum and many whorls. They are remarkably alike in their other characters. Both types came from the same rock-sample. It is believed that they represent the macrospheric and microspheric generation of a single species. In order to facilitate determination both generations were provisionally considered to be different species. The macrospheres are best compared with *Ps. subquadrata* Grozd. *et* Leb. and are also not unlike *Ps. paradoxa* (Dutk.), *Ps. juresanensis* Grozd. *et* Leb. and *Ps. greenlandica* Ross *et* Dunb. in a decreasing order of similarity.

The microspheres are most similar to *Ps. gorskyi* and resemble also *Ps. subquadrata* Grozd. *et* Leb., *Ps. nibelensis* Raus. and *Ps. krasnopolskyi* var. *kyselensis* Raus. in a decreasing order of resemblance. Macro and microspheres occur in our assemblage in about the same numbers. It is obvious that we may equally identify this assemblage with *Ps. subquadrata* as with *Ps. gorskyi*. *Ps. gorskyi* was first described, probably in 1934, by Dutkevitch although the name apparently did not become valid in the sense of the Code of Zool. Nomencl. until 1950. This may be deduced from the fact that in this year a publication of Grozdilova and Lebedeva introduces this species as *Pseudostaffella gorskyi* (Dutkevitch) sp. nov. (cf. Grozdilova and Lebedeva, 1950, p. 128).

Pseudostaffella ozawai (Lee *et* Chen, 1930)

Pl. XVII Figs. 6–10

Locality: A 5.

Description:

Radius vector:	550–595 (6–7th wh.)	
Form ratio:	0.74	(6–7th wh.)
Number of whorls:	6–7.5	

Umbilical depressions absent; volutions wholly involute; change of periphery during growth is from arched through arched to straight and back to arched; percentages of angularity for 3 specimens from 1st to 7th whorl respectively:

S.	—	—	50	17	—	—	—
S. (A.)	—	—	—	33	17	—	—
A.A.	100	100	50	50	83	100	100

Chomata extend to poles in inner 7 whorls; relative height in 3rd–6th whorl varies from 0.45 to 0.65; more frequently steep slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric.

Inner 1–2 whorls at large angle to subsequent whorls.

Differentiation of wall indistinct; only in outer whorls tectum and a thin, weakly differentiated, diaphanotheca locally observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	8	
Ax. Sag.										
Specimen: 1	22	62	103	159	241	327—				
39	19	54	86	153	238	340	—			R.v.
26	15	58	120	212	289	391	552			
21	15	47	80	136	212	314	442	595—		
Av.:	18	55	97	165	245	343	497	—		
			66	54	51	36				
			61	58	55	41				
			107	77	36	35	41			G.r.
			68	70	56	48	41	35		
Av.:			75	65	50	40	41			
		0.71	0.89	0.94	1.00	0.91				
		—	1.00	0.92	0.88	0.85	0.74			F.r.
		—	0.81	0.88	0.91	0.89	0.85	0.74		
Av.:		—	0.90	0.91	0.93	0.88	0.79	—		
		—	—	12	11	15	9			
		—	10	17	13	14	14			T.a.
		—	—	10	12	13	15	13		
Av.:		—	—	13	12	13	13	—		
		6	12	15	19	23				S.c.

Pseudostaffella cf. *larionovae* Rauser-Chernoussova *et* Safonova, 1951*

Pl. XVII Figs. 11–12
Pl. XVIII Figs. 1–2

Locality: A 7.

Description: Radius vector: 925–1040
Form ratio: 0.78
Number of whorls: 9

The two axial sections present show slight umbilical depressions and are wholly involute; percentages of angularity for 3 specimens from 1st to 9th volution respectively:

S.	25	—	—	34	34	16	16	34	—
S. (A.)	—	32	32	16	16	34	34	—	20
A.	75	68	68	50	50	50	50	66	80

Chomata extend to poles in inner 7.5–9 whorls; up to and including 8th whorl relative height varies from 0.33 to 0.60, in subsequent whorls this is reduced to a maximum of 0.25; generally steep slopes at the tunnel side.

Tunnel path almost symmetric (specimen 23) or slightly asymmetric to asymmetric (specimen 19); maximum deviation of symmetry for these specimens respectively 9° and 26°.

Inner 0.5–1 whorl sometimes at a slight angle to subsequent whorls.

In inner whorls wall distinctly of three layers; diaphanotheca sometimes observed beyond 4th or 5th whorl, remaining fairly dense and in consequence being indistinctly differentiated from the tectoria; upper-tectorium absent in outer 3–4 whorls.

Measurements:

Wh.n.	Ax.	Sag.	0	1	2	3	4	5	6	7	8	9	
Specimen:	23		42	90	150	212	306	400	523	680	816		
	19		40	80	153	238	331	442	578	718	867	1037	R.v.
		13	37	90	148	212	289	374	510	629	782	926	
		11	36	86	133	195	289	382	493	663	795	960	
Av.:			39	86	146	214	304	400	526	672	815	974	

	67	41	44	31	31	30	20		
	92	56	39	33	31	24	21	20	G.r.
	64	43	36	29	36	23	24	18	
	55	47	48	32	29	34	20	21	
Av.:	69	47	42	31	32	28	21	20	

	1	2	3	4	5	6	7	8	9	
	1.00	0.91	0.94	0.97	0.93	0.88	0.90	0.81		F.r.
	0.86	0.80	0.79	0.85	0.88	0.85	0.83	0.81	0.78	
	10	13	7	9	12	11	14	13		T.a.
	8	11	9	8	10	10	11	11		
	—	15	20	25	24	31	32	34	39	S.c.
	—	15	20	21	24	29	31	33	38	
Av.:	13	20	25	28	32	32	36	30	23	W.th.

* In Rauser-Chernoussova *et al.*, 1951.

Remarks: The present species may be compared with the holotype of *Ps. larionovae* Raus. *et* Saf. which is of Podolskian age (Rauser-Chernoussova *et al.*, 1951, pl. VII fig. 1) but differs in a large measure from the Kashirian specimen (ibid., fig. 2). A striking character of our form is the presence of typical *Ps. sphaeroidea*-type chomata especially in inner whorls. According to Rauser-Chernoussova this is sometimes observed in *Ps. larionovae* as well, although chomata are generally lower in outer whorls and rapidly diminish in height towards the poles. Another difference is the large number of volutions which reaches 9 in our specimens as against up to 7.5 in *Ps. larionovae.* Another somewhat similar species is *Pseudostaffella umbilicata* (Put. *et* Leont.). According to illustrations presented by Putrya and Leontovitch this species has much lower chomata which diminish in height towards the poles. One specimen referred to *Ps. umbilicata* by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, pl. VII, fig. 8) is very similar to our specimen 19. The maximum number of volutions in *Ps. umbilicata* is 7, although according to Rauser-Chernoussova specimens with 8.5 whorls may occur.

Pseudostaffella of. *sphaeroidea* (Ehrenberg, 1842)

Pl. XVIII Figs. 3–7
Pl. XIX Figs. 1–2

Locality: P 40.

Description: Radius vector: 705–975
Form ratio: 0.88–0.84 (6.5–8th wh.)
Number of whorls: 7–8

All specimens are slightly umbilicate and wholly involute; the periphery changes from arched through straight and back to arched; percentages of angularity for 4 specimens from 1st to 8th whorl respectively:

S.	12	30	80	80	60	44	—	—
S. (A.)	50	40	20	10	30	56	42	—
A.	38	30	—	10	10	—	58	100

Chomata extend to poles in inner 5–6.5 whorls; more frequently fairly steep slopes at the tunnel side.

Tunnel path symmetric or slightly asymmetric; average and range of maximum deviation of symmetry respectively 12° and 4–22°.

Inner 3 whorls sometimes at a slight angle (20°) to subsequent whorls; other specimens show an axis which maintains its original position throughout growth.

In outer whorls a "diaphanotheca" is present which shows about the same density as the upper-tectorium; lower-tectorium very thin in comparison with the "diaphanotheca" and only slightly more opaque.

Measurements: See Table 14.

Remarks: The description and illustration of *Borelis sphaeroidea* Ehrenberg [= *Pseudostaffella sphaeroidea* (Ehrenberg)] is insufficient according to present standards. It is not known to this writer if Ehrenberg's original collection has been restudied and described or whether the type locality has been resampled. However, there are many records of this species in literature some of which will probably not belong to Ehrenberg's species. Our specimens compare very well with the specimens described and figured by Ross and Dunbar (Ross and Dunbar, 1962, pp. 13–15, pl. 2, figs. 9—12) in a paper dealing with the fusulinids from NE Greenland. They fit slightly less well the specimens described by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, p. 128, pl. 9, figs. 3–5) but still seem to correspond sufficiently. One specimen of the present assemblage (specimen 27) is very similar to *Pseudostaffella rostovzevi* Raus.

Pseudostaffella sphaeroidea (Ehr., 1842) var. *cuboides* Rauser-Chernoussova, 1951

Pl. XIX Figs. 3–4

Locality: P 22–3.

Description: The single axial section present shows moderately developed umbilical depressions and is wholly involute; periphery arched in inner 1.5 whorls, straight to arched in 2–2.5 whorl and straight in 3rd–7th whorl.

Chomata extend to poles in inner 6.5 whorls, absent in 7th whorl; relative height varies from 0.40 to 0.47 in 2–3.5 whorl, from 0.50 to 0.62 in 4.5–6.5 whorl; steep or gentle slopes at the tunnel side.

Tunnel path almost symmetric, maximum deviation 11°; tunnel angle from 2nd to 6th whorl respectively 17°, 13°, 15°, 16° and 15°.

Axis of coiling maintains original position throughout growth.

Wall of three layers in inner whorls, a weakly differentiated diaphanotheca may be observed in outer whorls; thickness of spirotheca 19–24μ in 5–7th whorl.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 3	37	77	115	170	238	323	432	544	R.v.
6	51	103	153	238	314	416	510	616	
		49	48	40	36	34	25		G.r.
		49	56	32	32	22	21		
		0.75	0.85	0.90	0.79	0.91	0.85	0.81	F.r.

Remarks: The present species is best compared with *Ps. sphaeroidea* var. *cuboides* Raus. but it is also similar to *Ps. greenlandica* Ross *et* Dunb. The present species differs from both in having a somewhat smaller diameter for corresponding whorls. In shape, polar extension and height of the chomata it rather conforms to the first mentioned species [chomata of *Ps. greenlandica* resemble somewhat those in some species of *Ps.* ex gr. *gorskyi* (Dutk.)].

Pseudostaffella ex gr. *sphaeroidea* (Ehrenberg)

Pl. XIX Fig. 5

Locality: P 72.

Description: Umbilical depressions weakly developed to almost absent; whorls completely involute; periphery arched up to 1–1.5 whorl, straight in 2nd–5th whorl and straight or straight to arched in 5.5–7th whorl.

Chomata generally with steep slopes at the tunnel side; extend to poles in 7 whorls, still very broad in 7.5 whorl; relative height in 1.5–7th whorl ranges from 0.45 to 0.55.

Axis of coiling stable except for the first whorl which is at a small angle (19°) to subsequent whorls.

Tunnel path almost symmetric; tunnel angle from 2nd to 7th whorl respectively 10°, 10°, 10°, 11°, 12° and 15°.

Wall consists of four layers; diaphanotheca poorly differentiated; total thickness of spirotheca in outer whorls (5th–7th wh.) 32–38 μ.

Measurements:

Wh.n.	0	1		2		3		4		5		6		7	8	
Specimen: 19	43	98		165		259		362		490		656		850	—	R.v.
			68		57		40		35		34		30			G.r.
		0.85		0.86		0.97		1.02		0.97		0.96		0.84		F.r.

Remarks: The present species resembles *Pseudostaffella sphaeroidea* (Ehr.) as well as *Pseudostaffella rostovzevi* Raus., having characters giving it a position intermediate between the two. The large number of whorls and the sphaeroidal outline point towards *Ps. rostovzevi,* whereas the normal state of the juvenarium and the chomata, well developed even in outer whorls, are considered to be more characteristic for *Ps. sphaeroidea.*

Pseudostaffella parasphaeroidea (Lee *et* Chen, 1930)

Pl. XIX Fig. 6

Locality: P 4.

Description: Umbilical depressions very slightly developed; whorls completely involute; periphery arched up to and including the 2.5 whorl; straight in the 3rd–4.5 whorl; straight or straight to arched in the 5th–6.5 whorl and again arched in the 7th whorl.

Chomata extend to poles throughout growth; relative height 0.50 to 0.56 in 3.5–5th whorl, 0.33 to 0.43 in 6th–6.5 whorl; steep slopes at the tunnel side, often perpendicular.

Tunnel path symmetric; tunnel angle from 3rd–7th whorl respectively 12°, 9°, 10°, 13° and 12°.

Inner 2 whorls coiled at a large angle to subsequent whorls.

In outer 3 whorls below the tectum a thin, moderately differentiated, diaphanotheca and a lower-tectorium; secondary deposits above tectum seem to consist of chomata only.

Measurements:

Wh.n.	0	1		2		3		4		5		6		7	
Specimen: 20	15	47		86		131		208		314		391		561	R.v.
			83		53		59		51		24		43		G.r.
		0.45		—		1.15		1.14		1.08		1.13		1.00	F.r.

Remarks: The Spanish specimen is sufficiently close to the species described by Lee and Chen to identify it as *Ps. parasphaeroidea* (Lee *et* Chen). Almost identical in dimensions and general characters is a specimen of Grozdilova and Lebedeva (Grozdilova and Lebedeva, 1950, pl. V, fig 3). *Ps. ozawai* var. *compacta* Man. is somewhat similar as well.

6

Pseudostaffella ex gr. *parasphaeroidea* (Lee *et* Chen, 1930)
(sensu Rauser-Chernoussova *et al.*, 1951)
Pl. XX Figs. 1–6

Locality: L 11.

Description: Radius vector: 575–650
Form ratio: 0.81–0.87
Number of whorls: 6

Umbilical depressions absent (specimen 4), weakly expressed (specimens 15, 7) or clearly present (specimen 1); whorls completely involute; change of periphery during growth is from arched through straight and possibly back to arched in the 6th whorl; percentages of angularity for 4 specimens from 1st to 6th whorl respectively:

S.	—	25	25	63	75	50
S. (A.)	15	25	37	25	13	25
A.	85	50	38	12	12	25

Chomata extend to poles in inner 5–5.5 whorls; in 6th whorl either absent or very narrow (specimens 1, 4) or still extending to near the poles (specimens 15, 7); steep or gentle slopes at the tunnel side.

Tunnel path almost symmetric; average and range of maximum deviation of symmetry respectively 11° and 8–15°.

First half whorl at an angle to subsequent whorls.

Differentiation of wall indistinct; locally a tectum and a less dense layer below the tectum may be observed, occasionally the density of this layer below the tectum is somewhat less than that of the secondary deposits (i.e. chomata); specimen 4 shows in outer whorls a very thin lower-tectorium which layer is usually absent.

Measurements: See Table 15.

Remarks: The present specimens are similar to a number of species which are considered closely related to *Pseudostaffella parasphaeroidea* by Rauser-Chernoussova. (Rauser-Chernoussova *et al.*, 1951). This might be true but it cannot be concluded from the original description and illustration of *Ps. parasphaeroidea* (Lee *et* Chen.) Our Spanish specimens are best compared with *Pseudostaffella umbilicata* (Put. *et* Leont.); they differ from this species in having much narrower chomata in outer whorls. Other somewhat similar species are *Pseudostaffella kremsi* Raus. and *Pseudostaffella latispiralis* Kir.

Pseudostaffella sp. 1
Pl. XX Figs. 7–9

Locality: P 76.

Description: Radius vector: 320–335
Form ratio: 0.64–0.78
Number of whorls: 4.5–5

Umbilical depressions slightly to moderately developed; volutions wholly involute; percentages of angularity for 3 specimens from 1st to 5th whorl respectively:

S.	—	17	33	17	—
S. (A.)	—	—	50	83	40
A.	100	83	17	—	60

Chomata may extend to poles in inner 4.5 whorls; height in 2.5–5th whorl varies from 0.35 to 0.50; generally steep, often perpendicular, slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric.

Inner 1.5–2 whorls coiled at an angle to subsequent whorls.

In outer whorls protheca clearly differentiated in tectum and a less dense lower layer; this latter layer locally somewhat less dense than chomata; presence of tectoria doubtful.

Measurements:

Wh.n.	0		1		2		3		4		5	
Specimen: 15 (1)	24		62		115		185		270	320		
12	24		57		87		140		220		320	R.v.
7	—		43		64		120		221		320	
				85		61		46				
				53		60		57		45		G.r.
				50		87		84		50		
			—		—		0.84		0.78	0.78		
			0.50		0.80		0.75		0.72		0.64	F.r.
			0.50		—		0.82		0.77		0.69	
			—		17		15		17			
			—		10		9		17		14	T.a.
			—		—		14		16		15	

Remarks: A number of described Russian species correspond quite closely to our specimens. They seem to fit best *Ps. sofronizkyi* Saf. of the group *Ps. antiqua* (Dutk.). Also *Ps. compressa* (Raus.) and *Ps. compressa* var. *donbassica* Put. have many characters in common with the present form. Somewhat similar is also *Ps. paracompressa* var. *extensa* Saf. as described by Grozdilova and Lebedeva (Grozdilova and Lebedeva, 1954; pl. XVI, fig. 9). From the group *Ps. gorskyi* the present species is best compared with *Ps. praegorskyi* Raus. (cf. Rauser-Chernoussova *et al.*, 1951, pl. VI, fig. 5) and *Ps. composita* Grozd. *et* Leb.

Pseudostaffella sp. 2

Pl. XX Figs. 10–11

Synonymy: 1956, *Pseudostaffella sphaeroidea* (Lamarck).–van Ginkel in Kanis, J., Leidse Geol. Med., Deel 21, p. 402, fig. 15, specimen D.

Locality: P 94.

Description: The single specimen shows moderately developed umbilical depressions and is wholly involute; periphery straight in outer whorls (3.5–5.5 wh.).

Chomata probably extend to poles in inner 4–4.5 whorls; height up to 1/2 of chamber lumen in inner whorls and between 1/3 and 1/4 in outer whorls; more frequently steep slopes at the tunnel side.

Tunnel path almost symmetric; tunnel angle in 3rd, 4th, 5th and 5.5 whorl respectively 20°, 18°, 19° and 30°.

Inner 2 whorls coiled at a large angle to subsequent whorls.

Spirotheca not or hardly differentiated; thickness of spirotheca in outer whorls (5–5.5 wh.) 15–19μ.

Measurements:

Wh.n.	0		1		2		3		4		5		6		
Specimen: A	18		46		69		125		217		340		459		R.v.
				50		81		74		57					G.r.
			—		—		—		—		—		1.00		F.r.

Remarks: The present specimen may either belong to the group of *Ps. antiqua* (Dutk.) or to the group of *Ps. gorskyi* (Dutk.); its characters place it in an intermediate position. Of the first mentioned group *Ps. antiqua* (Dutk.) and *Ps. paracompressa* Saf. are very close to our specimen.
The group of *Ps. gorskyi* (Dutk.) in the sense of Rauser-Chernoussova *et al.* (1951) comprises species in which the typical generic characters are better developed than in the former group i.e. higher and broader chomata, more narrowly coiled whorls, somewhat flatter periphery and a less pronounced plectogyroid manner of coiling in inner whorls. One of the most primitive species of this group e.g. *Ps. praegorskyi* Raus. is quite similar to the present specimen although they are probably not conspecific.

Pseudostaffella sp. 3

Pl. XX Fig. 12

Locality: L 24.
Descriptions: The single specimen present shows a flat umbilical region and has a rounded periphery in inner 2 whorls, a rounded to flat periphery in 3.5–5th whorl and again a rounded periphery in the outer whorl (5.5–6.5 wh.); volutions completely involute.

Chomata extend to poles at least up to and including the 3.5 whorl, still wide up to the final whorl (relative width 0.45 in 6.5 whorl); relative height varies from 0.50 to 0.55 in 2.5–4 th whorl, from 0.30 to 0.45 in 4.5–6.5 whorl; more often with gentle slopes at the tunnel side.

Tunnel path almost symmetric; maximum deviation of symmetry about 10°; tunnel angle from 3rd to 6th whorl respectively 20°, 17°, 12° and 10°.

Inner 2 whorls coiled at a large angle to subsequent whorls.

Wall consists of tectum and a less dense lower layer which is about as dense as the secondary deposits.

Measurements:

Wh.n.	0		1		2		3		4		5		6		7	
Specimen: 17	—		60		110		136		208		306		425		510	R.v.
				83		24		53		47		39				G.r.
			0.57		0.69		1.16		1.04		1.03		0.84		0.74	F.r.

Remarks: The present species is probably new and might be classified either in the group of *Ps. parasphaeroidea* (Lee *et* Chen) or in the group of *Ps. ozawai* (Lee *et* Chen).

Pseudostaffella sp. 4

Pl. XXI Fig. 1

Locality: A 3.
Description: The single specimen present is wholly involute; umbilical regions flat; periphery probably arched in inner 3 whorls and flat in last half whorl.

Chomata apparently extend to poles; fairly low, relative height varies from 0.25 to 0.40; often with gentle slopes at the tunnel side.

Inner 2.5 whorls coiled at large angle to subsequent whorls.

Thickness of spirotheca in last whorls does not exceed 13 μ; differentiation of spirotheca not observed.

Measurements:

	Wh.n.	0		1		2		3		4		5	
Specimen: 14		—		30		73		112		176	185		R.v.
					143		53		58				G.r.
				—		—		0.97		0.80	0.93		F.r.

Remarks: At first glance one is inclined to refer this species to *Ps. antiqua* (Dutk.). There are, however, some minor differences with regard to shape of chomata and state of last whorls. These whorls are somewhat looser coiled in *Ps. antiqua* according to the original description of the latter species. Another possibility that has to be considered is that the specimen may represent a juvenile growth stage of *Ps. praegorskyi* Raus. (cf. *Ps. praegorskyi* of Grozdilova and Lebedeva, 1960, pl. XV, fig. 7, 8.). A decision in favour of one of these possibilities can hardly be made on the base of a single specimen.

Pseudostaffella sp. 5

Pl. XXI Fig. 2

Locality: P 4.

Description: The single specimen shows the following characters: umbilical depressions almost absent; wholly involute; periphery arched up to and including 2nd whorl, straight or arched to straight in subsequent whorls.

Chomata very high, relative height 0.60–0.75 in 3–4.5 whorl; extending to poles in inner 4.5 whorls and still very broad in 5th whorl; more often steep slopes at the tunnel side.

Tunnel path slightly asymmetric; tunnel angle from 2nd to 5th whorl respectively 11°, 6°, 8° and 14°.

Inner 1–2 whorls coiled at an angle to subsequent whorls.

Tectum and a weakly differentiated, thin, diaphanotheca may be observed in outer whorls; presence of tectoria doubtful.

Measurements:

	Wh.n.	0		1		2		3		4		5	
Specimen: 29 (2)		—		64		123		190		290		395	R.v.
					92		54		53		36		G.r.
				1.00		—		0.96		0.83		0.78	F.r.

Remarks: The present species may either belong to the group *Ps. parasphaeroidea* (Lee *et* Chen) sensu Rauser-Chernoussova *et al.*, 1951 or to the group *Ps. ozawai* (Lee *et* Chen); of the first mentioned group *Ps. larionovae* var. *polasnensis* Raus. *et* Saf. as well as *Ps. larionovae* subsp. *mosquensis* Raus. seem to be most closely related to the present species whereas in the second group *Ps. syzranica* Raus. *et* Saf. is most similar.

Pseudostaffella sp. 6

Pl. XXI Figs. 3–6

Locality: P 4.

Description:

Radius vector:	425–510 (5–5.5 wh.)
Form ratio:	0.88–0.95 (5–5.5 wh.)
Number of whorls:	5–6.5

Umbilical depressions slightly or moderately developed; wholly involute; change of periphery during growth is from arched through straight and probably again arched in outer whorls; percentages of angularity for 4 specimens from 1st to 6th whorl respectively:

S.	12	25	63	25	33	—
S. (A.)	13	12	37	50	17	—
A.	75	63	—	25	50	100

Chomata extend to poles in inner 4.5–6 whorls; relative height varies from 0.43 to 0.59 in 1.5–4th whorl, from 0.31 to 0.48 in 4.5–5th whorl; steep, often perpendicular, slopes at the tunnel side.

Tunnel path slightly asymmetric or almost symmetric; maximum deviation of symmetry varies from 7° to 18° and is on average 12° (N = 4).

Axis maintains original position throughout growth.

Tectum distinct; in outer whorls layer below tectum generally somewhat less dense than secondary deposits above tectum.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 28	39	86	153	229	340	467 510			
9	38	95	163	259	374 420				R.v.
19	37	92	144	229	330	460	— —		
15	34	84	144	234	312	425			
Av.:	37	89	151	238	339	451	—		
			78	50	48	37			
			72	59	44				G.r.
			57	59	44	39			
			71	62	35	35			
Av.:			70	58	43	37			
		0.85	0.89	0.96	0.95	0.88 0.95			
		0.96	1.00	0.97	0.87 0.94				F.r.
		0.88	0.82	0.73	0.81	0.79	— —		
		0.79	0.76	0.85	0.91	0.88			
Av.:		0.87	0.87	0.88	0.88	0.85	—		
		—	—	11	12	15			
		17	10	13	12				T.a.
		16	10	9	9	11	—		
		15	11	5	7	—			
Av.:		16	10	10	10	13			

Remarks: The present species is considered to belong to the group of *Ps. parasphaeroidea* (Lee *et* Chen) sensu Rauser-Chernoussova *et al.*, 1951. Of this group *Ps. umbilicata* (Put. *et* Leont.) and *Ps. larionovae* Raus. *et* Saf. are probably more closely related to the present species than any other species described. The generally ribbon-like chomata resemble those of *Ps. sphaeroidea* (Ehr.) although they are somewhat lower in the Spanish form. There is an obvious similarity with *Ps.* cf. *larionovae* from the "Cuenca de Beleño" (Asturias) (Loc. A7). The latter species differs mainly in having more volutions.

Pseudostaffella sp. 7

Pl. XXI Figs. 7–9

Locality: P 4.

Description:

Radius vector:	865–1020
Form ratio:	0.65–0.70
Number of whorls:	7.5–8

Umbilical depressions absent; volutions completely involute; change of periphery during growth is from arched through arched to straight and again to arched in 7th whorl; percentages of angularity for 2 specimens from 1st to 8th whorl respectively:

S.	—	—	—	—	25	25	—	—
S. (A.)	—	—	—	75	75	75	25	—
A.	100	100	100	25	—	—	75	100

Chomata extend to poles in inner 7.5 whorls, absent in 8th whorl (specimen 16); relative height in 3.5–7.5 whorl ranges from 0.25 to 0.55, on average 0.44; especially in older whorls steep slopes (often perpendicular) at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry for 2 specimens 11° and 16°.

First whorl sometimes coiled at a very slight angle to subsequent whorls.

Wall of three layers; in outer whorls layer above tectum (upper-tectorium) slightly more dense than layer below tectum.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	7		8	
	Ax. Sag.											
Speci-	2	43	102	170	268	365	514	714	892	1020		
men:	16	—	128	204	304	391	527	680	858		1020	R.v.
	29 (1)	38	105	182	265	357	477	640	795	867		
			67	58	37	41	39	25				
			63	47	28	35	29	26		19		G.r.
			73	46	35	34	34	24				
			0.75	0.70	0.79	0.81	0.78	0.73	0.70	0.68		F.r.
			0.66	0.65	0.64	0.73	0.71	0.69	0.67		0.67	
			—	8	8	9	13	13	12			T.a.
			—	6	6	11	10	9	11		—	

Remarks: It is not altogether certain that the two axial sections really belong to a single species. Both specimens have a large and nearly equal radius vector, a high number of whorls, a small form ratio, an arched periphery in the outer whorl and probably flat umbilical regions. Yet inner whorls of specimen 2 are strongly reminiscent of *Ps. sphaeroidea* (Ehr.) whereas early whorls of specimen 16 on the contrary are more similar to species of the group *Ps. ozawai* (Lee *et* Chen). There is possibly a more or less close relation to the species from Loc. A 7 (Cuenca de Beleño; Asturias) which was compared to *Ps. larionovae* Raus. *et* Saf. This holds good especially for specimen 2. However, both our specimens differ from *Ps. larionovae* in having a flat umbilical region and a relatively small form ratio. Some species of the group of *Ps. ozawai* e.g. *Ps. ozawai* (Lee *et* Chen), *Ps. ozawai* var. *compacta* Man. and *Ps. paraozawai* Man. seem to be quite close to the present specimens. Especially *Ps. paraozawai* might be closely similar. The same species probably occurs in the Socavón Limestone Member of the Corisa Formation.

Subfamily SCHUBERTELLINAE Skinner, 1931

Genus SCHUBERTELLA Staff *et* Wedekind, 1910

Staff, H. and Wedekind, R., Der Oberkarbone Foraminiferensapropelit Spitzbergens. Uppsala Univ., Geol. Inst., Bull., Uppsala, Sverige, 1910, Vol. 10 (1910–1911), No. 19–20, pp. 112, 121.
Thompson, M. L., Fusulinids of the subfamily Schubertellinae. Journ. Pal., Menasha, Wis., U.S.A., 1937, Vol. 11, p. 120.

Schubertella cf. *obscura* Lee *et* Chen, 1930 var. *mosquensis* Rauser-Chernoussova, 1951

Pl. XXII Figs. 1–4

Locality: L 25.

Description: Test changes from nautiliform (1st wh.) through nautiliform or spherical (2nd wh.) to spherical (3rd wh.).

Relative height of chomata varies between 0.20 and 0.40; broad, occasionally extending to poles throughout growth.

Septa entirely straight.

Axis of coiling either stable (specimen 36, macrosphere?) or inner 1–1.5 whorls coiled at an angle to subsequent whorls.

Wall indistinctly differentiated in tectum and less dense lower layer; presence of tectoria doubtful.

Measurements:

	Wh.n. 0	1	2		3	
Specimen: 36	32	65	112	133		
25	28	65	129		221	R.v.
23	25	62	103		183	
21	22	64	120		191	
		0.73	1.00		1.16	
		—	0.85		1.00	F.r.
		—	0.71		0.88	
		—	0.77		1.00	

Remarks: The present species is best compared with the Vereyan and Sub-Vereyan specimens of *Sch.* cf. *obscura* Lee *et* Chen var. *mosquensis* Raus. of the U.S.S.R. It is also somewhat similar to *Sch. texana* (Thomp.).

Schubertella cf. *obscura* Lee *et* Chen, 1930

Pl. XXII Figs. 5–12

Locality: P 63.

Description: First whorl lenticular; spherical or oval at maturity.

Chomata generally low, sometimes moderately high (specimens 12, 21); very wide, often extending to poles.

Inner 1.5–2.5 whorls coiled at large angle to subsequent whorls.

Wall differentiation indistinct or absent.

Measurements:

Wh.n.	0	1	2		3		4	
Specimen: 21	30	62	116		206			
25	29	67	99		174	211		
6	27	95	163					
20	27	60	118	140				R.v.
12	25	52	104	150				
24	24	73	123	165				
26	20	52	87	99				
		<1	—		1.15			
		—	—		—	1.15		
		—	1.27					
		—	0.91	1.08				F.r.
		0.75	—	1.19				
		—	—	1.08				
		—	—	1.20				

Remarks: The present specimens are very close, if not identical, to *Sch. obscura* Lee *et* Chen or one of its known varieties notably *Sch. obscura* var. *mosquensis* Raus. (cf. our specimens 25, 20). The latter variety, however, may be somewhat closer coiled. According to the original description of *Sch. obscura* this species shows dimorphism; the macrospheres with a non-rotating axis and a proloculum of about 40 μ, the microspheres with a rotating axis and a much smaller proloculum apparently not over 20 μ. All our specimens show a strongly rotating axis but have an initial chamber which measures 40–60 μ. The specimens here described are almost equally comparable with *Sch. mexicana* (Thomp.) and *Sch. diminutiva* (Thomp.) but both latter species are probably synonymous with *Sch. obscura* Lee *et* Chen or at least closely related to this species.

Schubertella cf. *pseudoobscura* Chen, 1934

Pl. XXII Figs. 13–16

Locality: P 4, A 6, A 7.

Description: Test changing from discoidal in 1st whorl to spherical or oval at maturity.

Chomata inconspicuous.

Inner 1–2.5 whorls coiled at large angle to subsequent whorls.

Wall not differentiated.

Measurements:

	Wh.n.	0	1	2		3	
Loc. A 6; specimen:	18	25	62	95	129		
	35	21	47	82	125		R.v.
Loc. P 4; specimen:	5	17	39	67		142	
Loc. A 7; specimen:	5		(not measured)				
			—	1.09	1.00		
			—	—	1.10		F.r.
			—	—		1.06	

Remarks: The four specimens from three different localities are considered to belong to the same species. The present specimens are very similar to *Sch. pseudoobscura*, a species described by Chen (1934) from the Chihsia Formation (Upper Carboniferous or Lower Permian) of China. In 1949 *Sch. obscura* Lee *et* Chen var. *plana* and in 1962 *Sch. toriyamai* were described respectively by Kireeva and Ishii both from Middle Carboniferous rocks. The latter species has been described in detail and comparison shows that it differs only in minor degree from our specimens (specimens from Locs. A 6 and P 4). The single specimen from Loc. A 7 is apparently very close to *Sch. obscura* var. *plana* Kir. It is not wholly clear if the minor differences between these species and with *Sch. pseudoobscura* are significant enough for specific differentiation. This is partly due to the fact that the original description of *Sch. pseudoobscura* gives no information with regard to its variability. We have provisionally identified our specimens with the first described species i.e. *Sch. pseudoobscura* Chen.

Schubertella cf. *subkingi* Putrya

Pl. XXII Fig. 17

Locality: L 11.

Description: Test changes from nautiliform (1st wh.) through spherical (2nd wh.) to elongate subrhomboidal (3–3.5 wh.).

Relative height of chomata varies between 0.18 and 0.28 (2–3.5 wh.); wide, occasionally extending to poles in inner 2.5 whorls.

Septa somewhat curved at poles of 3rd whorl and slightly folded at poles of 3.5 whorl.

Inner 1–1.5 whorl coiled at angle to subsequent whorls.

Wall indistinctly differentiated; locally tectum present.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 19	13	37		73		132	175		R.v.
			97		81				G.r.
		0.80		1.00		2.35	2.55		F.r.
		4		9		16	13		W.th.

Remarks: The present specimen is almost certainly conspecific with *Sch. subkingi* Put. as described and illustrated by Rauser-Chernoussova (1951). Unfortunately the original description of this species was not available.

Schubertella ex gr. *kingi* Dunbar *et* Skinner, 1937
(sensu Rauser-Chernoussova *et al.*, 1951)
Pl. XXII Figs. 18–20

Locality: P 10, P 22–2, P 38.

Description: Test changes from lenticular (1st. wh.) through spherical or short fusiform (2nd wh.) fusiform or fusiform to elongate subrhomboidal (3rd wh.) to fusiform or subcylindrical (4–5th wh.); poles bluntly pointed or rounded at maturity.

Chomata distinct; low and moderately wide in inner 2.5 whorls, low and narrow or even completely absent in subsequent whorls; maximum height 1/3 of chamber height.

Septa either essentially straight throughout growth or slightly and irregularly folded along a narrow zone of the axis beyond the 2–2.5 whorl.

Innermost whorl at an angle to subsequent whorls.

Wall either thin and not differentiated (specimen 1) or moderately thick and showing tectum and less dense lower layer (specimens 11, 14).

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 14	16	52		95		172		241			
11	—	52		95		153		251		459	R.v.
A	16	41		69		125		245			
			82		82						
			83		61		64		83		G.r.
			68		81		97				
		—		1.71		2.50		2.44			
		0.71		1.00		1.83		2.07		2.13	F.r.
		—		1.41		2.13		2.14			
11		9		11		16		21		24	W.th.
A		6		11		11		11			

Remarks: The three specimens present are from different localities. Specimen 14 (Fig. 20) is from the Lores Limestone Member, specimen 11 (Fig. 18) is from the Brañosera Limestone Member and specimen A (Fig. 19) is from the Sierra Corisa Limestone Member. These three specimens are considered to belong to a single species.

Schubertella cf. *pseudoglobulosa* Safonova, 1951*
Pl. XXII Figs. 21–23
Pl. XXIII Fig. 1

Locality: L 353.

Description: Test changes from nautiliform or spherical (1st wh.) through spherical, oval or short fusiform (2nd wh.) to spherical or oval (3rd–4th wh.).

Relative height of chomata varies from 0.15 to 0.30 in inner 1.5 whorls and from 0.20 to 0.45 in subsequent whorls; commonly narrow and symmetric or subsymmetric, sometimes extending to poles in inner 2 whorls.

* In Rauser-Chernoussova *et al.*, 1951.

Septal folding is observed beyond the 2nd whorl near the poles; occasionally septal loops are present, relative wavelength large.

Axis of coiling either stable or innermost whorl at a slight angle to subsequent whorls.

Wall indistinctly differentiated; locally with tectum and lower less dense layer, which latter layer is also somewhat less dense than the chomata.

Measurements:

	Wh.n.	0	1		2		3		4	
Specimen:	3	43	92		172		323			
	34	43	86		166		280	370		R.v.
	5	38	90		166	217				
	17	37	64		129		221		340	
				86		88				
				93		69				Gr.
				84						
				100		71		54		
			1.21		1.35		1.21			
			1.05		1.25		1.27	1.13		F.r.
			0.79		1.00	1.10				
			0.75		1.03		1.04		1.03	
			13		14		24			
			12		13		24			W.th.
			11		13	16				
			4		13		21		23	

Remarks: The present species is closely similar to *Sch. pseudoglobulosa* Saf. It differs in having up to 4 volutions as against 3.5 in *Sch. pseudoglobulosa.* Moreover, L/D ratio in the 3–3.5 volution is higher (1.25–1.38) than in corresponding whorls in *Sch. pseudoglobulosa.* This value, however, diminishes to about 1.00–1.10 in the 4th whorl which is comparable to values of Safonova's species. In addition septal folding in the polar regions seems to be somewhat better developed in the Spanish specimens.

Schubertella spp.

Pl. XXIII Figs. 2–22

Locality: P 1.

Description: The illustrated and described specimens of this genus from this locality are considered to belong to more than one species. The probable presence of juvenile forms, the possibility of having both macro and microspheres added to the relatively simple construction of this genus, do not allow a convincing division of the present material into several species. In order to compare with described species the studied specimens were subdivided in form groups.

Form 1a

Chomata asymmetric; maximum relative height 1/3 of chamber lumen; often fairly wide.

Axis of inner 1–2 whorls at angle to subsequent whorls.

Wall either weakly differentiated in tectum and less dense lower layer or homogeneous.

Measurements:

Specimen	Wh.n. 0	1	2		3	
94	32	65	97	110		
74	29	69	90	118		
48	26	49	—		120	
85	24	49	95	142		R.v.
119	24	49	88	125		
72	23	43	90		133	
92	22	49	77		120	
		0.60	0.68	0.94		
		—	0.95	1.05		
		0.61	—		1.07	
		—	—	1.00		F.r.
		—	—	1.05		
		0.70	0.62		0.92	
		—	0.72		1.04	

Form 1b

Chomata asymmetric or subsymmetric; maximum relative height 1/3 of chamber lumen; often fairly wide.

Axis either stable or 1st whorl at angle (up to 90°) to 2nd whorl.

Wall weakly differentiated in tectum and less dense lower layer.

Measurements:

Specimen	Wh.n. 0	1	2	
64	37	86	146	
49	35	90	159	R.v.
65	28	69	129	
		0.72	0.94	
		—	0.84	F.r.
		—	1.00	

Form 2

Chomata asymmetric or (last whorl) symmetric; maximum relative height 1/3 of chamber lumen; occasionally fairly wide.

Inner 2 whorls at large angle to subsequent whorls.

Wall differentiated in tectum and less dense lower layer.

Measurements:

Specimen	Wh.n. 0	1	2	3		4	
18	25	56	102	164	201		R.v.
		—	—	0.88	0.83		F.r.

Form 3a

Chomata absent or very poorly developed.

Axis of coiling maintains original position.

Wall weakly differentiated in tectum and less dense lower layer.

Measurements:

	Wh.n. 0	1	2		3	
Specimen: 100	46	97	145	184		
71	45	84	146		249	R.v.
36	42	90	159	215		
87	35	88	145		227	
		—	1.07	1.15		
		0.72	0.90		0.94	F.r.
		0.76	0.97	1.03		
		0.82	0.87		0.95	

Form 3b

Short fusiform to subrhomboidal.

Chomata quite variable in height, maximum height 1/2 of chamber lumen; often extending to poles; asymmetric.

Axis of coiling either stable or 1st whorl at angle to subsequent whorls.

Wall differentiated in tectum and less dense lower layer; presence of tectoria doubtful.

Measurements:

	Wh.n. 0	1	2	3		4	
Specimen: 129	43	77	125	202			
20	34	60	107	159	219		R.v.
66	31	56	101	157	198		
		0.94	1.21	1.42			
		0.86	1.00	1.22	1.23		F.r.
		0.77	1.09	1.49	—		

Form 4a

Short fusiform.

Chomata asymmetric or symmetric; absent in last half whorl, of moderate height in earlier whorls (relative height about 0.40).

First whorl at large angle to subsequent whorls.

Wall differentiated in tectum and less dense lower layer; presence of tectoria doubtful.

Measurements:

	Wh.n. 0	1	2	3		4	
Specimen: 47	—	—	70	145	190		R.v.
		—	—	1.21	1.39		F.r.

Form 4b

Short fusiform, slightly vaulted at maturity.

In contrast to above mentioned groups, septa not entirely straight at polar regions of outer whorl.

Chomata extend to poles in inner 3 whorls; in subsequent whorls they cover about 1/3 of lateral slopes; asymmetric or symmetric; maximum relative height 0.40 of chamber lumen.

Inner 1–2 whorls at large angle to subsequent whorls.

Wall distinctly differentiated in tectum and less dense lower layer; this may be observed as early as in the 2nd whorl; upper-tectorium probably present.

Measurements:

	Wh.n.	0	1	2	3	4	5	
Specimen: 131		30	69	118	176	292	—	R.v.
			—	1.38	1.71	1.69	—	F.r.

Form 5

Very short fusiform; poles pointed; lateral sides convex.

Septa probably not entirely straight at poles of 4–4.5 whorl.

Maximum relative height of chomata 1/3 of chamber lumen; they extend to poles in inner 3 whorls; asymmetric.

Tunnel clearly observed, slit-like.

Axis of inner 2 whorls at large angle to axis of subsequent whorls.

Wall as in form 4b.

Measurements:

	Wh.n.	0	1	2	3	4	5	
Specimen: 121		—	88	133	209	297	426	R.v.
			—	—	0.99	1.13	1.01	F.r.

Remarks: The present groups of specimens may be referred to respectively:

Form 1 = *Sch.* cf. *obscura* var. *mosquensis* Rauser-Chernoussova.
These specimens are best compared with *Sch. obscura* var. *mosquensis* Raus. They differ from this variety by their less distinct endothyral coiling and from the typical species in having a smaller L/D ratio as well as a smaller diameter.

Form 1b. Form 1b differs from Form 1a in the macrospheric state i.e. a larger proloculum, fewer whorls and a larger diameter for corresponding whorls. Moreover, the L/D ratio is still somewhat smaller. Form 1b certainly belongs to the group of *Sch. obscura* Lee *et* Chen. It is not impossible that they belong together in a single species.

Form 2 = *Sch.* cf. *obscura* var. *plana* Kireeva.
Position of Form 2 is intermediate between *Schubertella* and representatives of primitive species of *Pseudostaffella* e.g. *Ps.* ex gr. *antiqua* (Dutk.), *Ps.* ex gr. *variabilis* Reitl. or even *Ps. needhami* Thomp.

Form 3a = *Sch.* ex gr. *obscura* Lee *et* Chen.
To some degree Form 3a is similar to *Sch. australis* Thomp. *et* Mill., *Sch. texana* (Thomp.), *Sch. obscura* Lee *et* Chen (cf. Lee and Chen, 1930, pl. 6, figs. 14, 15) and *Sch. pseudoglobulosa* Saf.

Form 3b = *Sch.* ex gr. *obscura* Lee *et* Chen.
The present specimens may possibly be referred to *Sch. gracilis* Raus. They seem to differ from this species in having a slightly smaller diameter for corresponding whorls.

Sch. obscura Lee *et* Chen is also similar, especially if we compare with the fusiform to ellipsoidal shaped specimens of this species. Yet the present specimens show a more rhomboidal outline. It is considered that *Sch. minima* (Deprat) is closely allied if not identical. Unfortunately the given data in Deprat's description do not permit a detailed comparison.

Form 4a. Specimen 47 resembles *Sch. acuta* Raus. but differs in having a more loosely coiled test. It may also be very close to *Sch. minima* (Deprat). The latter species, however, has a smaller L/D ratio (1.5 as against 1.7 in our specimen). Moreover, its length should not exceed 0.50 mm, whereas this is 0.56 mm in our specimen. *Sch. obscura* Lee *et* Chen has a smaller L/D ratio but except for this parameter it is very similar to some specimens figured by Lee and Chen (Lee and Chen, 1930, pl. 6, figs. 16–17). *Sch. inominensis* (Tor.) may be rather close as well. Unfortunately this species is very badly reproduced. It has apparently a somewhat smaller diameter for corresponding whorls. *Sch. gracilis* Raus. on the contrary has a larger diameter for corresponding whorls. *Sch. giraudi* (Deprat) has more volutions.

Form 4b. Specimen 131 is best compared with *Sch. acuta* Raus. but differs in having a somewhat larger diameter for corresponding whorls and better developed chomata. Our specimen differs from *Profusulinella eolibrovichi* Saf. by its more loosely coiled test.

Form 5 = *Sch.* ex gr. *pauciseptata* Rauser-Chernoussova.
The single specimen present may possibly be referred to *Sch. pauciseptata* Raus., to the variety *globulosa* Saf. or to *Sch. borealis* Raus.

Schubertella spp.

Pl. XXIII Figs. 23–29

Locality: P 7.

Description: Here again we are confronted with the same difficulty as before when it had to be decided if the available specimens belong to a single species or rather constitute a heterogeneous selection. In the present case it is believed that the assemblage of specimens represent different growth stages of a single species and, moreover, that variation is accentuated by presence of micro and macrospheric types. Provisionally four form groups are here distinguished.

Form 1 shows low and fairly broad chomata, an indistinctly differentiated wall, an inner whorl which is at an angle to the outer whorls and an oval to spherical outline.

Form 2 shows rather wide and low or moderately high chomata; wall not or indistinctly differentiated; axis of coiling either constant or 1st whorl at slight angle to subsequent whorls; spherical, oval or short fusiform..

Form 3 has low or moderately high chomata which in inner 2 whorls are very wide; wall apparently homogeneous; innermost whorl at slight angle to subsequent whorls; short fusiform.

Form 4 with low or moderately high and fairly wide chomata in inner 3.5 whorls, absent in 4th whorl; septa somewhat folded at extreme polar ends of 4th whorl; wall weakly differentiated in tectum and less dense lower layer which latter layer is slightly less dense than secondary deposits above tectum; axis of coiling maintains original position; short fusiform (ellipsoïdal).

Measurements:

	Wh.n.	0	1	2		3		4	
Form 1 Specimen:	27	26	58	86	107				
Form 2	22 (1)	41	64	116		198			
	22 (2)	34	75	129	198				
	17	30	58	99		163	219		R.v.
	6	—	43	82		150	204		
Form 3	64	39	75	133		204	251		
Form 4	52	31	76	130		200		315	
			0.74	1.15	1.16				
			<1	1.00		1.28			
			1.10	1.87	1.61				
			0.37	0.87		1.05	1.13		F.r.
			<1	1.00		1.33	1.18		
			0.91	—		1.46	1.49		
			0.87	1.24		1.65		1.57	

Remarks: Form 1 and Form 2 may possibly be referred to *Sch. obscura* Lee *et* Chen but it is more likely that they belong together with Form 3 to a single assemblage in which Form 3 represents a mature specimen. This specimen is not readily comparable with any described species. It might be related to a certain extent with *Sch. mjachkovensis* Raus. The latter species, however, has a larger L/D ratio and, according to data of Rauser-Chernoussova, a much smaller diameter (= 0.30–0.35 mm). However, from her reproductions and the given magnification the diameter should vary between 0.40 and 0.54. Within the latter range is the diameter of Form 3 [specimen 64 = 0.45 (3.5 wh.)]. *Sch. mjachkovensis* Raus. also seems to differ in the state of the juvenarium. Form 4 is perhaps not conspecific with the other specimens. It seems to be rather close to *Sch. magna* Lee *et* Chen, *Sch. oliviformis* (Thomp.) and may be *Sch. mjachkovensis*. It is obvious that there is a close affinity to *Schubertella sp.* from the Lores Limestone Member (Loc. P 10).

Schubertella sp.

Pl. XXIII Figs. 30–31

Locality: P 7.

Description: Test lenticular (1st wh.), through nautiliform or spherical (2nd wh.) to spherical or oval (3rd wh.); chomata either absent or indistinctly developed; septa completely straight; well homogeneous.

Measurements:

	Wh.n.	0	1	2		3	
Specimen:	45 (2)	24	49	77	99		R.v.
	45 (1)	16	34	52		93	
			0.65	1.11	1.09		F.r.
			<1	<1		1.17	

Remarks: The present specimen is an extremely small species of *Schubertella* somewhat similar to the Lower Permian species *Sch. sphaerica* Sul. var. *compacta* Sul. Apparently it differs only in having fewer volutions. However, more specimens from this locality would be required to prove the presumed close relationship. They may also be related to *Sch. inominensis* (Tor.), but this species seems to have a different shape and number of whorls. *Schubertella minima*[1] (Tor.) has a larger L/D ratio and a larger diameter for corresponding whorls.

Schubertella sp.

Pl. XXIII Figs. 32–35

Locality: P 10.

Description: Test changes from lenticular to spherical (1st wh.) through spherical or oval (2nd wh.) to short fusiform or short cylindrical.

Septa slightly folded at poles of 3rd–4th whorl.

Chomata of medium height and generally fairly wide; often extending to poles in inner 2–3 whorls.

Axis of coiling either stable or inner 1–1.5 whorls coiled at angle to subsequent whorls.

Wall distinctly differentiated in tectum, diaphanotheca, lower and upper-tectorium.

Measurements:

Wh.n.	0	1	2	3		4	
Specimen: 15 L	34	86	133	219			
10	30	77	142	232	245		R.v.
13	25	62	107	188		297	R.v.
5	23	56	99	193			
		—	1.25	1.46			
		1.00	1.31	1.81	1.79		F.r.
		—	1.01	1.65		1.85	
		<1	1.31	1.80			

Remarks: None of the hitherto described species seems to be close to the present species. Yet the few sections we have do not allow the introduction of a new species. It resembles to some degree *Schubertella lata* Lee *et* Chen. The latter species, however, has a smaller diameter for corresponding whorls, a smaller L/D ratio as well as somewhat less developed chomata. The present specimens might as well be compared with some Carboniferous species of the group *kingi* Dunb. *et* Skin. (sensu Rauser-Chernoussova *et al.*, 1951).

Schubertella spp.

Pl. XXIV Figs. 1–14

Locality: P 38.

Description: Here also it is presumed, as with the fauna of the Piedras Luengas Limestone Member, that not all of the described and reproduced specimens belong to a single species. Distinction has been made between 4 different form groups,

[1] This species is a homonym of *Sch. minima* (Deprat), perhaps even a synonym. A second homonym of the species described by Deprat is *Sch. minima* Sosnina.

which eventually might prove to be independant species. This procedure was preferred in view of possible presence of macro- and microspheres, different growth-stages, relatively few number of specimens in the studied sample and the writer's lack of knowledge on the variability within species of this genus. Yet a comparison of these form groups with already described species can be made in the same way as if their independancy had been demonstrated.

Form 1a

Short fusiform; septa often slightly folded at poles of 2.5–3rd whorl.

Chomata relatively wide but not extending to poles; low to fairly high; maximum relative height 0.50 more commonly between 0.25 and 0.35.

Axis of coiling either stable or inner 1–2 whorls at a moderate angle to subsequent whorls.

Range and average of thickness of wall is: 8–12 μ (10 μ) (1st wh.), 10–19 μ (13 μ) (2nd wh.), 13–15 μ (14 μ) (3rd wh.); wall either differentiated in tectum and less dense lower layer or homogeneous.

Measurements:

	Wh.n.	0	1	2		3	
Specimen: 113		40	74	115	150		
129		38	71	120		201	
51		37	69	116		170	R.v.
71 (2)		31	69	103		166	
134		30	71	110	146		
			1.10	1.80	1.75		
			0.79	1.25		1.65	
			0.95	1.26		1.67	F.r.
			0.72	1.00		1.45	
			0.94	1.27	1.59		

Form 1b

Short fusiform; at poles of 3rd whorl septa slightly folded.

Chomata of moderate height or low, relative height 0.15–0.35; broad and sometimes extending to poles in inner 2 whorls.

Thickness of wall from 1st to 3.5 whorl respectively 7, 9, 17 and 15 μ; locally tectum and a less dense lower layer may be observed; presence of lower-tectorium doubtful.

Measurements:

	Wh.n.	0	1	2	3		4	
Specimen: 109		43	82	120	212	306		R.v.
			0.89	—	1.84	1.68		F.r.

Form 2

Short fusiform; septa essentially straight.

Chomata of moderate height to low; relative height varies from 0.15 to 0.30; fairly broad often extending to poles.

Inner 1–2 whorls at large angle to subsequent whorls.

Thickness of wall 6–9 μ (1st wh.), 11–12 μ (2nd wh.), 13 μ (3–3.5 wh.); composition of wall as in form 1.

Measurements:

	Wh.n.	0	1	2		3		4	
Specimen:	65	25	58	103	138				
	124	24	55	86		138	185		R.v.
	122	21	56	86		120			
			—	1.35	1.47				
			—	1.25		1.56	1.40		F.r.
			0.77	1.05		1.66			

Form 3

Spherical; septa straight.

Chomata either absent to very low (Form 3a) or fairly high (maximum relative height 0.50 ,Form 3b).

Axis of coiling either stable (Form 3b) or inner 1–2 whorls at an angle to subsequent whorls.

Thickness of wall 4–6 μ (1st wh.), 8–9 μ (2nd wh.), 11–13 μ (3rd wh.); composition of wall as in form 1.

Measurements:

	Wh.n.	0	1	2	3	
Specimen:	149	28	60	84	168	R.v.
	83	24	55	86	159	
			0.57	1.15	1.03	F.r.
			0.47	0.81	0.96	

	Wh.n.	0	1	2	3		4	
Specimen:	120	19	47	86	146	196		R.v.
			0.59	0.83	0.94	0.99		F.r.

Form 4

Short fusiform; septa straight.

Chomata absent or low; maximum relative height 0.35.

Inner 2–2.5 whorls coiled at large angle to subsequent whorls.

Thickness of wall 4–6 μ (1st wh.), 5 μ (2nd wh.) 7–11 μ (3rd wh.), 9–13 μ (4th wh.); indistinctly differentiated.

Measurements:

	Wh.n.	0	1	2	3		4	
Specimen:	67	—	39	69	110	138		R.v.
	86	10	33	54	81		132	
			0.58	—	1.10	1.34		F.r.
			0.48	—	—		1.71	

Remarks: Form 1a either is a juvenile stage of form 1b or both belong to a population, which is in process of speciation. It is not conspecific with any described species. It is probably allied to species of the group *Sch. obscura* Lee *et* Chen. We may also refer those specimens which were described as form 2 to *Sch.* ex gr. *obscura* Lee *et* Chen. Additional closely allied species are *Sch. inominensis* (Tor.), *Sch. minima* (Tor.), *Sch. obscura* Lee *et* Chen and *Sch. gracilis* Raus. There is some doubt whether form 3a and 3b belong to the same population; if not, we may refer specimen 149 and 83 (= form 3a) to *Sch. toriyamai* Ishii. Specimen 120 (= vorm 3b) is somewhat similar to *Sch. pauciseptata* var. *diversa* Kir. and to a lesser degree *Sch. australis* Thomp. *et* Mill. Similar is also *Sch.* cf. *obscura* (K. Ishii, 1962, pl. VI, fig. 41). We may refer the specimens described as form 4 to *Sch.* ex gr. *obscura* Lee *et* Chen. These specimens are closely allied to and perhaps identical with one of the following species: *Sch. paraobscura* Put. *et* Leont., *Sch. elongata* Kir. or *Sch. inominensis* (Tor.); somewhat less similar is the North American species *Sch. masoni* Thomp. *et* Hazz.

Schubertella spp.

Pl. XXIV Figs. 15–19

Locality: A 8.

Description: Specimens are provisionally assigned to three form groups. Further study may decide whether they are to be considered as three different species or that mutual differences may be explained by variation, different growthstage and presence of macro and microspheres.

Form 1

Test changes from nautiliform (1st wh.) through nautiliform, spherical or short fusiform (2nd wh.) to oval or fusiform (3rd wh.); chomata either low or moderately high and fairly wide; axis of coiling stable or inner whorl at slight angle to subsequent whorls; wall indistinctly differentiated in tectum and less dense lower layer.

Form 2

Test changes from lenticular (1st wh.) to spherical (3.5 wh.); at extreme polar regions of last whorl initial septal folding is observed; chomata moderately high and in inner 3 whorls very wide, in 3.5 whorl moderately wide and symmetric; inner 2.5 whorls coiled at angle to last whorl; differentiation of wall in tectum and less dense lower layer present in 3–3.5 whorl.

Form 3

Test changes from lenticular (1st wh.) through nautiliform or spherical (2nd wh.) through spherical or short fusiform (3rd wh.) to short fusiform or ellipsoidal (4–5th wh.); mature specimens show slightly folded septa at polar regions (4–5th wh.); chomata generally low and narrow, sometimes wide up to the 3rd whorl (specimen 25); inner 1–3 whorls coiled at angle to subsequent whorls; in outer whorls wall differentiated in tectum and less dense lower layer, maximum thickness 17 μ.

Measurements:

	Wh.n.	0	1	2		3		4	5	
Form 1 Specimen:	15	42	86	144		238				
	10	35	65	103	159					
	24(1)	20	56	95		150				R.v.
Form 2	24(2)	—	58	96		163	210			
Form 3	21	13	36	59		96		154	244	
	24(3)	17	45	77		127		211		
			1.05	1.47		1.46				
			1.07	1.50	1.35					
			0.69	0.91		1.00				
			—	—		1.12	1.04			
			—	—		0.96		1.47	1.38	
			—	0.83		1.52		1.70		

Remarks: The present groups of specimens may be referred to respectively:

Form 1 = *Schubertella* ex gr. *obscura* Lee *et* Chen.

Form 1 is best compared with *Schubertella oliviformis* (Thomp.). The present specimens differ in having slightly less volutions as well as a more fusiform shape instead of being ellipsoidal.

Form 2

The single specimen which we encountered is closely similar to *Schubertella obscura* Lee *et* Chen as described by Igô. (cf. Igô, 1957, pl. III, figs. 9–11, pp. 187–188). It differs slightly from the lectotype of *Sch. obscura* in that it seems to be looser coiled, has slightly undulant septa at the poles of the last whorl as well as slightly smaller chomata and a spherical to subquadratic shape. In some of these characters it rather approaches *Schubertella* of the group *pauciseptata* Raus. e.g. *Sch. pauciseptata* var. *diversa* Kir.; this variety differs, according to data given by Kireeva, in having a still smaller diameter for corresponding whorls, less prolonged endothyral coiling as well as a smaller L/D ratio.

Form 3 = *Schubertella* ex gr. *lata* Lee *et* Chen.

Our specimen is closely allied to *Schubertella lata* Lee *et* Chen and *Sch. magna* Lee *et* Chen both from the Huanglung Limestone Member of China. *Sch. masoni* Thomp. *et* Hazz. from the Permian of North America is somewhat similar as well. The present specimen differs from the former two species i.a. in having a smaller diameter for corresponding whorls and from the latter in having a greater diameter for corresponding whorls.

Schubertella? sp.

Pl. XXIV Figs. 20–21

Locality: A 1.

Description: Test changes from lenticular (1st wh.) through spherical (2nd–3rd wh.) to short fusiform or oval (4–6th wh.).

Septa completely straight or very slightly folded at poles of 5–6th whorl.

Chomata extend to poles in inner 4 whorls; sometimes still wide in 5th whorl (specimen 38) but absent (specimen 39) or narrow in 6th whorl; relative height varies from 0.20 to 0.33.

Inner 2 whorls at large angle to subsequent whorls.

Starting with 4th whorl wall differentiated in tectum and less dense lower layer; lower-tectorium may be present; upper-tectorium absent.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	
Specimen:	39	15	49	68	105	158	234	306	R.v.
	38	—	34	46	82	143	229	348	
				37	56	50	48	31	G.r.
				34	77	75	60	52	
			0.48	—	1.12	1.18	1.25	1.33	F.r.
			< 1	—	1.32	1.43	1.59	1.41	
			6	—	—	15	24	20	W.th.
			4	6	13	17	24	20	

Remarks: The species described above has characters intermediate between typical *Profusulinella* and *Schubertella.* Of the species referred to *Profusulinella* it is most similar to *P. ovata* Raus. This species differs, however, by its larger diameter for corresponding whorls as well as by its larger L/D ratio. *Sch? giraudi* (Deprat) is also close to *P. ovata* Raus. and our specimens. It is considered to be a *Profusulinella* by some and a *Schubertella* by others. *Sch.? giraudi* differs from our specimens in having slightly less whorls and a somewhat different shape at maturity i.e. short fusiform to subrhomboidal. Moreover, it possibly has a somewhat larger diameter for corresponding whorls. *Schubertella gracilis* var. *grandis* Reitl. differs in having a smaller L/D ratio and very obtuse poles. Somewhat similar species are also known from Permian strata e.g. *Sch. melonica* Dunb. *et* Skin., *Sch. paramelonica* Sul., *Sch. simplex* Lange var. *ishimbajevica* Sul. and *Sch. mulleriedi* Thomp. *et* Mill. They probably have all a different structure of the spirotheca.

Genus FUSIELLA Lee *et* Chen, 1930

Lee, J. S., Chen, S. and Chu, S., The Huanglung limestone and its fauna. Acad. Sinica, Nat. Res. Inst. Geol., Mem., Shanghai, China, 1930, No. 9, p. 107.

Fusiella cf. *praecursor* Rauser-Chernoussova, 1951

Pl. XXVIII Figs. 13–14

Locality: L 11.

Description: Radius vector: 235–265
Form ratio: 2.64–2.77
Number of whorls: 4.5–5

From 1st to 5th whorl test changes from discoidal (1st wh.) spherical or oval (2nd wh.) fusiform (3rd wh.) to fusiform or elongate rhomboidal (4–5th wh.); lateral sides straight or slightly concavo-convex; concave lateral sides may be present beyond inner 2 whorls; poles pointed or bluntly pointed at maturity.

Septa slightly folded or curved in polar area of 4–5th whorl.

Axial filling absent; sometimes a very slight darkening along the axis has been observed.

Chomata asymmetric; low and broad, extending to poles in inner 3–3.5 whorls, rudimentary developed or absent in 5th whorl; steep or gentle slopes at the side of the tunnel.

Tunnel path slightly asymmetric.

Axis straight; 1st whorl coiled nearly perpendicular to subsequent whorls.
Wall homogeneous.

Measurements:

	Wh.n.	0	1		2		3		4		5	
Specimen:	18 (1)	19	52		90		145		221	238		R.v.
	18 (2)	16	49		81		133		183		264	
				75		61		52				G.r.
				63		65		38		44		
			—		1.24		2.55		2.62	2.64		F.r.
			—		1.33		2.00		2.42		2.77	
			8		14		13		15	15		W.th.
			4		8		11		11		17	
					0.25	0.28	0.29	0.19	0.30	0.24		Ch.h.
					0.21		0.34		0.20	0.23		

Remarks: The present species might be referred to *Fusiella praecursor* Raus. but it is equally similar to *Fusiella typica* Lee *et* Chen var. *sparsa* Sheng. However, it is very well possible that the latter variety is a junior synonym of *Fusiella praecursor* Raus.

Fusiella sp.

Pl. XXVIII Figs. 15–16

Locality: P 4.

Description: Radius vector: 320–445
Form ratio: 3.00–3.50
Number of whorls: 6–7

From 1st to 7th whorl test changes from discoidal (1st wh.) rhomboidal (2nd–3rd wh.) to elongate rhomboidal or elongate fusiform (4–7th wh.); lateral sides straight or slightly concave; these slightly concave lateral sides may appear beyond inner 3 whorls; poles pointed or bluntly pointed.

Septa slightly curved or folded in extreme polar regions of 6–7th whorl.

Axial filling essentially absent; yet specimen 1 shows a very slight darkening along the axis in the 4th whorl.

Chomata rather wide in inner 3–3.5 whorls, possibly extending to poles; starting with 4–5th whorl chomata narrow and symmetric to subsymmetric; in 7th whorl chomata occasionally absent; relative height appr. 0.33; steep or gentle slopes at the tunnel side.

Tunnel path symmetric or slightly asymmetric.

Axis apparently slightly curved; 1st whorl coiled at a large angle to subsequent whorls.

Wall homogeneous.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	7	
	Ax. Sag.									
Specimen:	1	—	47	85	141	187	289	357		
	18	—	47	73	102	161	246	323	442	R.v.
	7	19	54	86	125	170	252	340		
	16	19	47	77	115	178	264	374		
Av.:		19	49	80	121	174	262	346		
				81	66	33	55			
				55	40	58	53	31	37	G.r.
				60	45	36	48	35		
				64	49	55	48	42		
Av.:				65	50	45	51	36		
	18		8	11	18	21	22	34		W.th.
	7		6	6	8	14	17	23		
	7		—	9	13	16	16	20		S.c.

Fusiella praetypica Safonova, 1951*
Pl. XXVIII Figs. 17–18

Locality: A 7.

Description: Radius vector: 245–285
Form ratio: 2.27
Number of whorls: 5

From 1st whorl to 5th whorl test changes from lenticular (1st wh.) spherical to oval (2nd wh.) rhomboidal (3rd wh.) rhomboidal to elongate rhomboidal (4th wh.) to elongate rhomboidal (5th wh.); beyond 3rd whorl lateral sides either straight or slightly concave; poles pointed at maturity; spirotheca smooth in inner whorls, septal grooves clearly expressed in 5th whorl.

Septa slightly folded in extreme polar regions of 5th whorl.

Axial filling absent.

Chomata low or of medium height; extending to poles in inner 3.5–4 whorls; in last half whorl width 0.25–0.50 of lateral slopes; asymmetric; moderately steep slopes at the tunnel side.

Tunnel path almost symmetric.

Axis straight; 1st whorl coiled perpendicular to subsequent whorls; beyond 1.5 whorl axis maintains its position.

Wall either homogeneous or three-layered (i.e. tectum, a less dense and thicker lower layer of the same density as a third layer: the upper-tectorium).

Measurements:

	Wh.n.	0	1	2	3	4	5	
Specimen:	2	17	47	77	122	176	284	R.v.
	9	—	34	60	95	163	249	
				64	58	44	61	G.r.
				75	57	73	53	
			—	1.08	1.67	2.12	2.27	F.r.
			—	9	13	15	19	W.th.
			—	—	—	13	17	

* In Rauser-Chernoussova *et. al.,* 1951.

Fusiella ex gr. *typica* Lee *et* Chen, 1930

Pl. XXVIII Figs. 19–20

Locality: P 7.

Description: Radius vector: 320–510
Form ratio: 2.47–3.04
Number of whorls: 6–7.5

From 1st to 7.5 whorl test changes from nautiliform (1st wh.) oval (2nd wh.) rhomboidal or elongate rhomboidal (3rd–4th wh.) to elongate rhomboidal (5–7.5 wh.); lateral sides straight or slightly concave; concave lateral sides appear beyond 2nd–3rd whorl; poles pointed, occasionally bluntly pointed.

Septa either folded in extreme polar regions of 5–7.5 whorl or completely straight.

Axial filling absent.

Chomata very narrow with respect to half-length; of medium height to rather high (about half chamber lumen or somewhat less); asymmetric, sometimes symmetric in 4–7.5 whorl; occasionally absent in last half whorl of mature specimens; generally steep slopes at the tunnel side.,

Tunnel path symmetric or asymmetric.

Axis straight (specimen 2) or perhaps slightly curved (specimen 65); 1st whorl coiled nearly perpendicular to subsequent whorls.

Wall homogeneous.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	8	
Specimen: 2	—	39	71	110	170	263	340			
65	20	43	77	110	159	227	322	425	510	F.r.
			83	55	54	55	29	32		G.r.
			80	42	45	43	42	32		
		—	1.24	2.31	2.85	2.71	2.68			F.r.
		—	—	1.92	2.27	2.92	3.04	2.72	2.47	
		9	11	14	15	19	25		-	W.th.
		8	9	13	14	17	17	23	24	

Remarks: The species described above is most similar to *Fusiella typica* Lee *et* Chen and *Profusulinella syzranica* Raus. differing from both in having a larger diameter and a higher number of whorls. *P. syzranica* Raus. is probably closely related to species of the group *P. librovitchi* (Dutk.) as well as to the genotype of *Fusiella* (= *Fusiella typica* Lee *et* Chen).

Fusiella praelancetiformis Safonova, 1951*

Pl. XXVIII Figs. 21–22

Locality: P 10.

Description: Radius vector: 180–204 (4th wh.)
Form ratio: 2.90–3.25 (4th wh.)
Number of whorls: 4–4.5

* In Rauser-Chernoussova *et al.*, 1951

From 1st to 4th whorl test changes from nautiliform or spherical (1st wh.) spherical or ellipsoidal (2nd wh.) to elongate rhomboidal (3rd–4th wh.); lateral sides essentially straight, sometimes very slightly concave or wavy; poles pointed or pointed to bluntly pointed.

Septa essentially straight; very slightly curved at extreme polar regions of 4–4.5 whorl.

Axial filling absent.

Chomata weakly developed, narrow and low; probably symmetric in 3.5–4.5 whorl.

Axis straight or curved; inner 1–2 whorls coiled at large angle to subsequent whorls.

Wall homogeneous.

Measurements:

	Wh.n. 0	1		2		3		4	
Specimen: 13	18	—		73		124		204	R.v.
12	18	39		64		118		182	
			—		70		65		G.r.
			64		84		54		
		—		—		3.00		3.25	F.r.
		—		—		2.16		2.92	
		6		12		17		23	W.th.
		4		8		13		15	

Fusiella cf. *pulchella* Safonova, 1951*

Pl. XXVIII Figs. 23–24

Locality: P 38.

Description: Radius vector: 175–225
Form ratio: 1.48–1.70
Number of whorls: 4–4.5

From 1st to 4.5 whorl test changes from discoidal (1st wh.) spherical (2nd wh.) to subrhomboidal (3–4.5 wh.); lateral sides straight or concave, concave lateral sides may appear beyond inner 2.5 whorls; poles pointed in outer whorls.

Septa straight from pole to pole.

Axial filling absent.

Chomata asymmetric; low or of medium height, rapidly decreasing in height towards poles but extending at least half way lateral sides; steep or gentle slopes at the tunnel side.

Tunnel path symmetric or weakly asymmetric.

Axis straight; inner 1.5–2.5 whorls coiled at large angle to subsequent whorls.

Wall very weakly differentiated in tectum and less dense lower layer.

* In Rauser-Chernoussova *et al.*, 1951.

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 118	19	42		65		105		176			R.v.
66	18	52		82		127		195	225		
			54		63		67				G.r.
			58		55		54				
		0.51		—		1.24		1.56			F.r.
		—		0.92		1.27		1.48	1.70		
118		6		8		13		15			W.th.
						0.33	0.29	0.31			Ch.h.
							0.39		0.47		

Fusiella cf. *lancetiformis* Putrya

Pl. XXVIII Fig. 25

Locality: P 36.

Description: Radius vector: 355
Form ratio: 3.66
Number of whorls: 8

From 1st to 8th whorl test changes from lenticular (1st wh.) oval (2nd wh.) elongate rhomboidal (3rd wh.) elongate rhomboidal to fusiform (4th wh.) triangular (5–6th wh.) to elongate fusiform or subcylindrical (7–8th wh.); lateral sides straight; poles pointed in 3rd–6th whorl, bluntly pointed in 7–8th whorl.

Supplementary deposits in axial zone fairly heavy developed.

Septa straight, sometimes slightly curved at extreme polar regions of outer whorls.

Chomata asymmetric and possibly extending to poles up to the 4th whorl; beyond 4th whorl rapidly becoming symmetric and very narrow with regard to half-length; relative height 0.25–0.35 (3.5–7th wh.).

Tunnel path asymmetric; tunnel angle very small with respect to length of the specimen.

Axis straight; 1st whorl coiled at large angle to subsequent whorls.

Differentiation of wall difficult to observe; locally two layers i.e. tectum and a lower, thicker, less dense layer are present.

Measurements:

Wh.n.	0	1		2		3		4		5		6		7		8	
Specimen: 13	18	37		60		84		120		162		204		267		355	R.v.
			62		40		43		35		26		31		34		G.r.
		0.61		1.33		2.38		2.99		3.74		3.66		3.59		3.66	F.r.
		—		—		—		—		11		15		18		16	W.th.

Remarks: The present *Fusiella* belongs without doubt to the group of *Fusiella lancetiformis* Put. Although the original paper of Putrya has not been available to the present writer, it probably differs from *F. lancetiformis* in having more whorls and a larger maximum diameter (the diameter for corresponding whorls however, is somewhat smaller).

Subfamily FUSULININAE Rhumbler, 1895

Genus PROFUSULINELLA Rauser-Chernoussova *et* Beljaev, 1936

Rauser-Chernoussova, D. M., Beljaev, G. M. and Reitlinger, E. A., Die oberpalaeozoischen Foraminiferen aus dem Petschora-Lande (der Westabhang des Nord-Urals). Akad. Nauk S.S.S.R., Poliarnaia Komissia, Trudy, Leningrad, 1936, Fasc. 28, pp. 175, 220.

Profusu linella sp.

Pl. XXIV Figs. 22–24

Locality: P 54.

Description:	Radius vector:	380–450
	Form ratio:	1.46 (5th wh.)
	Number of whorls:	5–5.5

Mature specimens short fusiform to subrhomboidal; lateral sides straight or convex.

Septa straight, possibly slightly curved at poles of last whorl; sagittal sections with short triangular septa in inner 4 whorls; rod-shaped in 5th whorl and about as thick as the spirotheca.

Chomata high and broad.

First whorl coiled at angle to subsequent whorls.

Wall consists of three layers i.e. tectum, upper-tectorium and lower layer, the last showing the same density as upper-tectorium; thickness of spirotheca in 4.5–5.5 whorl about 20–25 μ.

The radius vector from 1st to 5th volution is on average (N = 4) respectively: 61, 103, 175, 272 and 395 (in μ); form ratio of specimen 7 smaller than unity in inner 2 whorls, appr. 1.45–1.50 in 4–5th whorl.

Remarks: Unfortunately only a few badly orientated sections are present in our collection. This species is probably best compared with some early representatives of the group *Profusulinella rhomboides* (Lee *et* Chen) e.g. *Profusulinella fukujiensis* Igô and with *Profusulinella* ex. gr. *rhombiformis* Brazhn. *et* Pot. of Chernova (Chernova, 1961, Akademia Nauk S.S.S.R., Regional stratigraphy S.S.S.R., Vol. 5, p. 284, fig. 3). It is also similar to some species of the group *Profusulinella parva* (Lee *et* Chen) with respect to general shape and form ratio e.g. *Profusulinella parva* (Lee *et* Chen) and *Profusulinella convoluta* (Lee *et* Chen). It differs from this group of species in having a larger diameter for equal number of whorls and slightly more volutions. The *Profusulinella* from this locality is regarded as the oldest representative of this genus from Spain up to the present date.

Profusulinella ex gr. *pararhomboides* Rauser-Chernoussova *et* Beljaev, 1936 (1st assemblage)

Pl. XXIV Figs. 25–28

Locality: L 24.

Description:	Radius vector:	435–535
	Form ratio:	2.10–2.30
	Number of whorls:	5–5.5

From 1st to 5.5 whorl test changes from nautiliform (1st wh.) short fusiform (2nd wh.) subrhomboidal (3rd wh.) to elongate subrhomboidal (4–5.5 wh.); spirotheca smooth in all whorls; lateral sides straight or convex in inner 2.5–4 whorls; straight or slightly concave in subsequent whorls; in outer whorls poles pointed or bluntly pointed.

Septa straight (specimen 30) or slightly folded at poles of last whorl (specimen 31); thicker than spirotheca in sagittal sections.

Chomata extend to poles in inner 3.5–4 whorls, in outer whorls width 0.15–0.45 of lateral slopes; asymmetric or symmetric; generally steep, often perpendicular slopes at the tunnel side.

Tunnel path almost symmetric to slightly asymmetric.

Inner 1–2 whorls coiled at a large angle to subsequent whorls.

Wall consists of tectum and a lower less dense layer, the last showing the same density as secondary deposits (upper-tectorium and chomata).

Measurements: See table 16.
Remarks: Profusulinella extensa Rauser-Chernoussova seems to be most similar to our species of all those included in the previous group.

Profusulinella ex gr. *pararhomboides* Rauser-Chernoussova *et* Beljaev (2nd assemblage)

Pl. XXV Fig. 1

Locality: L 16.
Description: From 1st to 3.5 whorl test changes from short fusiform to oval (1st wh.) short fusiform (2nd wh.) to short fusiform to subrhomboidal (3–3.5 wh.); inner 2 whorls with straight or convex lateral sides, beyond 2nd whorl lateral sides straight or very slightly concave; poles in outer 2 whorls bluntly pointed or bluntly pointed to pointed.

At extreme polar regions of 3rd and 3.5 whorl a slight curving or undulation of septa is observed.

Chomata of medium height and extending to poles in inner 2.5 whorls; in 3rd whorl width 0.35–0.60 of lateral sides, asymmetric or subsymmetric; in 3.5 whorl width 0.20–0.90 of lateral sides, asymmetric of symmetric; generally steep slopes at the tunnel side.

Tunnel path slightly asymmetric to asymmetric.

First half whorl coiled at angle to subsequent whorls.

Wall indistinctly differentiated; at some places tectum and a lower less dense layer may be observed, which last layer is locally less dense than the secondary deposits.

Measurements:

	Wh.n.	0	1	2		3		4	
Specimen: 28		60	136	234		353	416		R.v.
			1.19	1.49		1.57	1.57		F.r.
			19	21		13	15		W.th.
				0.40	0.50	0.36	0.37		Ch.h.

Remarks: The specimen described above is very similar to the juvenile and neanic growth stage of *Profusulinella pararhomboides* Raus. and *P. rhombiformis* Brazhn. *et* Pot. var. *nibelensis* Raus. It is perhaps closest to the species referred by Rauser-Chernoussova to *Profusulinella pararhomboides* Raus. (Rauser-Chernoussova, *et al.*, 1951, pl. 17, fig. 3). Since only one specimen is present in our material, it is difficult to decide whether this is a young individual of *Profusulinella pararhomboides* or ancestral to this species.

Profusulinella ex gr. *pararhomboides* Rauser-Chernoussova *et* Beljaev (3rd assemblage)

Locality: A third assemblage probably belonging to the group of *Profusulinella pararhomboides* Raus. may be present at locality P. 70.

Description: Axis of coiling maintains original position throughout growth.

Wall of three layers; layer below tectum of same density as secondary deposits above tectum.

Radius of proloculum 48 μ; radius vector from 1st to 5.5 whorl respectively: 120, 195, 323, 476, 663 and 731 (in μ); thickness of wall in the same order respectively: 17, 21, 24, 26, 26 and 26 (in μ).

Remarks: Unfortunately we have only a central-oblique section of a single specimen of the present species. Although our section does not permit close comparison it is believed that it is most similar to the specimen referred to *Profusulinella pararhomboides* Raus. by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, Akademia Nauk S.S.S.R.; pl. 17, fig. 3).

Profusulinella cf. *parva* (Lee *et* Chen, 1930)

Pl. XXV Fig. 2

Locality: P 70.

Description:	Radius vector:	340–445
	Form ratio:	1.38
	Number of whorls:	5

Since the sections at our disposal are slightly oblique, it is hard to know how shape of test developed during growth; mature specimens probably have an ellipsoidal or short fusiform outline with straight or convex lateral sides and rounded or bluntly pointed poles.

Septa very slightly folded, starting at poles of 4th whorl.

Chomata extend to poles in inner 3.5 whorls; sometimes symmetric in 4–5th whorl; of medium height or high (0.30–0.50 of height of chambers in 4th whorl); frequently quadrangular in cross section; width in 5th whorl about one third of distance to poles; steep or gentle slopes at the tunnel side.

Tunnel angle small and tunnel path almost symmetric or slightly asymmetric.

Inner 1–1.5 whorls coiled at large angle to subsequent whorls.

Wall consists of three layers; layer below tectum sometimes locally less dense than secondary deposits above tectum.

Measurements:

Wh.n.	Ax.	Sag.	0	1		2		3		4		5	
Specimen:		28	23	49		99		187		297		442	
		12	19	50		86		140		225		340	R.v.
	41		13	42		87		150		250		360	
Av.:			18	47		91		159		257		381	
					100		88		59		49		
					72		63		61		51		G.r.
					107		72		67		44		
Av.:					93		74		62		48		
				0.75		0.98		1.30		1.41		1.38	F.r.
				—		—		—		21		19	
				7		9		15		21		22	W.th.
				6		12		16		19		17	
				6.5		10.5		15.5		20		19	

Remarks: It is very well possible that the species described above is identical with *Profusulinella parva* (Lee *et* Chen). Unfortunately the sections at our disposal do not provide conclusive evidence.

Profusulinella sp.

Pl. XXV Figs. 3–4

Locality: P 23.

Description: Radius vector: 365–460
Form ratio: 1.90–2.45
Number of whorls: 5–6

From 1st to 6th whorl test changes from nautiliform (1st wh.) oval or short fusiform (2nd wh.) fusiform (3rd–5th. wh.) to fusiform to elongate fusiform (6th wh.); poles bluntly pointed or, in outer whorls, bluntly pointed to pointed; lateral slopes straight or convex, a tendency to straight lateral slopes towards outer whorls.

Septa slightly folded at poles of 6th whorl; dark shadows in axial region are probably not caused by axial filling but by closely spaced septa.

Chomata low or of medium height, relative height varies from 0.25 to 0.47; width in outer whorls about 1/3 of lateral slopes; asymmetric; steep or gentle slopes at the tunnel side.

Tunnel path slightly asymmetric or asymmetric.

First whorl coiled at large angle to subsequent whorls.

Wall of three layers i.e. tectum, a lower less dense layer and upper-tectorium; last two layers equally dense.

Measurements:

Wh.n.	0	1		2		3		4		5		6	
Specimen: 1 (1)	19	52		86		146		226	250				
1 (2)	—	47		86		157		255		357	416		R.v.
26	—	56		99		161		263		365		459	
Av.:	—	52		90		155		248		361		—	
			65		61		55						
			91		74		62		40				G.r.
			77		63		63		39		26		
Av.:			78		66		60		39.5		—		
		0.63		1.50		1.92		2.04	2.09				
		—		1.67		2.03		2.00		1.86	—		F.r.
		—		1.74		2.00		1.97		2.05	2.44		
Av.:		—		1.64		1.98		2.00		1.96	—		
1 (1)		6		9		10		—	19				W.th.
26		6		11		17		17		—	—		

Remarks: In some respects the present species is similar to *Profusulinella arta* Leont. which it resembles in shape and size of the chomata and fairly narrowly coiled whorls. The specimens apparently differ from mature individuals of *P. arta* in having somewhat more stretched and more pointed poles.

Profusulinella ex gr. *parva* (Lee *et* Chen, 1930)

Pl. XXV Figs. 5–10

Locality: L 25.

Description: Radius vector: 595–715
Form ratio: 1.21–1.35
Number of whorls: 5–5.5

From 1st to 5.5 whorl test changes from nautiliform or spherical (1st wh.) spherical or oval (2nd wh.) short fusiform (3rd wh.) to short fusiform to oval (4–5.5 wh.); poles bluntly pointed in 3rd–4th whorl, rounded or rounded to bluntly pointed in subsequent whorls; lateral sides straight or convex in 3rd–4th whorl, convex in subsequent whorls; spirotheca smooth.

Septa straight or only slightly curved at extreme polar regions; sagittal sections with thick triangular, or rod-shaped septa in inner 5 whorls, rod-shaped in the last half whorl; as thick or thicker than the wall.

Chomata extend to poles in inner 3 whorls; width in 5–5.5 whorl varies from 0.20 to 0.65 of lateral sides; sometimes symmetric beyond the 3rd–4th whorl; slopes at tunnel side generally steep.

Tunnel path almost symmetric; maximum deviation of symmetry 11–14° (N = 3).

First whorl either coiled at angle to subsequent whorls (e.g. specimens 33 and 40) or axis maintains original position throughout growth (e.g. specimen 14).

Wall consists of three layers i.e. tectum, upper-tectorium and a lower layer which is of equal density as the upper-tectorium.

Measurements: See Table 17.

Remarks: The present species is very similar to some species of the group *P. parva* (Lee *et* Chen) e.g. *P. parva* (Lee *et* Chen), *P. parva* (Lee *et* Chen) var. *robusta* Raus. *et* Belj., *P. marblensis* Thomp., *P. fukujiensis* Igô and *P. beppensis* Tor. The two last mentioned species in particular seem to be closely allied to the present specimens. *P. fukujiensis* has a thinner spirotheca and a more rhomboidal outline, according to Igo's illustrations of this species. Moreover, the diameter for corresponding whorls is slightly smaller. The latter difference holds good also for *P. beppensis*, which species also has a thinner spirotheca and a much larger proloculum. More remotely similar are *P. prisca* (Deprat) of the similar named group and *P. subovata* Saf. of the group *P. ovata* Raus.

Profusulinella cavis Dalm., 1961 subsp. *arbejalensis* subsp. nov.

Pl. XXV Figs. 11–20

Synonymy: 1956, *Fusiella* (*Profusulinella*) sp. — van Ginkel in Kanis, J.; Leidse Geol. Med., Deel 21, p. 405, fig. 15, specimen F.

Type specimen: Specimen 27 (Pl. XXV, Fig. 11) is designated as the holotype.

Locality: P 63.

Description:	Radius vector:	390–535
	Form ratio:	1.22–1.56
	Number of whorls:	4.5–5

From 1st to 5th whorl test changes from nautiliform (1st wh.) spherical, oval or short fusiform (2nd wh.) short fusiform (3rd wh.) to short fusiform or oval (4–5th wh.); lateral slopes straight or convex, generally convex; poles bluntly pointed or rounded, in 4–5th whorl more frequently rounded whereas in 3rd whorl often bluntly pointed; periphery broadly arched; spirotheca smooth.

Septa straight in inner 3–4.5 whorls, slightly folded at polar regions of subsequent whorls; the regularity of folding is intermediate between *Profusulinella* and early *Aljutovella;* whenever folding is fairly regular, wavelength is large.

Chomata asymmetric and wide in inner 2–3.5 whorls, occasionally extending to poles; generally subsymmetric or symmetric in subsequent whorls (3rd–5th wh.); relative width in 3.5–5th whorl varies from 0.20 to 0.50 and is on average 0.33; steep or gentle slopes at the tunnel side.

Tunnel path almost symmetric; range and average of maximum deviation of symmetry respectively 7–18° and 11° (N = 7).

Inner 1–2.5 whorls coiled at angle to subsequent whorls.

Wall consists of three layers i.e. tectum inbetween less dense thicker layers; density of lower and upper layer is the same in inner whorls, in 4–5th whorl lower layer sometimes slightly less dense than upper layer

Measurements: See Table 18.

Remarks: The present subspecies is closely allied to *Profusulinella cavis* Dalm. The typical species differs in having a somewhat smaller maximum diameter as well as somewhat less developed chomata. Similar species are *P. latispiralis* Saf., *P. tchotchiai* Grozd. *et* Leb. and *Schubertella polymorpha* Saf.

Profusulinella cf. *rhombiformis* Brazhnikova *et* Potievskaja, 1948

Pl. XXV Figs. 21-26

Synonymy: 1956, *Fusiella (Profusulinella)* cf. *aljutovica* (Rauser-Chernoussova). – van Ginkel in Kanis, J., Leidse Geol. Med., Deel 21, p. 405, fig. 15, specimen A.

Locality: P 63.

Description:

	Radius vector:	345–580
	Form ratio:	1.41–1.72
	Number of whorls:	5–5.5

From 1st to 5.5 whorl test changes from nautiliform (1st wh.) spherical or oval (2n wh.) oval, short fusiform or subrhomboidal (3rd wh.) to short fusiform or subrhomboidal (4–5.5 wh.); in outer 3 whorls poles bluntly pointed, lateral sides straight or slightly convex (rarely slightly concave) and periphery arched or broadly arched; spirotheca smooth, at least in inner 4 whorls.

Septa straight from pole to pole in inner 3–4 whorls; slightly and irregularly folded at polar regions in subsequent whorls; specimen 25, a sagittal section of 4 whorls, shows triangular or rod-shaped septa which are thick as compared to the wall.

Chomata extend to poles in inner 2.5–4 whorls; in subsequent whorls relative width decreases from 0.40–0.45 (4th wh.) to about 0.20 (5–5.5 wh.); often symmetric beyond 4th whorl; notably high, and generally with steep slopes at the tunnel side.

Tunnel path symmetric or almost symmetric; average and range of maximum deviation of symmetry respectively 9° and 4–15° (N = 5).

Wall may consist of a tectum and a lower less dense layer; this differentiation locally observed beyond the 3rd whorl; if present, the lower layer is very weakly differentiated from a third layer: the lower-tectorium; an outer layer on the tectum might either be the upper-tectorium or perhaps only the continuation of the chomata.

Measurements: See Table 19.

Remarks: Unfortunately we have only rather poor sections of this species, nevertheless it seems evident that this assemblage belongs to the group of *P. rhomboides* (Lee *et* Chen). They differ from *P. rhomboides* (Lee *et* Chen) in having somewhat larger form ratios, larger diameters for corresponding whorls, somewhat less volutions and higher chomata. The present species is best compared with *P. rhombiformis* Brazhn. *et* Pot. The latter species seems to differ only in the somewhat higher chomata as well as in the slightly larger proloculum. Almost equally similar is *P. primitiva* Grozd. *et* Leb., The latter may be a junior synonym of *P. rhombiformis* Brazhn. *et* Pot.

Profusulinella ex gr. *rhomboides* (Lee *et* Chen, 1930)

Pl. XXV Figs. 27–30

Locality: P 1.

Description:

	Radius vector:	560–595 (6–6.5 wh.)
	Form ratio:	1.84–1.89 (6–6.5 wh.)
	Number of whorls:	5.5–6.5

From 1st to 6.5 whorl test changes from nautiliform (1st wh.) spherical or oval (2nd wh.) short fusiform or subrhomboidal (3rd wh.) short fusiform to subrhomboidal, subrhomboidal or elongate subrhomboidal (4th wh.) to subrhomboidal or elongate subrhomboidal (5–6.5 wh.); lateral slopes straight or convex up to 3.5

whorl, straight or slightly concave in subsequent whorls; poles bluntly pointed or pointed; periphery in outer whorls arched or broadly arched.

Septa slightly folded in a narrow zone along the axis starting at poles of 4–5th whorl.

Chomata probably extend to poles in inner 3–3.5 whorls, in subsequent whorls relative width decreases; asymmetric, but in last 2 whorls becoming symmetric; steep or gentle slopes at the tunnel side.

Tunnel path slightly asymmetric or almost symmetric; maximum deviation of symmetry 15–20° (N = 3).

Axial filling absent or indistinctly developed.

Inner 1–2 whorls coiled at a large angle to subsequent whorls.

Wall either not differentiated or shows tectum as well as a less dense lower layer; tectoria thin or absent.

Measurements: See Table 20.

Remarks: The present specimens are best compared with the species identified as *Profusulinella rhomboides* (Lee *et* Chen) by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, pl. XVI, figs. 5, 7) and *Profusulinella albasensis* sp. nov. They resemble *Profusulinella biconiformis* Kir. and *Profusulinella pseudorhomboides* Put. somewhat less. The present specimens have a greater form ratio and a larger diameter for corresponding whorls than *Profusulinella rhomboides* (Lee *et* Chen). Moreover, the lateral sides of *P. rhomboides* are clearly straight whereas our specimens show evident concavity albeit only slight. They differ from *P. albasensis* sp. nov. in having a larger form ratio somewhat fewer whorls, less concave lateral sides and slightly less intense and less regular septal folding at polar regions. *Profusulinella biconiformis* Kir., although somewhat similar in shape, has a much smaller diameter for corresponding whorls whereas *P. pseudorhomboides* Put. has a larger diameter for corresponding whorls and a much larger proloculum.

Profusulinella sp.

Pl. XXVI Fig. 1

Locality: P 1.

Description: Only a single specimen of the present species has been encountered.

From 3rd to 5th whorl test changes from spherical (3rd wh.) short fusiform (4th wh.) to short fusiform to subrhomboidal (5–5.5 wh.); in last 2 whorls lateral sides straight or concave; poles pointed in 4–5th whorl; periphery broadly arched.

Septa slightly folded at poles of 5th whorl.

Chomata probably wide (to poles?) and asymmetric (inner 3 whs.), width 0.30 to 0.40 of lateral slopes and symmetric (last 2 whs.).

Axial filling absent.

Tunnel almost symmetric.

Inner 3 whorls perpendicularly coiled to subsequent whorls.

Differentiation of wall not observed.

Measurements:

Wh.n.	0	1	2	3		4		5	
Specimen: 85	26	69	138	225		345		497	R.v.
		—	—	—		1.49		1.53	F.r.
				21	29	32	35	31	T.a.

Remarks: The present specimen is best compared with that illustrated by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, pl. XIII, fig. 6) which she referred to *Profusulinella parva* (Lee *et* Chen). This Russian specimen differs in having a somewhat smaller diameter and form ratio and clearly convex lateral sides. The specimen here described is also not unlike certain species of the group *P. librovitchi* (Dutk.) (e.g. *P. biconiformis* Kir. and *P. pseudolibrovitchi* var. *atelica* Raus.).

Profusulinella cf. *prisca* (Deprat, 1912)

Pl. XXVI Figs. 2–5

Locality: P 1.

Description:

Radius vector:	550–680
Form ratio:	1.25–1.48
Number of whorls:	6–6.5

From 1st to 6.5 whorl test changes from nautiliform (1st wh.) spherical or oval (2nd wh.) oval or short fusiform (3rd wh.) short fusiform (4th wh.) to short fusiform or subrhomboidal (5–6.5 wh.); lateral sides convex or straight with a tendency to straight lateral sides in outer whorls; poles rounded or bluntly pointed; periphery generally broadly arched.

Septa very weakly folded at poles of 6–6.5 whorl.

Chomata sometimes extend to poles in inner 3 whorls; relative width in 3.5–6th whorl varies from 0.30 to 0.40.

Tunnel path slightly asymmetric; average and range of maximum deviation of symmetry respectively 17° and 13–22° (N = 4).

First whorl coiled at large angle to subsequent whorls.

A weakly differentiated diaphanotheca is sometimes observed in outer whorls.

Measurements: See Table 21.

Remarks: The present species is most similar to *P. prisca* (Depr.) from which it differs in having a slightly larger form ratio. In this respect it is closer to *P. prisca* as described by Rauser-Chernoussova *et al.* (1951) and Putrya (1956). Occasionally subrhomboidal specimens are encountered (e.g. specimen 2) which point to a close relation with *P. integra* Chern. The latter species, however, generally has more volutions and on average a slightly larger form ratio.

Sagittal sections of *Profusulinella* from the Piedras Luengas Limestone Member (Loc. P 1).

Pl. XXVI Figs. 6–11

Since there are apparently about three species of *Profusulinella* with nearly the same radius vector in the Piedras Luengas Limestone it is rather difficult to refer a particular sagittal section to one of these species. For reasons of comparison with sagittal sections of this genus from other horizons it is considered useful to present their characters.

Description: Spirotheca generally smooth; septa short or high triangular in inner 4–5 whorls, from 4.5–6.5 whorl rod-shaped; mostly thick in comparison with the wall.

Measurements: See Table 22.

Profusulinella prisca (Deprat, 1912) subsp. *guebleri* subsp. nov.

Pl. XXVI Figs. 12–21

Synonymy: 1943, *Fusulinella bocki* Moeller var. *delepinei* Gübler. — Gübler in Delépine G., Acad. Sci. Mém., Paris, 1943, Ser. 2, Vol. 66, No. 3, p. 102, pl. 2, figs. 1–4 (non figs. 5–7 = *Fusulinella delepinei* van Ginkel).

Type specimen: Fig. 1 right hand specimen of Gübler's plate 2 is designated as the holotype of *Profusulinella prisca* (Deprat) subsp. *guebleri*.

Locality: A 1.

Description:	Radius vector:	590–835
	Form ratio:	1.29–1.55
	Number of whorls:	6–7

From 1st to 7th whorl test changes from nautiliform (1st wh.) spherical (2nd wh.) short fusiform (3rd wh.) to short fusiform or subrhomboidal (4–7th whorl); lateral sides straight or convex in inner 3 whorls, essentially straight in subsequent whorls; periphery broadly arched; poles bluntly pointed or rounded; spirotheca smooth.

Septa folded in polar areas, starting at poles of 3.5–5.5 whorl; folding rather intense but not as regular as in typical species of *Aljutovella* since arcuate folding on lateral sides is absent or indistinctly developed; with respect to septal folding the present species is better compared with *Profusulinella prisca* var. *timanica* Kir. and *Profusulinella paratimanica* Raus.; septa in sagittal sections short triangular (inner 4–4.5 whs.), high triangular or rod-shaped (subsequent whs.), sometimes club-shaped (7th wh.); in outer whorls nearly as thick as the spirotheca.

Chomata extend to poles in inner 3.5–4 whorls; beyond this stage of growth they cover 0.10–0.75 of lateral slopes and are either asymmetric or symmetric; when asymmetric height often rather abruptly decreases towards poles; generally steep slopes, often perpendicular, at the tunnel side; in outer whorls occasionally gentle slopes.

Tunnel path almost symmetric or slightly asymmetric; average and range of maximum deviation of symmetry respectively 14° and 8–20° (N = 4); tunnel angle from 2nd to 6th whorl respectively 11° (N = 1), 19–21° (N = 3), 18–20° (N = 4), 24–34° (N = 4) and 34° (N = 1).

Inner 1–2.5 whorls coiled at a large and sometimes perpendicular angle to subsequent whorls.

Inner 4 whorls show a *Profusulinella*-type of wall; in 5th whorl a diaphanotheca appears which is thick in comparison to tectoria especially in 6th and 7th whorl; this diaphanotheca is hardly less dense than lower-tectorium and contrast between both layers is not as striking as in typical representatives of *Fusulinella;* in outer 2 whorls of mature specimens upper-tectorium very thin or wholly absent.

Measurements: See Table 23.

Remarks: Gübler (1943) described from Ribadesella (Asturias) a new variety of *Fusulinella bocki*. It was named *Fusulinella bocki* Moeller var. *delepinei* new. var. In his description Gübler distinguished a slender type and a short type which he included both in his new variety. On his plate 2 Gübler illustrates the short type in figs. 1–4 and the slender type in figs. 5–7. According to modern criteria these two types obviously belong to two different genera. The description of *Profusulinella prisca* (Depr.) subsp. *guebleri* subsp. nov. is based on samples collected from the type-locality of *Fusulinella bocki* Moell. var. *delepinei* Gübl. The present specimens of *Profusulinella prisca* (Depr.) subsp. *guebleri* are synonymous with the short type of *Fusulinella bocki* Moell. var. *delepinei* Gübl. As for the slender type of *Fusulinella bocki* Moell. var. *delepinei* Gübl., this is indeed a real *Fusulinella.* It is considered to be sufficiently different from *Fusulinella bocki* Moell. to be brought to species level. The here described new subspecies is closely similar to *Profusulinella prisca* (Depr.) var. *timanica* Kir. It differs from Kireeva's variety in having a smaller maximum diameter (1.00–1.50 mm as against 1.00–2.00 mm in *P. prisca* var. *timanica*), in the maximum number of volutions (6–7 as against 6–7.5 in *P. prisca* var. *timanica*) and perhaps in a slight difference in shape and massiveness of the chomata. Other somewhat similar species are *Profusulinella paratimanica* Raus., *Aljutovella priscoidea* (Raus.) and *Aljutovella complicata* Saf.

Profusulinella prisca (Deprat, 1912) subsp. *rauserae* subsp. nov.

Pl. XXVII Figs. 1–9

Synonymy: 1951, *Profusulinella prisca* (Deprat) forma *asiatica* Rauser-Chernoussova, Safonova *et* Chernova. — Rauser-Chernoussova, D.M., *et al.*, Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Minist. Neftianoi Prom. S.S.S.R., 1951; pp. 165, 166; pl. 15, fig. 4.

Type specimen: Specimen 9 (Pl. XXVII, Fig. 3) is designated as the holotype.

Locality: A 5.

Description:	Radius vector:	435–580
	Form ratio:	1.12–1.33
	Number of whorls:	6–7

From 1st to 7th whorl test changes from nautiliform (1st wh.) nautiliform or spherical (2nd wh.) spherical or short fusiform (3rd wh.) short fusiform (4–5th wh.) to short fusiform or subrhomboidal (6–7th wh.); lateral sides straight or convex; poles bluntly pointed to rounded; periphery arched or broadly arched; spirotheca smooth.

Septal folding starts at poles of 4–5th whorl, in subsequent whorls extending a short distance up the lateral slopes; folding not very irregular and in this respect transitional to typical *Aljutovella.*

Chomata generally extend to poles in inner 4 whorls, in subsequent whorls relative width quickly decreases; sometimes symmetric in 6–7th whorl; steep and often perpendicular slopes at the tunnel side.

Tunnel path almost symmetric; average and range of maximum deviation of symmetry respectively 12° and 8–16°.

Inner 1–3 whorls coiled at an angle to subsequent whorls.

Diaphanotheca may be observed in outer 2 whorls; relatively thick with respect to tectoria but differentiation from both upper and lower-tectorium (if present) is weak.

Measurements: See Table 24.

Remarks: As far as can be deduced from the description of *P. prisca* (Deprat) forma *asiatica* by Rauser-Chernoussova, this Russian form is synonymous with the specimens described above and sufficiently different from *P. prisca* (Deprat) to be considered as a subspecies. Other somewhat similar species or subspecies are: *Profusulinella prisca* var. *sphaeroidea* Raus., *P. chernovi* Raus. and from Spain *P.* cf. *prisca* (Deprat) and *P. prisca* (Deprat) subsp. *guebleri* subsp. nov. both described in this paper.

Profusulinella albasensis sp. nov.

Pl. XXVII Figs. 10–12

Type specimen: Specimen 33 (Pl. XXVII, Fig. 18) is designated as the holotype.
Locality: P 3.
Description:

Radius vector:	565–780
Form ratio:	1.31–1.59
Number of whorls:	6–7.5

From 1st to 7th whorl test changes from nautiliform (1st wh.) spherical or short fusiform (2nd wh.) oval, short fusiform or subrhomboidal (3rd–4th wh.) to subrhomboidal (5–7th wh.); lateral sides straight or convex in inner 3 whorls, in subsequent whorls straight or concave; poles pointed or bluntly pointed; periphery broadly arched; spirotheca essentially smooth sometimes slightly inflated between septa in 6–8th whorl.

Septa folded in a narrow zone along axis starting at poles of 3.5–5th whorl; type of folding in some specimens is intermediate between the irregular folding of typical *Profusulinella* and the more regular folding of typical *Aljutovella* (e.g. specimen 38); sagittal sections show triangular or thick rod-shaped septa.

Chomata extend to poles in inner 3–4.5 whorls, asymmetric; in subsequent whorls occasionally subsymmetric or symmetric; from 5–7.5 whorl width 0.15–0.35 of lateral slopes; generally steep often perpendicular slopes at the tunnel side.

Tunnel path slightly asymmetric or almost symmetric; average and range of maximum deviation of symmetry respectively 16° and 10–24° (N = 8).

Inner 1–2 whorls coiled at large angle (up to 90°) to subsequent whorls.

Inner 5 whorls show a typical *Profusulinella*-type wall structure; in outer 2 whorls a weakly differentiated diaphanotheca is sometimes observed.

Measurements: See Table 25.

Remarks: The present new species is best compared with *Profusulinella rhomboides* (Lee *et* Chen) as described and illustrated by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951, p. 169, pl. XVI, figs. 6–7). The two specimens of Rauser-Chernoussova show somewhat weaker septal folding. *Profusulinella rhomboides* (Lee *et* Chen) has fewer volutions (5–7), a smaller diameter and a smaller form ratio. Moreover, *P. albasensis* sp. nov. has often concave lateral sides, whereas they are apparently straight in *Profusulinella rhomboides* (Lee *et* Chen). Other somewhat similar species are (in decreasing order of resemblance): *Fusulinella? paraiowensis* (Put.), *Profusulinella integra* Chern., *Aljutovella postaljutovica* Saf. as described by Putrya (Putrya, 1956, p. 81, pl. VII, figs. 8–9) and *Profusulinella pseudorhomboides* Put.

Profusulinella ex gr. *staffelloides* Manukalova

Pl. XXVIII Fig. 1a

Locality: P 95.

Description: Umbilical depressions weakly developed to almost absent; volutions completely involute; periphery arched but becoming flat in last half whorl.

Chomata asymmetric, extending to poles in inner 3–4 whorls; in last whorl relative width about 0.50–0.75; height of chomata about half chamber lumen which decreases to one-third in last half whorl.

Tunnel angle from 2nd to 5th whorl respectively 9°, 13°, 14° and 23°. Inner 1–1.5 whorl coiled almost perpendicular to subsequent whorls. Differentiation of wall not observed.

Measurements:

Wh.n.	0	1		2		3		4		5	
Specimen: 18	18	56		77		120		189		268	R.v.
			38		56		57		42		G.r.
		—		—		1.16		1.09		1.11	F.r.

Remarks: Our sample yielded only a single specimen of the present species. This specimen is intermediate between *Pseudostaffella* of the group *Ps. antiqua* (Dutk.) and *Profusulinella* of the group *P. staffelloides* Man. *Ps. antiqua* (Dutk.) and *Ps. kanumai* Igô of the former group and *P. staffelloides* Man., *P. staffellaeformis* Kir. and *P. bona* Grozd. *et* Leb. of the latter group have many characters in common with the present specimen. The most similar species seems to be *P. staffellaeformis.* This species differs from the Spanish specimen in having a more convex periphery, a slightly greater radius vector for each whorl and a slightly greater proloculum. Unfortunately the original description of *P. staffelloides* was not available to the present writer.

Profusulinella? sp.

Pl. XXVIII Fig. 1

Locality: P 70.

Description: From 1st to 4.5 whorl test changes from spherical (1st wh.) subrhomboidal (2nd wh.) to elongate rhomboidal (3–4.5 wh.); lateral sides straight; poles pointed in 2nd–4th whorl, pointed or bluntly pointed in 4.5 whorl; periphery narrowly arched.

Septal fluting starts at poles of 2.5–3rd whorl and is rather intense at poles of outer whorls in mature specimens; the regularity of folding is reminiscent of that in species of *Aljutovella.*

State of chomata in inner whorls doubtful; from 3–4.5 whorl symmetric (subquadratic) and high; relative height 0.40 to 0.50 in 4.5 whorl.

Tunnel path probably symmetric or almost symmetric; tunnel angle from 1–4.5 whorl respectively 23°, 18°, 23°, 27° and 31°.

Axis maintains original position throughout growth.

Wall structure in outer whorls apparently somewhat more evolved than in typical *Profusulinella* since a diaphanotheca is fairly well differentiated.

Measurements:

Wh.n.	0	1	2	3	4		5	
Specimen: 6	—	73	161	301	475	556		R.v.
		1.41	1.63	1.89	1.79	1.86		F.r.

Remarks: In this sample only a single specimen of this species has been encountered which apparently is intermediate between *Aljutovella* and *Profusulinella.* A study of the population to which this specimen belongs may decide whether it has to be referred to *Profusulinella* or rather to *Aljutovella.* The fairly well developed diaphanotheca points also to *Fusulinella.* A comparison with *Aljutovella* shows a probable relation to *A.* ex gr. *tikhonovitchi* Raus. notably to *A. fallax* Raus. A comparison with *Profusulinella* renders *P. rhombiformis* Brazhn. *et* Pot. and the variety *nibelensis* Raus. of the group *P. pararhomboides* Raus. as most similar to the present specimen.

Profusulinella cf. *librovitchi* (Dutkevitch, 1934 a)

Pl. XXVIII Figs. 2–3

Locality: P 72.

Description: Radius vector: 510–615
Form ratio: 2.05–2.20 (6–6.5 wh.)
Number of whorls: 6.5–7

From 1st to 7th whorl test changes from nautiliform (1st wh.) spherical or oval (2nd wh.) to elongate subrhomboidal (3rd–7th wh.); median region of test inflated (rounded periphery and concave lateral sides); lateral sides occasionally concave already in 2.5–3rd whorl; poles pointed or pointed to bluntly pointed, at maturity sometimes bluntly pointed to rounded.

Beyond 4.5–5.5 whorl septa slightly folded in extreme polar regions.

Chomata do not extend to poles not even apparently in inner whorls; narrow; asymmetric or symmetric; steep or moderately steep slopes at the tunnel side; relative height varies from 0.36 to 0.55 (3.5–5th wh.), from 0.34 to 0.40 (5.5–6.5 wh.).

Axial filling absent.

Tunnel path symmetric or almost symmetric.

First whorl coiled nearly perpendicular to subsequent whorls.

Wall shows a tectum and a less dense thicker lower layer.

Measurements:

Wh.n.	0		1		2		3		4		5		6		7	
Specimen: 4	19		54		85		136		204		306		438 510			
18	—		—		73		123		204		306		434			R.v.
24	14		39		77		125		196		306		459		612	
Av.:	16		46		78		128		201		306		444		—	
				57		60		50		50		43				
				—		68		66		50		42				G.r.
				100		61		57		57		50		33		
Av.:				78		64		58		53		46		—		
4			0.96		1.40		2.19		2.37		2.22		2.08 2.03			F.r.
18			—		1.29		1.68		2.17		2.00		2.20			
Av.:			—		1.34		1.93		2.27		2.11		2.14			
			9		11		13		17		28		30 26			
			—		—		13		17		22		28			W.th.
			6		9		—		17		24		30		30	
Av.:			7		10		13		17		25		29		—	

Remarks: Except for the somewhat larger form ratio, the specimens described above are similar to *Profusulinella librovitchi* (Dutk.).

Profusulinella ex gr. *librovitchi* (Dutkevitch)
(1st assemblage)
Pl. XXVIII Figs. 4–5

Locality: A 5.

Description: Radius vector: 438–510
Form ratio: 1.67–1.81
Number of whorls: 6.5

From 1st to 6.5 whorl test changes from nautiliform (1st wh.) spherical (2nd wh.) short fusiform (3rd wh.) short fusiform or subrhomboidal (4th wh.) to subrhomboidal to elongate subrhomboidal (5–6.5 wh.); lateral sides straight or convex in inner 3.5–4.5 whorls, concave in subsequent whorls; poles pointed or pointed to bluntly pointed; periphery arched.

Septa straight from pole to pole in inner 5.5–6 whorls, very slightly folded at extreme polar regions of 6–6.5 whorl.

Chomata extend to poles in all whorls; steep, often perpendicular slopes at the tunnel side; asymmetric and high; relative height varies from 0.35 to 0.60 (3rd–6.5 wh.).

Tunnel path symmetric; tunnel angle small, from 3rd to 6th whorl respectively 10°, 11°, 10–12° and 13°.

Axial filling absent.

Inner 1–1.5 whorls coiled at an angle to subsequent whorls.

Wall of three layers in inner 4 whorls; of four layers, by presence of a diaphanotheca, in subsequent whorls.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 21	—	43	80	133	211	306	484 510		R.v.
40	14	37	60	112	179	259	374 438		
			85	68	58	45	58		G.r.
			65	86	60	45	44		
		—	1.03	1.42	1.55	1.67	1.47 1.67		F.r.
		—	—	1.12	1.43	1.97	1.75 1.81		

Remarks: The present specimens occur together with *Fusulinella* ex gr. *pulchra* Raus. and it is possible that they are merely the microspheric generation of the latter. This assumption could also explain the presence of a diaphanotheca in the outer whorls, which is perhaps somewhat too well defined for a species belonging to the genus *Profusulinella*. On the other hand, it is rather uncommon for the microspheric generation not to have more whorls than the macrospheric generation. Another possibility is that some specimens (e.g. specimen 12) referred to *F.* ex gr. *pulchra* belong to the macrospheric generation of *P.* ex gr. *librovitchi*. Our specimens are most similar to *P. prolibrovitchi* Raus. and *P. biconiformis* Kir. of the group *P. librovitchi* (Dutk.) but they also have a number of characters in common with *P. pseudorhomboides* Put.

Profusulinella ex gr. *librovitchi* (Dutkevitch) (2nd assemblage)

Pl. XXVIII Figs. 6–8

Locality: A 8.

Description: Radius vector: 320–400
Form ratio: 2.07 (6th wh.)
Number of whorls: 5–6

From 1st to 6th whorl test changes from nautiliform (1st wh.) spherical (2nd wh.) to elongate subrhomboidal (3rd–6th wh.); starting with 3rd whorl lateral sides straight or slightly concave; beyond 3rd whorl poles pointed or bluntly pointed; septal grooves slightly marked throughout growth.

Septa slightly folded in extreme polar regions of outer 2 whorls.

Chomata extend to poles in inner 3.5 whorls; at the end of 4th whorl width 0.50 of lateral slopes which is reduced to 0.10–0.15 in 5–6th whorl; sometimes symmetric in last 2 whorls; relative height of chomata generally varies from 0.30 to 0.50.

Axial filling absent.

Tunnel path slightly asymmetric to asymmetric.

First whorl coiled perpendicular to subsequent whorls.

Differentiation of wall not observed.

Measurements:

Wh.n.			0	1		2		3		4		5		6	
	Ax.	Sag.													
Specimen:	14		23	48		70		116		183		285		400	
		23	15	45		77		120		202	246				R.v.
		17	—	52		90		142		212		323			
Av.:			19	48		79		126		199		304			
					44		66		58		56		40		
					71		56		68						G.r.
					75		57		49		52				
Av.:					63		60		58		54				
				1.02		1.42		2.13		2.09		2.15		2.07	F.r.
				8		9		11			18			26	
				5		9		11			16	17			W.th.
				8		9		13			18			28	
Av.:				7		9		12			17			27	

Remarks: The specimens described above resemble *Profusulinella syzranica* Raus., especially in the rapid elongation of the inner whorls. In this respect the present species also resembles *Fusiella* (e.g. *Fusiella* ex gr. *typica* from Loc. P 7). *P. syzranica* Raus. differs chiefly in its greater form ratio.

Profusulinella ex gr. *librovitchi* (Dutkevitch)
(3rd assemblage)
Pl. XXVIII Figs. 9–11

Locality: P 38.

Description: Radius vector: 490–615
Form ratio: 2.20–2.30 (6–6.5 wh.)
Number of whorls: 6–7.5

From 1st to 6.5 whorl test changes from nautiliform (1st wh.) spherical or subrhomboidal (2nd wh.) subrhomboidal or elongate subrhomboidal (3rd wh.) to elongate subrhomboidal (4–6.5 wh.); lateral sides straight or concave, concave lateral sides as early as in 2–2.5 whorl; poles pointed or pointed to bluntly pointed.

Septa slightly curved or folded in extreme polar regions of 5–6.5 whorl.

In inner 3.5 whorls chomata broad and perhaps extending to poles, asymmetric; beyond 4–6.5 whorl chomata very narrow, subsymmetric to symmetric, sometimes quadrangular or rectangular; relative height low to medium, varying generally from 0.25 to 0.50; absent in 6.5 whorl; normally steep, sometimes gentle (inner whorls) slopes at the side of the tunnel.

Axial filling either absent or very weakly developed in extreme polar regions.

Tunnel path slightly asymmetric.

First whorl coiled at large angle to subsequent whorls.

Wall indistinctly differentiated; showing tectum, a somewhat less dense lower layer and an equally dense upper-tectorium.

Measurements:

	Wh.n.	0	1		2		3		4		5		6		7		8	
	Ax. Sag.																	
Specimen:	110	—	49		86		133		221		353		493					
	146	17	43		67		112		183		255		374	450				
	10	21	60		99		159		238		357		501	544				R.v.
	74	14	—		80		133		219		336							
	135	13	39		72		116		172		269		391		527	612		
Av.:		16	48		81		131		207		314		440					
				74		55		66		60		40						
				55		68		63		40		47						
				64		61		50		50		40						G.r.
				63		67		73		63								
				86		61		48		56		45		35				
Av.:				68		62		60		54		43						
			—		1.60		2.06		2.23		2.48		2.28					F.r.
			—		1.26		1.73		2.14		2.57		2.39	2.19				
			—		—		13		18		24		26					
			—		11		13		17		21		25	20				
			4		6		11		17		21		25	24				W.th.
			4		9		12		16	19								
			6		9		11		15		18		20		26	24		

Remarks: Although the specimens described above are considered to belong to the group of *P. librovitchi* (Dutk.), their position within this group seems to be rather eccentric in that they should be allied to the group of *Fusiella typica* Lee *et* Chen, the genotype of *Fusiella.* Our specimens are most similar to *Profusulinella librovitchi* (Dutk.) var. *perseverata* Saf. Safonova described this variety as having 7.5–9 whorls with a L/D ratio of 2.5–2.6 in the 4–5th whorl, which decreases to 2.0 in the outer whorls. A similar decrease of the L/D ratio has also been observed in our specimens and by extrapolation of this trend we might expect that our sagittal section with 7.5 whorls is from a specimen with about the same form ratio as the variety described by Safonova.

Profusulinella ex gr. *librovitchi* (Dutkevitch)
(4th assemblage)

Pl. XXVIII Fig. 12

Locality: P 10.

Description: From 1st to 5.5 whorl test changes from nautiliform (1st wh.) spherical to short fusiform (2nd wh.) to rhomboidal (3–5.5 wh.); lateral sides essentially straight but beyond inner 2 whorls sometimes very slightly concave; poles pointed or pointed to bluntly pointed.

Septa straight; very slightly curved at poles of the 5.5 whorl.

Chomata asymmetric in inner 5 whorls, symmetric in 5.5 whorl; narrow, even in first whorls probably not extending to poles; of medium height, up to half the height of chambers; steep or gentle slopes at the tunnel side.

Axial filling absent.

Tunnel path slightly asymmetric.

First whorl coiled at large angle to subsequent whorls.

Wall indistinctly differentiated; tectum observed besides a lower layer of equal density or slightly less dense than the secondary deposits.

Measurements:

	Wh.n.	0		1		2		3		4		5		6	
Specimen: 1		13		41		69		112		163		224	280		R.v.
					68		62		46		37				G.r.
				—		1.12		1.38		1.69		1.77	1.63		F.r.

Genus ALJUTOVELLA Rauser-Chernoussova, 1951

Rauser-Chernoussova, D. M. *et al.*, Middle Carboniferous fusulinids of the Russian Platform and adjacent regions. Moscow, Akad. Nauk. S.S.S.R., Inst. Geol. Nauk, Minist. Neftianoi Prom. S.S.S.R., 1951, p. 182.

Aljutovella wagneri sp. nov.

Pl. XXIX Figs. 1–22

Type specimen: Specimen 29 (Pl. XXIX, Fig. 1) is designated as the holotype.
Locality: L 353.

Description:		
	Radius vector:	370–710
	Form ratio:	1.71–2.05
	Number of whorls:	4–5

From 1st to 5th whorl test changes from nautiliform, spherical or oval (1st wh.) oval or short fusiform (2nd wh.) short fusiform or fusiform (3rd wh.) short fusiform, fusiform or short subcylindrical (4–5th wh.); spirotheca smooth, sometimes very slightly inflated between septa in 4–5th whorl.

Septa straight from pole to pole in inner whorls; in subsequent whorls septa become folded first at poles and progressively over lateral slopes until at maturity septal folding extends from pole to pole; this extension of folded septa with growth (expressed in number of whorls present) is given in the table below.

Wh. n.:	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
s.	100	100	60	30	—	—	—	—	—	—
p.	—	—	40	55	30	15	—	—	—	—
l.s.	—	—	—	15	60	55	55	20	20	—
ch.	—	—	—	—	10	30	45	80	70	—
pp.	—	—	—	—	—	—	—	—	10	100

(The abbreviations s., p., l.s., ch. and pp. stand for respectively straight from pole to pole, folded at poles, folding extending up lateral slopes, folding extending to chomata, septa folded from pole to pole; the numbers represent percentages).

In sagittal sections, septa high-triangular or rod-shaped in inner 3–3.5 whorls; in outer 2 whorls rod-shaped; distal ends generally pointed.

Chomata may be broad and asymmetric in inner 2 whorls; beyond 2nd whorl chomata symmetric or subsymmetric; quadrangular, rectangular, or dome-shaped; steep or gentle slopes at the tunnel side.

Tunnel path symmetric or slightly asymmetric.

Axis generally maintains original position throughout growth; occasionally first half whorl coiled at an angle to subsequent whorls.

Wall of three layers as in *Profusulinella;* quite often, however, a diaphanotheca is weakly differentiated contrasting with the lower-tectorium; this lower-tectorium thin in comparison with the diaphanotheca and upper-tectorium.

Measurements: See Table 26.
Remarks: Aljutovella wagneri sp. nov. belongs to the group *Aljutovella aljutovica* (Raus.). The present species is most similar to *A. eoaljutovica* Saf., which differs in the more microspheric state (i.e. smaller proloculum, more volutions and smaller diameter for corresponding whorls.). Moreover, septal folding seems to be somewhat less developed in *A. eoaljutovica* Saf. *Aljutovella wagneri* sp. nov. is also present 1.5 km W of Carmenes, Río Torio, León (Loc. L 25).

Genus HEMIFUSULINA von Moeller, 1877

Moeller, V. von, Ueber Fusulinen und aehnliche Foraminiferen—Formen des russischen Kohlenkalkes (vorläufige Notiz.). Neues Jahrb. Min., Geol., Pal., Stuttgart, Deutschland, 1877, pp. 144, 146.

Hemifusulina ex gr. *moelleri* Rauser-Chernoussova, 1951
(1st assemblage)
Pl. XXX Figs. 1–7

Locality: L 426.

Description:

Radius vector:	315–480 (5–6th wh.)
Form ratio:	2.85–3.25
Number of whorls:	5–6.5

From 1st to 6th whorl test changes from spherical to fusiform (1st wh.) fusiform (2nd wh.) fusiform, elongate fusiform or fusiform to short subcylindrical (3rd wh.) elongate fusiform or cylindrical (4th wh.) to subcylindrical or cylindrical (5–6th wh.); poles bluntly pointed or rounded; spirotheca fairly smooth in inner 3–4 whorls, septal furrows well developed in subsequent whorls.

Septa straight or hardly folded in inner 1.5–3 whorls, progressively extending up lateral slopes, yet without reaching the tunnel, in subsequent whorls; in some specimens folding does not even extend as far as the chomata; it is noteworthy that in 6–6.5 whorl this folding retreats polewards again; septal folding regular, high near poles and progressively lower towards the median plane; in sagittal sections, septa sometimes rod-shaped but usually short triangular; these short triangular septa may still be present in 6th whorl; septa as thick or somewhat thicker than spirotheca.

Chomata do not extend to poles even in inner whorls; they reach maximum relative height apparently in 3rd–4th whorl, in subsequent whorls they tend to be reduced again and are often absent in 5–6.5 whorl; generally steep to perpendicular slopes at the tunnel side; more often asymmetric in inner whorls and generally symmetric or subsymmetric in outer whorls.

Tunnel path nearly symmetric or slightly asymmetric; maximum deviation of symmetry on average 17°; range 9–25° (N = 6); tunnel high; height varies from 0.25 to 0.50 of chamber lumen (2nd–6th wh.); this high tunnel added to shape of septa and the delicate wall gives the typical appearance of sagittal sections of the genus *Hemifusulina.*

Axis maintains original position throughout growth.

Wall very thin, which is typical for *Hemifusulina*; differentiation of wall is poor and a diaphanotheca can hardly be distinguished; mural pores, a rather typical character of *Hemifusulina,* were not observed in this species.

Measurements: See Table 27.

Remarks: The described fusulinid definitely belongs to the group of *Hemifusulina moelleri* Raus. of which the closest species are *H. moelleri* Raus., *H. kashirica* Raus., *H. plana* Man. and, to a certain extent, also *H. pseudobocki* (Put. *et* Leont.). Measurements of these species are tabulated and compared to those of the present species.

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	F.r.	W.th.
1. *H.* ex gr. *moelleri*	5–6.5	58–126	450–660	2.9–3.6	14–22
2. *H. moelleri* (= *F. bocki* Moeller)	5	84	480	3.1–3.4	–19
3. *H. moelleri* (emend. Raus.)	5–7.5	60–130	450–780	2.8–3.6	15–20
4. *H. kashirica*	5.5–7	45–75	370–470	2.8–3.2	13–20
5. *H. plana*	6–6.5	20–80	300–410	2.6–3.5	15–30
6. *H. pseudobocki*	5–6	110–200	730	3.5–3.7	20–30

Number 1 (*H.* ex gr. *moelleri*) refers to our material from Spain. The other species are known from the U.S.S.R. Number 2 refers to data given by Moeller (1878) for *Fusulina bocki* Moeller. Rauser-Chernoussova (1951) considered this species to belong to the genus *Hemifusulina* and since the binomen *Hemifusulina bocki* was not available she chose thebinomen *Hemifusulina moelleri.* Number 3 [*H. moelleri* (emend. Raus.)] is considered by Rauser-Chernoussova to be conspecific with Moeller's species. Rauser-Chernoussova's description of *H. moelleri* is evidently based on assemblages from different localities in an extensive area and not on the assemblage from the type-locality of Moeller's species. Since Moeller's description is very short and partly based on one axial section only, we still remain in doubt as to the exact nature and variability of *Hemifusulina moelleri* Raus. For this reason it is considered premature to identify our species with *H. moelleri* Raus., although our measurements correspond sufficiently well with those given by Rauser-Chernoussova. Moreover, identification with *H. kashirica* and *H. plana* cannot be excluded with certainty.

Hemifusulina ex gr. *moelleri*
(2nd assemblage)
Pl. XXX Figs. 8–16

Locality: L 11.

Description:	Radius vector:	555–820 (6.5–7th wh.)
	Form ratio:	3.00–3.30
	Number of whorls:	6.5–7.5

From 1st to 7th whorl test changes from spherical or oval (1st wh.) short fusiform (2nd wh.) fusiform (3rd wh.) fusiform or fusiform to short subcylindrical (4th wh.) elongate fusiform or subcylindrical (5th wh.) to subcylindrical (6–7.5 wh.); poles pointed or bluntly pointed beyond 2nd whorl, bluntly pointed or bluntly pointed to rounded in outer whorls (6–7.5 wh.); spirotheca smooth in inner 4–6.5 whorls, generally shallow septal grooves in subsequent whorls.

Initial septal folding at poles of 1.5–2nd whorl; in subsequent whorls progressively extending up lateral slopes and covering about half of lateral slopes in 2.5–3rd whorl; tunnel is reached in 3.5–5.5 whorl; sometimes in outermost whorls retreating somewhat in a poleward direction; septal folding regular; absolute and relative height of septal arches decreases towards the median plane; in sagittal sections septa rod-shaped or triangular; these short triangular septa occasionally still present in 7th whorl; as thick, or somewhat thicker than the spirotheca.

Chomata do not extend to poles even in inner whorls, although poles might possibly be reached in inner 2 whorls of some specimens in our collection; relative width rarely exceeds 0.40 and usually varies between 0.10 and 0.20; asymmetric in inner 2–3 whorls, in subsequent whorls generally subsymmetric or symmetric; maximum relative height is reached in 2.5–4.5 whorl, in subsequent whorls they tend to be reduced again and are often absent in 5.5–7th whorl; quadrangular, rectangular or dome-shaped.

Tunnel path almost symmetric or asymmetric; maximum deviation of symmetry varies from 9° to 29° and is on average 18° (N = 6); tunnel high, up to 0.60 of chamber lumen.

Axis maintains original position throughout growth.

Wall weakly differentiated; tectum, diaphanotheca and lower-tectorium present, upper-tectorium apparently absent; lower-tectorium thin as compared to diaphanotheca, however, in outer whorls often of equal thickness; diaphanotheca appears in 3rd to 4th whorl; mural pores occasionally observed in outer whorls.

Measurements: See Table 28.

Remarks: The species described above is very similar to the species from the Panda Limestone Member [*Hemifusulina* ex gr. *moelleri* Raus. (1st assemblage)]. The 1st assemblage differs from the 2nd assemblage chiefly by a somewhat lower number of whorls, more elongate inner whorls and septal folds which appear in a later growth-stage and do not extend as far to the median plane as in the 2nd assemblage. The 1st and 2nd assemblages were found in different sections whose exact stratigraphic correlation is not known. Hence we have no external evidence as to which of the assemblages is older. The differences just mentioned might be a valuable clue to the solution of this problem, but the present wr:ter is insufficiently acquainted with the evolutionary tendencies within the genus *Hemifusulina.*

Genus BEEDEINA Galloway, 1933

Galloway, J. J., A manual of Foraminifera. Principia Press, Bloomington, Indiana, U.S.A., 1933, p. 401.

Ishii, K., On the Phylogeny, Morphology and Distribution of *Fusulina, Beedeina* and allied fusulinid genera. Journal of the Institute of Polytechnics, Osaka City University, Series G, Vol. 4, 1958, pp. 43, 44, 49, 50.

Beedeina bona (Chern. *et* Raus., 1951 *) subsp. *lenaensis* subsp. nov.

Pl. XXXI Figs. 1–9

Type specimen: Specimen 59 (Pl. XXXI, Fig. 1) is designated as the holotype.

Locality: A 3.

Description:	Radius vector:	625–850 (4.5–5th wh.)
	Form ratio:	1.56–2.11
	Number of whorls:	4.5–5.5

From 1st to 5th whorl test changes from spherical, ellipsoidal or subrhomboidal (1st wh.) short fusiform or subrhomboidal (2nd–3rd wh.) to short fusiform, fusiform, subrhomboidal or elongate subrhomboidal (4–5th wh.); lateral sides straight (sometimes wavy) or slightly convex; periphery narrowly or broadly arched; poles generally bluntly pointed or pointed.

Septal folding starts at poles of 1.5–2.5 whorl, reaches tunnel at the end of the 3rd whorl and generally extends from pole to pole at the end of the 4th whorl; folding mostly fairly irregular for this genus; septal loops as high as half the chamber

* In Rauser-Chernoussova *et al.*, 1951

height, sometimes even higher; relative wavelength in 3–4.5 whorl varies between 17 and 29.

Chomata extend to poles in inner 1–3 whorls, in subsequent whorls they become progressively more narrow; relative width as measured in 3 specimens 0.14–0.28 (4–5th wh.); beyond 2nd–4th whorl chomata generally symmetric or subsymmetric (quadrangular, or dome-shaped); generally steep, sometimes perpendicular, slopes at the tunnel side.

Tunnel angle fairly small, tunnel path slightly asymmetric; average and range of maximum deviation of symmetry respectively 17° and 7–31°.

Axis maintains original position throughout growth.

An important character of the present subspecies is the weakly differentiated diaphanotheca which in some specimens was not observed at all; tectoria well developed.

Measurements: See Table 29.

Remarks: The new subspecies differs from *Beedeina bona* (Chern. *et* Raus.) in frequently having more developed chomata and less intensely folded septa. Moreover, in *B. bona* the diaphanotheca seems to be somewhat more distinct. *B. bona* is reported to have 4.5–5 whorls as against 4.5–5.5 whorls in the present subspecies. Diameter of proloculum is slightly greater and number of volutions slightly smaller in *B. bona*. The subspecies here described is clearly a primitive subspecies of the genus *Beedeina*. It is not unlike such primitive species as for example *B.? prima* (Thomp.) or *B. pseudokayi* (Put.).

Beedeina corisaensis sp. nov.

Pl. XXXI Figs. 10–18

Type specimen: Specimen 14 (Pl. XXXI, Fig. 10) is designated as the holotype.

Locality: P 98.

Description:	Radius vector:	1120–1260
	Form ratio:	1.95–2.22
	Number of whorls:	6.5–7.5

From 1st to 7th whorl test changes from subrhomboidal (1st wh.) subrhomboidal or subtriangular (2nd–3rd wh.) subrhomboidal or short fusiform (4th wh.) to short fusiform, subrhomboidal or elongate subrhomboidal (5–7th wh.); lateral sides usually straight, sometimes slightly convex or, in outer whorls, slightly concave; poles pointed or, in outer whorls, bluntly pointed; periphery usually narrowly arched in inner whorls and broadly arched in outer whorls.

Septal folding starts at poles of 1st–2nd whorl and progressively spreads over the lateral slopes; beyond 3rd–5th whorl folding extends from pole to pole; height of septal loops at least half chamber lumen; relative wavelength varies from 8.5 to 19 (4–6.5 wh.); folding usually very regular; septa as thick, or thicker than wall; in sagittal sections triangular in inner 4–5 whorls, triangular or short rod-shaped in subsequent whorls.

Chomata extend to poles in inner 1–2 whorls; always present in inner 6 whorls, sometimes absent in subsequent whorls; asymmetric in inner 1.5–3.5 whorls, subsymmetric or symmetric in subsequent whorls; shape in outer whorls quadrangular, dome-shaped or irregular and constricted at their base; steep, sometimes perpendicular, slopes at the tunnel side.

Tunnel angle small; its path slightly asymmetric; average and range of maximum deviation of symmetry 15° and 8–12° respectively.

Axis maintains original position throughout growth.

Wall in outer whorls consists of three layers i.e. tectum, diaphanotheca and lower-tectorium; diaphanotheca sometimes already observed in 2nd whorl; its thickness in 4–5th whorl varies from 15 to 26 μ; the lower-tectorium varies considerably in thickness but is essentially the same thickness as the diaphanotheca; in inner 3–4 whorls upper-tectorium possibly present; very fine pores may occur beyond 2nd–3rd whorl; they penetrate all layers of the wall but are especially well visible in the lower-tectorium.

Measurements: See Table 30.

Remarks: Beedeina corisaensis sp. nov. belongs to the group of *Beedeina elegans* and resembles in decreasing order of similarity *Beedeina ichinotaniensis* (Igô), *B. rockymontana* (Roth *et* Skin.), *B. elegans* (Raus. *et* Belj.), *B. illinoisensis* (Dunb. *et* Henb.), *B. meeki* (Dunb. *et* Con.), *B. equilaqueata* (Alex.) and *B. haworthi* (Beede). The septal folding and state of chomata in the present species corresponds more to that of Eurasian species (*B. elegans*, *B. ichinotaniensis*) than to the American species with the possible exception of *B. rockymontana*. The external shape of the present species corresponds quite well with all the above mentioned species except of *B. haworthi* which apparently never shows an inflated median region. *B. ichinotaniensis* differs from the present species in having slightly less whorls and possibly a somewhat smaller L/D ratio. *B. elegans* has slightly less whorls, fewer septa, and a somewhat larger L/D ratio. *B. rockymontana* has a much smaller proloculum, fewer septa and a slightly larger L/D ratio.

Beedeina sp.

Pl. XXXI Figs. 19–20

Locality: A 5.

Description: Septa intensely folded especially near poles; loops high, up to 3/4 of chamber lumen; relative wavelength varies from 23 to 31 in outer whorls.

Chomata extend to poles in inner 2.5 whorls; in subsequent whorls they become progressively narrower with respect to length, but persist even to the final whorl.

Diaphanotheca hardly differentiated.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 8		36	95	181	280	400	552	748 833		R.v.
				92	55	42	38	35		G.r.

Form ratio about 1.7 in outer whorls (specimen 31 = C. obl. section).

Remarks: The present specimens resemble most *Beedeina subdistenta* (Put.) from the Donetz basin (U.S.S.R.) and *Beedeina pumila* (Thomp.) from Iowa (U.S.).

Beedeina cf. *schellwieni* (Staff, 1912)

Pl. XXXI Figs. 21–22

Synonymy: 1912, *Girtyina* cf. *ventricosa* (Meek *et* Hayden). — Staff, H. Palaeontographica, Vol. 59, pl. 18, figs. 8 and 9.

Locality: A 1.

Description: Inner 4 whorls subrhomboidal to short fusiform; outer 2 whorls short fusiform; periphery broadly arched throughout growth; poles bluntly pointed or pointed; lateral sides essentially straight, sometimes weakly concave or convex; spirotheca essentially smooth up to 6th whorl; in 6th whorl septal furrows slightly marked.

Septa straight from pole to pole in 1st whorl; septal folding gradually spreads over lateral slopes and extends to tunnel at end of 3rd or 4th whorl; relative wavelength 23 in 6th whorl; number of septa from 2nd to 5th whorl respectively 19, 23, 26 and 31.

Chomata extend to poles in inner 1.5 whorls; in 2nd whorl still asymmetric and broad; in subsequent whorls narrow and symmetric or subsymmetric; quadrangular in 3rd whorl, dome-shaped in subsequent whorls; relative height of chomata varies from 0.30 to 0.55.

Tunnel path slightly asymmetric or almost symmetric; maximum deviation of symmetry 12°; tunnel angle small, from 1st to 6th whorl respectively 19°, 17°, 21°, 23°, 29° and 31°.

Axis maintains original position throughout growth.

In inner 2–4 whorls wall of four layers; in subsequent whorls upper-tectorium apparently absent; also inner-tectorium possibly absent in outer 2 whorls; in first 2 whorls diaphanotheca about as thick as lower or upper-tectorium and fairly distinct although still rather dense; mural pores not observed.

Measurements:

	Wh.n.		0	1	2	3	4	5	6	
Section:	Ax.	Sag.								
Specimen:	41		98	161	264	416	578	790	1033	R.v.
		40	86	170	272	391	523	718	901	
				63	58	39	37	31		G.r.
				60	44	34	37	25		
				1.58	1.39	1.51	1.68	1.74	1.78	F.r.
				16	26	45	31	43	39	W.th.
				—	30	32	45	43	51	

Remarks: Igô (1957) pointed out the resemblance of Staff's figure 1, pl. 18 (= *Girtyina schellwieni*) with his figures 8 and 9 of the same plate (= *Girtyina* cf. *ventricosa*) (cf. Staff, 1912). Igô considered these three specimens to be conspecific and designated the better section (fig. 8) as the lectotype of *G. schellwieni* Staff. The present axial section resembles the lectotype of *Beedeina schellwieni* (Staff) very closely. Other somewhat similar species are *B. ichinotaniensis* (Igô) var. *rotundata* (Igô), *B. cheni* (Igô) and *B. similis* (Gall. *et* White).

Beedeina ex gr. *elegans* (Rauser-Chernoussova *et* Beljaev, 1937)*

Pl. XXXII Figs. 1–2

Locality: P 38.

Description: From 1st to 6.5 whorl test changes from spherical (1st wh.) subrhomboidal (2nd wh.) elongate subrhomboidal (3rd–4th wh.) to elongate subrhomboidal or fusiform (5–6.5 wh.); slightly concave lateral sides in 2nd whorl, straight or slightly convex sides in subsequent whorls; periphery narrowly or broadly arched; poles bluntly pointed or pointed.

Up to 1st whorl septa folded only at pole regions, in 2nd whorl spreading already quite a distance over lateral slopes and extending from pole to pole from 5th whorl onwards; folding very regular and high, generally more than half the height of chambers; relative wavelength from 3rd whorl to 6th whorl varies between 10 and 17.

Chomata may extend to poles in inner 2 whorls, becoming symmetric and relatively narrow in subsequent whorls; distinct in 3rd, 4th and sometimes 5th whorl; in outer whorls (5.5–6.5 wh.) absent or rudimentary developed; normally about half the height of chambers, less than one quarter in outer whorls if present at all.

Axial filling sometimes present in inner 4 whorls; weakly developed.

Tunnel path slightly asymmetric or asymmetric; maximum deviation of symmetry 21°; tunnel angle fairly small; from 1st to 6th whorl respectively 14°, 17–20°, 17–21°, 17–22°, 22–23°, 28–29° and 27–44°.

Axis maintains original position throughout growth.

Wall relatively thick, consisting of four layers; diaphanotheca thickens at the expense of the tectoria during growth; upper-tectorium absent in outer whorls; mural pores not observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	7	
Specimen: 1	101	153	251	391	561	765	1028 1173		R.v.
2	103	183	306	467	654	841	1037 1207		
		64	56	43	36	34			G.r.
		67	53	40	29	23			
		1.33	1.90	2.13	2.21	2.29	2.27 2.43		F.r.
		1.86	2.11	2.50	2.56	2.77	2.82 2.93		
		24	30	—	34	47	34		W.th.
		26	26	41	45	39	38		

Remarks: The present species is most similar to *Fusulina* (?) *innae* (Roz.). Another more or less similar species is *Beedeina elegans* (Raus. *et* Belj.) and its variety *tanaica* (Sem.). The most closely allied species from SE Asia is *Beedeina higoensis* (Kan.) and from the U.S.A. *Beedeina knighti* (Dunb. *et* Henb.) and *Beedeina equilaqueata* (Alex.).

Beedeina ex gr. *distenta* (Roth *et* Skinner, 1930)

Pl. XXXII Fig. 3

Locality: P 2.

Description: Test subrhomboidal throughout growth; lateral sides straight; periphery arched; poles pointed; height of chambers constant from median region to poles.

* In Rauser-Chernoussova and Fursenko, 1937.

Septa straight from pole to pole in inner 2–2.5 whorls; in subsequent whorls folded, starting at poles and progressively spreading over lateral slopes; extending to chomata at the end of 5th whorl; relative wavelength 13–22 in outer 2 whorls.

Chomata extend to poles in inner 2.5–3 whorls, becoming narrower in subsequent whorls; width in 6.5–7th whorl 0.10–0.20 of lateral slopes; dome-shaped or subquadrangular in outer whorls; relative height 0.35–0.60; absent in last half whorl; steep slopes at the tunnel side.

Tunnel path slightly asymmetric; tunnel angle small, from 1st–7th whorl respectively 15°, 13°, 13°, 13°, 16°, 21° and 20°; maximum deviation of symmetry 15°.

Axis maintains original position throughout growth.

Pores visible (at 235 magnification) in wall of outer whorls; they penetrate all layers as well as the chomata; lower-tectorium thick with respect to diaphanotheca; the latter can only be clearly observed in last 2–3 whorls; upper-tectorium seems to be well developed only in inner whorls.

Measurements:

	Wh.n.	0	1	2	3	4	5	6	7	8	
Specimen: 1		70	119	204	289	442	612	850	1122	1258	R.v.
			71	42	53	38	39	32			G.r.
			1.50	1.33	1.62	1.58	1.69	1.76	1.70	1.74	F.r.
			22	29	33	45	56	61	28		W.th.

Remarks: The single specimen present is best compared with *Beedeina distenta* (Roth *et* Skin.), *Beedeina novamexicana* (Needham), *Beedeina similis* (Gall. *et* White), *Beedeina paradistenta* (Saf.) and *Beedeina samarica* (Raus. *et* Belj.). The last two species belong to *Beedeina* ex gr. *elegans.*

Beedeina ex gr. *rauserae* (Chernova, 1951)*

Pl. XXXII Figs. 4–10

Locality: P 82.

Description: Radius vector: 714–1275
Form ratio: 2.70–3.75 (4.5 wh.)
Number of whorls: 4.5–5.5

From 1st to 5.5 whorl test changes from subrhomboidal or subrhomboidal to short fusiform (1st wh.) subrhomboidal, elongate subrhomboidal or fusiform (2nd–3rd wh.) to fusiform or elongate fusiform (4–5.5 wh.); lateral sides straight or slightly convex; poles pointed or bluntly pointed.

Septal folding very high; even in median region of test septal folding often extends from bottom to roof of chambers; in sagittal sections first septal loops appear in 2nd whorl; relative wavelength varies from 10 to 16 in 3.5–4.5 whorl.

Chomata extend to poles in inner 1.5 whorls; narrow and symmetric in 3rd whorl; either absent or developed as pseudochomata in 4–5.5 whorl.

Tunnel angles in 2 specimens from 1st to 4th whorl are respectively 12° and 18° (1st wh.), 15° and 16° (2nd wh.), 21° (3rd wh.), 34° and 40° (4th wh.); maximum deviation of symmetry 16° and 22°.

* In Rauser-Chernoussova *et al.*, 1951.

Axial filling completely absent.

Axis straight or slightly curved; no angle between inner and outer whorls.

Wall essentially consists of four layers; diaphanotheca fairly dense and consequently contrasts poorly with tectoria; in outer whorls the diaphanotheca is the most prominent layer, its thickness is here usually 21–28 μ; in inner 2 whorls upper-tectorium thick in comparison with other layers, but in outer whorls only locally present and relatively thin; lower-tectorium often rather indistinct, in outer whorls normally as thick or thinner than the diaphanotheca; very fine mural pores occasionally observed in lower-tectorium of outer whorls.

Measurements: See Table 31.

Remarks: The rhomboidal inner whorls with their well developed chomata and the very high septal folds indicate that the present species belongs to the genus *Beedeina* of the group *rauserae* Chern. This group also contains *B. disputabilis* (Chern.) and *B. juncta* (Chern.). Our species is most similar to *Beedeina rauserae* from which it differs mainly by its macrospherical state i.e. larger proloculum, constant axis of coiling, smaller number of whorls and larger diameter for corresponding whorls.

Beedeina? ex gr. *ozawai* (Rauser-Chernoussova *et* Beljaev, 1937)*

Pl. XXXIII Figs. 1–5
Pl. XXXII Figs. 11–15

Locality: P 4.

Description:

Radius vector:	935–1345
Form ratio:	2.85–3.35
Number of whorls:	4.5–5.5

From 1st to 5.5 whorl test changes from spherical (1st wh.) subrhomboidal or elongate subrhomboidal (2nd wh.) fusiform, elongate fusiform or elongate subrhomboidal (3rd–5th wh.); lateral sides usually straight sometimes slightly convex; poles bluntly pointed or bluntly pointed to pointed.

Septal folding very high often extending from floor to roof of chambers; in median region often somewhat lower but still occupying at least half of chamber lumen; relative wavelength varies from 12 to 17 in 3–3.5 whorl and from 11 to 14 in 4–5th whorl; septal loops appear in 2nd–3rd whorl.

Chomata distinct, asymmetric and sometimes extending to poles (1st–2nd wh.); narrow, symmetric, subsymmetric or irregular in shape (subsequent whorls); in 5th whorl often still present; in outer whorls possibly in reality pseudochomata.

Tunnel path almost symmetric; maximum deviation of symmetry varies from 12° to 16° with an average of 14° (N = 4).

Axis maintains original position throughout growth; straight.

Wall essentially consists of four layers; upper-tectorium rudimentary developed; in inner 2–3.5 whorls diaphanotheca as thick, or thicker than lower-tectorium; in subsequent whorls this relation is reversed; some specimens show fine mural pores penetrating the wall which occasionally are visible even as early as the 1st whorl. The diaphanotheca may even be observed in 1st whorl but usually it is entirely absent in inner 2 whorls; thickness of diaphanotheca varies from 10 to 30 μ in 4–5th whorl.

* In Rauser-Chernoussova and Fursenko, 1937.

Measurements: See Table 32.

Remarks: The present species is most similar to *B.? ozawai* (Raus. *et* Belj.) and its variety *pronensis* (Raus.). It conforms in septal folding, rhomboidal inner whorls, presence of chomata and expansion of the spire. It differs in having a larger proleculum, a greater diameter for corresponding whorls and, when compared to tho typical species, in having a larger L/D ratio. Moreover, the wall is thicker and the number of septa is somewhat higher. The Russian species has been introduced as *Fusulina ozawai* sp. nov. In spite of the resemblance to *Fusulina cylindrica* Fischer de Waldheim, the type species of *Fusulina*, it is believed that the present species and all others of the group *F. ozawai* descended from typical *Beedeina* as redefined by Ishii (1958).

Beedeina? ex gr. *acuta* (Lee, 1927)

Pl. XXXIII Figs. 6–9

Locality: P 52.

Description: Radius vector: 980–1140
Form ratio: 2.90–3.15
Number of whorls: 6–6.5

From 1st to 6.5 whorl test changes from spherical or subrhomboidal (1st wh.) fusiform, subrhomboidal or elongate subrhomboidal (2nd wh.) to fusiform, elongate fusiform or elongate fusiform to elongate subrhomboidal (3–6.5 wh.); lateral sides essentially straight, sometimes slightly convex or concave; poles bluntly pointed to pointed in inner whorls and bluntly pointed to rounded in outer whorls.

Septal folding regular and fairly high; septal loops generally occupy 1/2 to 3/4 of chamber lumen in median region of test and occasionally extend from bottom to roof of chambers; septal loops appear in 4th whorl of sagittal sections; in 1st whorl septa folded only at poles; relative wavelength varies from 16 to 19 in 3–3.5 whorl, from 7.4 to 14 in 4–5th whorl and from 8.6–9.7 in 5.5–6th whorl.

In inner 2 whorls chomata high and often extending to poles; relative height decreases in 3rd whorl to 1/4 to 1/3 of chamber height; rudimentary developed or absent in subsequent whorls.

Tunnel path slightly asymmetric; maximum deviation of symmetry varies from 17° to 21° with an average of 19° (N = 3); tunnel angle very small for the length of these specimens.

Axis straight, maintaining original position throughout growth.

Wall essentially of four layers; upper-tectorium quite distinct in inner volutions, as thick or thicker than diaphanotheca in inner 2 whorls and as thick or thinner in 3rd and 4th whorl; in subsequent whorls upper-tectorium rudimentary or absent; lower-tectorium may be thicker than diaphanotheca in 5–7th whorl; thickness of diaphanotheca varies from 15 μ to 17 μ in 4–5.5 whorl; very fine mural pores, penetrating all layers of wall sometimes observed as early as the 1st whorl, usually only clearly visible in 5th and 6th whorl.

Measurements: See Table 33.

Remarks: The present group is established to include the following species: *Beedeina? acuta* (Lee), *Beedeina? forakerensis* (Skin.), *Beedeina? donbassica* (Put.), *Beedeina? lebedevi* (Put.) and perhaps also *Beedeina? stepanovi* (Put.) and *Beedeina? genbizkii* (Put.). Putrya's original description of the four last mentioned species has not, unfortunately,been available to this writer. Subsequently Putrya introduced the new genus

Pseudotriticites with *Fusulina donbassica* Putrya as its genotype. According to Rjazanov (1958a) this genus would contain a number of species which have in common only the presence of simple mural pores penetrating all layers of the wall but which otherwise were not apparently closely related. When this was realized two new genera were established: the genera *Putrella* Rauser-Chernoussova (genotype: *Pseudotriticites brazhnikovae* Put.) and *Quasifusulinoides* Rauser *et* Rozovskaja (genotype: *Pseudotriticites fusiformis* Roz.). In the opinion of Rjazanov (1958a) the remaining species of *Pseudotriticites* i.e. *P. donbassica*, *P. lebedevi*, *P. stepanovi* and *P. genbizkii* do not differ essentially from the genus *Fusulina* since the latter genus also often has pores penetrating all layers of the wall. Consequently the usefulness of *Pseudotriticites* was denied and the genus rejected. It is agreed with Rjazanov that those four species of *Pseudotriticites* are better retained in the genus *Fusulina* that is to say *Fusulina* s.l., since the latter genus was found by Ishii (1958) to consist of species on one hand similar to its genotype (*F. cylindrica* Fischer de Waldheim) and on the other hand containing species closely related to the genus *Beedeina* Galloway which had fallen into disuse. It is believed by the present writer that the four species under consideration [at least *F. donbassica* Put. and *F. lebedevi* Put. as figured by Rjazanov (1958a)] are closer to *Beedeina* than to *Fusulina*. The Spanish species evidently is very similar to *Beedeina? lebedevi* (Put.) differing only in its probably somewhat larger dimensions. Some elongate species of the group *elegans* Raus. *et* Belj. are also comparable including *Beedeina siviniensis* (Raus.) which differs mainly by a wall structure in which mural pores are entirely absent or only present in outer whorls.

Beedeina? ex gr. *conspecta* (Rauser-Chernoussova, 1951)

Pl. XXXIII Figs. 10–11

Locality: P 36.

Description:	Radius vector:	900–1075 (5.5–7th wh.)
	Form ratio:	3.30–4.15
	Number of whorls:	6–7

From 1st to 7th whorl test changes from subtriangular or subrhomboidal (1st wh.) elongate subrhomboidal or fusiform to short subcylindrical (2nd wh.) fusiform or subcylindrical (3rd wh.) to elongate subrhomboidal or subcylindrical (4–7th wh.); lateral sides straight or slightly convex, subhorizontal; periphery broadly arched; poles bluntly pointed.

Septa intensely fluted; septal loops closely set, relative wavelength varies from 5.7 to 9.5 in 6–7th whorl; folding quite regular; in polar half of shell septa often folded from bottom to roof of chambers (cf. specimen 10).

Chomata not observed beyond 4th whorl; already in 3rd and 4th whorl often absent or rudimentary developed.

Tunnel path asymmetric or slightly asymmetric; maximum deviation of symmetry for 2 specimens is 27° and 47°.

The most conspicuous character of this species is its very heavy developed axial filling which is present from 2nd whorl to penultimate whorl.

Axis of coiling maintains same position throughout growth; straight or only slightly curved.

Wall essentially of four layers; in outer whorls upper-tectorium absent or rudimentary developed; diaphanotheca about as thick, or thicker than lower-tectorium; total thickness of wall about 40 μ in outer whorls which is nevertheless rather thin with respect to the large size of this species; fine mural pores have occasionally been observed in outer whorls.

Measurements: See Table 34.

Remarks: The rhomboidal inner whorls point to a close relationship with *Beedeina? conspecta* (Raus.) and *Beedeina? pulchella* (Gryz.). Both species were referred to the genus *Fusulina* and placed together in a single group (Rauser-Chernoussova *et al.*, 1951). Although axial filling is known to occur in some species of *Fusulina* which amongst other characters would distinguish them from *Beedeina,* the rhomboidal inner whorls with rather broad chomata point to the derivation of species of the group *F. conspecta* Raus. from typical *Beedeina. Beedeina? conspecta* (Raus.) and *B.? pulchella* (Gryz.) differ from the Spanish species in having somewhat fewer whorls, a larger L/D ratio, a slightly thinner wall, sometimes a more loosely coiled spirotheca and less complete axial filling. *Fusulina bella* Sem. *et* Meln. and *Fusulina pankouensis* (Lee) are also very similar as well as *Fusulina pankouensis* (Lee) var. *okensis* Raus. Yet they differ in the state of inner whorls which shows that both species have to be definitely referred to the genus *Fusulina.*

Genus VERELLA Dalmatskaja, 1951

Dalmatskaja, I. I., New genus of fusulinids from the lower part of the Middle Carboniferous of the Russian platform. Moscow. Obsch. Ispyt. Prirody; Trudy, otdel Geol., 1951, Tom. I, tabl. I, pp. 194–196.

Verella sp.

Pl. XXXIV Figs. 1–5

Locality: L 16.

Description:	Radius vector:	430–630
	Form ratio:	3.10–4.65
	Number of whorls:	4–4.5

From 1st to 4.5 whorl test changes from rhomboidal to elongate rhomboidal (1st wh.) elongate rhomboidal to elongate fusiform (2nd wh.) to elongate fusiform (3–4.5 wh.); lateral slopes straight, slightly convex or slightly concave; poles pointed to bluntly pointed; spirotheca smooth.

Septal folding starts at poles of 2nd–4.5 whorl, progressively extending over the lateral slopes during growth, but not reaching the tunnel.

Chomata extend to poles in inner 2 whorls; from 2nd to 3rd whorl they sometimes merge with the axial filling; beyond 3rd whorl chomata cover 0.10–0.60 of lateral slopes; sometimes absent in last half whorl of mature specimens (4.5 wh.); steep or slightly sloping at the tunnel side.

Three out of five specimens with asymmetric, one with slightly asymmetric and one with nearly symmetric tunnel path.

Axial filling present in most specimens but weakly developed; if present it is observed in 1st–3rd whorl.

Axis of coiling maintains original position throughout growth; straight, at maturity sometimes slightly curved at the poles.

The thin wall either homogeneous or only very weakly differentiated; occasionally a relatively thin lower-tectorium may be observed; protheca less dense than chomata and axial filling.

Measurements: See Table 35.

Remarks: [1] The present assemblage contains specimens which are intermediate between *Verella* and *Eofusulina*. Other specimens are probably close to *Verella prolixa* Sheng.

Genus EOFUSULINA Rauser-Chernoussova, 1951

Rauser-Chernoussova, D. M. *et al.* Middle Carboniferous fusulinids of the Russian Platform and adjacent regions. Moscow: Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Minist. Neftianoi Prom. S.S.S.R., 1951, p. 268.

Putrya, F. S., Stratigraphy and Foraminifera of the Middle Carboniferous of the eastern Donetz Basin. Vses. Neft. Nauchno-Issled. Geol.-Razved. Inst. (V.N.I.G.R.I.), Trudy, N.S., 1956, sbornik 8, p. 458.

Eofusulina cf. *triangula* (Rauser-Chernoussova *et* Beljaev, 1936)

Pl. XXXIV Figs. 6–11

Locality: A 1.

Description:	Radius vector:	670–920
	Form ratio:	4.20–4.90
	Number of whorls:	3–3.5

From 1st to 3.5 whorl test changes from elongate rhomboidal or elongate fusiform (1st wh.) elongate fusiform or subtriangular (2nd wh.) to elongate fusiform (3–3.5 wh.); lateral sides often undulated especially in outer whorls, otherwise straight or convex; poles pointed throughout growth.

Septa invariably folded from pole to pole from 2nd whorl onwards, occasionally this may be observed even in the 1st whorl; sagittal sections show first septal loops in 1st–2nd whorl; septal folds extremely high, even near the tunnel; range of relative wavelength in 1.5–2nd whorl, 2.5–3rd whorl and 3.5 whorl respectively 10–21, 9–11 and 6–7.

Chomata either wholly absent or rudimentary developed in the 1st whorl only.

Tunnel angle in 3 specimens from 1st to 3rd whorl respectively 33–41° (1st wh.), 33–84° (2nd wh.) and 92° (3rd wh.).

Axial filling absent or very weakly developed.

Axis straight, maintaining original position throughout growth.

Protheca either not differentiated or locally with tectum and inner less dense layer; thin lower-tectorium possibly present; mural pores locally observed but difficult to distinguish.

Measurements: See Table 36.

Remarks: The present species is closely allied with, but not identical to *Eofusulina triangula* (Raus. *et* Belj.); it differs in having 3.5 whorls as against 3 whorls in *E. triangula*, a larger L/D ratio, a larger diameter for corresponding whorls and a somewhat thicker spirotheca. It conforms in its triangular shape as in the high and irregular type of septal folding.

[1] According to Mrs. Rauser-Chernoussova who after seeing the photographs was so kind to give her opinion about these specimens.

Eofusulina cf. *paratriangula* (Putrya)

Pl. XXXIV Figs. 12–16

Locality: P 3.

Description:	Radius vector:	595–725
	Form ratio:	4.10–6.55
	Number of whorls:	3–3.5

From 1st to 3.5 whorl test changes from fusiform or elongate fusiform (1st wh.) elongate fusiform (2nd wh.) to elongate fusiform or subcylindrical (3–3.5 wh.); lateral sides wavy (especially in outer whorls), straight or slightly convex; poles pointed in inner whorls, pointed or bluntly pointed in outer whorls.

Septal folding almost reaches the tunnel even as early as the 1.5 whorl; from 2nd to 3rd whorl folding either reaches tunnel or extends from pole to pole; in last half whorl (i.e. 3.5 whorl) invariably extending from pole to pole; pattern of folding rather regular for *Eofusulina*, but rather irregular in comparison with typical species of the subgenus *Paraeofusulina*; in median region of outer 2 whorls relative height of septal arches varies from 0.5 to 1; relative wavelength in 1–1.5 whorl varies from 11.5 to 17, in 2–2.5 whorl and 3–3.5 whorl respective range is 8 to 11.5 and 7 to 8.5.

Chomata weakly developed and only present up to and including the inner 0.5–1 whorl.

Axial filling weakly developed or absent.

Axis of coiling straight, undulated or curved.

Wall either not differentiated or consisting of tectum and a lower less dense layer.

Measurements: See Table 37.

Remarks: The present species is about equally similar to *E. paratriangula* [1] (Put.) and *E. binominata* (Put.). The differences between the latter two species lies largely in the respective presence or absence of axial filling. In the present specimen this axial filling is either absent or rather weakly developed. The elongate fusiform to triangular shape of the inner whorls of our species is slightly more similar to that of *E. paratriangula* (Put.).

Eofusulina cf. *binominata* Putrya, 1956

Pl. XXXIV Figs. 17–19

Locality: A 3.

Description:	Radius vector:	570
	Form ratio:	4.0–5.8
	Number of whorls:	2.5

Test elongate fusiform throughout growth; lateral sides straight, slightly convex or undulated; poles pointed.

Septal folding extends across whole length of test beyond inner 1–1.5 whorl; septal arches very high and sometimes reach roof of chambers even in the median region near the tunnel; relative wavelength in 2nd whorl 12 (N = 1); in 2.5 whorl 7–12 (N = 2).

[1] The original description of *E. paratriangula* (Putrya) was not available to the present writer.

Chomata either wholly absent or present only as very small patches in the first half whorl.

Tunnel angle in 1st whorl 25–45°, increasing to 45–85° in subsequent whorls.

Axis curved or undulated.

Axial filling slightly to moderately developed.

Wall consists of a protheca which generally is not differentiated; occasionally a tectum and a less dense inner layer were observed; fine mural pores locally present; tectoria probably entirely absent.

Measurements:

	Wh.n.	0	1	2		3	
Specimen: 21		170	255	510			
60		153	238	459	570		R.v.
29		153	212	357	570		
			3.68	4.37			
			3.71	4.44	5.79		F.r.
			3.20	4.64	4.00		
			15	26			
			21	28	33		W.th.
			17	32			

Remarks: The present species is closely allied with but not identical to *E. binominata* Put.; it differs by its more macrospheric state i.e. less volutions and a greater proloculum. Moreover, the species described above has a slightly thicker wall which occasionally shows very fine mural pores. Mutually similar characters include the diameters of corresponding whorls, the presence of axial filling and a cylindrical shape occurring at an early stage of growth. *E. triangula* var. *rasdorica* (Put.) of Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951) and *E. triangula* var. *fusiformis* Grozd. *et* Leb. are other somewhat similar forms.

Eofusulina (*Paraeofusulina*) *rasdorica* sp. nov.

Pl. XXXIV Fig. 20
Pl. XXXV Figs. 1–10

Synonymy: 1938, *Fusulina triangula* var. *rasdorica* Putrya. — Putrya, F. S., Mat. Geol. Min.; Dir. geol., Azov-Black Sea, Vol. 2.

Type specimen: Specimen 10 (Pl. XXXV, Fig. 3) is designated as the holotype.

Locality: P 1.

Description: Radius vector: 645–885
Form ratio: 4.3–5.5
Number of whorls: 4–5

First whorl shows an elongate rhomboidal or more or less triangular shape; this triangular shape is sometimes maintained throughout growth; more often it passes into a nearly symmetric shell with respect to the axial plane; in general, test changes from triangular or elongate rhomboidal (1st–2nd wh.) to elongate fusiform (3rd–5th wh.); poles pointed throughout growth; lateral sides essentially straight.

Septal fluting regular and typical for the subgenus *Paraeofusulina*; mostly very high and often extending from bottom to roof of chambers even in the median region near the tunnel; septal folding extends across the whole length of shell beyond 1.5–2nd whorl; relative wavelength varies from 9 to 14 in 2nd–3rd whorl and from 5.3 to 9.5 in 3.5–4.5 whorl.

Rudimentary chomata often visible in 1st whorl and sometimes even in 2nd whorl.

Moderately developed axial filling present in all specimens.

Axis generally curved; sometimes angular in the median plane.

Protheca locally and weakly differentiated in outer tectum and inner somewhat less dense layer; lower-tectorium probably present but thin with respect to protheca; mural pores occasionally observed.

Measurement: See Table 38.

Remarks: All measured and figured specimens are macrospheres, only a very small number of microspheres were encountered.

Unfortunately the publication which contains the original description of *Fusulina triangula* var. *rasdorica* Put. was not available to the present writer. However, it is believed that the present species is very similar since both differ in the same sense from the closely allied *Eofusulina (Paraeofusulina) trianguliformis* Put. (cf. Putrya, 1956, V.N.I.G.R.I., Trudy, N.S., sbornik 8, p. 458).

Eofusulina (Paraeofusulina) sp.

Pl. XXXV Figs. 11–14

Locality: A 3.

Description:	Radius vector:	405–565
	Form ratio:	6.0–7.4
	Number of whorls:	3–3.5

From 1st to 3.5 whorl test changes from elongate rhomboidal (1st wh.) elongate rhomboidal or elongate fusiform (2nd wh.) to elongate fusiform or elongate cylindrical; lateral sides slightly concave, straight (sometimes parallel to axis) or slightly convex; poles pointed in inner whorls and pointed or rounded in last whorl.

Septal folding extends across whole length of test beyond 1–1.5 whorl; septal arches high, even near tunnel total height of septa may be involved in the folding; relative wavelength in 3–3.5 whorl is 6.3–6.7 ($N = 1$); in 1.5–2nd whorl this value varies between 8.5 and 11.

Chomata were not observed.

Axial filling weakly or heavily developed.

Axis generally curved.

Wall consists of a protheca which generally is homogeneous; very thin tectoria sometimes locally present; fine pores, not under 3 μ in diameter in last 2 whorls, were often observed.

Measurements:

Wh.n.	0	1		2		3		4	
Specimen: 61	115	195		404	503				
12	106	153		255		391	493		R.v.
21	85	119		195		323	408		
			107						
			67		53				G.r.
			64		65				
		6.00		5.60	5.90				
		3.56		6.53		6.80	6.00		F.r.
		3.36		4.13		6.17	7.33		
		20		27	—				
		13		21		26	26		W.th.
		15		15		21	26		

Genus FUSULINA Fischer de Waldheim, 1829

Fischer de Waldheim, G., Les Cephalopodes fossiles de Moscou et ses environs. Soc. Imp. Nat. Moscou, Bull., Moscou, Russie, 1829, Année 1, p. 330.
Thompson, M. L., Upper Desmoinesian Fusulinids. Am. Journ. Sci., 1945, 5th Ser., Vol. 243, pp. 446, 447; pl. 1.
Ishii, K., On the Phylogeny, Morphology and Distribution of *Fusulina*, *Beedeina* and allied fusulinid genera. Journ. Inst. Polytechnics, Osaka City Univ., 1958, Ser. G., Vol. 4, pp. 38–44.

Fusulina rossoschanica Putrya subsp. *kamerlingi* subsp. nov.

Pl. XXXV Figs. 15–16
Pl. XXXVI Figs. 1–2

Type specimen: Specimen 5 (Pl. XXXVI, Fig. 1) is designated as the holotype.
Locality: L 408.

Description:		
	Radius vector:	860–1312
	Form ratio:	4.2–5.5
	Number of whorls:	4–5

From 1st to 5th whorl test changes from oval, subrhomboidal or fusiform (1st wh.) fusiform or elongate fusiform (2nd wh.) triangular, fusiform or elongate fusiform (3rd wh.) to triangular or elongate fusiform (4–5th wh.); lateral sides essentially straight sometimes slightly convex or concave, often irregular; poles bluntly pointed or pointed (2nd–4th wh.), bluntly pointed to rounded in last whorl.

Septal folding very high often extending from floor to roof of chambers; in median region somewhat less in height but still occupying at least half the chamber lumen; folding fairly irregular; in first half-whorl septa only folded at the poles, from pole to pole starting with 1st–3rd whorl; relative wavelength varies from 10 to 12 in 3rd whorl and from 5.5 to 7.5 in 4–4.5 whorl; septa as thick or slightly thinner than wall.

Chomata asymmetric and distinct in 1st whorl; it is difficult to decide in which whorl true chomata are replaced by pseudochomata; these secondary deposits generally absent in 4.5–5th whorl; height with respect to chamber lumen very low [measurements of chomata (See table) refer to their minimum height which is between the septa, where the steep downward slope of the chomata adjacent to the septa becomes horizontal]; as is normal in this genus the chomata are relatively narrow as well.

Range and average of tunnel angle as measured in 4 specimens from 1st–5th whorl is respectively: 12–32°, 22° (N = 4); 19–37°, 27° (N = 4); 29–52°, 39° (N = 3); 30–52°, 42° (N = 3); 46° (N = 1); maximum deviation of symmetry varies from 12–33° and is on average 21° (N = 4).

Axis straight or curved, more often straight; no angle between axis of coiling of inner and outer whorls.

Axial filling absent or very weakly developed.

Wall consists of tectum, diaphanotheca and lower-tectorium; diaphanotheca generally well defined and even visible in 1st whorl; however, some specimens show an indistinct differentiation of the wall.

Measurements: See Table 39.

Remarks: The main differences between *F. rossoschanica* Put. [1] subsp. *kamerlingi* subsp. nov. and *F. rossoschanica* Put. + *F. rossoschanica* Put. var. *grandis* Put. are demonstrated by the values of some of their respective important parameters given in the table below.

	No. of Wh.	Diam. Prol.	D	L	L/D	W.th.
F. rossoschanica	4.5 (sometimes only 3–3.5	300–350	1200–2000 (mostly 1700–1800)	5500–12000 (mostly 8000–9000)	4.5–5.5	30–35
var. *grandis*	4–5 (normally 4.5)	400–500	2100–2300	10000–12000	± 5	40
subsp. *kamerlingi*	4–5	320–410	1900–2500	9500–12400	4.5–5.6	39–60

Wall structure

F. rossoschanica	Tectum, diaphanotheca, upper and lower-tectorium
var. *grandis*	Tectum, diaphanotheca, upper and lower-tectorium
subsp. *kamerlingi*	Tectum, diaphanotheca and lower-tectorium.

Fusulina elegantissima Man. is very similar to *Fusulina rossoschanica* Put. and its varieties. Future studies of both species may well prove them to be synonymous.

Fusulina agujasensis sp. nov.

Pl. XXXVI Figs. 3–8

Type specimen: Specimen 9 (Pl. XXXVI, Fig. 5) is designated as the holotype.

Locality: P 72.

Description:

Radius vector:	1054–1326
Form ratio:	2.83–3.30
Number of whorls:	4.5–5

From 1st to 5th whorl test changes from subrhomboidal or short fusiform (1st wh.) subrhomboidal to fusiform or fusiform (2nd wh.) fusiform (3rd wh.) to elongate

[1] The original paper introducing *F. rossoschanica* has not been available to the present writer.

fusiform (3rd–5th wh.); lateral sides straight, convex or irregular; poles pointed, bluntly pointed or, in outer whorls, bluntly pointed to rounded.

Septal folding extremely high, generally extending from bottom to roof of chambers even in median half of test; septa hardly folded in first half whorl, in 1st whorl folded at poles and up lateral slopes; folding reaches chomata in 1.5 whorl; sagittal sections show first septal loops in 2nd whorl; relative wavelength varies from 13–15 in 3rd whorl to 9–10 in 3.5–4.5 whorl; from 1st whorl to 5th whorl number of septa for 2 specimens is respectively: 10 (2 ×); 20, 22; 24, 27; 25, 32;?, 37.

Chomata weakly developed; probably true chomata in inner whorls and pseudochomata in outer whorls; most probably completely absent in 5th whorl; in inner 1.5 whorls height varies from 1/4 to 1/2 of chamber lumen, whenever observed in subsequent whorls relative height always less than 1/3; sometimes extending to poles in first half-whorl, still broad and asymmetric at the end of 1st whorl; in subsequent whorls narrow and symmetric or irregular.

Tunnel path asymmetric to almost symmetric; maximum deviation of symmetry varies from 10–29°, on average 19° (N = 4); tunnel only clearly observed in 1st–2nd whorl, in subsequent whorls often very low or absent; tunnel angle in 1st whorl and 2nd whorl respectively 12–19° and 22–27°.

Axial filling completely absent.

Axis straight; maintains original position throughout growth.

Wall consists essentially of four layers; upper-tectorium, however, rudimentary developed; diaphanotheca and lower-tectorium of about same thickness, the former measuring 28 μ (N = 2) in 3rd–4th whorl; mural pores not observed.

Measurements: See Table 40.

Fusulina agujasensis sp. nov.
(2nd assemblage)
Pl. XXXVI Figs. 9–11
Pl. XXXVII Figs. 1–8

Locality: L 21.

Description:	Radius vector:	1025–1210
	Form ratio:	2.50–3.45
	Number of whorls:	4–5

From 1st to 5th whorl test changes from spherical, subrhomboidal or short fusiform (1st wh.) subrhomboidal or short fusiform (2nd wh.) fusiform, elongate fusiform or elongate subrhomboidal (3rd wh.) to elongate fusiform or elongate subrhomboidal (4–5th wh.); lateral sides straight or slightly convex, sometimes slightly irregular; poles bluntly pointed or bluntly pointed to rounded.

Septal folding very high often extending from bottom to roof of chambers even in median half of shell; relative wavelength varies from 15–22 in 2.5–3.5 whorl, from 11.5–14 in 4–4.5 whorl; sagittal sections show first septal loops in 2nd whorl.

Chomata asymmetric and narrow in 1st whorl, rudimentary developed up to the 3.5 whorl, absent or rudimentary developed (pseudochomata?) in 4–4.5 whorl, never observed in 5th whorl.

Tunnel path slightly asymmetric; maximum deviation of symmetry varies from 14° to 21°, on average 18° (N = 6).

Axial filling completely absent.

Axis straight, maintaining original position throughout growth.

Wall essentially of four layers; upper-tectorium, however, rudimentary developed in outer whorls; lower-tectorium about as thick as diaphanotheca; thickness of diaphanotheca 20–30 μ in 4–5th whorl; mural pores occasionally observed, indistinct.

Measurements: See Table 41.

Fusulina agujasensis sp. nov.
(3rd assemblage)
Pl. XXXVII Fig. 9

Locality: A 7.

Description: Axial section short fusiform in 1st whorl, fusiform in 2nd–4th whorl and elongate fusiform in 5th whorl; lateral sides convex or slightly concave.

Septal folding high; in central half of test not less than half height of chambers and sometimes even extending from bottom to roof.

Chomata distinctly developed in inner 1.5 whorls, rudimentary developed or absent in subsequent whorls.

Axial filling completely absent.

Axis maintains original position throughout growth.

Wall consists essentially of four layers; upper-tectorium, however very thin and only locally present; thickness of diaphanotheca up to 26 μ in 4–5th whorl, generally thin in comparison with lower-tectorium; at one place very fine pores penetrating the lower-tectorium were observed.

Measurements:

	Wh.n.	0	1		2		3		4		5	
	Ax. Sag.											
Specimen:	3	196	382		578		850		1105		1377	R.v.
	1	166	323		510		731		969		1156	
				51		47		30		28		G.r.
				58		43		33				
			1.60		1.94		2.05		2.34		2.58	F.r.
			26		47		73		69		43	W.th.
			—		34		39		39			

Remarks: The present species belongs to the group of *F. kamensis* Saf. and is closely allied to *Fusulina cotarazoe* sp. nov., *F. aspera* Chern. and *F. kamensis* Saf. Some differences between these species are brought out in the characters tabulated below.

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	Diam. (maturity)	L/D
Fusulina cotarazoe	4.5–5.5	300–550	1700–2000	1950–2600	3.0–4.0
Fusulina agujasensis	4–5	250–440	1500–2150	1900–2600	2.7–3.7
Fusulina kamensis	4.5–5	205–345	1510–1760	1730–2110	2.8–3.5
Fusulina aspera	4–5.5	200–310	1060–1430	1490–1870	4–5.5

It is evident that with respect to general dimensions the present species is about intermediate between *F. cotarazoe* sp. nov. and *F. kamensis*. The fusiform or even slightly rhomboidal inner whorls, the smaller form ratio and the more narrow mural pores, which usually are observed only in the last one or two whorls, distinguish the present species from *F. cotarazoe* sp. nov. The state of juvenarium in our species is more similar to *F. aspera* than to *F. kamensis.*

Fusulina cotarazoe sp. nov.
Pl. XXXVII Figs. 10–11
Pl. XXXVIII Figs. 1–3

Type specimen: Specimen 4 (Pl. XXXVII, Fig. 11) is designated as the holotype.
Locality: P 40.

Description:	Radius vector:	1155–1335
	Form ratio:	3.00–3.75
	Number of whorls:	4.5–5.5

From 1st to 5.5 whorl test changes from spherical or short fusiform (1st wh.) fusiform (2nd wh.) fusiform or elongate fusiform (3rd wh.) to elongate fusiform or elongate fusiform to subcylindrical (4–5.5 wh.); lateral sides irregular; poles bluntly pointed or bluntly pointed to rounded.

Septa intensely but rather irregular folded; folding extremely high, generally extending from bottom to roof of chambers; relative wavelength varies from 8 to 13.5 in 4–5th whorl; septal loops in sagittal sections appear as early as in the 1st whorl.

Chomata distinct in inner 1.5 whorls; asymmetric in first half-whorl; absent or rudimentary developed in 2–3.5 whorl; not observed beyond 3rd–4th whorl.

Tunnel path slightly asymmetric or asymmetric; maximum deviation of symmetry varies from 18° to 42°, on average 27°.

Axial filling completely absent.

Upper-tectorium in all specimens rudimentary and only locally developed; lower-tectorium thinner than diaphanotheca in inner whorls, beyond 3rd–4th whorl lower-tectorium as thick or sometimes even thicker than diaphanotheca; thickness of diaphanotheca varies from 20 μ to 34 μ in outer whorls (4–5th wh.); the majority of specimens show very fine mural pores; in a single specimen pores were observed even in the 1.5 whorl; generally they only appear in the 4th whorl.

Measurements: See Table 42.

Fusulina cotarazoe sp. nov.
(2nd assemblage)
Pl. XXXVIII Figs. 4–14

Locality: P 58.

Description:	Radius vector:	1070–1380
	Form ratio:	2.75–3.20 (4.5–5 wh.)
	Number of whorls:	4.5–5.5

From 1st to 5.5 whorl test changes from spherical or short fusiform (1st wh.) subrhomboidal, elongate subrhomboidal or fusiform (2nd wh.) elongate subrhomboidal or fusiform (3rd wh.) to elongate fusiform or elongate fusiform to subtriangular (4–5.5 wh.); lateral sides straight or slightly convex, often irregular; poles generally pointed in 2nd whorl, bluntly pointed or bluntly pointed to rounded in subsequent whorls.

Septa intensely, but for this genus somewhat irregularly, folded; folding extremely high generally extending from bottom to roof of chambers, only in median half of shell sometimes less than half the chamber lumen; relative wavelength varies from 8 to 14 in 4–5th whorl; sagittal sections show first septal loops in 1st or 2nd whorl.

Chomata asymmetric and distinct in 1st whorl; in subsequent whorls only rudimentary or absent; never observed in 5–5.5 whorl.

Tunnel path slightly asymmetric; maximum deviation of symmetry varies from 14° to 22°, on average 17.5°.

Axial filling completely absent.

Axis straight, maintaining original position throughout growth.

In inner 1.5 or 2 whorls wall of four layers; in subsequent whorls upper-tectorium, already relatively thin in inner 2 whorls, completely absent; lower-tectorium becomes relatively thicker during growth; in inner 3 whorls about as thick as diaphanotheca or thinner, in subsequent whorls on average as thick and sometimes locally thicker; diaphanotheca varies from 17 μ to 35 μ in outer whorls (4–5th wh.); the majority of specimens with very fine mural pores; in some well preserved specimens pores were observed even in the 2.5 whorl, generally, however, they appear in 4–5th whorl.

Measurements: See Table 43.

Fusulina cotarazoe sp. nov.

(3rd assemblage)

Pl. IXL Fig. 1

Locality: P 73.

Description: From 1st to 5.5 whorl test changes from spherical (1st wh.) short fusiform (2nd wh.) fusiform (3rd wh.) to elongate fusiform or subtriangular (4–5.5 wh.); lateral sides straight or convex in inner whorls and straight (sloping or horizontal) in outer whorls; poles bluntly pointed or bluntly pointed to rounded.

Septal folding very high; even in central half of test folding usually extends from bottom to roof of chambers, only near the tunnel sometimes lower but never less than half the chamber lumen; relative wavelength 7–10 in 4–5th whorl.

Chomata may be present up to and including the 3.5 whorl; even from the start narrow and rudimentary.

Tunnel angle from 1st whorl to 5th whorl respectively: 13°, 17°, 24° 24° and 44°; maximum deviation of symmetry is 21°.

Axial filling completely absent.

Axis curved; no angle between axis of inner and outer whorls.

Wall with a well defined diaphanotheca beyond 2nd whorl; its thickness in 5th whorl about 28 μ; lower-tectorium in outer whorls about as thick as diaphanotheca; upper-tectorium rudimentary developed; mural pores not observed.

Measurements:

Wh.n.	0	1	2	3	4	5	6	
Specimen: 19	174	272	421	629	901	1309	1402	R.v.
		1.31	1.58	2.19	3.28	3.25	3.53	F.r.

Remarks: The present new species also belongs to the group of *Fusulina kamensis* Saf. Of the species from this group, *Fusulina kamensis* Saf. and *Fusulina aspera* Chern. are most similar to the Spanish species. Some differences can be seen from the characters tabulated below:

	No. of Wh.	Diam. Prol.	Diam. 4th wh.	Diam. (maturity)	L/D
Fusulina kamensis	4.5–5	205–345	1510–1760	1730–2110	2.8–3.5
Fusulina aspera	4–5.5	200–310	1060–1430	1490–1870	4.0–5.5
Fusulina cotarazoe	4.5–5.5	300–550	1700–2000	1950–2600	3.0–4.0

The larger dimensions of *F. cotarazoe* are also expressed in the thickness of the spirotheca which in outer whorls is 30–75 μ whereas this is 30–45 μ in the other species. *Fusulina rossoschanica* var. *grandis* Put. is of about the same size as *F. cotarazoe* but the former has a L/D ratio of 5.0 and more rounded poles.

Genus HIDAELLA Fujimoto *et* Igô, 1955

Fujimoto, H., and Igô, H., *Hidaella*, a new genus of the Pennsylvanian fusulinids from the Fukuji District, eastern part of the Hida mountainland, central Japan. Pal. Soc. Japan, Trans. Proc., Tokyo, 1955, N.S., No. 18, p. 46.

Hidaella kameii Fujimoto *et* Igô, 1955 subsp. *nalonensis* subsp. nov.

Pl. IXL Figs. 2–11

Type specimen: Specimen 31 (1) (Pl. IXL, Fig. 2) is designated as the holotype.
Locality: A 5.

Description:		
	Radius vector:	275–520
	Form ratio:	2.80–3.80
	Number of whorls:	5–6

From 1st to 6th whorl test changes from nautiliform (1st wh.) spherical, oval or short fusiform (2nd wh.) short fusiform, fusiform or fusiform to subcylindrical (3rd wh.) fusiform, elongate triangular, elongate fusiform, or cylindrical (4th wh.) to subcylindrical or cylindrical (5–6th wh).; poles pointed or bluntly pointed in 3rd–4th whorl gradually becoming more rounded in 5–6th whorl. A distinctive character of this genus is the strongly and irregularly undulated lateral sides, which is also very well shown in the present subspecies.

Septa straight in inner 2–4 whorls, irregularly folded in polar regions of subsequent whorls; at maturity (5–6th wh.) folding extremely intense at the poles, weak or absent near the median plane; sagittal sections show widely spaced, short-triangular septa in inner 4–4.5 whorls, thick rod-shaped septa in subsequent whorls.

Chomata extend to poles in inner 2.5–4 whorls; generally steep, often perpendicular slopes at the tunnel side.

Tunnel almost symmetric or slightly asymmetric; maximum deviation of symmetry varies from 6° to 22°, on average 15° (N = 8).

Inner 1–2 whorls coiled at a large angle to subsequent whorls; axis straight or nearly so.

Wall of three layers in inner whorls; in 5–6th whorl also a generally very well differentiated but extremely thin diaphanotheca may be observed in the equatorial region; maximum thickness of the four-layered wall of outer whorls about 25 μ.

Measurements: See Table 44.

Remarks: The subspecies here described differs from the typical species in having a slightly smaller proloculum, a slightly greater form ratio, a slightly smaller tunnel angle and somewhat thinner walls. The spirotheca is extremely thin and shows a diaphanotheca only in the median region of the outer whorls. There is apparently also a close affinity to *Profusulinella fluxoidalis* Man. which occurs in the C_2^5 (K) series of the Donetz basin (= Vereyan of Moscow basin) and especially to *H. variabilis* (Kir.). Since the present subspecies is from strata which this writer compares with the upper part of the Kashirian of the Moscow basin, we might consider *P. fluxoidalis* or a closely similar form as a possible ancestor. *H. kameii* subsp. *nalonensis* differs from *H. variabilis* (Kir.) in having more volutions as well as a smaller diameter for corresponding whorls. Moreover, septal folding is apparently much more intense.

Genus FUSULINELLA von Moeller, 1877

Moeller, V. von., Ueber Fusulinen und aehnliche Foraminiferen des russischen Kohlenkalkes (vorläufige Notiz.). Neues Jahrb. Min., Geol., Pal., Stuttgart, Deutschland, 1877, p. 144.
Thompson, M. L., Upper Desmoinesian Fusulinids. Am. Journ. Sci., 1945, 5th Ser., Vol. 243, pp. 447–450, pl. 1.

Fusulinella pandae sp. nov.

Pl. XL Figs. 1–12
Pl. XLI Fig. 1

Type specimen: Specimen 15 (Pl. XL, Fig. 7) is designated as the holotype.

Locality: L 426.

Description:	Radius vector:	770–1260
	Form ratio:	2.00–2.70 (6th wh.)
	Number of whorls:	6–7.5

From 1st to 6th whorl test changes from nautiliform or spherical (1st wh.) ellipsoidal or short fusiform (2nd wh.) short fusiform or fusiform (3rd wh.) fusiform (4–5th wh.) to fusiform or elongate fusiform (6th wh.); lateral sides essentially convex or straight, occasionally concave; poles bluntly pointed; spirotheca smooth in inner 4–6 whorls, septal grooves weakly expressed in subsequent whorls.

Septal folding starts at poles of 3.5–4.5 whorl; mature specimens show weakly to moderately folded septa in polar regions; sagittal sections with short, thick triangular septa in inner 2.5–3.5 whorls; high and slender triangular or rod-shaped up to and including the 4–5.5 whorl and thin, straight or wavy, rod-shaped in subsequent whorls.

Chomata extend to poles in inner 3–5 whorls; relative width varies from 0.15 to 0.75 in 4.5–6th whorl; asymmetric up to and including 5–6th whorl, often symmetric or subsymmetric in subsequent whorls; generally steep slopes (often perpendicular) at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry varies from 8–25°, on average 15° (N = 8).

Axis straight; part of 1st whorl may be at a slight angle to subsequent whorls.

Wall of four layers; diaphanotheca thin in comparison with both the tectoria; upper-tectorium shows a tendency to decrease in relative thickness during growth, beyond 4th or 5th whorl generally as thick or even thinner than the diaphanotheca; the lower-tectorium on the other hand becomes relatively thicker in outer whorls; thickness of diaphanotheca is 9–17 μ in 5th whorl and 15–24 μ in 6–7th whorl.

Measurements: See Table 45.

Remarks: The present new species is markedly variable which becomes evident when specimens of the present assemblage are compared to other species. Different specimens compare closely with different species; e.g. specimen 4 is close to *F. schwagerinoides* (Deprat) and specimen 9 is somewhat similar to *F. vozhgalensis* Saf. subsp. *molokovensis* Raus. It is possible that the present variability is quite normal but that it is commonly obscured due to splitting natural populations in a number of artificial species. Another difficulty which hampers evaluating the variability of the present species lies in the unfortunate circumstance that so many of the species introduced in literature are illustrated by only one or two specimens.

Fusulinella maldrigensis sp. nov.

Pl. XLI Figs. 2–16

Type specimen: Specimen 15 (1) (Pl. XLI, Fig. 4) is designated as the holotype.

Locality: P 7.

Description:

Radius vector:	660–1215
Form ratio:	1.85–2.60
Number of whorls	5.5–7

From 1st to 7th whorl test changes from nautiliform or spherical (1st wh.) oval or short fusiform (2nd wh.) short fusiform, fusiform or ellipsoidal (3rd wh.) fusiform (4th wh.) to fusiform or elongate fusiform (5–7th wh.); lateral sides essentially straight or convex, sometimes slightly concave or irregular; poles bluntly pointed or rounded; spirotheca smooth in inner 3–6.5 whorls, septal grooves generally weakly expressed in subsequent whorls.

Septal folding starts at poles of 2.5–3.5 whorl; specimens of this assemblage with a relatively small form ratio show weak to moderate septal folding restricted to the poles, specimens with a larger form ratio show moderate to intensive septal folding in 5–6.5 whorl, which extends considerable distance over the lateral slopes; sagittal sections show short, thick triangular septa in inner 2.5–4 whorls, often high triangular or thick rod-shaped up to the 6th whorl and thin rod or club-shaped beyond the 4.5 whorl.

Chomata extend to poles in inner 2.5–5 whorls; relative width varies from 0.30 to 0.70 (5–5.5 wh.), from 0.20 to 0.65 (6–6.5 wh.); asymmetric in inner 4–6 whorls, sometimes subsymmetric or symmetric in subsequent whorls; specimens with the shorter form ratio show wider and higher chomata; generally steep, sometimes gentle slopes at the tunnel side.

Tunnel path slightly asymmetric or almost symmetric; maximum deviation of symmetry varies from 5° to 19°, on average 13°.

Axis straight or slightly curved; either maintains original position or 1st whorl at slight angle to subsequent whorls.

Wall of four layers; diaphanotheca generally thinner than upper or lower-tectorium but sometimes of equal thickness in 3–4.5 whorl; in subsequent whorls relative thickness of lower-tectorium increases that of upper-tectorium decreases; diaphanotheca appears in 2nd–4th whorl; its thickness varies from 13–17 μ (4th wh.), 11–21 μ (5–5.5 wh.) and 17–21 μ (6th wh.).

Measurements: See Table 46.

Remarks: One of the most allied species is *F. helenae* Raus. (cf. our specimens 12 and 59). *F. rara* Shlykova may be also very similar (cf. our specimens 15 (2), 16 and 53). Somewhat less closely related seems to be *F. vozhgalensis* Saf., *F. vozhgalensis* subsp. *molokovensis* Raus. and *F. tokmovensis* var. *longa* Reitl. (cf. our specimens 15 (1) and 62).

Fusulinella loresae sp. nov.

Pl. XLI Figs. 17–20
Pl. XLII Figs. 1–12

Type specimen: Specimen 30 (Pl. XLII, Fig. 1) is designated as the holotype.

Locality: P 10.

Description: Radius vector: 625–1295
Form ratio: 2.05–2.65 (5.5 wh.)
Number of whorls: 5.5–7.5

From 1st to 6th whorl test changes from nautiliform (1st wh.), short fusiform (2nd wh.) fusiform (3rd–4th wh.) to fusiform or elongate fusiform (5–6th wh.); lateral sides convex in inner 3 whorls and convex or straight in outer whorls, often not a smooth curving line but irregularly undulated; sagittal sections show a smooth spirotheca in inner 3–5 whorls and clearly marked septal grooves in subsequent whorls; poles bluntly pointed.

Septal folding starts at poles of 2.5–3rd whorl; sagittal sections show short triangular septa in inner 2.5–3.5 whorls, high triangular, rod or club-shaped in 2.5–4.5 whorl, rod or club-shaped in 4–7.5 whorl; in outer whorls of sagittal sections sometimes very thin and curved; this added to the irregular outline of the theca serves as a valuable distinctive characteristic.

Chomata may extend to poles in inner 3 whorls; occasionally still covering about 3/4 of lateral slopes in 4.5 whorl; relative width varies from 0.20 to 0.40 in 5–7th whorl; asymmetric in inner 4.5–6 whorls, sometimes symmetric or subsymmetric in subsequent whorls; commonly steep slopes at the tunnelside.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry 8–25°, on average 15° (N = 9).

First whorl often at an angle to subsequent whorls; axis generally straight, possibly curved in some specimens.

Wall of four layers including a very distinct diaphanotheca; thickness of diaphanotheca varies from 17 μ to 26 μ in 5–6th whorl; lower and upper-tectorium in general about as thick as diaphanotheca up to and including the 5.5 whorl; relative thickness of lower-tectorium quickly increases in subsequent whorls, upper-tectorium on the contrary becomes very thin; very fine mural pores occasionally observed in 4–7th whorl; a single specimen even showed pores in the 2nd whorl.

Measurements: See Table 47.

Remarks: Fusulinella podolskensis Raus., *F. colaniae* Lee *et* Chen, *F. colaniae* Lee *et* Chen subsp. *meridionalis* Raus., *F. helenae* Raus. and *F. pseudobocki* Lee *et* Chen are all similar to the new species. Comparison shows that:

Fusulinella podolskensis differs by its different wall structure, although it is similar with respect to juvenarium which is of the type of *F. schwagerinoides* (Deprat):

F. colaniae subsp. *meridionalis* has a thinner wall and a smaller L/D ratio:

F. colaniae is tighter coiled and has a much smaller maximum diameter:

F. helenae and *F. pseudobocki* have a different shaped juvenarium (cf. *F. bocki* Moeller).

Some of our specimens show a rugose spirotheca in outer whorls. According to Nikitina (1961), who observed this in *F. pseudobocki*, it is a normal phenomenon in species of *Fusulinella* living under strong hydrodynamic circumstances. This character, sensitive as it is to ecological factors, should not yet have been fixed genetically. The specimens in which Nikitina observed these rugose walls are all of upper Myachkovian age.

Fusulinella schwagerinoides (Deprat, 1913) subsp. *alvaradoi* subsp. nov.

Pl. XLII Figs. 13–15
Pl. XLIII Figs. 1–11

Type specimen: Specimen 14 (Pl. XLII, Fig. 13) is designated as the holotype.

Locality: P 22–2.

Description:	Radius vector:	770–1395
	Form ratio:	2.25–3.05 (6th wh.)
	Number of whorls:	6–7

From 1st to 6th whorl test changes from nautiliform (1st wh.) nautiliform, spherical or short fusiform (2nd wh.) subtriangular, fusiform or fusiform to subcylindrical (3rd–4th wh.) to fusiform, elongate fusiform or fusiform to subcylindrical (5–6th wh.); lateral sides convex or straight and subhorizontal; poles obtuse and rounded in inner whorls, bluntly pointed or pointed in outer whorls; one of the most conspicuous characters of the present subspecies is the high rate of increase of the radius vector which gives it a superficial resemblance to the Permian *Paraschwagerina*; spirotheca irregularly undulated in outer whorls.

Septal folding starts at poles of 2.5–4th whorl; in outer whorls moderately or intensely folded at poles and wholly straight in or near the median plane; sagittal sections show septa which are thin in comparison to the wall; triangular or rod-shaped in inner 3–4 whorls, acute rod-shaped, club-shaped or irregular in subsequent whorls.

Chomata wide and asymmetric in inner 2–5 whorls, extending at least halfway down lateral slopes and occasionally to the poles; in subsequent whorls relatively narrow and subsymmetric or symmetric; generally with steep to perpendicular slopes at the tunnel side.

Tunnel path symmetric or asymmetric; maximum deviation of symmetry varies from 9° to 33° and is on average 18° ($N = 8$).

First whorl coiled at angle to subsequent whorls; axis straight.

Wall of four layers; in inner 4 whorls diaphanotheca about as thick as lower or upper-tectorium; in subsequent whorls relative thickness of lower-tectorium rapidly increases whereas the upper-tectorium becomes thinner; thickness of diaphanotheca is 9–22 μ in 4–5th whorl and 17–26 μ in 5.5–7th whorl; very fine mural pores are usually present in 5–7th whorl.

Measurements: See Table 48.

Remarks: When Alvarado and Sampelayo (1945) mentioned the presence of *Triticites* (besides *Fusulina* and *Fusulinella*) in the Sierra Corisa Limestone Member they probably had in mind the present new subspecies of *F. schwagerinoides.* As in *Triticites* the present subspecies also shows pores penetrating the wall although narrower, not of honey-comb type and in outer whorls only. The new subspecies differs from the typical species by its microspheric state i.e. smaller proloculum, higher number of whorls and an unstable axis of coiling in innermost whorls. Moreover, the L/D ratio is smaller in the typical species.

Fusulinella mosquensis Raus. *et* Saf., 1951 * subsp. *abismoe* subsp. nov.
Pl. XLIV Figs. 1–20

Type specimen: Specimen 30 (Pl. XLIV, Fig. 1) is designated as the holotype.
Locality: P 73.

Description:	Radius vector:	540–935
	Form ratio:	2.00–2.65
	Number of whorls:	5–6.5

From 1st to 6.5 whorl test changes from nautiliform or spherical (1st wh.) oval, short fusiform or fusiform (2nd–3rd wh.) fusiform (4–5th wh.) to fusiform or elongate fusiform (6–6.5 wh.); lateral sides straight or convex, occasionally somewhat irregular in outer whorls; poles pointed or bluntly pointed, spirotheca smooth in inner 3.5–5.5 whorls (in one specimen up to and including 7th whorl), septal grooves well defined in subsequent whorls.

Septal folding starts at poles of 2–3.5 whorl, weakly to moderately folded septa in polar area at maturity; sagittal sections show short triangular septa in inner 2.5–4 whorls, high and slender triangular or rod or club-shaped in subsequent whorls.

Chomata nearly always extend to poles in inner 2–4 whorls; relative width of chomata 0.20–0.80 (4–5th wh.) and 0.20–0.40 (5–6th wh.); steep (sometimes perpendicular) or gentle slopes at the tunnel side; sometimes symmetric beyond 3.5 whorl.

Tunnel path symmetric or slightly asymmetric; maximum deviation of symmetry varies from 3° to 28° with an average of 15° (N = 15).

Axis maintains original position throughout growth; straight.

Wall of four layers; diaphanotheca appears in the 2.5 whorl; lower tectorium as thick, or thinner than the diaphanotheca in inner 3–4 whorls as thick or thicker in subsequent whorls; upper-tectorium conversely is thicker than the diaphanotheca in inner whorls and thinner in outer whorls; thickness of diaphanotheca 13–24 μ (5–6th wh.).

Measurements: See Table 49.

Remarks: The specimens from this locality are considered to be closely allied to *Fusulinella mosquensis* Raus. *et* Saf. They differ from the typical species in having, on average, more volutions and a thicker wall for corresponding whorls. They are also similar to *F. pseudobocki* Lee *et* Chen and *F. itadorigawensis* Ishii. Both species differ in having shorter inner whorls (smaller L/D ratio) except in comparison with our specimen 36. According to the original description of *F. colaniae* Lee *et* Chen this species has a tighter coiled spire as well as a smaller maximum diameter. However, only a redescription of *F. colaniae* could prove it to be distinct from the present

* In Rauser-Chernoussova *et al.*, 1951.

subspecies. *F. rara* Shlykova is probably closely allied also but this species has a much larger L/D ratio (according to data in text). The description and illustration of *F. rara* Shlykova forma *acuta* Reitl. is too poor to be of any use for comparison.

Fusulinella cf. *soligalichi* Dalm., 1961 subsp. *archedensis* Semikhatova *et* Melnikova, 1961*

Pl. XLIV Figs. 21–23

Locality: P 22–3.

Description: From 1st to 6th whorl test changes from nautiliform (1st wh.) spherical to short fusiform (2nd wh.) short fusiform (3rd–4th wh.) to fusiform (5–6th wh.); lateral sides straight or convex; in outer whorls poles pointed or bluntly pointed; spirotheca smooth.

Septal folding starts at poles of 3.5–4.5 whorl; at poles of outer whorls folding is still very weak or moderate; sometimes extending up lateral slopes to near the median plane (specimen 5).

Chomata extend to poles in inner 4–4.5 whorls; width in 4.5–5th whorl varies from 1/2 to 2/3 of lateral slopes; asymmetric up to 5.5 whorl, subsymmetric or symmetric in subsequent whorls; steep, often perpendicular slopes at the tunnel side.

Tunnel path almost symmetric; maximum deviation of symmetry in both axial specimens 9°.

Axis straight; inner 1–1.5 whorl sometimes coiled at angle to subsequent whorls.

Wall of four layers; diaphanotheca as thick, or thinner than lower or upper-tectorium; lower-tectorium apparently somewhat better developed than upper-tectorium.

Measurements:

	Wh.n.		0	1	2	3	4	5		6	
	Ax.	Sag.									
Specimen:		1	27	65	129	221	357	578			
	2		31	67	115	204	323	493	629		R.v.
	5		31	64	116	187	306	489		816	
				100	71	62	62				
				73	77	58	53				G.r.
				80	61	64	60		67		
				0.74	1.12	1.25	1.47	1.79	1.80		F.r.
				0.87	1.11	1.45	1.67	1.81		1.79	
				8	15	19	28	24			
				9	13	26	45	49	26		W.th.
				11	15	28	43	30	27		
				7	12	13	16	18			S.c.
					0.29	0.43	0.53	0.55	0.53		Ch.h.
					0.36	0.35	0.38	0.38	0.41	0.11	
					31	30	25	32		—	T.a.
					25	28	31	33		67	

Remarks: The specimens described above are very similar to *Fusulinella soligalichi* Dalm. subsp. *archedensis* Sem. *et* Meln. Unfortunately the information in the original description does not permit close comparison. Other less similar but probably rather closely related species are *F. bocki* Moell., *F. iowensis* Thomp. var. *leyi* Thomp. and perhaps also *F. llanoensis* (Thomas).

* In Semikhatova, 1961.

Fusulinella delepinei van Ginkel, 1959

Pl. XLV Figs. 1–15

Synonymy: 1943, *Fusulinella bocki* Moeller var. *delepinei* Gübler. — Gübler in Delépine, G.; Acad. Sci. Mém., Paris, 1943, Ser. 2, Vol. 66, No. 3, p. 102, pl. 2, figs. 5–7 (non pl. 2, figs. 1–4 = *Profusulinella prisca* subsp. *guebleri* subsp. nov.).

Type specimen: Specimen 15 (Pl. XLV, Fig. 4) is designated as the holotype.

Locality: A 1.

Description:

	microspheres	macrosphere (specimen 15)
Radius vector:	850–1260	600
Form ratio:	1.70–2.05	2.55
Number of whorls:	5.5–7	4.5

From 1st to 7th whorl in the microspheric types test changes from nautiliform (1st wh.) spherical, oval or short fusiform (2nd wh.) short fusiform, fusiform or subcylindrical (3rd–4th wh.) to short fusiform or fusiform (5–7th wh.).

From 1st to 4.5 whorl in the macrospheric type test changes from nautiliform (1st wh.) fusiform (2nd–3rd wh.) to fusiform to elongate fusiform (4–4.5 wh.). Lateral sides essentially convex with a tendency to straight or even slightly concave sides in outer whorls; periphery broadly arched; poles bluntly pointed; spirotheca smooth in inner 3.5 whorls, smooth or very slightly inflated between septa in subsequent whorls.

Septa straight from pole to pole in inner 3–4 whorls, slightly folded at the poles of subsequent whorls.

In specimen 15 (macrospherical type) septal fluting starts even at the poles of the 2.5 whorl.

In sagittal sections septa short triangular in inner 2.5 whorls; from 2.5–5th whorl short or high and slender triangular, to rod-shaped; in 5–7th whorl thin rod or club-shaped.

Chomata (microspherical type) extend to poles in inner 3.5–4.5 whorls and cover about half the lateral slopes in 5th whorl; relative width decreases to 0.15–0.40 in outer whorls; asymmetric up to 6th whorl, subsymmetric or symmetric in outer 2 whorls (6–7th wh.); generally steep, often perpendicular slopes at the tunnel side.

Chomata (macrospherical type) do not extend to poles and cover 0.50 to 0.75 of lateral slopes in inner 3.5 whorls; relative width decreases to 0.20–0.25 in outer whorls (4–4.5 whorl); asymmetric up to the 4th whorl, symmetric in last whorl.

Tunnel path (microspherical type) almost symmetric or slightly asymmetric; average and range of maximum deviation of symmetry respectively 15° and 10–19°.

The macrospherical type shows an almost symmetric tunnel path; maximum deviation of symmetry 9°.

The microspherical type shows inner 1–2 whorls coiled at an angle to subsequent whorls.

Axis maintains original position in specimen 15.

Wall of four layers i.e. tectum, diaphanotheca and both upper and lower-tectorium; upper-tectorium thin as compared to both diaphanotheca and lower-tectorium. Up to 3.5–5.5 whorl diaphanotheca as thick, or thicker than lower-tectorium, whereas in subsequent whorls frequently thinner; diaphanotheca appears in 3rd–4th whorl; from 4th whorl to 6th whorl it is respectively 9–17 μ, 13–21 μ and 17–22 μ in thickness.

Measurements: See Table 50.

Remarks: The description of *Fusulinella delepinei* van Ginkel is based on samples from the type locality of *Fusulinella bocki* Moell. var. *delepinei* Gübler. In an earlier publication (van Ginkel, 1959) *F. bocki* Moell. var. *delepinei* Gübler was considered to be sufficiently different from *F. bocki* Moell. to bring it to species level. At that time, however, it was not realized that the description of Gübler's variety was based on a heterogeneous assemblage of specimens i.e. *Profusulinella prisca* (Depr.) subsp. *guebleri* subsp. nov. and *F. delepinei* van Ginkel. As a consequence when the differences between *F. bocki* Moeller and Gübler's variety were reported, this was done with his figures 1–4 (= *Profusulinella prisca* (Depr.) subsp. *guebleri* sp. nov.) in mind, although this was not stated explicitly nor was the type specimen of *F. delepinei* designated. In the present paper *Fusulinella delepinei* van Ginkel is identified with Gübler's figures 5–7 (pl. 2). Since these figures do not present oriented sections, a type specimen is chosen from the present writer's collection.

A comparison of *Fusulinella delepinei* van Ginkel with *Fusulinella bocki* Moell. shows the following differences: *Fusulinella bocki* Moell. is of macrospherical type with respect to the present species. [1] This means that Moeller's species has a larger proloculum, a nonplectogyroid juvenarium and fewer whorls. In addition the diaphanotheca is better developed in *F. bocki* Moell. and also septal fluting is more intense. In all these characters *F. delepinei* is obviously more primitive than *F. bocki*; on the other hand, chomata are more strongly developed in *F. bocki.* The differences permit us to consider our specimens as specifically distinct from *F. bocki* Moell. *F. delepinei* evidently belongs to the group of *F. schubertellinoides* (Put.) [2]. Other closely allied species are: *F. praebocki* subsp. *lata* Reitl., *F. praecolaniae* Saf., *F. tokmovensis* var. *longa* Reitl. and *F. paraschubertellinoides* (Put. *et* Leont.). The present species is closer to each of the species just mentioned above than to *F. bocki* Moell. It is believed that *F. delepinei* van Ginkel is most similar to *F. paraschubertellinoides* (Put. *et* Leont.) The present species differs from the latter mainly in having a thicker spirotheca and by the appearance of a diaphanotheca in an earlier stage of growth.

Fusulinella branoserae van Ginkel, 1957

Pl. XLV Figs. 16–21
Pl. XLVI Figs. 1–11

Locality: P 38.

Description:

Radius vector:	430–1055
Form ratio:	2.50–3.65
Number of whorls:	4.5–6.5

From 1st to 6th whorl test changes from nautiliform or spherical (1st wh.) spherical, ellipsoidal or short fusiform (2nd wh.) short fusiform to elongate fusiform or subcylindrical (3rd–5th wh.) to elongate fusiform or subcylindrical (6th wh.); beyond 2nd whorl lateral sides straight or convex, beyond 4th whorl often undulated; a single specimen (specimen 108) shows slightly concave sides at maturity; poles bluntly pointed to rounded (subcylindrical specimens) or bluntly pointed to pointed (elongate fusiform specimens); spirotheca smooth in inner 2 whorls, generally

[1] This difference apparently does not hold for specimens from the Timan region (U.S.S.R.) referred to *Fusulinella bocki* Moell. by Rauser-Chernoussova (1951).

[2] The original description of *F. schubertellinoides* has not been available to the present writer.

smooth or slightly inflated between septa in subsequent whorls, septal furrows sometimes well marked in 5–6.5 whorl.

Septa straight from pole to pole in inner 1.5–3 whorls, folded at polar regions of subsequent whorls; folding gradually more intense as specimens become mature often extremely intense but irregular septal folding at poles of 5–6th whorl; sagittal sections show triangular septa in inner 4 whorls which become rod or club-shaped and thin in comparison to wall in subsequent whorls.

Chomata do not extend to poles apparently not even in inner whorls, yet width in inner 3 whorls is at least half distance from tunnel along lateral slopes to poles; relative width in mature specimens varies from 0.15 to 0.45; asymmetric up to 5th whorl, asymmetric or symmetric in subsequent whorls; steep, frequently perpendicular, or gentle slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric, average and range of maximum deviation of symmetry respectively 11° and 5–23° (N = 10); average and range of tunnel angle from 2nd–5th whorl are respectively: 23° (10–33°), 33° (20–54°), 47° (29–59°) and 60° (43–76°).

First whorl either coiled at an angle to subsequent whorls or axis maintains original position throughout growth. This respective state of axis is clearly correlated with size of proloculum and number of whorls.

Wall of four layers i.e. tectum, diaphanotheca and both upper and lower-tectorium; generally diaphanotheca as thick as upper or lower-tectorium; locally, however, lower-tectorium somewhat thicker and upper-tectorium slightly thinner than diaphanotheca; in lower-tectorium very fine pores frequently observed (specimen 67); thickness of diaphanotheca in 5–6th whorl is 15–22 μ.

Measurements: See Table 51.

Remarks: The above description of *F. branoserae* is based on holotype and paratypes of this species. The present species is an advanced and specialized representative of the genus *Fusulinella* Moeller. Its distinctive characters are the large form ratio, the rather small radius vector and the fairly thin spirotheca which occasionally shows pores in the outer whorls penetrating all layers of the wall. *Fusulinella branoserae* is similar to *Fusulinella gracilis* Kanm. We might consider both species to belong to a specialized and probably dead-end branch of *Fusulinella* Moeller. They seem to be restricted to the Myachkov substage of the Moscovian.

Fusulinella ex gr. *mosquensis* Rauser-Chernoussova *et* Safonova, 1951 *

Pl. XLVI Figs. 12–19
Pl. XLVII Figs. 1–5

Locality: P 22–1.

Description:

Radius vector:	560–1140
Form ratio:	2.00–2.90
Number of whorls:	5–6

From 1st to 6th whorl test changes from nautiliform, spherical or oval (1st wh.) oval or short fusiform (2nd wh.) short fusiform or fusiform (3rd wh.) fusiform (4th wh.) to fusiform or elongate fusiform (5–6th wh.); sometimes slightly inflated at maturity (specimens 7, 6 and 4); lateral sides convex, straight or, at maturity, concave or irregular; poles bluntly pointed, sometimes rounded; spirotheca smooth up to 5th whorl, septal grooves slightly marked in subsequent whorls.

* In Rauser-Chernoussova *et al.*, 1951.

Septal folding starts at poles of 2–3.5 whorl; at maturity folding moderate at poles, extending sometimes a considerable distance up the lateral slopes towards the median plane (e.g. specimens 4 and 5); septa in sagittal sections thick triangular or rod-shaped (inner 3 whs.) rod-shaped (4th wh.), rod or club-shaped (5–6th wh.).

Chomata may extend to poles up to 4th whorl; specimen 4 characterized by well-developed septal folding, shows chomata which though wide, do not reach poles in inner whorls; width varies from 0.20 to 0.70 of lateral slopes in 5–5.5 whorl; generally steep, sometimes perpendicular slopes at the tunnel side; asymmetric up to 4th whorl, asymmetric or symmetric in subsequent whorls.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry varies from 6° to 28° and is on average 17° (N = 9).

Axis straight or curved; normally maintaining original position throughout growth; occasionally 1st whorl coiled at a very slight angle to subsequent whorls.

Wall of four layers; diaphanotheca generally of equal or lesser thickness than upper or lower-tectorium; thickness of diaphanotheca is 6–15 μ in 4.5 whorl and 11–20 μ in 5th whorl.

Measurements: See Table 52.

Remarks: The present species is closely similar to the species referred by Rauser-Chernoussova (Rauser-Chernoussova *et al.*, 1951) to *Fusulinella rara* Shlykova. According to the original description of *Fusulinella rara*, this species has a somewhat smaller maximum diameter i.e. slightly less volutions with a nearly equal diameter for corresponding whorls.

Fusulinella ex gr. *colaniae* Lee *et* Chen, 1930
Pl. XLVII Figs. 6–22

Locality: P 57.

Description:

Radius vector:	710–1080
Form ratio:	2.05–2.45
Number of whorls:	5.5–6.5

From 1st to 6.5 whorl test changes from nautiliform or spherical (1st wh.) spherical, oval or short fusiform (2nd wh.) short fusiform or fusiform (3rd wh.) to fusiform or inflated fusiform (4–6.5 wh.); lateral sides straight or convex up to 4–6th whorl, often concave (e.g. specimens 3 and 6) in subsequent whorls; poles bluntly pointed or bluntly pointed to rounded; spirotheca smooth in inner 3.5–5 whorls, septal grooves weakly marked in subsequent whorls; spirotheca sometimes fairly irregular in outer whorls (e.g. specimens 3 and 6).

Septal folding starts at poles of 2–2.5 whorl, moderate (e.g. specimens 10, 2 and 3) or intense (e.g. specimen 6) at maturity; adult specimens show somewhat undulatory septa in outer whorls up to or near median plane; degree of folding seems to be negatively correlated with development of chomata; septa in sagittal sections may be triangular (up to 4.5 wh.), thick rod-shaped (2–5.5 wh.), thin rod-shaped (5–6.5 wh.).

Chomata extend to poles in inner 2–5 whorls, generally in inner 2–3 whorls; width of chomata varies strongly in different specimens: generally wide in 3–4.5 whorl covering about 1/3 to 2/3 of lateral slopes; occasionally chomata still cover 3/4 of lateral slopes in 6th whorl and somewhat less than 1/2 in 6.5 whorl (e.g. specimen 10); asymmetric in inner 3–5 whorls, sometimes subsymmetric or symmetric in subsequent whorls; generally steep, sometimes gentle slopes at the tunnel side.

Tunnel path almost symmetric to asymmetric; maximum deviation of symmetry varies from 11° to 40° and is on average 24° (N = 10).

Axis of coiling straight, maintaining original position throughout growth.

Wall of four layers; thickness of diaphanotheca is 9–13 μ in 4th whorl and 13–22 μ in 5–6th whorl which is about equal to the upper or lower-tectorium; in outer whorls of mature specimens diaphanotheca sometimes slightly thicker than upper-tectorium and slightly thinner than lower-tectorium.

Measurements: See Table 53.

Remarks: The present species may be compared with species of the group *Fusulinella colaniae* Lee *et* Chen (sensu Rauser-Chernoussova *et al.*, 1951). Some specimens (e.g. specimen 5) show a certain resemblance to species of the group *F. schwagerinoides* (Deprat) (sensu Rauser-Chernoussova *et al.*, 1951).

F. colaniae subsp. *meridionalis* Raus. which is similar in many respects differs in having slightly less volutions and a smaller diameter. Moreover, it has a much thinner wall. *F. rara* forma *curta* Reitl. (cf. our specimen 6) has been inadequately described and for th's reason apparent differences cannot be trusted to be of significant value. The same holds for *F. rasdorica* Sem. *et* Meln. and *F. colaniae* subsp. *rasdorica* Sem. *et* Meln. The latter subspecies has apparently a much larger L/D ratio. The Japanese species *F. itadorigawensis* Ishii and *F. kamitakarensis* Igô are also similar. The former has a much smaller form ratio in inner three whorls. The latter has a much thinner diaphanotheca, less-fluted septa as well as a lower maximum diameter.

Fusulinella ex gr. *bocki* Moeller, 1878
(1st assemblage)

Pl. XLVIII Figs. 1–11
Pl. IL Fig. 1

Locality: L 21.

Description: Radius vector: 935–1355
Form ratio: 1.95–2.75
Number of whorls: 5.5–7

From 1st to 7th whorl test changes from spherical or oval (1st wh.) oval or short fusiform (2nd–3rd wh.) oval, short fusiform or fusiform (4–5th wh.) to fusiform or elongate fusiform (6–7th wh.); lateral sides essentially convex or straight, sometimes in outer whorls slightly concave or irregular; poles bluntly pointed; spirotheca smooth in inner 4–5.5 whorls, septal grooves generally weakly expressed in subsequent whorls.

Septal folding starts at poles of 3–4.5 whorl; moderately folded in polar regions at maturity; septa in sagittal sections thick and short triangular (inner 2–3 whs.), high and slender triangular or rod-shaped (3.5–5.5 wh.) thin rod or club-shaped (6–7th wh.).

Chomata extend to poles in inner 3–5 whorls; relative width varies from 0.25 to 0.75 in 5–6.5 whorl.

Asymmetric up to and including 4–6.5 whorl, sometimes symmetric or subsymmetric in subsequent whorls, generally steep slopes (often perpendicular) at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry varies from 10° to 21° with an average of 14° (N = 8).

Axis straight, maintaining original position throughout growth.

Wall of four layers; diaphanotheca weakly differentiated, yet generally distinct beyond 3rd–5th whorl; not observed in inner 5 whorls of a single specimen; thin in comparison with both tectoria, especially upper-tectorium; in outer whorls (6–7th whorl) relative thickness of lower-tectorium increases; thickness of diaphanotheca 4–13 μ (4.5–5th wh.), 13–21 μ (5.5–6th wh.).

Measurements: See Table 54.

Remarks: The present species is best compared with *F. pseudobocki* Lee *et* Chen. The latter species differs, however, in having slightly fewer volutions as well as a smaller diameter for corresponding whorls. They seem to be more closely allied to specimens from the Agujas Limestone Member (Loc. P 72) than any other *Fusulinella* collected by us in NW Spain. *F. valida* Reitl. var. *superba* Reitl. and *F. soligalichi* Dalm. subsp. *firma* Reitl. are also similar to some extent.

Fusulinella ex gr. *bocki* Moeller
(2nd assemblage)

Pl. IL Figs. 2–9

Locality: A 6.

Description: Radius vector: 560–935
Form ratio: 1.90–2.25
Number of Whorls: 5.5–6

From 1st to 6th whorl test changes from nautiliform to spherical (1st wh.) oval or short fusiform (2nd wh.) short fusiform or fusiform (3rd–4th wh.) to fusiform (5–6th wh.); lateral sides convex or straight up to and including 4th whorl, sometimes slightly concave or irregular in subsequent whorls; poles bluntly pointed or bluntly pointed to rounded; spirotheca smooth in inner 2.5–4.5 whorls, slightly marked septal furrows in subsequent whorls.

Septal folding starts at poles of 2.5–4th whorl; at maturity weak or moderate septal folding in polar area, extending some distance up the lateral slopes; septa in sagittal sections thick, short triangular (inner 2–3 whs.) high and slender triangular or thick rod-shaped (up to 5th wh.) thin rod or club-shaped (5–6th wh.).

Chomata extend to poles in inner 3–4 whorls; still wide in outermost whorls; relative width varies from 0.50 to 0.65 in 5–6th whorl; generally asymmetric, sometimes symmetric or subsymmetric in 5–6th whorl; steep (occasionally perpendicular) or gentle slopes at the tunnel side.

Tunnel path almost symmetric to asymmetric; maximum deviation of symmetry varies from 13° to 38° and is on average 23° (N = 5).

Axis straight, generally maintaining original position throughout growth; occasionally 1st whorl coiled at an angle to subsequent whorls.

Wall of four layers; diaphanotheca distinct, sometimes as thick as lower or upper-tectorium but generally slightly thinner.

Measurements: See Table 55.

Remarks: The present species is about intermediate between *F. pseudobocki* Lee *et* Chen and *F. bocki* var. *pauciseptata* Raus. *et* Belj. The latter, which resembles it in the small number of septa, differs in having on average somewhat less volutions and a slightly smaller L/D ratio (2.0–2.2 as against 2.0–2.4). *F. pseudobocki* differs in having on average a somewhat larger diameter and L/D ratio. Moreover, inner whorls are apparently relatively shorter (smaller L/D ratio). *F. bocki* subsp. *intermedia* Raus., *F. simplicata* Tor., *F. mosquensis* Raus. *et* Saf. and *F. praebocki* subsp. *lata* Reitl. are somewhat similar species.

Fusulinella ex gr. *bocki* Moeller
(3rd assemblage)
Pl. IL Figs. 10–13

Locality: P 4.

Description:	Radius vector:	561–714
	Form ratio:	1.60–1.95
	Number of whorls:	4.5–5

From 1st to 5th whorl test changes from spherical (1st wh.) short fusiform (2nd wh.) short fusiform, fusiform or short subcylindrical (3rd–5th wh.); lateral sides convex or straight; periphery sometimes flat; poles bluntly pointed or rounded and obtuse.

Septal folding starts at poles of 3rd–4th whorl; in outer whorls folding weak or moderate, occasionally extending some distance up the lateral slopes.

Chomata extend to poles in inner 3.5–5 whorls; width still considerable in subsequent whorls; generally with steep slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry in 3 specimens is 11°, 9° and 22° respectively.

Axis straight, generally maintaining original position throughout growth; occasionally first half whorl coiled at an angle to subsequent whorls (e.g. specimen 27).

Wall of four layers; diaphanotheca thin as compared to upper and lower-tectorium, sometimes of equal thickness; not observed in inner 1.5–3 whorls; thickness of diaphanotheca is 7–9 μ in 4th whorl and 13–17 μ in 4.5 whorl.

Measurements: See Table 56.

Remarks: The present species is closely related to *Fusulinella bocki* Moell. and some of its varieties and subspecies, notably *F. bocki* var. *pauciseptata* Raus. *et* Belj. and *F. bocki* subsp. *intermedia* Raus. *et* Saf. Somewhat similar are also *F. praebocki* Raus. and *F. mosquensis* Raus. *et* Saf. Unfortunately our sample yielded only few oriented specimens so that truly close comparisons with any of the above mentioned species could not be made.

Fusulinella ex gr. *bocki* Moeller
(4th assemblage)
Pl. IL Figs. 14–19

Locality: P 58.

Description:	Radius vector:	1110–1250 (6–6.5 wh.)
	Form ratio:	1.60–2.00 (5.5–7.5 wh.)
	Number of whorls:	6–7.5

From 1st to 7.5 whorl test changes from spherical (1st wh.) short fusiform (2nd wh.) short fusiform or fusiform (3rd–5th wh.) to fusiform (6–7.5 wh.); lateral sides straight or convex; poles bluntly pointed; spirotheca smooth in inner 4.5–6 whorls, septal furrows well marked in subsequent whorls; specimen 24 shows aberrant growth beyond the 3rd whorl.

Septal folding starts at poles of 3–3.5 whorl; at maturity still weakly folded near the poles, sometimes extending, however, to near the median plane (e.g. specimen 16); septa in sagittal sections thick triangular (inner 2.5 whs.) slender and curved triangular or rod-shaped (up to 4.5 wh.); more often club-shaped (beyond 4.5 wh.).

Chomata extend to poles in inner 3–5 whorls, still very wide in subsequent whorls; relative width is 0.60–0.75 up to the 6th whorl, reducing to 0.50 in 6.5 whorl (e.g. specimen 16); asymmetric throughout growth; steep, generally perpendicular slopes at the tunnel side.

Tunnel path slightly asymmetric; maximum deviation of symmetry for 3 specimens is 13°, 20° and 20° respectively.

Axis straight, maintaining original position throughout growth.

Wall of four layers; diaphanotheca generally about as thick as upper-tectorium and often thinner than lower-tectorium; thickness of diaphanotheca is 11–19 μ (4th wh.), 13–22 μ (5th wh.) and 21–26 μ (6th wh.).

Measurements: See Table 57.

Remarks: The present species resembles the following species or subspecies: *Fusulinella bocki* Moell., *F. bocki* subsp. *biconiformis* Ishii, *F. bocki* subsp. *timanica* Raus., *F. pseudobocki* Lee *et* Chen, *F. tokmovensis* var. *longa* Reitl. The Spanish specimens differ in having either a larger L/D ratio (up to 2.25), more whorls (up to 7.5) or a larger diameter (up to 2.30 mm). Moreover, the L/D ratio increases more rapidly and to relatively higher values in inner whorls. There is apparently a close relation with *Fusulinella* sp. from the Cotarazo Limestone Member (Loc. P 40).

Fusulinella ex gr. *pulchra* Rauser-Chernoussova *et* Beljaev, 1936 (1st assemblage)

Pl. L Figs. 1–6

Locality: A 1.

Description:	Radius vector:	860–1165
	Form ratio:	1.50–2.05
	Number of whorls:	7–7.5

From 1st to 7.5 whorl test changes from spherical or oval (1st wh.) spherical, oval, short fusiform or subrhomboidal (2nd wh.) subrhomboidal to short fusiform (3rd–4th wh.) to subrhomboidal or elongate subrhomboidal (5–7.5 wh.); generally with inflated median region beyond the 3rd whorl; lateral sides straight or convex in inner 2–3 whorls, straight or concave in subsequent whorls; poles pointed or bluntly pointed (2nd–6th wh.), bluntly pointed or rounded (7–8th wh.); periphery arched; spirotheca smooth.

Septal folding starts at poles of the 3.5–4.5 whorl; this folding is restricted to a narrow zone along the axis and extends in the 7–7.5 whorl somewhat up the lateral slopes; septa in sagittal sections thick triangular (inner 3.5 whs.), rod-shaped with generally rounded ends (subsequent whorls); appr. as thick as the wall or in outer whorls slightly thinner.

Chomata extend to poles in inner 4–6 whorls; starting with appr. the 4th whorl relative height in a poleward direction abruptly decreases to a thin sheet which extends over the lateral slopes to near the poles; generally asymmetric throughout growth, sometimes subsymmetric in 6–7.5 whorl; relative width in outer whorls 0.10–0.70 (6.5 wh.), 0.20–0.40 (7th wh.); generally steep, frequently perpendicular slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry ranges from 8° to 23° and is on average 12° (N = 6); average and range of tunnel angle from 2nd to 7th whorl are respectively: 18° (14–23°); 15° (7–23°); 17° (13–20°); 19° (16–23°); 20° (15–29°); 25° (20–35°).

Axis usually maintains original position throughout growth; occasionally inner whorls at a slight angle to subsequent whorls.

Wall in inner 3.5–4.5 whorls is reminiscent of that in *Profusulinella*; in outer whorls a diaphanotheca appears which, although relatively thick with respect to the tectoria, is still weakly differentiated.

Measurements: See Table 58.

Remarks: The species described belongs without doubt to the group of *Fusulinella pulchra* Raus. *et* Belj. To some degree it is similar to species such as *F. itoi* (Ozawa), *F. pulchra* Raus. *et* Belj., *F. eopulchra* Raus., *F. biconica* (Hayasaka), *F. subpulchra* Put. [1] and *F. subpulchra* var. *submesopachis* Put. It is most similar to *F. subpulchra* Put. and *F. subpulchra* var. *submesopachis* Put., although it apparently is neither identical with the typical species nor with the variety. The present specimens may be considered to be a subspecies of *F. subpulchra* Put.

Fusulinella ex gr. *pulchra* Rauser-Chernoussova *et* Beljaev (2nd assemblage)

Pl. L Figs. 7–19

Locality: A 5.

Description:	Radius vector:	550–765 (6–7th wh.)
	Form ratio:	1.80–2.30
	Number of whorls:	6–7.5

From 1st to 6.5 whorl test changes from nautiliform, spherical or spherical to short fusiform (1st wh.) short fusiform or subrhomboidal (2nd–3rd wh.) to subrhomboidal or elongate subrhomboidal (4–6.5 wh.); lateral sides straight or convex in inner 2.5–4 whorls; straight or concave in subsequent whorls; generally pointed or bluntly pointed poles in 2nd–5th whorl, bluntly pointed to rounded in subsequent whorls; periphery broadly arched.

Septa straight from pole to pole in inner 3.5 whorls; occasionally straight in inner 5–5.5 whorls (e.g. specimens 12, 33); clearly folded at polar ends — often extending for quite a distance up the lateral sides — in subsequent whorls.

Chomata extend to poles in inner 4–5.5 whorls; relative height in outer whorls abruptly decreases polewards and chomata continue as very low ribbons to near the poles; asymmetric in inner 5.5 whorls, sometimes subsymmetric in 6–7.5 whorl; generally steep, often perpendicular slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; maximum deviation of symmetry varies from 5° to 25°, on average 12° (N = 10).

Axis either maintains original position throughout growth or inner 2–3 whorls coiled at a very slight angle to subsequent whorls.

[1] The original description of *F. subpulchra* has not been available to the present writer.

Diaphanotheca generally observed; relatively thick, but only slightly less dense than the tectoria.

Measurements: See Table 59.

Remarks: The specimens here described are closely related to species of the group *Fusulinella pulchra* Raus. *et* Belj. especially to the assemblage from the limestone of Ribadesella (Loc. A 1). The present specimens differ from those of Ribadesella (Loc. A 1) in having somewhat higher chomata, a smaller radius vector for corresponding whorls, a higher form ratio and somewhat thinner walls. They are apparently still closer to *Fusulinella subpulchra* Put. than the subspecies from Ribadesella.

Fusulinella sp. 1

Pl. L Figs. 20–21
Pl. LI Figs. 1–8

Locality: A 8.

Description:

Radius vector:	740–920
Form ratio:	2.30–2.80
Number of whorls:	6–6.5

From 1st to 6.5 whorl test changes from nautiliform or spherical (1st wh.) spherical, short fusiform or fusiform (2nd wh.) short fusiform or fusiform (3rd wh.) to fusiform or elongate fusiform (4–6.5 wh.); in inner 5 whorls lateral sides straight (sometimes horizontal) or convex, in subsequent whorls generally very irregular (e.g. specimen 5) sometimes strongly concave; spirotheca smooth in inner 4–5 whorls, septal grooves weakly marked in subsequent whorls.

Septal folding starts at poles of 3–3.5 whorl and is moderate or intense at polar regions of outer whorls (5–6.5 wh.); even in the median plane septa no longer straight in some specimens; sagittal sections show short and thick triangular septa in inner 2.5–4 whorls, up to and including 5th whorl high and slender triangular or thick rod-shaped, in 6th whorl thin rod-shaped or wavy.

Chomata extend to poles in inner 2.5–3 whorls; relative width varies from 0.45 to 0.80 in 4–5th whorl, from 0.30 to 0.45 in 5.5–6th whorl; asymmetric up to 5.5 whorl, sometimes subsymmetric in subsequent whorls; steep or gentle slopes at the tunnel side.

Tunnel path almost symmetric to asymmetric; maximum deviation of symmetry varies from 13° to 31° and is on average 20° (N = 5).

Axis maintains original position throughout growth; slightly curved (e.g. specimen 9) or straight.

Wall of four layers; thickness of diaphanotheca is 13–17 μ (5th wh.), 21–24 μ (6th wh.); in outer whorls diaphanotheca thick with respect to upper-tectorium; starting with 4–5th whorl relative thickness of lower-tectorium strongly increases.

Measurements: See Table 60.

Remarks: The present species is most similar to *F. schwagerinoides* (Depr.) var. *adjuncta* Shlykova, *F. colaniae* Lee *et* Chen and the subspecies *meridionalis* Raus., *F. velmae* Thomp. var. *protensa* Thomp. and, in less degree, *F. mosquensis* Raus. *et* Saf.

F. schwagerinoides var. *adjuncta* is similar in about every character except for the larger proloculum and less intensely fluted septa in the polar regions.

F. mosquensis is similar to some specimens of the present assemblage but differs in having on average a smaller L/D ratio as well as fewer whorls and less intensely fluted septa.

F. colaniae subsp. *meridionalis* has on average a smaller L/D ratio as well as a thinner wall and less volutions.

F. velmae var. *protensa* has more septa in corresponding whorls, a smaller tunnel angle in outer whorls and probably a thinner wall.

Fusulinella sp. 2

Pl. LI Figs. 9–13
Pl. LII Figs. 1–10

Locality: P 40.

Description:

Radius vector:	705–1190
Form ratio:	1.55–2.35
Number of whorls:	5.5–6.5

From 1st to 6.5 whorl test changes from spherical or short fusiform (1st–2nd wh.) short fusiform or fusiform (3rd–5th wh.) to fusiform (6–6.5 wh.); a single specimen is short subcylindrical at maturity (5th wh.); lateral sides essentially convex, in outer whorls sometimes straight or irregular; poles bluntly pointed or rounded; spirotheca smooth up to and including 5–5.5 whorl.

Septal folding starts at poles of 2nd–4th whorl; folding weak or moderate at maturity sometimes extending up the lateral slopes to near the sagittal plane (e.g. specimens 13, 14, 7 and 9); sagittal sections show short triangular septa in inner 2.5–3.5 whorls, up to 4–4.5 whorl short to slender triangular or thick rod-shaped, up to 6th whorl generally thin rod-shaped.

Chomata extend to poles in inner 2–5 whorls; relative width varies from 0.20 to 0.60 in 5–6.5 whorl; asymmetric up to 5th whorl, subsymmetric or asymmetric in subsequent whorls; steep or gentle slopes at the tunnel side.

Tunnel path occasionally almost symmetric but more often slightly or wholly asymmetric; maximum deviation of symmetry varies from 6° to 33° and is on average 23° (N = 9).

Axis straight, normally maintaining original position throughout growth; sometimes 1st whorl coiled at an angle to subsequent whorls (e.g. specimens 33, 10).

Wall of four layers; diaphanotheca distinct in all whorls except for innermost 2 whorls; its thickness in 5th whorl varies from 11 μ to 24 μ; tectoria nearly as thick as diaphanotheca; in outer whorls of some specimens a tendency to a relatively somewhat thicker lower-tectorium and a thinner upper-tectorium has been observed.

Measurements: See Table 61.

Remarks: Specimens differ very much from each other especially if we bear in mind the narrow limits which nowadays define newly introduced species. Yet it is believed that the present assemblage represents a single highly variable species.

We may distinguish three main types (connected to each other by transitional specimens) represented by respectively specimen 33 (cf. *F. bocki* Moell., *F. bocki* subsp. *timanica* Raus.), specimen 9 (cf. *F. pseudobocki* Lee *et* Chen) and specimen 7 [cf. *F.* ex gr. *schwagerinoides* (Depr.)].

Fusulinella sp. 3

Pl. LII Figs. 11–12

Locality: P 72.

Description: Radius vector: 1140–1330 (6th wh.)
Form ratio: 1.85–2.05 (6th wh.)
Number of whorls: 6–7

From 1st to 6th whorl test changes from oval or short fusiform (1st wh.) short fusiform (2nd wh.) to short fusiform or fusiform (3rd–6th wh.); lateral sides convex.

Septal folding starts at poles of 3.5–4.5 whorl and is still weak at maturity; sometimes spreading a short distance up the lateral slopes.

Chomata extend to poles in inner 4–5 whorls, still wide and usually fairly high in subsequent whorls; occasionally symmetric beyond 4th whorl; generally steep slopes at the tunnel side.

Tunnel path slightly asymmetric to asymmetric; maximum deviation of symmetry in 2 specimens respectively 22° and 28°.

Axis straight; first half whorl may be at an angle to subsequent whorls.

Wall of four layers; diaphanotheca as thick, or thinner than tectoria varying from 17 μ to 21 μ (4–5th wh.) and 24 μ to 28 μ (5.5–6.5 wh.).

Measurements: See Table 62.

Remarks: The species described above is probably new. Unfortunately our material is too scanty to base a new name upon. The most typical character is the extremely large diameter. In this respect only *F. valida* Reitl. subsp. *superba* Reitl. may be compared with the Spanish species. However, the subspecies described by Reitlinger shows straight or even slightly concave lateral sides and narrower chomata. The juvenaria of both the Spanish specimens and *F. valida* are very much alike and point to their mutual affinity.

Genus OBSOLETES Kireeva, 1950

Kireeva, G. D., New species of fusulinids from limestones of the series C_3^1 and C_3^2 of the Donetz basin. Mater. Stratigr. Paleontol. Donetz Bas., Moscow, Ugletekhizdat, 1950, pp. 193–214, 4 pls.

Obsoletes? sp. (aff. *O. mirabilis* Kir., 1950)

Pl. LIII Figs. 1–2

Locality: P 36.

Description: From 1st to 5.5 whorl test changes from short fusiform (1st wh.) fusiform (2nd wh.) fusiform or short cylindrical (3rd wh.) elongate fusiform or cylindrical (4th wh.) to cylindrical (5–5.5 wh.); lateral sides convex or straight and horizontal; poles either bluntly pointed or, especially at maturity rounded; spirotheca often irregularly undulated in last 2 whorls.

Septal folding starts at poles of 1.5–2.5 whorl; at the pole region of mature specimens folding moderate to intense; specimen 3 shows in 3–4.5 whorl septal folding extending a great distance up the lateral slopes to near the median plane.

Chomata extend to poles in inner 2.5–3 whorls; still wide and asymmetric in 3.5–4th whorl with a relative width varying from 0.25 to 0.50; beyond 4th whorl symmetric or subsymmetric, very narrow or even absent; average and range of relative height from 1st to 5.5 whorl respectively: 0.34, 0.27–0.41 (1st wh.); 0.41, 0.33–0.47 (2nd wh.); 0.47, 0.41–0.54 (2.5 wh.); 0.51, 0.46–0.56 (3rd wh.); 0.49, 0.42–0.57 (3.5 wh.); 0.45, 0.33–0.55 (4th wh.); 0.37, 0.33–0.40 (4.5 wh.); 0.25, 0.00–0.36 (5th wh.); 0.11, 0.00–0.23 (5.5 wh.).

Tunnel path slightly asymmetric or asymmetric; maximum deviation of symmetry of two axial sections 26° and 30°; average and range of tunnel angle from 2nd to 5th whorl in five specimens: 24°, 17–31° (2nd wh.); 35°, 28–43° (3rd wh.); 50°, 40–67° (4th wh.); 64°, 46–72° (5th wh.).

Wall thin with respect to size of specimens; it consists of four layers in inner whorls and, by absence of upper-tectorium, of three layers in outer whorls; diaphanotheca thick as compared to upper or lower-tectorium; its thickness varies from 17 μ to 24 μ (4.5 wh.).

Measurements:

Wh.n.	0	1	2	3	4	5	6	
Av.:	40	91	161	271	449	762	849	R.v.
R.:	24–46	71–99	140–170	238–306	389–544	659–960	818–880	
Av.:			79	68	65	70		G.r.
R.:			61–97	60–80	55–78	60–79		
Specimen: 3		1.78	1.85	2.26	3.03	3.44		F.r.
9		1.32	1.95	2.44	2.94	3.03	3.46	
Av.:		12	17	26	27	35	34	W.th.
R.:		9–15	13–22	21–30	23–34	26–43		

Remarks: Unfortunately only a few oriented sections were available. The taxonomical position of the present specimens is about intermediate between *Fusulinella* and *Obsoletes* (genotype: *Fusulina obsoleta* Schellw.). The genus *Obsoletes* was introduced by Kireeva in 1950 for a number of species occurring in the C_3^o zone of the Donbass (U.S.S.R.). They are considered to be closely allied to and at least partly off-shoots of the slightly older *Protriticites*. They differ from the latter genus mainly in having a thinner wall caused by nearly total reduction of the tectoria which especially holds good for the outer whorls. *Protriticites* and *Obsoletes* conform in the presence of mural pores. The wall of the present species is rather similar to that of *Obsoletes*. The latter genus as well as our specimens show a thin wall with a relatively thick diaphanotheca. Yet there is a difference since in our specimens no mural pores were observed. With respect to the wall the present species is apparently intermediate between *Fusulinella* and *Obsoletes*. When we take into account other characters there is certainly an obvious resemblance with some species of *Obsoletes*. Notably similar is *Obsoletes mirabilis* Kir. Less similar but probably corresponding in the structure of its wall is the somewhat older *Fusulinella praesimplex* (Lee.)

Genus PROTRITICITES Putrya, 1948

Putrya, F. S., *Protriticites*, a new genus of fusulinids. Trudy L'vovsk, Obshch. Geol., Paleont. Ser., 1948, No. 1, pp. 89–96, 1 pl.
Rjazanov, G. F., Morphology and systematic position of the genus *Protriticites* Putrya, 1948. Dokl. Akad. Nauk S.S.S.R., 1958, T. 123, No. 4, pp. 752–755, 1 pl.

Protriticites sp.

Pl. LIII Figs. 3–14

Locality: P 52.

Description:

Radius vector:	578–850
Form ratio:	2.44–3.64
Number of whorls:	5–6

From 1st to 6th whorl test changes from spherical, oval or subtriangular (1st wh.) short fusiform or fusiform to short subcylindrical (2nd-3rd wh.) fusiform, elongate fusiform or subcylindrical (4–5th wh.) to subcylindrical (6th wh.); lateral sides convex in inner 3–5 whorls tending to become straight (subhorizontal) or undulated in subsequent whorls; spirotheca smooth in inner 4–4.5 whorls, in subsequent whorls locally and slightly inflated between septa.

Septal folding starts at poles of 2nd–4th whorl; in 5–6th whorl septal folding intense but wholly irregular; sagittal sections show triangular septa in inner 2–4 whorls, in subsequent whorls rod-shaped and as thin or thinner than the spirotheca.

Chomata extend to poles in inner 2.5–3.5 whorls; asymmetric in inner 3–5 whorls, sometimes symmetric in subsequent whorls; width 0.20–0.30 of lateral slopes in 5.5–6th whorl; generally steep slopes at the tunnel side.

Tunnel path almost symmetric or slightly asymmetric; average and range of maximum deviation of symmetry respectively 15° and 9–21°.

Axis of coiling maintains original position throughout growth.

Beyond 3rd–5th whorl and with a magnification of appr. 60 × pores are discerned penetrating all four layers of the wall as well as the chomata; when a larger magnification is used (230 ×) we may observe them also in inner whorls. In outer whorls diaphanotheca and especially lower-tectorium well developed, whereas upper-tectorium is indistinctly developed or absent.

Measurements: See Table 63.

Remarks: The present species is closely similar to a number of species described by Kireeva from the C_3^n zone of the Donbass (Kireeva, 1949, 1950). Notably similar are *Protriticites lutugini* Kir. (N3), *P. umbonoreticulatus* Kir. (N5), and *P. plicatus* Kir. var. *bella* Kir. (N5).

SUMMARY AND GENERAL CONCLUSIONS

1. Many species of Carboniferous fusulinids are inadequately described; the statistical data and illustrations given being inadequate to enable a reliable determination for a related assemblage. In fact so many new descriptions are inadequate that most assemblages of Spanish fusulinids could be referred to more than one species. A first step to solve this problem would be the establishment of a uniform comprehensive scheme to be followed in describing new fusulinid species.

2. The Spanish fusulinid faunas are closely comparable with those described from Eurasian depositional areas e.g. U.S.S.R., China, Japan, Spitzbergen, Hungary, Yougoslavia and Greenland. This holds not only for the recognized species and genera but also for the succession and overlap of genera which in NW Spain is especially similar to that observed in Russia. It differs in the same degree from the succession of genera and recognized species from the U.S.A.

3. The fusulinid-bearing Carboniferous rocks of NW Spain have yielded all except four or five of the genera that have been found in the same stages elsewhere. The missing genera are *Wedekindellina* which is known both in the U.S.A. as well as Eurasia, *Putrella* and *Quasifusulinoides* found in Russia, *Bartramella* occurring in the U.S.A. and the subgenus *Eofusulina* (*Akiyoshiella*) known from Japan.

SUMARIO Y CONCLUSIONES GENERALES

1. Muchas especies de las Fusulinidae Carboníferas se describen inadecuadamente; los datos estadísticos y las ilustraciones dadas, son inadecuadas para una determinación digna de confianza sobre una asociación emparentada. Y en efecto, son inadecuadas tantas descripciones nuevas, que la mayoría de las asociaciones de las Fusulinidae españoles podrían atribuirse a mas de una especie. El primer paso para solucionar este problema sería la composición de un esquema uniforme y amplio, que se usaría para describir las especies nuevas de Fusulinidae.

2. La fauna de las Fusulinidae españoles se puede comparar muy bien, con aquella descrita de las áreas Eurásicas depositarias (U.S.S.R., China, Japón, Spitzbergen, Hungría, Yugoeslavia y Groenlandia). Esto es igual, no sólo para las especies y géneros reconocidos, sino también para la sucesión y coincidencia de los géneros que en el NO. de España es especialmente semejante a la observada en Rusia. Se diferencian en el mismo grado que en la sucesión de los géneros y especies reconocidos en Estados Unidos.

3. Las rocas carboníferas del NO. de España que tienen Fusulinidae, producen todas, excepto cuatro o cinco, géneros que se han encontrado en los mismos pisos de otras partes. Los géneros que faltan son: *Wedekindellina* que es conocida tanto en los Estados Unidos como en Eurasia, *Putrella* y *Quasifusulinoides* encontrados en Rusia, *Bartramella* existente en los Estados Unidos y el subgénero *Eofusulina* (*Akiyoshiella*) conocida en el Japón.

РЕЗЮМЕ И ОБЩИЕ ЗАКЛЮЧЕНИЯ

1. Много видов фузулинид недостаточно описано; статистические данные и изображения не могут дать надежного определения родственного сообщества. В самом деле столько новых описаний не удовлетворяют, что большинство сообществ испанских фузулинид могло бы относиться к более чем одному виду. Первым шагом к решению этого вопроса являлось бы установление единой общепринятой шкалы при описании новых видов фузулинид.

2. Испанская фауна фузулинид хорошо можно сравнивать с фауной описанной из евразийских осадочных областей (СССР, Китай, Япония, Шпицберген, Венгрия, Югославия, Греция). Это относится не только к известным видам и родам, но тоже к последовательности и совместному нахождению, обстоятельство которое в Испании является особенно аналогичным с тем в СССР. Обе по последовательности родов и известных видов одинаково отличаются от американской фауны.

3. В каменноугольных пародах, содержащих фузулиниды, северо-западной Испании наблюдаются все — за исключением трех или четырех — роды, которые найдены в тех же ярусах на других территориях. Отсутствующими родами являются: *Wedekindellina*, известна в США и Евразии, *Putrella*, *Quasifusulinoides*, встречены в СССР, *Bartramella*, найдена в США и подрод *Eofusulina* (*Akiyoshiella*) известна из Японии.

PART II

SPANISH CARBONIFEROUS FUSULINIDS AND THEIR SIGNIFICANCE FOR CORRELATION PURPOSES

I BIOSTRATIGRAPHIC UNITS BASED ON FUSULINID ASSEMBLAGES

Study of fusulinid assemblages from a great number of localities all in the Carboniferous of the Cantabrian mountains, resulted in the recognition of three or possibly four major assemblage-zones and four or perhaps five subzones as is shown in fig. 1.

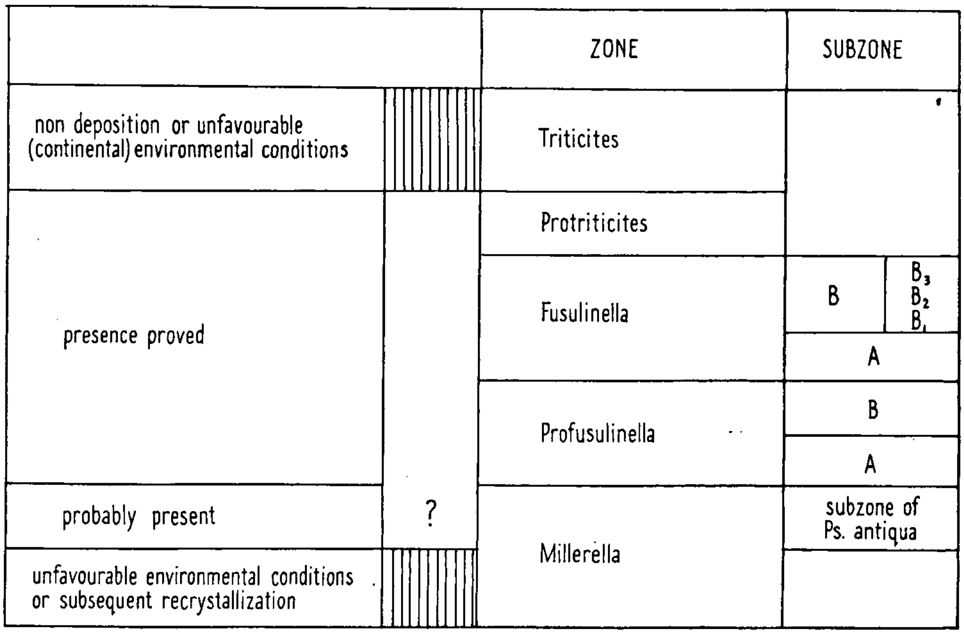


Fig. 1

Assemblage Zones

Zone of Millerella. — The Zone of Millerella, known from other parts of the world, can only be doubtfully identified in the samples from NW Spain investigated to date, so that its special local characteristics cannot yet be described. Although dating by other fossils confirms that the lowermost Carboniferous deposits are represented in many sections, they are usually devoid of fusulinids or at best only yield a meagre fauna. The Alba Formation has yielded no foraminifers at all and samples from the Escapa Formation contained only isolated specimens which often could belong equally as well to the Profusulinella or the Millerella Zone. A single locality (P 76; Mudá Formation), which is certainly contemporaneous with the Escapa Formation, yielded a more varied fauna with respect to number as well as to species content than any other. This fauna which is characterized by presence of *Pseudostaffella antiqua* (Dutk.) and by absence of the genus *Profusulinella* might possibly be correlated with the Ps. antiqua subzone of the U.S.S.R. This subzone constitutes the uppermost subzone of the Zone of Millerella. Apart from this locality near Mudá no rich fusulinid faunas are known in Spain which might belong to the Zone of Millerella.

Zone of Profusulinella. — The Zone of Profusulinella is characterized by the appearance of *Profusulinella* and by absence of the higher-evolved genus *Fusulinella*. This zone is subdivided in a lower subzone A and an upper subzone B. The immediate precursor of *Eofusulina*, the genus *Verella* is typical for the uppermost part of subzone A. Subzone B is characterized by the appearance of the genus *Eofusulina*. The generally more varied and richer faunas of subzone B consist mainly of the genera *Eofusulina*, *Profusulinella* and *Millerella*.

Zone of Fusulinella. — The Zone of *Fusulinella* is characterized by the appearance of the genus *Fusulinella* and by absence of the genus *Protriticites*. Almost simultaneously the genera *Beedeina* and *Fusiella* appear, the former perhaps somewhat earlier than *Fusulinella* and the latter possibly somewhat later. *Profusulinella* persists in this zone but its number with regard to species as well as to specimens rapidly dwindles in favour of its successor *Fusulinella*. This zone also is subdivided into a lower subzone A and an upper subzone B. The lower subzone is characterized by a peculiar mixture of old and new elements. The genus *Eofusulina* is still present as well as *Profusulinella* species of the group *prisca* (Deprat). The upper subzone is characterized by the appearance of the genus *Fusulina* and the fauna by now is wholly renewed. *Profusulinella* is only represented by the rather aberrant group of *P. librovitchi* and the primitive genus *Eofusulina* is no longer present. The upper subzone has been subdivided according to the evolutionary development of *Fusulinella* into B_1, B_2 and B_3 levels, corresponding respectively with the former subzones B, C and D (Brouwer and van Ginkel, 1964). By means of field correlations and correlation of fusulinid associations, the stratigraphic levels of limestones with faunas of the subzone B of Fusulinella have been established. Subsequent comparison of the parameters of species of *Fusulinella* from the different stratigraphic horizons resulted in a tripartition of the subzone B. Systematic differences of these parameters are shown in the figures 2-8 and are discussed on pp. 175—180.

Zone of Protriticites. — The Zone of Protriticites is characterized by the appearance of the genus *Protriticites*. We know of only three assemblages (Locs. P52, P 36, P99) all in the Pisuerga basin which belong to this zone. Besides *Protriticites* the following genera have been recorded: *Fusiella*, *Staffella*, an elongate species probably of *Beedeina* and a species which is provisionally considered to be an *Obsoletes*.

Zone of Triticites. — No evidence to prove the presence of the Triticites Zone known from other parts of the world have been found in NW Spain. This zone would naturally follow the Zone of Protriticites and be characterized by the appearance of *Triticites*. However, either changes in environmental conditions from paralic to limnic or upheaval of large areas of the present Cantabrian mountains had taken place by the time we might have expected the genus *Triticites* to have appeared.

The evolution of Fusulinella in subzone B

Consistent evolutionary trends have been determined for some diagnostic characters of *Fusulinella* through the B subzone i.e. from the B_1 subdivision to the B_3 subdivision. These characters include chomata height, spirotheca thickness, number of septa, radius of proloculum, number of whorls, radius vector, form ratio and percentage increase of the radius vector, which are dealt with separately below.

Relative heights of Chomata. — In the table (fig.2), the relative heights of chomata measured in assemblages from the various limestone members belonging to the B subzone of Fusulinella, subdivisions B_1, B_2 and B_3, are given as averages for 1, 1.5 and 2nd whorls (column I); 3, 3.5 and 4th whorls (column II) and 5, 5.5 and 6th whorls (column III). An overall average for each column in each subdivision has also been calculated and is presented together with the range of the values found. The figures show that on average the relative heights of chomata increase from the 1st to the 3rd whorl but decrease from the 4th to the 6th whorl in almost every member. In addition it can be seen that there is a continuous tendency for the relative height to decrease through subdivisions B_1 and B_2 to B_3.

Subzone B (Subdivision B_3)	I	II	III
Sierra Corisa Lst. Mbr. (P22–2)	0.26	0.32	0.25
Lores Lst. Mbr. (P10)	0.30	0.36	0.31
Brañosera Lst. Mbr. (P38)	0.31	0.33	0.25
	R.: 0.26–0.31	R.: 0.32–0.36	R.: 0.25–0.31
	Av.: *0.29*	*0.34*	*0.27*
(Subdivision B_2)			
Sierra Corisa Lst. Mbr. (P57)	0.34	0.34	0.31
Sierra Corisa Lst. Mbr. (P22–1)	0.33	0.39	0.40
Fito Fm. (A8)	0.34	0.37	0.34
Abismo Lst. Mbr. (P73)	0.32	0.35	0.31
Maldrigo Lst. Mbr. (P7)	0.35	0.39	0.39
Cotarazo Lst. Mbr. (P40)	0.30	0.33	0.27
	R.: 0.30–0.35	R.: 0.33–0.39	R.: 0.27–0.40
	Av.: *0.33*	*0.36*	*0.34*
(Subdivision B_1)			
Agujas Lst. Mbr. (P72)	0.47	0.43	0.39
Camasobres Lst. Mbr. (P4)	0.37	0.39	—
Panda Lst. Mbr. (L426)	0.33	0.40	0.34
Panda Lst. Mbr. (L21)	0.38	0.44	0.39
Escalada Fm. (A6)	0.25	0.38	0.33
	R.: 0.25–0.47	R.: 0.38–0.44	R.: 0.33–0.39
	Av.: *0.36*	*0.41*	*0.36*

Fig. 2

Thicknesses of spirotheca. — In the table (fig. 3), the averages of the thicknesses of spirotheca in microns, measured in various limestone members belonging to the B subzone of Fusulinella, subdivisions B_1, B_2 and B_3 are shown for each successive whorl (1—6). Overall averages for each whorl in every subzone are given together with the range and percentage increase for each whorl. The figures show that the wall thickness increases from the 1st to the 6th whorl in all cases. Yet the percentage increases calculated clearly show a decrease in the rate of thickening from the 3rd to 4th whorl in the B_1 subdivision and from the 4th to the 5th whorl in the B_3 subdivision. In addition there is a very striking and consistent decrease in the wall thicknesses for corresponding whorls between all the subdivisions in an upward direction (B_1—B_3), the only doubtful assemblages being from Locs. P40 and P38. The differences between the overall averages for corresponding whorls in different subdivisions are so great that the thickness of the n th whorl in the B_1 subdivision is equal to the thickness of the (n+1)th whorl in the B_3 subdivision.

Subzone B						
Wh. No.	1	2	3	4	5	6
(Subdivision*B*$_3$)						
Brañosera Lst. Mbr. (P38)	9	14	19	29	33	40
Lores Lst. Mbr. (P10)	10	15	22	32	42	57
Sierra Corisa Lst. Mbr. (P22–2)	8	12	20	32	49	50
	R.: 8–10	R.: 12–15	R.: 19–32	R.: 29-32	R.: 33–49	R.: 40–57
	Av.: *9*	*13.5*	*20.5*	*31*	*41*	*49*
Relative increase of averages:		50 %	52 %	51 %	32 %	20 %
(Subdivision *B*$_2$)						
Fito Fm. (A8)	11	16	26	34	42	39
Maldrigo Lst. Mbr. (P7)	12.5	19	30	38	45	73
Abismo Lst. Mbr. (P73)	12	21	31	39	50	45
Sierra Corisa Lst. Mbr. (P57)	10	15	27	34	38	44
Sierra Corisa Lst. Mbr. (P22–1)	11	20	31	41	39	—
	R.: 10–12	R.: 15–21	R.: 26–31	R.: 34–41	R.:38–50	R.: 44–73
	Av.: *11.5*	*18*	*29*	*37*	*43*	*50*
		57 %	61 %	28 %	16 %	16 %
Cotarazo Lst. Mbr. (P40)	13.5	20	29	42	52	—
Cotarazo Lst. Mbr. (P58)	16	23	38	38	51	59
	Av.: *15*	*21.5*	*33*	*40*	*51.5*	—
		43 %	53 %	21 %	29 %	—
(Subdivision *B*$_1$)						
Panda Lst. Mbr. (L21)	14	27	36	41	51	53
Panda Lst. Mbr. (L426)	12.5	20	29	43	41	40
Escalada Fm. (A6)	12	18	30	38	49	—
Camasobres Lst. Mbr. (P4)	15	19	29	31	—	—
Agujas Lst. Mbr. (P72)	16	25	41	51	69	78
	R.: 12–16	R.: 18–27	R.: 29–41	R.: 31–51	R.: 41–69	R.: 40–78
	Av.: *14*	*22*	*33*	*41*	*52*	*57*
		57 %	50 %	24 %	27 %	10 %

Fig. 3

Number of septa (cumulative). — In the table (fig. 4) averages of the cumulative number of septa are given up to each successive whorl (1—6) and are calculated for the various limestone members belonging to the B subzone of Fusulinella, subdivisions B_1, B_2 and B_3. In addition overall averages are presented for each whorl in every subdivision. The figures demonstrate that from the B_1 subdivision to the B_2 subdivision two different lines of development are followed. The first lineage shows a decreasing cumulative number of septa; a trend that persists into the B_3 subdivision. The second line of development, on the contrary, shows an increasing cumulative number of septa (Locs. P 40, P 58). There seems to be a negative correlation between the cumulative number of septa and the formratio although no statistical calculations have been made to confirm this conclusion.

Subzone B

Number of septa in whorls up to and including: —

(Subdivision B_3)	1st	2nd	3rd	4th	5th	6th
Sierra Corisa Lst. Mbr. (P22–2)	6	15	27	40	55	72
Lores Lst. Mbr. (P10)	6	16	27	40	55	71
Brañosera Lst. Mbr. (P38)	7	17	29	42	56	73
Average:	*6*	*16*	*27.5*	*40.5*	*55*	*72*
(Subdivision B_2)						
Fito Fm. (A8)	6	17	29	42	58	75
Abismo Lst. Mbr. (P73)	7	17	29	42	57	73
Maldrigo Lst. Mbr. (P57)	7	18	31	45	62	81
Sierra Corisa Lst. Mbr. (P57)	7	18	32	46	61	80
Sierra Corisa Lst. Mbr. (P22–1)	7	17	29	43	59	—
Average:	*7*	*17.5*	*30*	*43.5*	*59.5*	*77*
Cotarazo Lst. Mbr. (P58)	7	19	33	50	68	88
Cotarazo Lst. Mbr. (P40)	7	18	31	46	62	—
Average:	*7*	*18.5*	*32*	*48*	*65*	(*88*)
(Subdivision B_1)						
Escalada Fm. (A6)	6	17	29	42	58	—
Panda Lst. Mbr. (L426)	7	18	30	44	59	76
Panda Lst. Mbr. (L21)	7	19	33	50	70	91
Average:	*7*	*18*	*31*	*45*	*62*	*83.5*

Fig. 4

Correlation between radius of proloculum and number of whorls. — The table (fig. 5) presents the results of measurements of the radii of the proloculi of assemblages from limestone members belonging to Fusulinella subzone B, subdivisions B_1, B_2 and B_3, expressed as averages and compared to the average and maximum number of whorls found. The figures show that the proloculi tend to be somewhat larger in the B_1 than in the B_2 and B_3 subdivisions which corresponds to a slightly greater number of whorls in the lower subdivisions as compared to B_3. The correlation of these trends is only weakly significant and contrasts strongly with the highly significant but negative correlation that has been found in single assemblages (cf. van Ginkel, 1957).

Subzone B

(Subdivision B_3)	Radius proloculum	Number of whorls Average	Maximum
Lores Lst. Mbr. (P10)	31	5.6	7.5
Brañosera Lst. Mbr. (P38)	33	4.6	6.5
Sierra Corisa Lst. Mbr. (P22-2)	24	5.9	7
Sierra Corisa Lst. Mbr. (P22-3)	30	5.5	6
Average:	*29.5*	*5.4*	*6.7*
(Subdivision B_2)			
Maldrigo Lst. Mbr. (P7)	38	5.5	7
Abismo Lst. Mbr. (P73)	43	5.1	6.5
Sierra Corisa Lst. Mbr. (P22-1)	39	5.1	5.5
Sierra Corisa Lst. Mbr. (P57)	41	5.8	6.5
Fito Fm. (A8)	37	5.4	6.5
Average:	*38.5*	*5.4*	*6.4*
Cotarazo Lst. Mbr. (P40)	48	5.8	6.5
Cotarazo Lst. Mbr. (P58)	50	5.9	7.5
Average:	*49*	*5.85*	*7.0*
(Subdivision B_1)			
Agujas Lst. Mbr. (P72)	55	6.1	7
Camasobres Lst. Mbr. (P4)	46	4.5	5
Panda Lst. Mbr. (L21)	48	5.7	7
Panda Lst. Mbr. (L426)	42	5.9	7.5
Escalada Fm. (A6)	39	5.4	6
Average:	*46*	*5.5*	*6.5*

Fig. 5

Radius vector. — The graphs in fig. 6 show the volution number on the abscissa and the radius vector expressed in microns on the ordinate. Since the radius vector is an exponential function of the volution number, semilogarithmic graphpaper has been used. Each line represents the connection of means of each whorl and corresponds to an assemblage from a particular locality. The shadowed graph to the right combines all the data used in the left-hand graphs and represents for each whorl the range of means (dark-shadowed field) and the overall range (light-shadowed field). The comparison of the right-hand graphs for the subdivision (fig. 6) shows that the radius vector tends to decrease consistently from the B_1 subdivision to the B_3 subdivision.

Form ratio. — The graphs in fig. 7 show the volution number on the abscissa and the form ratio on the ordinate. In the graphs to the right each line represents the connection of means of each whorl and corresponds to an assemblage from a particular locality. Shadowed graphs to the right combine the left-side graphs and represent the range of means for each whorl in a particular subdivision (dark-shadowed area) and the overall range (light-shadowed area). It is clearly shown that the form ratio for corresponding whorls tends to increase from the B_1 subdivision to the B_3 subdivision. This does not hold good for the innermost whorls which on the contrary show a tendency to decrease. This results in successively higher rates of increase of the form ratio for the B_2 and B_3 subdivisions over that of the B_1 subdivision.

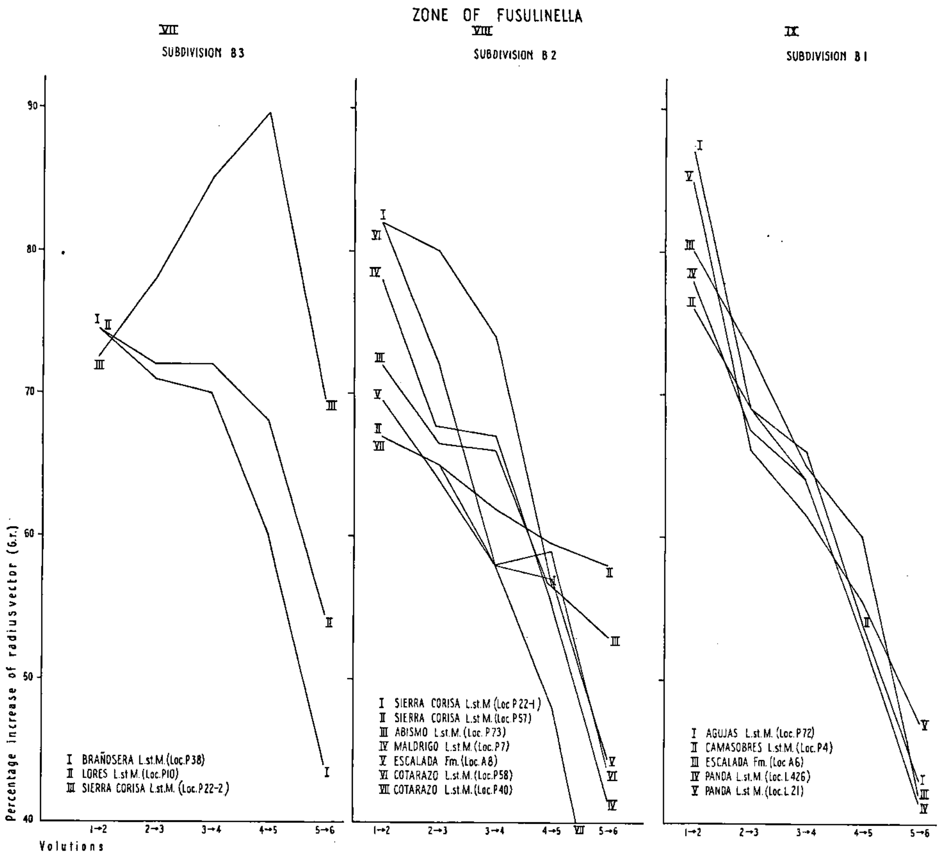


Fig. 8

Percentage increase of the radius vector (G.r.). — The graphs in fig. 8 show the volution number on the abscissa and the percentage increase of the radius vector on the ordinate. The comparison of the graphs for the subdivisions shows that the percentage increase tends to decrease with a higher and more constant rate from the B_1 to the B_3 subdivision.

The evolution of mutually dependent characters in Fusulinella

The observed systematic changes of assemblages of *Fusulinella* throughout the Fusulinella Zone subzone B are most probably connected to changes in the primordial growthstage. The impression is gained that a large proloculum occurring in an early assemblage is comparable to a smaller proloculum and a certain number (n) of innermost chambers in later assemblages. This would mean that a certain characteristic change, independent of ontogenetic change directly controlled by physicochemical factors, that occurred in the N th chamber of a specimen of an earlier assemblage should be expected at the (N + n) th chamber of specimens in later assemblages. The sudden decrease of spirothecal growth that has been found appears

ZONE OF FUSULINELLA; SUBDIVISION B3

I

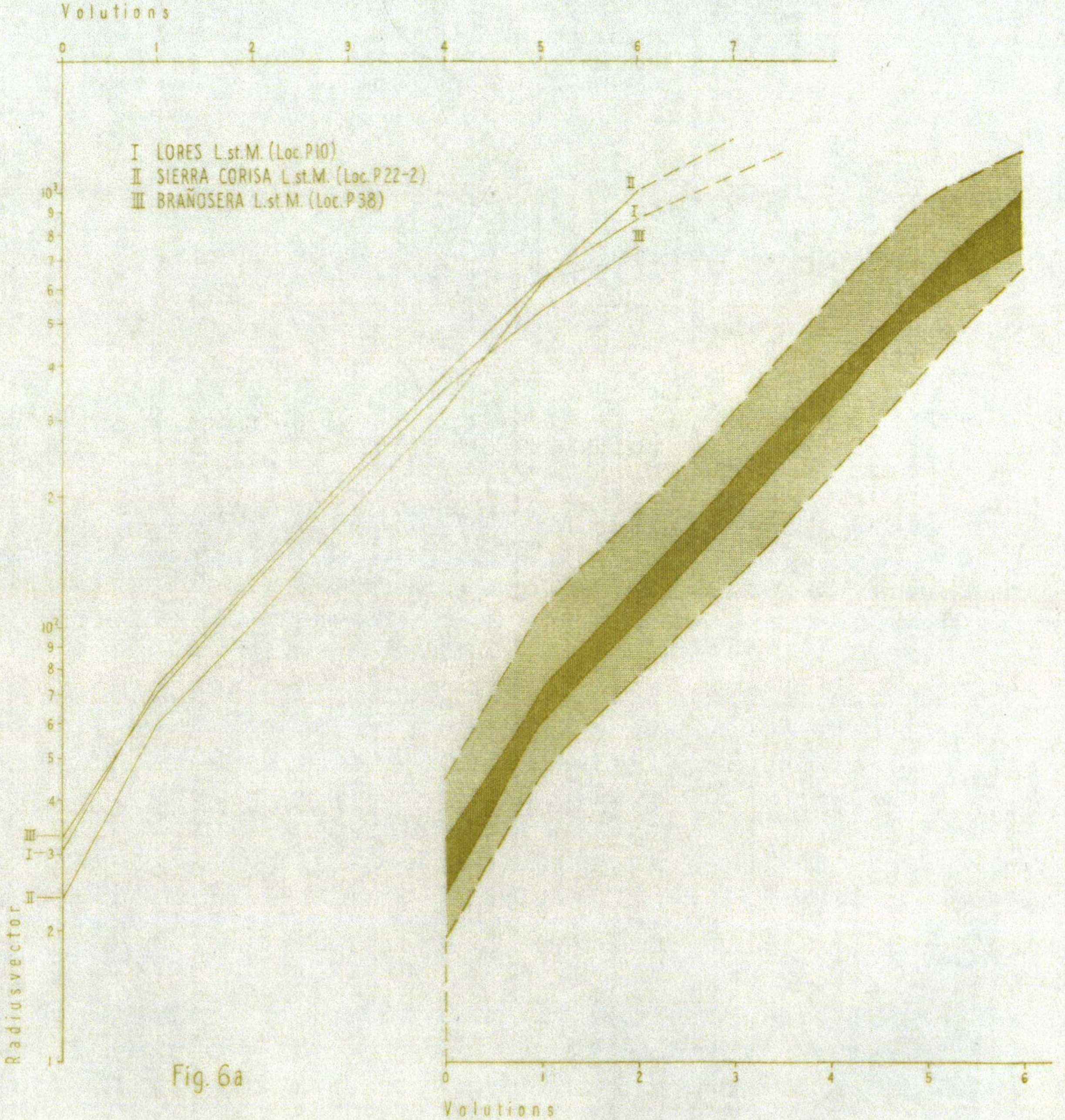
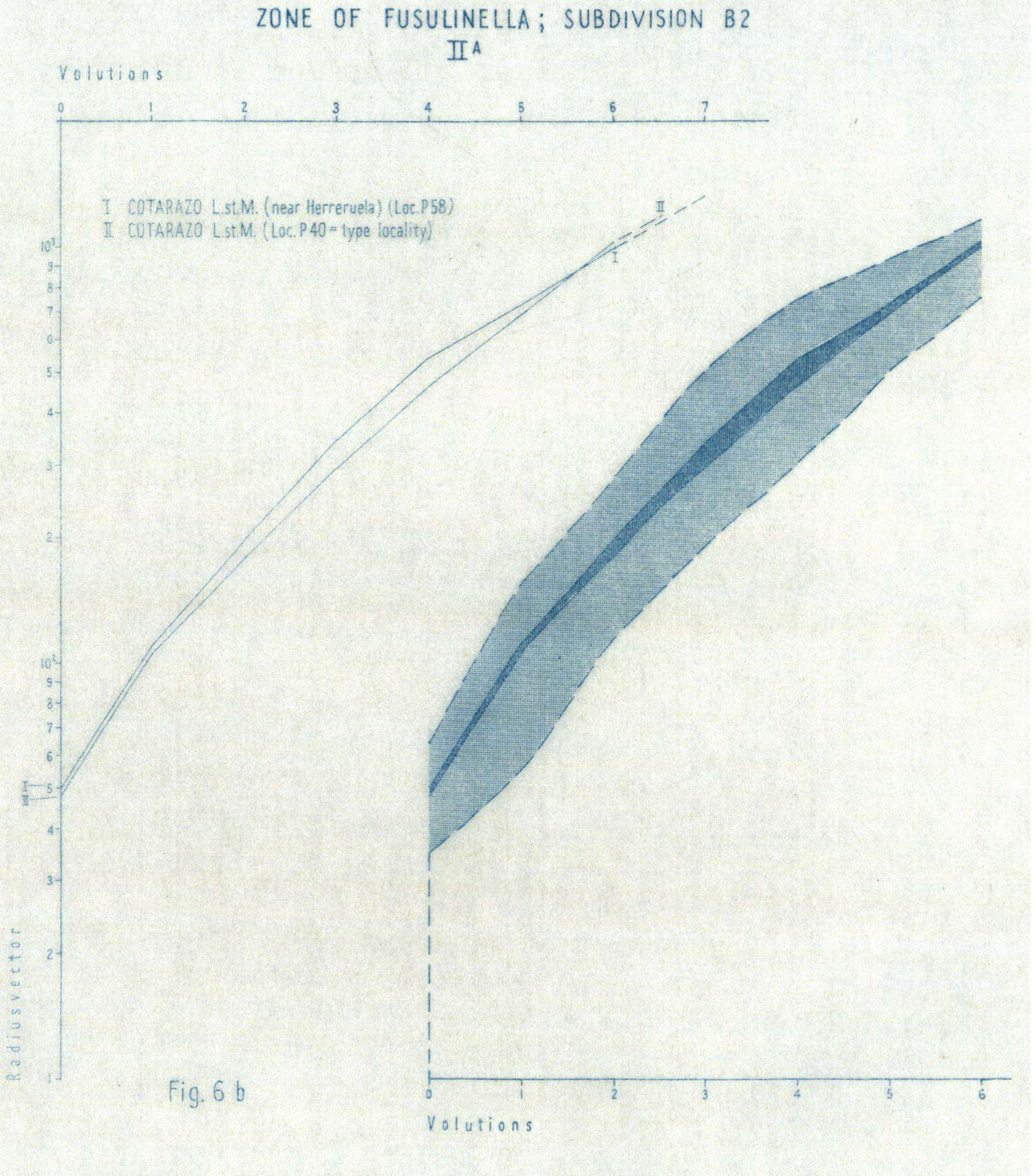
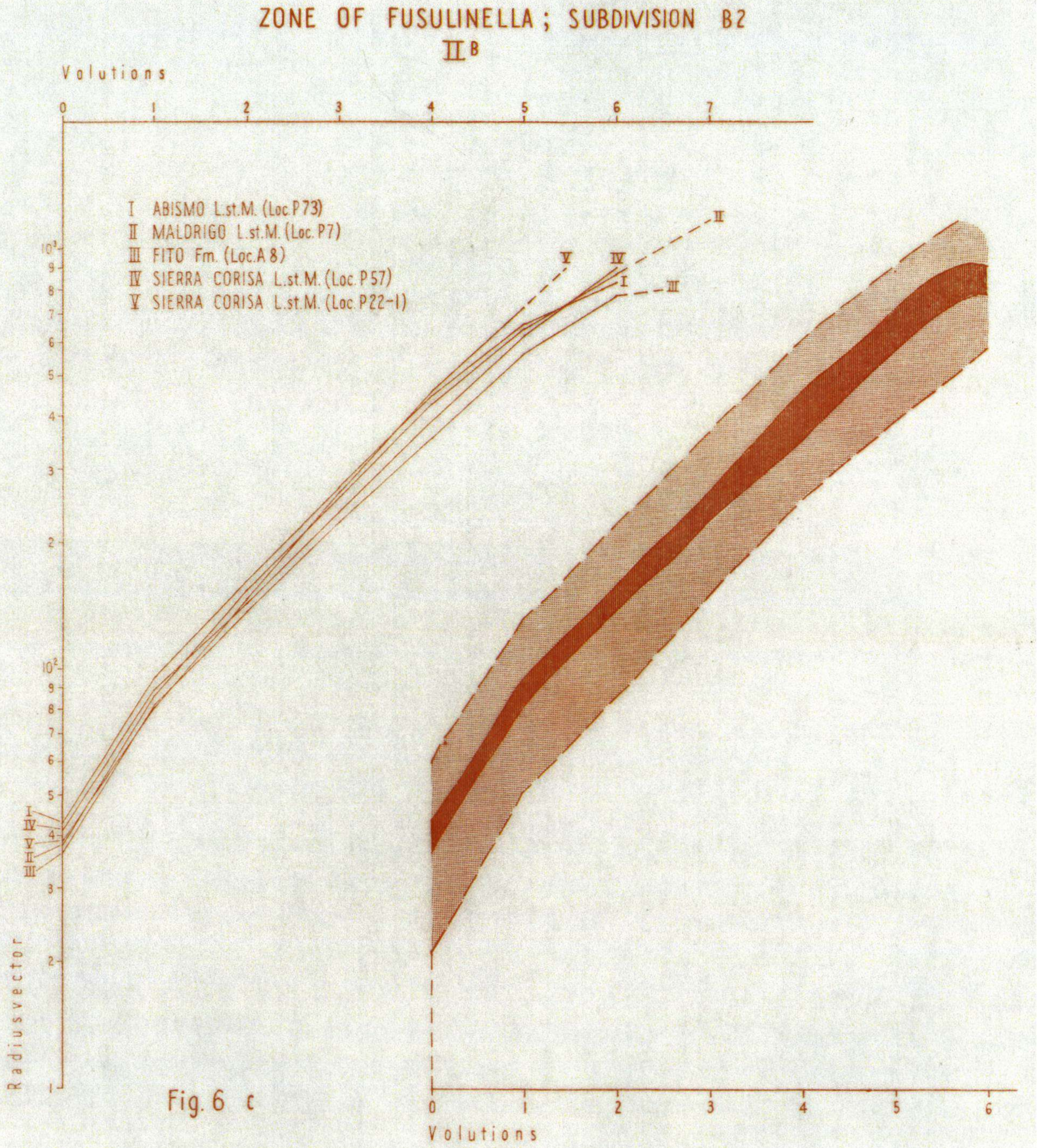


Fig. 6a


ZONE OF FUSULINELLA; SUBDIVISION B2
II A
Volutions
0
1
2
3
4
5
6
7
I COTARAZO L.st.M. (near Herreruela) (Loc.P58)
II COTARAZO L.st.M. (Loc.P40 = type locality)
I
II
10³
9
8
7
6
5
4
3
2
10²
9
8
7
6
5
4
3
2
1
Radiusvector
0
1
2
3
4
5
6
Volutions
Fig. 6 b


ZONE OF FUSULINELLA ; SUBDIVISION B2
II B
Volutions
I ABISMO L.st.M. (Loc. P73)
II MALDRIGO L.st.M. (Loc. P7)
III FITO Fm. (Loc. A8)
IV SIERRA CORISA L.st.M. (Loc. P57)
V SIERRA CORISA L.st.M. (Loc. P22-1)
Radiusvector
Volutions
Fig. 6 c

ZONE OF FUSULINELLA; SUBDIVISION B1

III

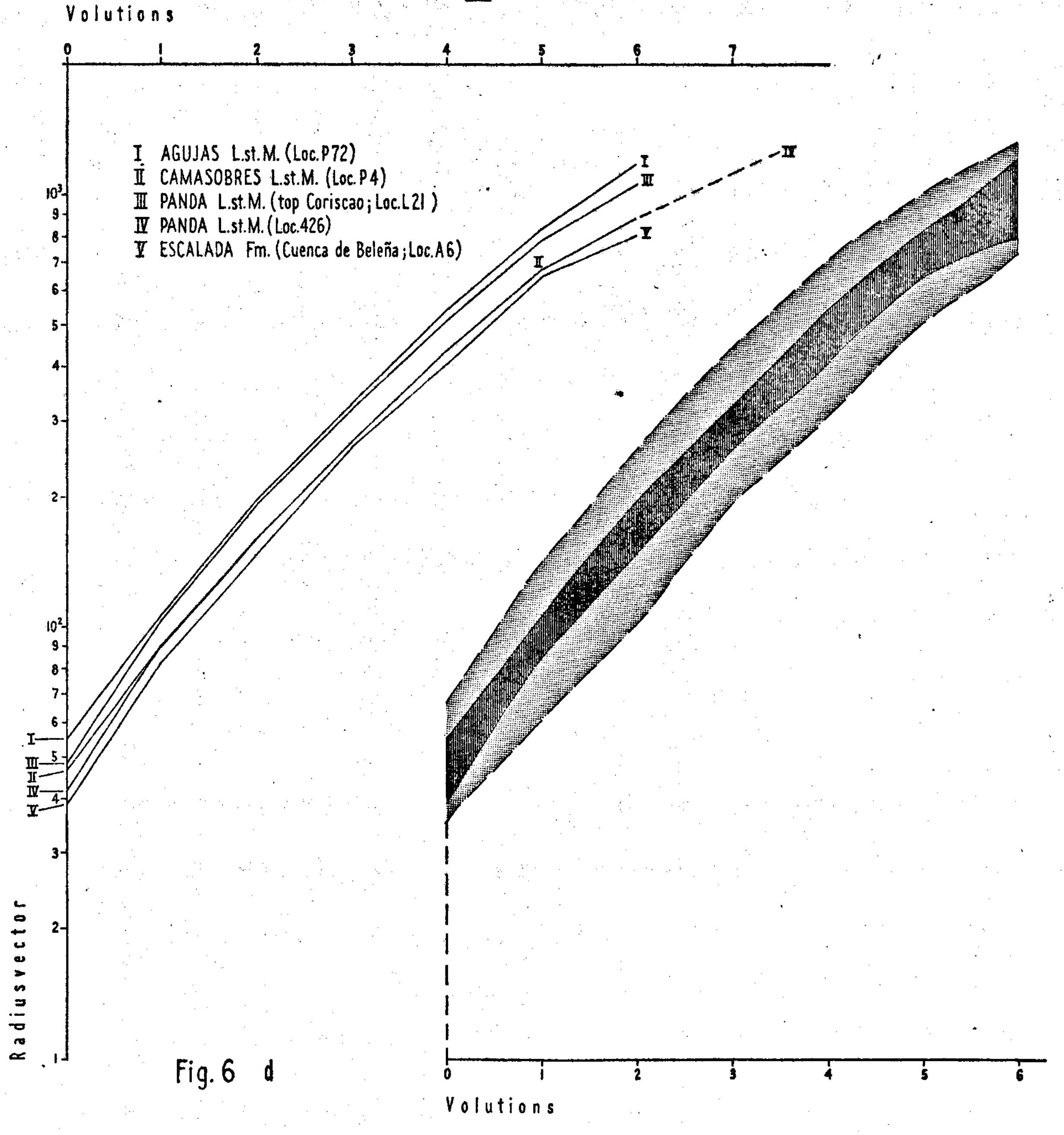


Fig. 6 d

ZONE OF FUSULINELLA; SUBZONE B3

IV

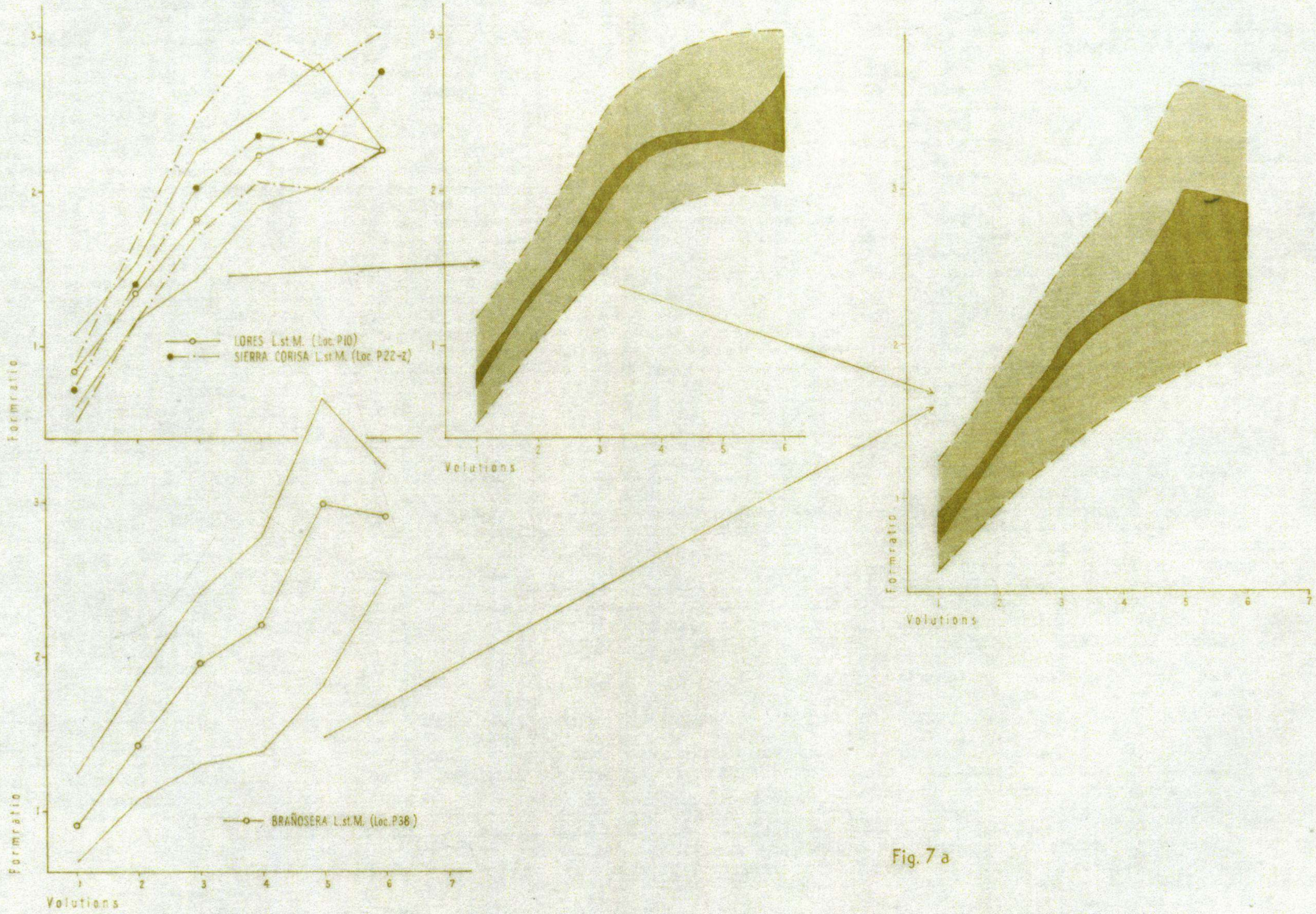


Fig. 7 a

ZONE OF FUSULINELLA ; SUBZONE B2

V

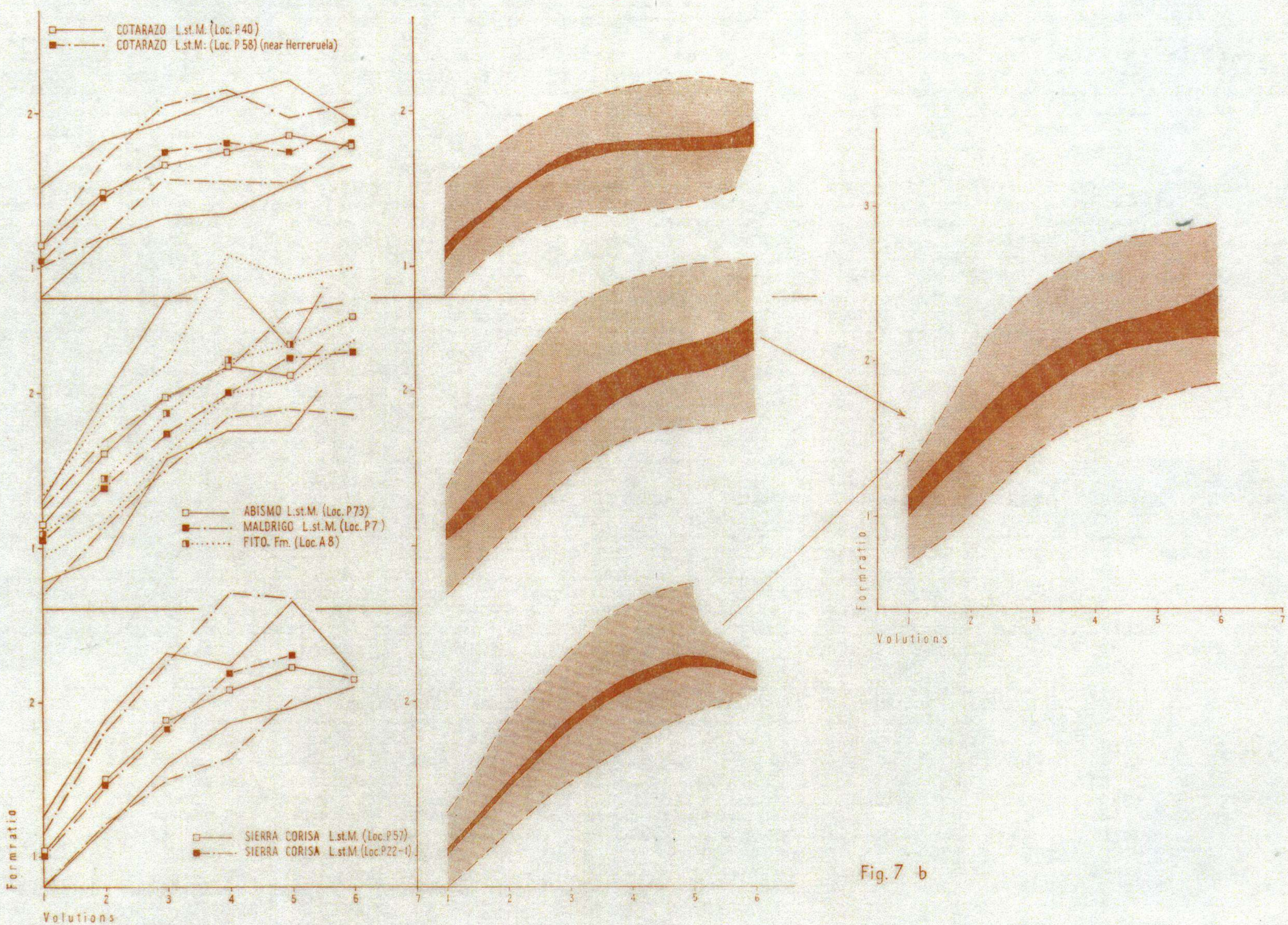


Fig. 7 b

ZONE OF FUSULINELLA; SUBZONE B1
VI

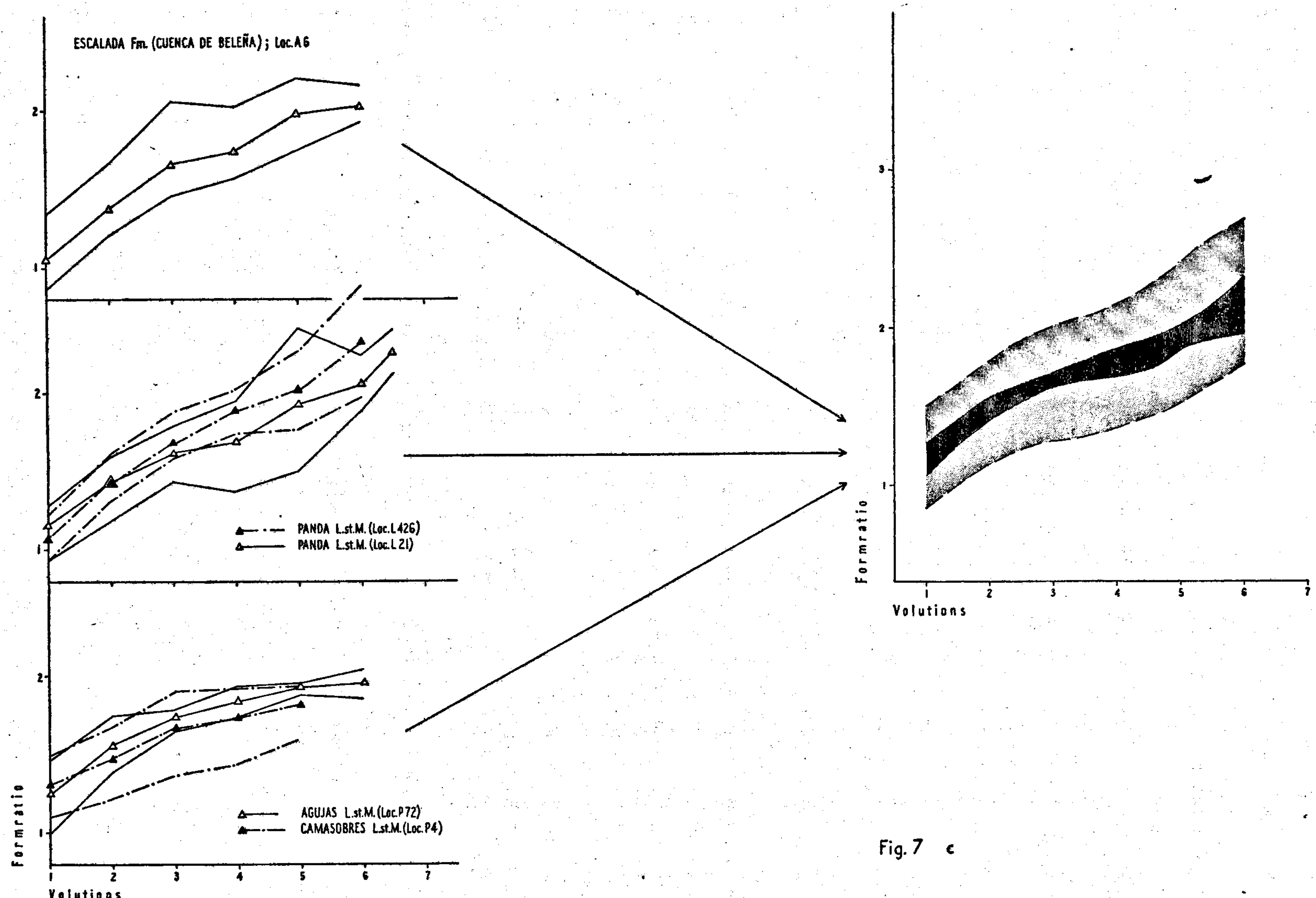


Fig. 7 c

to illustrate this trend and lends support to this hypothesis. The decrease is found in the 3rd whorl in assemblages belonging to subdivision B_1, but in the 4th whorl in assemblages from subdivision B_3 (p. 176). This line of reasoning also leads to the anticipation of an increase in the total number of chambers (whorls) in individuals of later assemblages. Not only has this not been found but, on the contrary, the total number of whorls remains about constant with a possible, slight tendency to decrease in the later assemblages as discussed above (p. 178). We might explain this by supposing that together with the introduction of new initial chambers round a smaller proloculum the last chambers of earlier assemblages were not formed in later assemblages.

One is inclined to consider that the total amount of protoplasm produced by individuals of a certain genus such as *Fusulinella* was limited to a fairly stable maximum. This maximum value would have been relatively constant for a given genus, though variable between genera, and would have been independent of the variations in other characters. Since we know that there is a strong tendency in all fusulinids for the form ratio to increase, we can imagine that this character might override the maximum volume as the factor limiting size. Whenever this maximum volume was attained, a further increase of the form ratio in later assemblages would necessarily lead to the failure to form the last chamber corresponding to those of earlier assemblages. This tendency to a larger form ratio might finally lead to species of which the total volume of the individuals is no longer determined by the maximum possible volume but by the form ratio itself because the increase of the form ratio over a specific critical value might make the shells of such species extremely fragile before the maximum volume could be attained.

Summarizing the two changes from which the changes in development could have followed and which explain the differences in form of *Fusulinella* species observed from subdivision B_1 to B_3 we have:

1. tendency for the form ratio to increase
2. changes in the primordial growthstage

II A REVIEW OF LITHOSTRATIGRAPHIC UNITS

Rapid facies changes and great variations in thickness over relatively short distances characterized sedimentation in NW Spain during the Carboniferous. These features render the distinction of useful lithostratigraphic units very difficult. It easily leads to confusion by the introduction of too many formations. On the other hand it may lead also to the distinction of only a few loosely defined formations, which as a consequence are less indicative for environment of deposition and which obscure palaeogeographic features. A balance between these two extremes enables the general progression of depositional history to be followed. In the following lines a review of lithostratigraphic units best suited to this purpose has been presented. The arrangement of lithostratigraphic units in the correlation chart (fig. 9) and the order in which they are given below is according to regions representing typical areas of development.

1 Lower Carboniferous rock sequences usually present in León, Palencia and Asturias

The following formations have been distinguished:

Escapa Formation
Alba Formation
Vegamián Formation

Vegamián Formation. — The Vegamián Formation is here used as designated by Comte (1959) for these distinctive rocks which despite their usually very small thickness are extremely widespread. The Vegamián Formation occurs in N Palencia, N León and Asturias. Since this unit is lithologically and palaeontologically distinct from the Alba Formation, the earlier definition of Comte (1959) is now preferred to the later suggestion of Brouwer and van Ginkel (1964) that these rocks should be grouped into a single Sella Formation.

The type section is situated 1 km SSW of Vegamián (León) which shows about 15 m of black or greenish shales sometimes with nodules of silico-phosphate (Comte, 1959, p. 330).

Usually the Vegamián Formation also contains thin beds of black chert. Nodules of markasite or thin lenses of limestone have also been recorded. According to Mr. J. F. Savage (oral comm.) this formation contains layers of siderite near Barniedo de la Reina (León). The Vegamián Formation seems to be well developed in NW Palencia where a thickness of 30 m has been measured by Mr. J. van Veen (oral comm.).

The Vegamián Formation is the lowermost Carboniferous formation in the Cantabrian mountains. The Vegamián Formation in the Asturo-Leonide facies area rests apparently conformably upon the Ermita Formation (uppermost Devonian). It is in its turn conformably overlain by the Alba Formation. In some areas of the Leonides there are local unconformities between these formations (Higgins, Wagner-Gentis and Wagner, 1964) which could explain the local absence of the Vegamián Shale (e.g. in the Esla nappe; Rupke, 1965). The Vegamián Formation in the Palentian facies area may rest upon nodular limestone of Famennian age

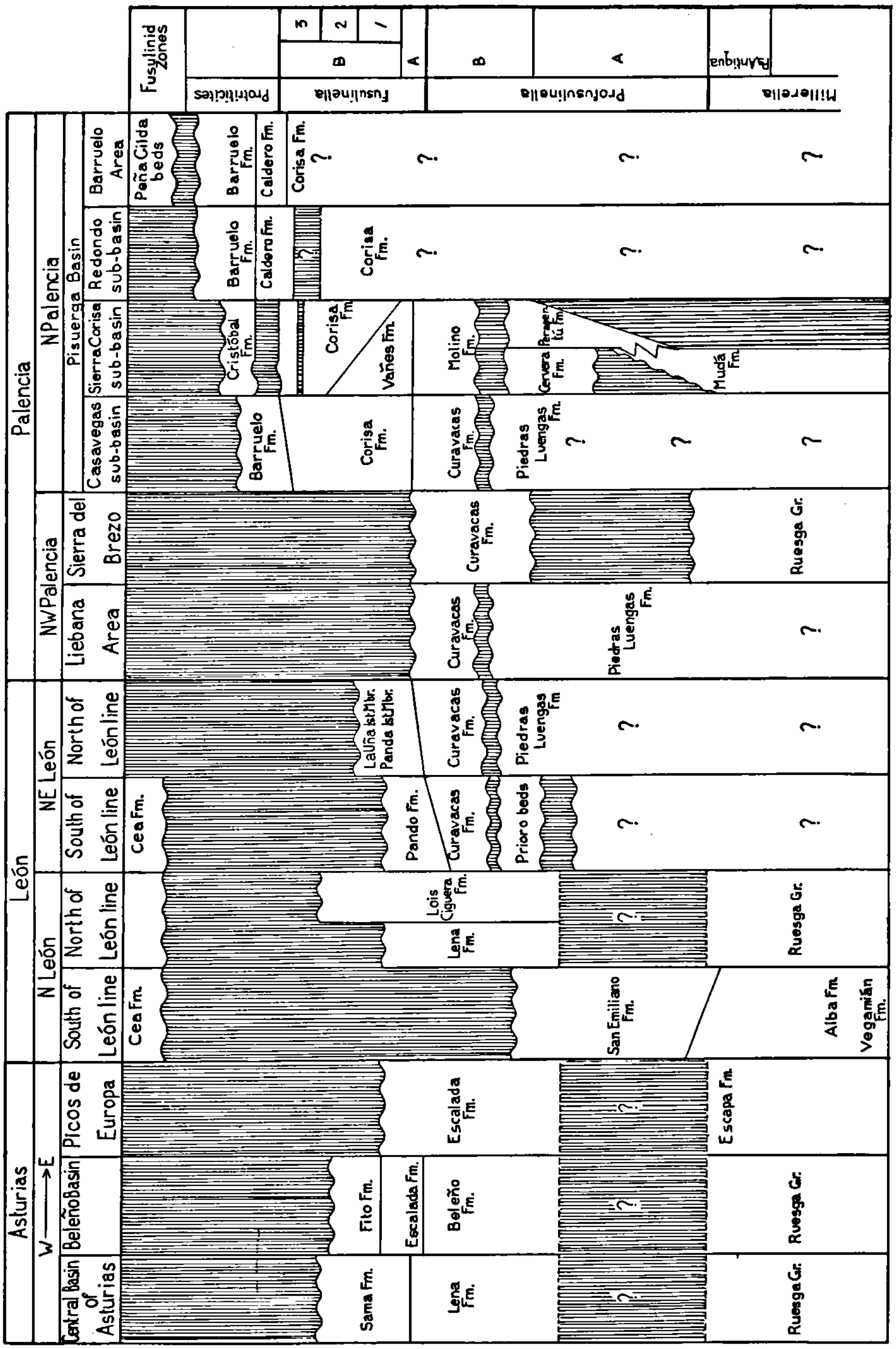

Asturias
W ——→ E
Central Basin of Asturias
Beleño Basin
Picos de Europa
León
N León
South of León line
North of León line
NE León
South of León line
North of León line
Palencia
NW Palencia
Liebana Area
Sierra del Brezo
N Palencia
Pisuerga Basin
Casavegas sub-basin
Sierra Corisa sub-basin
Redondo sub-basin
Barruelo Area
Fusulinid Zones
Protriticites
Fusulinella
Profusulinella
Millerella
Pseudostaffella antiqua
Sama Fm.
Lena Fm.
Ruesga Gr.
Fito Fm.
Escalada Fm.
Beleño Fm.
Escapa Fm.
Cea Fm.
San Emiliano Fm.
Alba Fm.
Vegamián Fm.
Lois Ciguera Fm.
Pando Fm.
Curavacas Fm.
Prioro beds
La Uña lst Mbr.
Panda lst Mbr.
Piedras Luengas Fm.
Barruelo Fm.
Corisa Fm.
Cristóbal Fm.
Vañes Fm.
Molino Fm.
Cervera Fm.
Perapertú Fm.
Mudá Fm.
Caldero Fm.
Peña Cilda beds

Fig. 9

(= Montó Schichten of Kullmann, 1960) and again is overlain by the Alba Griotte. The latter formation here does not always show its characteristic red colour (e.g. Valdeón, León). Whether the Vegamián Shales formed a rather continuous sheet affected later by erosion in lower or middle Viséan time or that they were deposited in an irregular pattern due to epeirogenic movements cannot be definitely decided, and it is probable that both influences had some effect.

Fossils are extremely rare in the Vegamián Formation. A benthonic fauna (*Lingula* etc.) has been recorded from the top of the formation in places by Higgins *et al.* (1964) and traces of a similar fauna also occur near Barniedo de La Reina (León) (Mr. J. F. Savage, oral comm.). In addition conodonts have been encountered at the base and just above the Vegamián Formation in the Bernesga region (Higgins *et al*, 1964). The conodont and goniatite faunas from the base of the overlying Alba Formation are usually typical of the lower Viséan. Since the conodont fauna from the base of the Vegamián Formation is typical of the Upper Tournaisian, this formation in this region must belong either to the uppermost Tournaisian or the lowermost Viséan.

Alba Formation. — The Alba Formation as proposed by Comte (1959) is here accepted for the unit often described as the Griotte (de Sitter, 1962; Koopmans, 1962; Kanis, 1956). This unit is almost ubiquitous throughout the Cantabrian mountains at or near the base of the Carboniferous sequence, and due to its characteristic appearance and relatively small thickness has been a valued marker horizon in mapping.

The Alba Formation is especially well developed in the Leonide thrustfolded area. Other characteristic developments of this formation are present in road exposures along the stretch Cangas de Onis- Puerto de Pontón in the valley of Río Sella.

The type locality of the Alba Formation is in the Bernesga valley near Puente de Alba (León).

The Alba Formation generally consists of red (= Marbre Griotte) and grey (= Marbre Campan) nodular limestone, red nodular marl, red claystone, red often silica-bearing shale, red and black chert beds and radiolarite. All transitions between these lithotopes may occur. The maximum thickness of this formation is about 30 m.

The Alba Formation rests either upon the Vegamián Formation or upon pre-Carboniferous rocks. In the Esla Nappe and the Valsurvio Dome this unit rests upon Devonian quartzitic sandstones. It is not always certain that the quartzitic sandstones which sometimes underlie the Alba Formation are really of Upper Devonian age. Spanish geologists hold that in many parts of Asturias the Alba Formation rests on the "Quarzita armoricana" which should be of Ordovician age. Yet the possibility exists that the uppermost part of the "Quarzita armoricana" represents the lithologically closely similar, uppermost Devonian quartzitic sandstones typically represented in the Leonide thrustfolded zone (Ermita Formation of Comte, 1959).

The Alba Formation is conformably overlain by the Escapa Limestone in most areas of León, Palencia and Asturias. However, in León south of the Leonide thrustfolds (Alba syncline) a succession of clastic sediments follows on top of the Alba Formation and thick massive limestones similar to the Escapa Formation appear only higher in the section. Also in Palencia near Cardaño de Arriba a clastic series is recorded on top of the Alba Formation. In the latter case tectonically active ridges may account for the absence of the Escapa Formation.

Breaks in sedimentation have been recorded between the Alba Formation and the Vegamián Formation (Higgins, Wagner-Gentis and Wagner, 1964). Moreover, also within the Alba Formation sedimentation apparently was not always continuous since Kullmann (1963) states that in NW Spain middle Viséan strata corresponding with the Crenistria Zone (Go α) are only known from the Río Bernesga area (León).

Goniatite faunas from the Alba Formation have been studied by Kullmann (1961, 1962, 1963) and Wagner-Gentis (1960, 1963 and in Wagner 1955, 1957, 1962); the conodont faunas by Higgins (1962). The information supplied by these authors reveals that the deposition of the Alba Formation has not been restricted to the upper Viséan (Delépine, 1943) but locally had already started in the lower Viséan * and in some places continued into the Namurian A. Fusulinids or other foraminifers have never been found in the Alba Formation. When the time-span of the Alba and the underlying Vegamián formations and the thickness of both are considered, it becomes obvious that the Lower Carboniferous in NW Spain is represented by an extremely condensed sequence.

Escapa Formation. — The Escapa Formation as proposed by Brouwer and van Ginkel (1964) is here accepted and so is considered to be equivalent to the Caliza de Montaña of Spanish authors (e.g. Paillete, 1855; Julivert, 1961) and the Calcaire des Cañons of the French school (e.g. Barrois, 1882). The Escapa Formation had a large geographical extension at the time of its deposition since it is generally present whenever the base of the Carboniferous is exposed.

The sequence indicated by Barrois (1882) and Delépine (1943) in the Sierra de Escapa (Asturias) is provisionally proposed as the type area until detailed work on this unit provides a measured type section.

The Escapa Formation is characterized by the occurrence of limestone, recrystallized limestone to marble and dolomitic limestone to dolomite. The limestone may be massive or bedded with a grey-blue or black colour. Dolomitization is generally indicated by yellow-brown or pink patches. Also subordinate occurrences of mineral veins have been recorded as well as bipyramidal quartz crystals enclosed in the recrystallized limestone (Koopmans, 1962, Barrois, 1882). Intercalations of sandstones and shales occur.

In the "Picos de Europa" (Asturias) Delépine (1943) gives a thickness of 600 to 700 m for the whole of his Calcaire des Cañons; his lower subdivision of 200 m of black slightly dolomitised limestones with yellow-pink dolomites is considered as the Escapa Formation, the upper subdivision is here considered to belong to the Escalada Formation. Julivert (1961) records 100 to 250 m for the Escapa Formation in the Beleño basin, which is immediately west of the Picos de Europa. Still further to the west in the Central Basin of Asturias Dr. M. N. Llopis Lladó (oral comm.) gives a thickness of approximately 80 m for this unit. South of the León line (León Palencia) thicknesses apparently are often somewhat greater and amount to 800 m in N León (Delépine, 1943; Comte 1959; Rupke, 1965) and to 300 m in N Palencia (Sierra del Brezo) (Kanis, 1956).

* Recently Budinger and Kullmann (1964) showed that in the valley of the Río Teverga, 2 km N of Entrago in Asturias strata of lower Tournaisian age may occur. This conclusion was based on studies of conodonts by the first author. The lithologic characteristics of the strata in which these conodonts have been found ("ungeschichtete Kalke, hellgrau, rotfleckig") may either point to the Alba Formation or the upper part of the Ermita Formation in which pink, coarse-grained limestone lenses are known to occur.

With respect to these results, Mr. H. A. van Adrichem Boogaert (Leiden) remarks (oral comm.) that the conclusions about the age of the formations by their conodont contents in this condensed part of the Carboniferous sequence have to be made with extreme care. Reworking of the sediments during the various small regressions and transgressions may easily have given rise to mixed faunas.

The Escapa Formation usually rests conformably upon the Alba Formation in almost every reported section throughout its wide extent. At its top the sequence with overlying formations is also usually conformable or at least paraconformable because there is some evidence of non-sequences in places such as the red shale in the Beleño basin, Asturias (Julivert, 1961). North of the León-line non-sequences and slight angular disconformities may exist between the Escapa and the overlying Lois-Ciguera or Lena formations.

The Escapa Formation is extremely poor in fossils. Goniatites obtained near the base and near the top of this formation have been identified as belonging to possibly Namurian A or (near the top) lower Namurian B assemblages (Kullmann, 1962). Occasionally (San Emiliano area) very poor faunas of fusulinids are found in the upper part of the Escapa Formation which have been identified as belonging to Bashkirian assemblages which will be described in a future publication.

2 North León (south of León line)

The following formations have been distinguished:

San Emiliano Formation
Escapa Formation (described in section 1)
Alba Formation (id.)
Vegamián Formation (id.)

San Emiliano Formation. — The San Emiliano Formation is here used as designated by Brouwer and van Ginkel (1964) to include rocks deposited in an about E-W striking basin in a geographical situation which probably corresponded approximately with the present Leonide thrustfolded area (León).

The E-W striking section situated between the villages Villargusan and Pinos extending from the Escapa Limestone to the valley of Río Luna is designated as the type section. Unfortunately the lower part of this section that is from the Escapa Limestone to the lowest fusulinid containing limestone (Loc. L 24), shows structural complications. Another typical section in the San Emiliano area is the NNW-SSE section through San Emiliano and Candemuela.

The formation consists principally of an alternation of shales, subgreywackes and limestones, the stratigraphically higher part of the section is slightly more sandy and contains moreover, some thin carbonaceous shales. The whole sequence which is about 1750 m in thickness contains more than ten limestone horizons which are individually up to 40 m thick (San Emiliano area). These limestones are generally light-grey coloured in contrast to the often black, massive, bituminous sometimes coarse-grained (calcarenitic) or even dolomitic, underlying limestones of the Escapa Formation. In the sections mentioned there is a single quartzitic sandstone bed about 20 m thick.

The San Emiliano Formation rests conformably upon the Escapa Formation. The transition between both formations is gradual and a separation must necessarily be based on an arbitrarily defined ratio of limestone to clastic sediments. Besides, the base of the San Emiliano Formation may laterally pass into the upper part of the Escapa Formation. The San Emiliano Formation is stratigraphically the highest unit involved in the Leonide thrustfolding. Locally the unconformable contact with the overlying Cea Formation* may be observed.

* The Cea Formation (Koopmans, 1962) has been described in detail by Helmig, 1965. It consists of limnic sediments deposited in intramontane basins along the southern and western borders of the Cantabrian Mountains (upper Westfalian D-Stephanian C). Here the Cea Formation has not been dealt with since it was considered to be outside the scope of the present paper.

North of the Leonide thrustfolded area the San Emiliano Formation becomes rapidly thinner whilst the proportion of clastic sediments increases.

The San Emiliano Formation yields an abundant fauna of foraminifers, algae, brachiopods, corals, crinoids, bryozoans, ostracods and trilobites. The fusulinid assemblages from a limestone near the top of this unit (Loc. L 16) may correspond to those of the uppermost Bashkirian strata of Russia. The lowest fusulinid-containing limestone (Loc. L 24) has also yielded an assemblage assignable to the Bashkirian. Carbonaceous shales near the top of this formation yielded very poor floras which might either belong to the Namurian C or Westfalian A (Wagner, 1959) or to the Westfalian A (Dr. F. Stockmans, written comm.).

3 North León (north of León line)

The following formations have been distinguished:

Lois-Ciguera Formation
Lena Formation
Escapa Formation (described in section 1)
Alba Formation (id.)
Vegamián Formation (id.)

Lena Formation. — The Lena Formation is here used as defined by Barrois (1882) to include rocks outcropping in the valleys of the rivers Porma and Huerna as well as near Pola de Lena, La Vega and Barzana in Asturias.

The section through the Vegarada valley approximately 5 km NE of Canseco (León) is here designated as the type section of this unit. This section has been presented by Rácz (1965) although there called Lois-Ciguera Formation following Brouwer and van Ginkel (1964). The Lena Formation may also be well seen along the main road León-Oviedo between "Puerto de Pajares" and Pola de Lena.

The Lena Formation consists of shales which are often carbonaceous, sandy shales, sandstones, greywackes with remains of plants, many relatively thin beds of limestone (usually less than 40 m thick), some thin (5—10 m) beds of conglomerate and some poor generally unworked coal seams. The total thickness of this unit in the type section is approximately 1700 m. Apparently the Lena Formation has been deposited in a marine to paralic environment.

In León the Lena Formation is found in the Asturides north of the León-line resting paraconformably upon the Escapa Formation. The lowest part of the Lena Formation here is probably a condensed sequence with local nonsequences and even some local angular unconformities. To the north and northeast the Lena sedimentation most probably passed laterally into the Escalada and Beleño Formations of the Beleño basin (Asturias). Similarly a lateral passage into the lower part of the Lois-Ciguera Formation to the east is implied by the mapping as well as the fusulinid faunas.

The Lena Formation forms the uppermost unit in the Carboniferous sequence of NW León. Locally it is unconformably overlain by limnic deposits which possibly may be referred to the Cea Formation. The Lena Formation is conformably overlain by the Sama Formation in Asturias.

The Lena Formation is rich in fossils especially fusulinids but also algae, other plants, and brachiopods. Detailed work on the fusulinids from this formation has yet to be done. The algal fauna from this unit has been described by Rácz (1965). Wagner (1962) has described a flora as upper Westfalian (probably Westfalian C) from high in the formation. The Lena Formation except for the uppermost and possibly the lowermost part of this unit as present in León, has been deposited during the Lower Moscovian as based on fusulinid evidence.

Lois-Ciguera Formation. — The Lois-Ciguera Formation as designated by Brouwer and van Ginkel (1964) together with additional data supplied by Mr. J. de Meyer (Leiden) is here used for rocks outcropping in the upper valley of the Río Esla near Lois, Ciguera and Anciles (N León).

Sediments of this unit consist of greywacke, shale, limestone and occasionally a carbonaceous shale or coal seam. Sandstones are usually of greywacke or subgreywacke type. The proportion of limestone in the whole sequence is fairly high (approximately 30—50 % of the total thickness). The thickness of the limestone beds is very variable ranging from a few meters to 250 m (Toya Masiva Lst. Mbr.). In the Ciguera section the following limestone members may be distinguished from top to bottom: Ciguera, Terrionda, Toya Stratificada and Toya Masiva. The total thickness of the Lois-Ciguera Formation is approximately 1250 m.

The Lois-Ciguera Formation rests paraconformably upon the Escapa Formation. The lowest part of the Lois-Ciguera Formation is probably a condensed sequence with local non-sequences and possibly some restricted angular unconformities. A lateral passage of the lower part of this unit into the Lena Formation to the west is implied by the mapping as well as the fusulinid faunas. The Lois-Ciguera Formation is unconformably overlain to the south and west by the Stephanian rocks of the Salamón basin which are the uppermost Carboniferous strata present in this area (Helmig, 1965).

The Lois-Ciguera Formation yielded well preserved fusulinid faunas. An assemblage from the Toya Masiva is of Lower Moscovian (upper Kashirian) type. Fusulinids (Fusulinella subzone B, top of subdivision B_2 or base of subdivision B_3) from near the top of this unit indicate that sedimentation probably ceased in Upper Moscovian (Myachkovian) time.

4 Northwest León (south of León line)

The following formations have been distinguished:

Pando Formation
Curavacas Formation (described under section 8)
Prioro beds (See section 9, Piedras Luengas Formation).

Pando Formation. — The Pando Formation as designated by Brouwer and van Ginkel (1964) is used here for the rocks around the Tejerina syncline (NE León) although excluding the lower conglomerate sequence now considered correlable with the Curavacas Formation. A lithological section and description is also given in Rupke (1965).

The type section of the Pando Formation is designated along the valley between the "Puerto de Pando" and Prioro.

The sequence which is 450 m thick as a whole, starts with a series of shales and sandstones 70 m thick. This is followed by the Mesao Limestone Member which consists of an alternation of limestone, shale and sandstone with a maximum thickness of approximately 300 m. The uppermost part of the formation again consists of an alternation of shales and sandstones (130 m).

The Pando Formation rests conformably upon the Curavacas Formation and is overlain with angular unconformity by conglomerates of the Cea Formation. The partly contemporaneous Lois-Ciguera Formation west of Riaño shows an association of fusulinids which suggest that at the time of deposition two faunal provinces were in existence possibly separated by tectonically active zones.

. The Pando Formation has yielded abundant well-preserved brachiopods as well as many fusulinids and corals. A single goniatite and a number of trilobites have also been recorded. The fusulinids point to an upper Lower Moscovian age although a lower Upper Moscovian age cannot be excluded (Mesao Lst. Mbr.; Loc. L 11). The goniatite is of Bashkirian type according to Dr. J. Kullmann (written comm.) while the trilobites also indicate a Bashkirian age for this unit (Dr. G. Hahn, written comm.). Palaeontological data with respect to the biostratigraphic level of the Pando Formation are thus highly contradictory.

5 Central basin of Asturias

The following formations have been distinguished:

Sama Formation
Lena Formation (described in section 3)
Escapa Formation (described in section 1)
Alba Formation (id.)

Sama Formation. — The Sama Formation is here used as designated by Barrois (1882) for strata outcropping in a large but rather badly exposed area which constitutes the Central Coal Basin of Asturias also known as the Basin of Sama de Langreo.

Most data with respect to this formation are obtained by observations,measurements and correlations in the different coal mines since practically the entire formation is hidden from view by soil and vegetation. A compilation of data with respect to this unit represented in a stratigraphic column has been given by de Sitter (1949). Its rocks mainly consist of an alternation of shales, sandy shales, greywackes (often micaceous and with impressions of *Calamites* or stigmaria), quartzose sandstones, limestone-conglomerates (upper part of this unit) and coal seams. Limestones containing marine faunas are apparently only of some importance in the lower part of the Sama Formation. According to Barrois (1882) there are up to eighty coal seams with thicknesses of 30—150 cm and occasionally seams up to 2.5—3 m (valley of Candin). From top to basal strata of this formation the following coal-bearing members have been distinguished: La Oscura, La Modesta, Sorriego, Entreregueras, Sotón (alto y bajo), Maria Luisa, San Antonio and Las Generalas*. The maximum thickness of the Sama Formation should be in the order of 2500—3000 m. Apparently the Sama Formation has been deposited in a continental to paralic environment.

The Sama Formation rests conformably upon the Lena Formation but its lower part is certainly equivalent with the upper part of the Lena Formation as mapped in other regions (e.g. León). The upper part of the continental to paralic Sama Formation presumably is equivalent to the entirely marine Fito Formation (Beleño basin of Asturias). The Sama Formation is the uppermost unit in the Central Basin of Asturias.

The age of the Sama Formation has been studied through the fossil flora by Jongmans (1951, 1952), Jongmans and Wagner (1957) and Wagner (1959). According to Jongmans the top of this unit reaches perhaps into the Stephanian A whereas Wagner states that sedimentation ceased towards the close of the Westfalian D. The first author was of the opinion that the lower part of the Generalas Coal Member (= base of Sama Formation) may even be indicative of the Westfalian B. According to Wagner (1959) the sampled flora does not allow a discrimina-

* In this paper the Generalas Coal Member is incorporated in the Sama Formation.

tion between the Westfalian B and C. Fusulinid faunas have been recorded from the lower part of the Sama Formation (Generalas and Maria Luisa Coal Members). Unfortunately the present author did not succeed in refinding these fusulinid-containing beds. Rojo (1933) mentions *Fusulinella sphaeroidea* Moeller [= *Pseudostaffella sphaeroidea* (Moeller)] a species that should occur in the San Antonio Coal Member. The same species had already been described by Barrois (1882) from samples of the top of the Lena Formation as well as from basal strata of the Sama Formation (probably near our locality A 3). *Fusulina cylindrica* Fischer de Waldheim has been recorded by several authors, for the first time by Verneuil (Verneuil and Collomb, 1852), from near the top of the Lena Formation as well as from basal strata of the Sama Formation. It is presumed by the present writer that these fusulinid faunas from approximately the limit of the Sama and Lena formations are closely comparable with the fauna from Pola de Lena (Loc. A 3) described in this paper. This should imply that all assemblages previously recorded as *Fusulina cylindrica* should be considered to belong to either *Eofusulina* or *Paraeofusulina*. It is equally probable that records of *Pseudostaffella sphaeroidea* (Moeller) have to be allocated to *Ps.* ex gr. *gorskyi* (Dutk.) As a consequence these faunas should indicate a Lower Moscovian age. Near the limit of the Sama and Lena Formations (83 m below Seam 4 of the Generalas Coal Member) a fauna of cephalopods has been found by Delépine which he compared with a corresponding fauna occurring at the Petit-Buisson level of Belgium. The Aegir-Petit Buisson-Mansfield level has been designated as the limit of the Westfalian B and C substages (Jongmans 1928).

6. Beleño basin

The following formations have been distinguished:

Fito Formation
Escalada Formation
Beleño Formation
Escapa Formation (described under section 1)
Alba Formation (id.)
Vegamián Formation (id.)

Beleño Formation. — The Beleño Formation is here introduced for a clastic sequence in the Beleño basin which is situated immediately west of the "Picos de Europa" (Asturias).

The rocks consist predominantly of shale which varies from 250 to 350 m in thickness. The lowermost 100 m contains sandy shales and sandstones whereas at the top of this unit there are 20 to 50 m of alternating shales and limestones with an isolated thin (up to 70 cm) coal seam.

The Beleño Formation rests upon the Escapa Formation (= Caliza de Montaña) paraconformably but it is presumed that an hiatus exists between them. The Beleño Formation is in its turn conformably overlain by the Escalada Formation. It is highly probable that the Curavacas Formation is at least partly a lateral equivalent of the Beleño Formation which (latter) may also pass into the Lena Formation towards the west.

Except for the upper 20 to 50 m which have yielded some few brachiopods and a very poor flora, no fossils have been encountered in the Beleño Formation. Stratigraphic relations make it likely that it was probably deposited during the Lower Moscovian.

Escalada Formation. — The Escalada Formation is here introduced for a massive limestone in the Beleño basin which is situated immediately west of the "Picos de Europa" (Asturias). This formal name is proposed to supersede that of "Caliza masiva superior" of Spanish authors (e.g. Julivert, 1961). Although the typical area of this unit is in the Beleño basin, it is recognized over the whole eastern border of the Central Basin of Asturias.

The Escalada Formation is a rather persistent unit of massive limestone varying in thickness between 80 and 250 m in the Beleño basin.

The Escalada Formation rests conformably upon the Beleño Formation. Presumably there is a lateral transition between these formations in an area between the Beleño basin and the "Picos de Europa" where the Escalada Formation probably thickens at the expense of the Beleño Formation. The Escalada Formation is conformably overlain by the Fito Formation. To the west a gradual passage into the top of the Lena Formation or the base of the Sama Formation is presumed.

Fusulinids from the Escalada Formation (Locs. A 1, A 5, A 6) resemble those of Lower Moscovian (upper part of Kashirian) or Upper Moscovian (lower part of Podolskian) assemblages.

Fito Formation. — The Fito Formation is here introduced for an alternation of sandstones, shales and limestones in the Beleño basin which is situated immediately west of the "Picos de Europa" (Asturias).

The Fito Formation may have a maximum thickness of about 700 m. The limestone beds, with exception of a single bed of 90 m, are not over 25 m thick. The number of these beds varies from nine to sixteen.

The Fito Formation rests conformably upon the Escalada Formation and is the uppermost rock unit in this area although it may be locally overlain by unconformable Stephanian strata. The Fito Formation was probably contemporaneous with the Sama Formation and may well have graded into this unit.

Fusulinids from limestones near the base and near the top of this formation all belong to Upper Moscovian assemblages (Locs. A 7, A 8).

7. *Picos de Europa* (*Asturias*)

The following formations have been distinguished:

- Escalada Formation (described under section 6)
- Escapa Formation (described under section 1)
- Alba Formation (id.)
- Vegamián Formation (id.)

8. *Pisuerga basin* (*Palencia*)

The following formations have been distinguished:

- Barruelo Formation
- Cristóbal Formation
- Caldero Formation
- Corisa Formation
- Vañes Formation
- Molino Formation
- Curavacas Formation.

Curavacas Formation. — The Curavacas Formation as described by Kanis (1956) is used here to include not only the typical conglomerate sequence between Resoba and Polentinos but also the important shale and sandstone wedges that interfinger with the conglomerates from the west (N Palencia, NE León).

A type section has not yet been designated. Recorded maximum thicknesses in the typical areas vary between 500 to 800 m.

The Curavacas Formation in the typical region consists mainly of quartzite-conglomerate. However, intercalations of shale and sandstone play an important part in the whole sequence of this unit. In certain areas thin beds or lenses of limestone occur. The conglomerate beds generally consist of pebbles of orthoquartzite. Pebbles with a diameter of more than 50 cm are not unusual. Slightly angular blocks of limestone with diameters up to 150 cm have been reported (Koopmans, 1962). Lydite also occurs, although in subordinate quantities. As a rule the conglomerate beds show poor sorting. The sum of lithological properties of this formation added to the occurrence of plant remains or even well preserved faunas point to a fluviatile torrential type of environment of deposition. Part of these conglomerates may have been carried into the sea, since occasionally we find wholly marine limestone (Albas Limestone, Casavegas sub-basin, Pisuerga basin) closely associated with conglomerate.

The Curavacas Formation rests unconformably upon the Devonian of Lebanza-Polentinos; to the south, towards the Sierra del Brezo (Palencia), the nature of the contact is less clear but here also the contact with the underlying Mudá? Formation was probably originally unconformable. Towards the north, in the Casavegas sub-basin (N Palencia) the Curavacas Formation rests locally with clear angular unconformity upon the Piedras Luengas Formation. In this area, the Curavacas Conglomerate is conformably overlain by the Corisa Formation. To the west (headwaters Río Cea, León), the Curavacas Conglomerate rests presumably unconformably upon the Prioro beds. In this area the Curavacas Formation is conformably overlain by the Pando Formation.

Fusulinids encountered in the Albas Limestone (Loc. P 3) belong to a Lower Moscovian assemblage (lower Kashirian). Those from the limestone near Arbejal (Loc. P 63) equally belong to the Lower Moscovian (lower Vereyan). However, it is possible that the limestone near Arbejal is not intraformational near the base of the Curavacas Formation but belongs to the irregularily eroded Mudá? Formation underneath. Wagner (1960b) has described floras from various localities of the Curavacas Conglomerate north of the Sierra del Brezo which he considered to be of probable upper Westfalian B age. Dr. F. Stockmans (written comm.) concluded upon a Westfalian A age for a flora from the base of the Curavacas Formation near Cardaño de Arriba (NW Palencia). Mr. H. W. J. van Amerom (oral comm.) considered floras from the upper Río Cea near Puerto de Pando (León) as most probably of middle Westfalian age.

Molino Formation. — The Molino Formation has been proposed by Frets (1965) for a sequence in the Sierra Corisa sub-basin of the Pisuerga basin (N Palencia) exposed in a N-S striking area east of San Cebrián de Mudá and west of Perapertú.

The type section is along the road San Cebrián to San Martin de Perapertú.

The Molino Formation consists mainly of subgreywacke, greywacke and dark sandy often micaceous shale. Near the base of this unit there is a polymictic breccia with angular fragments of limestone and greywacke (1—2 m in thickness). Above this breccia follows a greywacke which laterally may pass into conglomerate (50 m in thickness). On top of this greywacke follows an alternation of greywackes and shales (thickness about 300 m). This last member shows groove-casts, flute-casts and graded bedding. Occasionally on top of this greywacke-shale series two horizons of a wild-flysch facies are observed with angular limestone fragments of 10—30 cm in diameter and greywacke embedded in brown shale. The thickness of the complete section should be 400 m. The detailed description of this formation is given in Frets (1965).

The Molino Formation rests with an angular unconformity upon the Perapertú Formation and is conformably overlain by the Vañes Formation.

Only small undeterminable plant fragments have been found in this unit so that its age remains somewhat uncertain. However, stratigraphic relations make it likely that it was probably deposited during the Lower Moscovian.

Vañes Formation. — The Vañes Formation is used here as proposed by de Sitter (1957) for a sequence in the Sierra Corisa sub-basin of the Pisuerga basin (N Palencia) and developed from Vañes (W) to San Cebrián (E).

The NE-SW section which starts with a very sandy sequence approximately 400m NW of Rabanal de los Caballeros and terminates against a small outcrop of limestone SE of the hill of San Cristóbal has been designated as the type section.

This sequence consists of sandstone, sandy shale and subordinate thicknesses of shale with a total thickness of about 1000 m.

The Vañes Formation rests conformably upon the Molino Formation and passes upwards and laterally into the Corisa Formation.

Only a few badly preserved plant remains have been found in this unit. However, stratigraphic relations make it likely that the lower part has been deposited during the upper Lower Moscovian or lower Upper Moscovian.

Corisa Formation. — The Corisa Formation as proposed by Nederlof and de Sitter (1957) is restricted to the Pisuerga basin (N Palencia). This unit is typically developed in the Sierra Corisa sub-basin but is recognized also in the Casavegas and Redondo sub-basins as well as in the Barruelo area.

The SE-NW section which starts with the Socavón Limestone Member (SE of the Maria mine) and terminates with the topmost limestone bed of the Sierra Corisa Limestone Member is designated as the type section of this unit.

The Corisa Formation consists of a typical paralic sequence of mainly sandstones and shales with lensing limestone beds and a few coal seams.

Where the contact is seen the Corisa Formation lies conformably upon older formations. The upper contact with overlying formations is conformable in the Casavegas sub-basin, paraconformable in the Redondo sub-basin and locally unconformable in the Sierra-Corisa sub-basin.

The floras from the various sub-basins indicate lower Westfalian D and Westfalian D-Stephanian A substages. Corals from the Sierra Corisa sub-basin indicate the Moscovian stage. Fusulinids from all the sub-basins are compared to Upper Moscovian assemblages.

The Sierra Corisa sub-basin: From top to bottom the Sierra Corisa, Cotarazo and Socavón limestone members are shown here. The San Cebrián Coal Member is stratigraphically above the Socavón Limestone and below the Cotarazo Limestone. There is a clastic sequence of quartzitic sandstones, subgreywackes and shales separating the members mentioned above. The total thickness of this unit in the type section is approximately 1600 m.

The Corisa Formation rests conformably upon the Vañes Formation and the lower part of the Corisa Formation even passes laterally into the upper part of the Vañes Formation. Near "Cabra Mocha" the Corisa Formation is overlain with angular unconformity by the Cristóbal Formation. To the east no angular unconformity can be seen but a short break in sedimentation presumably occurred.

The present unit in the Sierra Corisa sub-basin yielded rich faunas of foraminifers as well as algae, corals, bryozoans and crinoids. A flora from the San Cebrián Coal Member indicates a lower Westfalian D age (Wagner, 1959). Corals in the Socavón and Cotarazo Limestone Members indicated respectively a Moscovian and Upper Moscovian age for these members (de Groot, 1963). All limestone members mentioned above yielded fusulinid assemblages of Upper Moscovian type (Locs. P 22, P 57, P 98, P 40, P 58, P 82).

The Casavegas sub-basin: From top to bottom the Lores, Casavegas, Maldrigo, Castrillo and Camasobres Limestone Members are developed here. The Casavegas Coal Seams are stratigraphically above the Maldrigo Limestone and below the Lores Limestone and include the Casavegas Limestone. The clastic sequence between these members consists of shales and sandstones. The sandstones in the lower part of the sequence are sometimes flaggy and occasionally slightly quartzitic; in the upper part of the sequence there are brown to greenish coloured quartzitic sandstones and subgreywackes. The total thickness of this unit in this sub-basin is approximately 2000 m.

The present unit in the Casavegas sub-basin conformably overlies the Curavacas Formation and is in its turn conformably overlain by the Barruelo Formation.

Fossils are relatively rare; yet foraminifers, algae, brachiopods, gastropods and trilobites have been found. The flora from the Casavegas Coal Seams not characteristic for the Westfalian D nor for the Stephanian A, is poor in number of species (Wagner, in Nederlof and the Sitter, 1957). The fusulinids belong to assemblages of the Upper Moscovian(Locs. P 10, P 7, P 4).

Redondo sub-basin: The Corisa Formation shows from top to bottom the Abismo and Agujas Limestone Members but in the Redondo sub-basin no coal seams have been encountered. Intervening strata consist of sandstones and shales. The total thickness of this unit in the Redondo sub-basin is approximately 750 m. The detailed lithology of the Corisa Formation is given in Nederlof (1959) *.

The actual base of the formation is covered by unconformable overlying Permo?-Triassic sandstones and conglomerates ("Cuesta of the Cordillera Iberica") The Corisa Formation in the Redondo sub-basin is overlain by the Caldero Formation. The state of this contact is probably not wholly conformable (See Caldero Formation).

The fossil fauna consists of foraminifers, corals (Agujas Lst. Mbr.), a few brachiopods and crinoid columnals. On fusulinid evidence we may conclude that the entire formation has been deposited in Upper Moscovian time (Locs. P 72, P 73).

Barruelo area: The base of the Rubagón section in the Barruelo area is considered to belong to the Corisa Formation. It includes the Brañosera Limestone Member as well as a sequence of shales on top of that limestone. Total thickness is 500 m.

In the Barruelo area as in the Redondo sub-basin the base of the formation is covered by disconformably overlying Permo?-Triassic strata. The Corisa Formation

* Following the concept in the present paper, most formations Nederlof distinguished in the Redondo sub-basin are to be ranked as members.

in this area is conformably overlain by strata which are considered to belong to the Caldero Formation (Nederlof, 1959).

The Brañosera Limestone yielded fusulinid assemblages of Upper Moscovian type (Loc. P 38).

Caldero Formation. — The Caldero Formation described by Nederlof (1959) is typically developed in the Redondo sub-basin of the Pisuerga basin (N Palencia) where it is very well exposed in the valley of the "Arroyo de la Varga".

Nederlof (1959) mentions a lower graded sequence and a higher more sandy sequence. The graded sequence appears in the field as a regular alternation of sandstones and shales. On microscopic examination clear grading of the sandstone beds can be seen. These sandstone beds vary in thickness from 2 to 50 cm whereas shales vary from 1 to 100 cm. Maximum thickness of this lower sequence is 1000 m. It gradually grades into an upper sequence consisting of shales and poorly sorted, lime- and clay-bearing, fine-grained sandstones. There are about six to seven sandstone beds in this upper series each 20 to 30 m in thickness. In this sequence we encounter also a thin dark blue-grey to black limestone (Corros Limestone Member).

The Caldero Formation rests upon the Corisa Formation. Since locally indications of wild-flysch exist at the boundary between these formations, it is presumed that some tilting took place after deposition of the Corisa Formation. Probably slightly later in time a similar process occurred after deposition of the Corisa Formation in the Sierra Corisa sub-basin (N Palencia). The Caldero Formation is conformably overlain by the Barruelo Formation.

The Corros Limestone Member (Loc. P 52) contains a fusulinid fauna which corresponds to either Upper Moscovian (uppermost Myachkovian) or Lower Gzhelian (lowermost Kasimovian) assemblages. No other fossils have been encountered in the Caldero Formation.

Cristóbal Formation. — The Cristóbal Formation is used here as defined by Wagner and Wagner-Gentis (1963) for rocks outcropping in the Sierra Corisa sub-basin of the Pisuerga basin (N Palencia).

A type section has not yet been designated since no good sections through the whole sequence are known.

The Cristóbal Formation consists of sandstones, shales, coal seams, limestones and a single conglomerate bed. Two coal-bearing levels are known; the lower (San Cristóbal Coal Member) is situated quite near the base and the upper (San Felices Coal Member) is near the top of this formation. Between these coal-bearing levels there are some shales, sandy shales, proto- and orthoquartzitic sandstones, a possibly rather thick and lensing limestone and a single conglomerate bed. The Estalaya Limestone Member is a fairly persistent but rather thin and impure limestone in this succession, important for its faunal content. The total thickness of the Cristóbal Formation is at least 750 m.

The Cristóbal Formation rests locally with angular unconformity upon the Corisa Formation (e.g. "Cabra Mocha"); to the east this angular contact disappears but a minor hiatus is presumably present. The Cristóbal Formation is the youngest unit of the Sierra Corisa sub-basin. Of the Cantabrian mountains the present formation is stratigraphically the highest unit deposited in a marine to paralic environment.

The San Cristóbal Coal Member has yielded a flora which is of lowermost Stephanian A type (Wagner and Breimer, 1958) whereas the San Felices Coal Member has yielded a flora of typical Stephanian A aspect (Wagner, 1959). As a consequence the whole unit must belong to the Stephanian A. Gastropods (Dr. Butusova, written comm.) and fusulinids (Loc. P 36) from the Estalaya Limestone Member may be compared with faunas from the Kasimov substage of the U.S.S.R.

Barruelo Formation. — The Barruelo Formation as proposed by de Sitter (1957) for a sequence of continental to paralic rocks is restricted to the Pisuerga basin (N Palencia). This unit is typically developed in the Barruelo area but is recognized also in the Casavegas and Redondo sub-basins.

The section exposed in the valley of the Río Rubagón (Barruelo area) is designated as the type section of this unit.

The Barruelo Formation consists of a typical continental to paralic sequence of mainly sandstones and shales with numerous workable coal seams. Full marine limestones or shales may occur. For a detailed description of the Barruelo Formation especially with regard to the occurrences and composition of coal seams reference is made to Nederlof and de Sitter (1957).

The Barruelo Formation either rests conformably upon the Corisa Formation (Casavegas sub-basin) or on the Caldero Formation (Redondo sub-basin, Barruelo area). It is the uppermost unit in the Pisuerga basin whereas it is unconformably covered by the Peña Cildá Conglomerate in a small area 4.5 km WNW of Barruelo de Santullán.

The floras from the various sub-basins and the Barruelo area indicate Westfalian D-Stephanian A and Stephanian A substages.

Barruelo area: The main rock types are shale, sandstone, quartzite-conglomerate and coal. Near the base of the formation the Peñacorba Coal Member is found which contains three to four workable coal seams. About 350 m higher in the section there begins the Calero Coal Member containing about five to seven workable coal seams. Quartzite-conglomerates are recorded near the top of the Calero Coal Member and also at the top of the Barruelo Formation in this area. Total thickness should be approximately 1000 m.

The Barruelo Formation rests conformably upon the Caldero Formation and is unconformably overlain by the Peña Cildá Conglomerate, which contact may be observed in a very small area.

The Peñacorba Coal Member has yielded a flora of Stephanian A age comparable with that of the San Felices Coal Member of the Cristóbal Formation (N Palencia) whereas the floras from the Calero Coal Member, also of Stephanian A age, should be contemporaneous with those from the Redondo Coal Member of the Barruelo Formation in the Redondo sub-basin (N Palencia) (Wagner, 1955). In the midst of the Calero Coal Member a freshwater fauna of a Stephanian A type occurs, which, according to Wagner (1955) is characterized by a profusion of the phyllopod *Leaia baentschiana* Beyrich. The Peña Cildá Conglomerate should be of Stephanian B age as based on floral evidence (Wagner, 1955).

Casavegas sub-basin: The main rock types are shale, white to greyish quartzitic-sandstone, subgreywacke and coal. The Urbaneja Limestone Member is an impure limestone bed containing algae and crinoid fragments near the top of the formation just above the Rosa Maria Coal Member comprising uneconomic coal seams. The Areños Coal Member near the base of the formation includes between two and five exploitable coal seams. The total thickness of this formation measured on the watershed between the villages Lores and Casavegas is approximately 1000 m.

The Barruelo Formation rests conformably upon the Corisa Formation and forms the uppermost unit in this area.

The rather meagre flora from the Areños Coal Member was neither conclusively Westfalian D nor Stephanian A (Wagner and Wagner-Gentis, 1963). Similarly a small flora from the much higher Rosa Maria Coal Member could belong to either substage (Mr. H. W. J. van Amerom, oral comm.). The Urbaneja Limestone Member has yielded algae comparable with some of the Cristóbal Formation and belonging to the algal Zone VI (Rácz, in press) according to Dr. L. Rácz (oral comm.). Since floras from the Cristóbal Formation have been definitely assigned to the Stephanian A it seems probable that at least the higher part of the Barruelo Formation in the Casavegas area will have to be allocated to this substage.

Redondo sub-basin: The main rock types are shale, coal and sandstone which generally is of protoquartzite and occasionally of orthoquartzite type.

Three levels with coal-bearing strata are distinguished. They are from top to bottom the Reboyal, Redondo and Lomba Coal Members. The single limestone of this unit (San Juan Limestone Member) is an impure limestone of biostromal type. The thickness of this formation in this area as measured in the valley of the upper Pisuerga from the "Pozo Caldero" up to the youngest deposits of the Redondo area is approximately 1350 m.

The Barruelo Formation rests conformably upon the Caldero Formation and forms the uppermost unit in this area.

This formation yielded good faunas of pelecypods, some brachiopods and a single cephalopod. Whenever fossil floras have been encountered, they have indicated a Stephanian A age (Wagner, 1959).

9. Formations cropping out from beneath the flanks of the Pisuerga basin

The following formations have been distinguished:

a. South of the Pisuerga basin:
Mudá Formation
Perapertú Formation
Cervera Formation

b. North of the Pisuerga basin:
Piedras Luengas Formation.

Mudá Formation. — The Mudá Formation is here used as proposed by Wagner and Wagner-Gentis (1963). It is to be found along the southern border of the Pisuerga basin and is typically developed near Mudá and Monasterio (N Palencia).

No satisfactory type section can be designated due to the rapid facies changes to be observed in these rocks and the complicated tectonics that have affected them.

The Mudá Formation consists of limestones and shales with, an occasional lydite breccia. The limestone is either dark and bedded or light-grey and massive and in its appearance very similar to the Escapa Limestone. It may be distinguished from the latter by the rare exposures in which these limestones pass laterally into shale.

The Mudá Formation either rests conformably upon the Alba Formation in the rare places where the latter formation is present in this area or with a presumably angular unconformity upon Devonian strata. It is in its turn overlain unconformably by the Cervera Formation. To the west the Mudá Formation is thought to pass laterally into the Escapa Formation of the Sierra del Brezo.

The limestones are usually barren of fossils but one isolated outcrop (Loc. P 76) near Mudá contains a thin horizon bearing fusulinids. This fauna is correlable with lower to middle Bashkirian types and proves the contemporaneity of the Mudá Formation with at least part of the Escapa Formation.

Perapertú Formation. — The Perapertú Formation is here accepted as defined by Wagner and Wagner-Gentis (1952), being typically developed along the east flank of the Pisuerga basin in a narrow N-S zone west of the Peña Cildá mountain and the Devonian of the San Julian mountain (N Palencia).

Because of the intricate tectonic structures together with the rapid facies changes no representative section can be offered.

The formation is characterized by typical occurrences of reef limestone laterally passing into clastic sediments. The debris zone surrounding these reefs consists of large blocks of reef limestone cemented by calcite whereas nearer to the periphery of such a zone the blocks are embedded in shale. Between the reefs there is mainly shale with some beds of sandstone, conglomerate and bedded limestone. The conglomerate has quartzite pebbles but generally also angular blocks of limestone, the latter being derived from the reef limestone; the bedded limestone consists mainly of organic debris which is equally thought to be derived from the reef limestone; occasionally quartzite pebbles were encountered as well. The maximum thickness of a reef limestone in this unit should be about 250 m. The total thickness of the formation is not known (Wagner and Wagner-Gentis, 1952).

The Perapertú Formation rests with angular unconformity upon the Devonian of San Julian mountain and is overlain with angular unconformity by the Molino Formation of the Pisuerga basin.

The Perapertú Formation has yielded corals, conodonts, foraminifers, brachiopods and algae. The coral fauna yielded a great number of new species. A single species, however, is known from the Lower Moscovian of the Donetz basin (U.S.S.R.) (de Groot, 1963). Higgins (in Wagner and Wagner-Gentis, 1963) studied the conodont faunas and concluded upon an age of either Upper Namurian or Westfalian A. A fusulinid fauna from a reef limestone immediately west of the Devonian of San Julian mountain (Loc. P 70) and another fauna north of the village Verbios are both considered to be correlable with those of the lowermost Moscovian (Vereyan substage).

Cervera Formation. — The Cervera Formation is here accepted as proposed by Brouwer and van Ginkel (1964) consisting of the rocks forming the southern border of the Pisuerga basin between Mudá and Cervera de Pisuerga (N Palencia).

No satisfactory type section can be designated because these rocks consist of a monotonous clastic sequence without marker beds which have largely suffered isoclinal folding.

This unit consists of sandstone (greywacke, subgreywacke of brown-grey colour often micaceous, sometimes calcareous), siltstone and subordinate deposits of claystone, shale and quartzite-conglomerate. A single limestone bed less than 50 cm in thickness and containing crinoid columnals has been recorded.

The Cervera Formation rests unconformably upon the Mudá Formation and presumably also upon isolated outcrops of Devonian rocks. Its relation to the Curavacas Formation in the west and the Perapertú Formation in the east is still a problem.

These problematical relations are partly due to the unfortunate circumstance that the Cervera Formation contains hardly any fossils. Plant fragments are normally encountered but up to the present only a locality west of Valsadornin yielded a recognizable flora though consisting of not more than two species. They might indicate a possible Namurian B age (Wagner in Kanis, 1956). A goniatite of the Reticuloceras Zone (Dr. J. Kullmann, written comm.) found immediately west of the main road Cervera-Vañes and west of the village Valsadornin (Fretz, 1965) does not contradict this result.

Piedras Luengas Formation. — The Piedras Luengas Formation is here used as designated by Brouwer and van Ginkel (1964) to include rocks mainly exposed to the north of the watershed of the Duero in the extreme north of Palencia and SW Santander.

The intricate tectonic structure seriously hampers the designation of a trustworthy section. Consequently even an approximate thickness of this unit cannot be given. A fairly good section through the upper part of the Piedras Luengas Formation may be shown between the villages Dobres and Bárago (Liebana area) along the Río Frio. This sequence is approximately 600 m thick. The lower part of the Piedras Luengas Formation may be shown between the Viorna Conglomerate of the Curavacas Formation in the south and the overthrusted Escapa Limestone of the "Picos de Europa" in the north. This is more or less the area around Potes. This sequence is believed to be at least 1000 m thick.

The main rock types are limestone, shale, sandstone (usually of greywacke type) and conglomerate. Near the top of this unit there is the Piedras Luengas Limestone Member. The thickness of this member is highly variable; its maximum thickness amounts to approximately 200 m. The formation is moreover characterized by graded greywacke-shale alternations and occasionally relatively thin beds of conglomerate. The conglomerates contain pebbles of quartzite, limestone, lydite or clear quartz. The proportion of lydite seems to be somewhat higher in these conglomerates than in those of the Curavacas Formation.

The stratigraphic relation with underlying rocks is not yet solved. We might perhaps consider the thin black limestones of Lon (Liebana area) as an appropriate base of this formation if we could prove that these limestones represent the southwards outwedging equivalents of the Escapa Limestone of the "Picos de Europa". This view receives some support from the observed black shale (Vegamián Formation?) stratigraphically somewhat below the limestones of Lon. The Piedras Luengas Formation is overlain by locally clearly angular unconformable strata of the Curavacas Formation.

The Piedras Luengas Formation has yielded relatively few fossils. Fusulinids, algae and corals have been recorded. Moreover, Wagner (1959) described a flora from near the village Dobres which he considered to be of Namurian C or possibly Westfalian A age. Unfortunately the exact stratigraphic position of this locality is not certain. Such a flora could belong equally well to the upper part of the Piedras Luengas Formation as to the base of the Curavacas Formation. The Piedras Luengas Limestone Member (Loc. P 1) has yielded fusulinids of Lower Moscovian (probably upper Vereyan) type.

Prioro beds: It might be possible that the lithologically somewhat similar sediments round Prioro and the "Puerto de Monte Viejo" (León) and those allocated to the Piedras Luengas Formation belonged to a single depositional environment although both rock successions are at present isolated areal unities separated mainly by rocks belonging to the unconformably overlying Curavacas Formation. This possibility receives some support by the at least partly similar age of both sequences. A sample of limestone 5 km SE of Pedrosa del Rey (Loc. M.V. 28) of Mr. J. F. Savage has yielded fusulinids comparable with those from the Piedras Luengas Limestone Member (Loc. P 1). On the other hand both areas are at different sides of the León line. * Moreover, there is some evidence that north of this line, in a SE-NW zone running from near San Julian Mountain (Palencia) in the south-east to at least Cardaño de Arriba in the north-west, there has been a break in sedimentation when the Piedras Luengas Formation and contemporaneous sediments (i.e. Prioro beds) were deposited respectively north and south of this zone. Until more detailed mapping has been done it does not seem appropriate to introduce a formal name for the sediments of the Prioro-Monte Viejo area nor to allocate them to the Piedras Luengas Formation. According to Mr. J. F. Savage (oral comm.) the Prioro beds rest unconformably upon rocks which should belong to the algal Zone II of Rácz (1965). In their turn they are unconformably overlain by the Curavacas Formation here.

* Locality M.V. 28 is on León line.

III SHORT SYNTHESIS OF SEDIMENTARY HISTORY

The stratigraphy of the Carboniferous rocks of NW Spain can by typified primarily by their variability. Variations in facies and thicknesses record an intricate and changing pattern of depositional basins largely related to tectonically active zones. Complicated tectonic structures have been impressed upon these rocks making the accurate determination of thicknesses and, sometimes, the spacial relationships between units difficult or even impossible.

In recent years studies of the various fossil faunas and floras from the Carboniferous rocks of NW Spain have assisted the unravelling of some of their geologic history. The studies of the fusulinid faunas here presented will, it is hoped, throw further light on this subject. The stratigraphic synthesis put forward below should be considered as considerably simplified and, in certain respects, not wholly firmly based. The extent and shortcomings of present knowledge are emphasised in the review of the stratigraphic units considered acceptable, discussed in the preceding chapter.

First episode (including the Millerella Zone)

The first episode comprised a considerable time span, including the Tournaisian and Viséan Stages as well as the Namurian A substage and is represented by what is usually a very thin sequence of marine rocks, the Vegamián, Alba and Escapa Formations. Sedimentation was certainly very slow at first, probably interrupted occasionally by some intervals of slight erosion. The Vegamián and Alba Formations are consequently very thin everywhere but despite this they, and especially the latter, are extremely widespread throughout the Palaeozoic areas of Palencia, León, and Asturias. This wide distribution of extremely thin formations suggests transgression over a relatively flat surface. Since the underlying formation is almost invariably the same uppermost (Famennian) Devonian sandstone the major morphogenetic uplift seems to have taken place somewhat earlier in Devonian time. Nevertheless some continuing epeirogenic activity probably complicated the sedimentation pattern being partly responsible for the absence or lithologically modified character of these formations along the León line, the Cardaño line and the Esla Nappe. The Escapa and its near-shore equivalent the Mudá Formation show that the rate of sedimentation increased towards the end of this episode. Generally a much thicker sequence represents a much shorter time span. South of the León line and in Asturias the carbonate "Caliza de Montaña" facies — the Escapa Formation — was deposited while either sedimentation of the clastic "culm" facies — the Mudá and lower Piedras Luengas Formations — or erosion took place along the central zone (Cardaño line).

Second episode (Profusulinella Zone, subzone A)

The interval represented by the subzone A of Profusulinella was much shorter than the preceding episode, corresponding approximately to substages B and C of the Namurian. In contrast to the restricted number of formations of wide expanse characterizing the first episode, a much more diversified sedimentation pattern is shown in this and the following episodes. This finds expression not only in the rapid facies changes but also in the great variation in thickness of contemporaneous sequences in the various regions. The sediments still represent marine conditions though many must have laid down in very shallow, near-shore environments. The León line became very clearly expressed in the sedimentation pattern dividing the area of very rapid sedimentation — the San Emiliano Formation (N León) — from that of condensed sequences and hiatuses in northern León and Asturias. The tectonic events controlling the sedimentation pattern could be explained by purely epeirogenic movements but it seems likely that orogenic movements culminated in the extensive thrust-folding of the Leonides towards the end of this episode. Between the Cardaño line and the presumably slightly uplifted "Picos de Europa" a series of rapidly deposited clastic rocks — middle part of the Piedras Luengas Formation — was laid down. South of the Cardaño line (N Palencia) and the León line (N León) sedimentation had ceased towards the close of this episode and rocks werefolded shortly afterwards.

Third episode (Profusulinella Zone, subzone B)

The third stage of development was also relatively short, corresponding to approximately the lower half of the Westfalian Stage. An important event was the resumption or at least acceleration of sedimentation in Asturias at the beginning of this episode. Especially in the Central Basin of Asturias the rate of sedimentation increased. Here marine to paralic conditions prevailed in which the Lena Formation was laid down (strictly speaking the term Central Basin only applies to younger sediments — Sama Formation — that have had a much more restricted area of deposition). To the east in the Beleño basin and the "Picos de Europa" deposition was under wholly marine conditions and took place at somewhat slower rates (Beleño and lower part of Escalada Formations). North of the Cardaño line in N Palencia as well as north of the León line (in NW León) clastic sedimentation persisted with even limestones interbedded with them (upper part of the Piedras Luengas Formation). Condensed sequences with unconformities can be seen representing this part of the succession along the León and Cardaño lines demonstrating their activity at this time. Quite soon much more profound activity took place which brought about the deposition of the Curavacas Formation. In the west these beds differ little from the underlying ones (Prioro beds) having a few thin bands of quartzite-conglomerate interbedded with them. To the east, however, the conglomerates increase in importance and in Curavacas mountain where they are entirely dominant the facies becomes even terrestrial, fluviatile. The rather young age of these beds and the fact that they rest in places upon Lower Devonian rocks suggest that they represent the onlap of the uppermost layers of this sequence onto an old land area. South of the León line sedimentation had ceased except for a few anomalous areas e.g. Rucayo, Prioro and Perapertú.

Fourth episode (Fusulinella Zone, subzone A, and subdivisions B_1, B_2)

The fourth stage of development took about the same time as the second or third, corresponding approximately to the upper half of the Westfalian Stage. Sedimentation continued at rapid rates but gradually in more restricted areas which towards

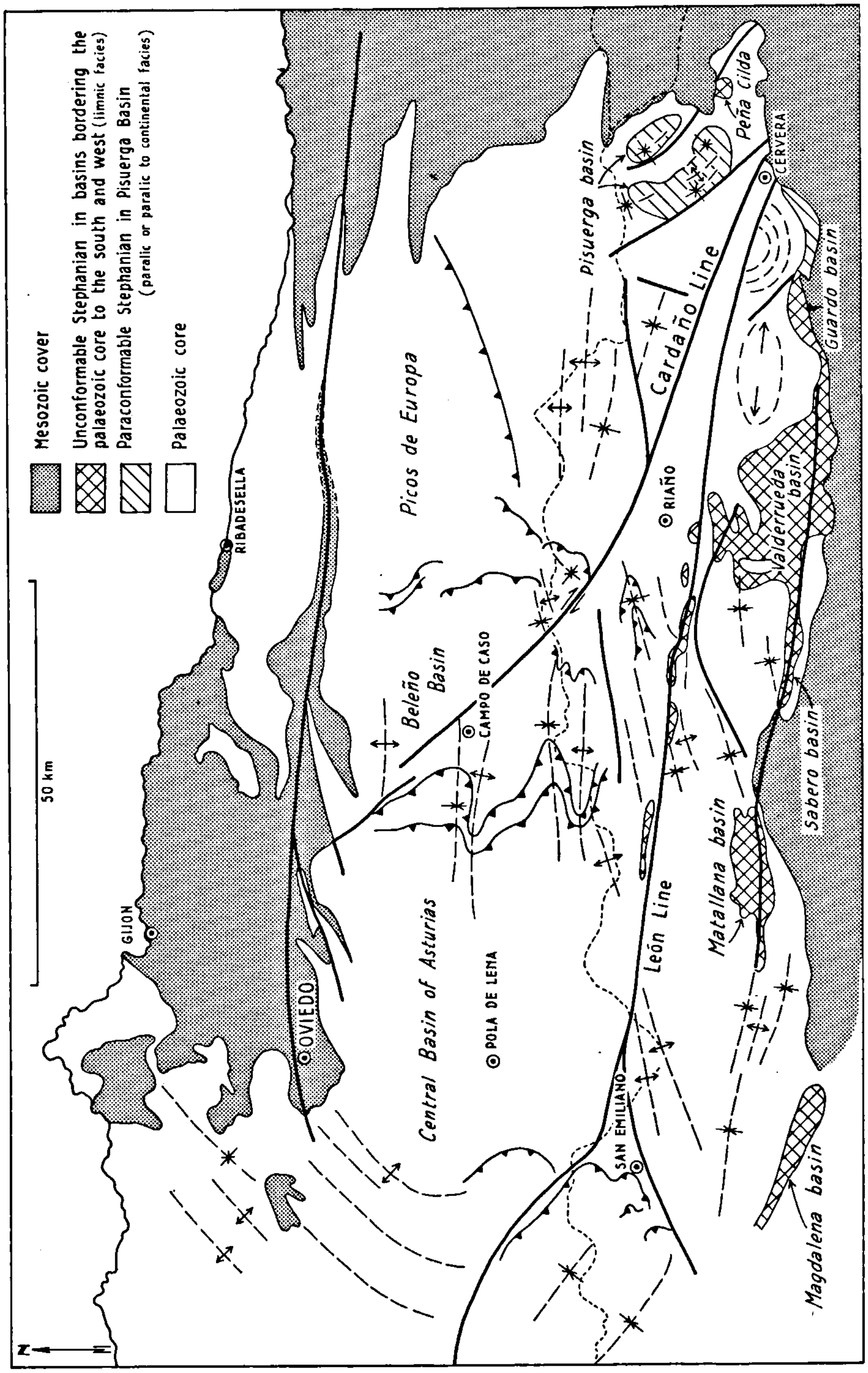

Mesozoic cover
Unconformable Stephanian in basins bordering the palaeozoic core to the south and west (limnic facies)
Paraconformable Stephanian in Pisuerga Basin (paralic or paralic to continental facies)
Palaeozoic core
50 km
N
GIJON
OVIEDO
RIBADESELLA
Picos de Europa
Beleño Basin
CAMPO DE CASO
Central Basin of Asturias
POLA DE LENA
SAN EMILIANO
León Line
Cardaño Line
RIAÑO
Pisuerga basin
Peña Cilda
CERVERA
Guardo basin
Valderrueda basin
Sabero basin
Matallana basin
Magdalena basin

Fig. 10

the close of this episode become well defined into individual basins such as the Central Basin of Asturias where a continental to paralic sequence — the Sama Formation — was deposited. In the Beleño basin marine conditions continued although deposition is at a lower rate as compared to the Central Basin. Deposition ceased in the "Picos de Europa" about halfway through this episode. In Palencia the Pisuerga basin had by now become clearly defined although it was in fact subdivided into a number of sub-basins. Marine or marine to paralic conditions prevailed throughout and different sequences (all classified under the Corisa Formation) seem to have developed under the influence of more or less continuous epeirogenic activity especially concentrated along certain lines (e.g. Barruelo line). Tectonic activity seems to have existed throughout this episode and apparently culminated in folding which finally ended sedimentation in Asturias and NW León towards the close of this episode. No similar phase is found in the Pisuerga basin. Here an hiatus may be present throughout at the end of the B_2 and in the B_3 subdivisions but an angular unconformity is only rarely developed and the discordance is so slight that no impression of a folding phase at this level is obtained.

Fifth episode (Fusulinella Zone, subdivision B_3)

The Fusulinella Zone, subdivision B_3, is by far the shortest of the intervals discussed but is very significant because the area under active sedimentation may well have been the smallest of any time during the whole of the Carboniferous Period in NW Spain. Almost the entire Cantabrian Mountain region had probably risen above sealevel and was undergoing erosion. Only in the Pisuerga basin did in places rapid sedimentation continue in a marine or marine to paralic environment (upper part of the Corisa Formation).

Sixth episode (including the Protriticites Zone)

The sixth episode possibly covered a longer time than the second, third and fourth episodes being approximately equivalent to the Stephanian Stage. This last episode in the Carboniferous history is typified by deposition of limnic sediments in intramontane basins along the southern and western borders of the Cantabrian Mountains (Cea Formation). Only in the Pisuerga basin did marine to paralic conditions persist for a short time (e.g. the Cristóbal Formation). Partly contemporaneous deposition of the Barruelo Formation took place under continental to paralic conditions in the Pisuerga and Guardo-Cervera basins. This formation passes further west into the limnic sediments characterizing the Cea Formation (Valderrueda, Sabero, Matallana and Magdalena basins) whereas the rocks, especially of the base, become younger and their limnic character more obvious. The Pisuerga Basin seems to have been subjected to quite strong, compressive folding quite early in this episode; an event that must have been contemporaneous with sedimentation further west. Deformation of the later sediments in the western basins seems to have been partly synsedimentary and possibly passive, effected by block-fault movements in the underlying "suprabasement" (Helmig, 1965).

IV ON THE SIGNIFICANCE OF NW SPAIN FOR THE CORRELATION OF MIDDLE CARBONIFEROUS DEPOSITS IN RUSSIA AND NW EUROPE

In recent decades Russian palaeontologists and stratigraphers made considerable progress towards a better understanding of the stratigraphy of the Carboniferous in the U.S.S.R. This resulted in a close correlation of the stratigraphic subdivisions used in the U.S.S.R. with that of NW Europe (Aisenverg *et al.*, 1960; Gorsky et Stepanov *et al.*, 1960).

The often thick and uninterrupted sequences present in Russia yield much more

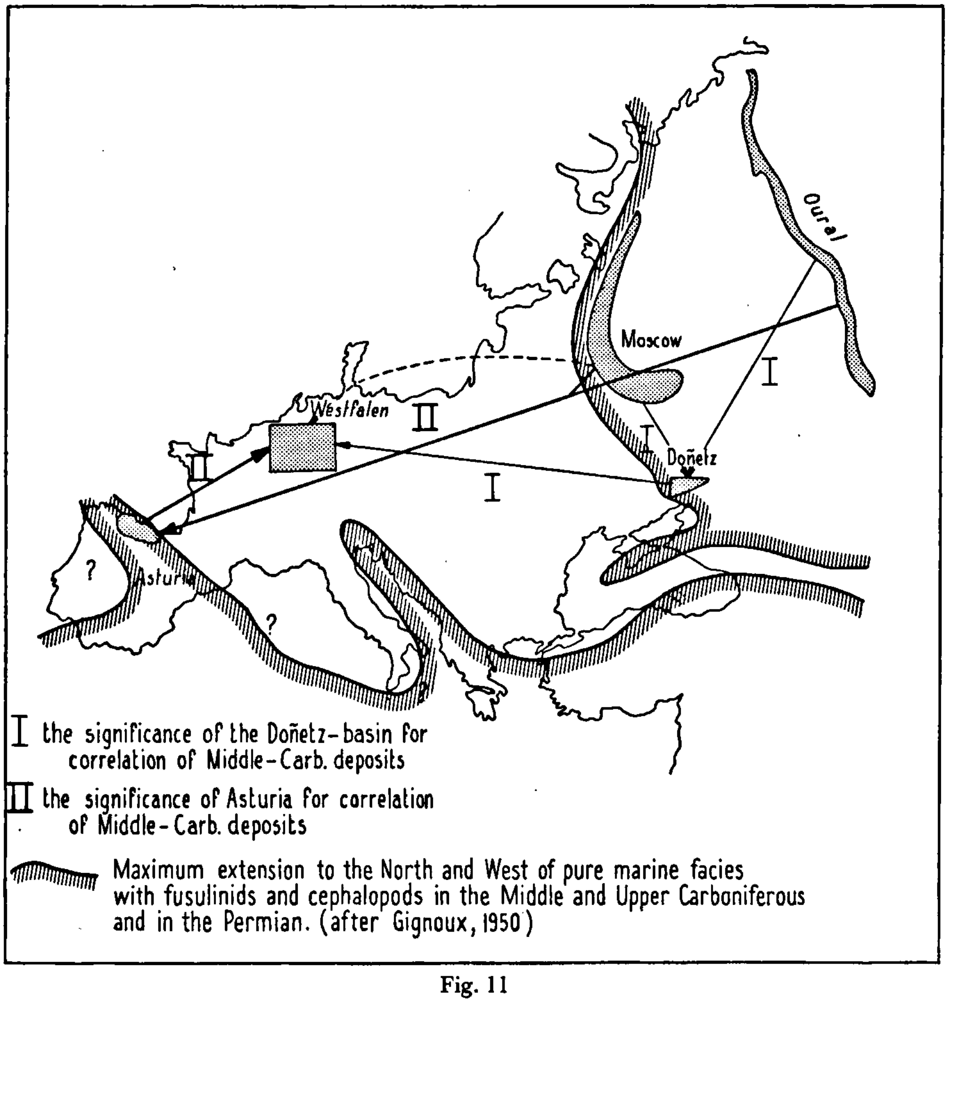


Fig. 11

complete and simple sections far more suitable as standard reference than the patchy occurrences of frequently severely tectonised and separated parts of the succession found in NW Europe.

In NW Europe the type sections of various stages are widely separated, to a large extent due to Variscan orogenic movements. Moreover, the environment was clearly marine from Tournaisian to lower Namurian whereas from the middle Namurian to the end of the Stephanian it was largely continental. Consequently it is difficult to correlate the biozones of a wholly marine fauna in terms of middle and upper Carboniferous stages of NW Europe.

The Carboniferous of the Donetz basin on the other hand is developed as a complete, very thick, and for the greater part paralic, succession of strata. This basin shows an alternation of coal seams yielding good floras and limestones containing full marine faunas.

It is therefore rather unfortunate that the originally better known Carboniferous of NW Europe was chosen as the standard reference (Jongmans, 1928).

The Donetz basin has provided Russian biostratigraphers with excellent opportunities to compare the marine deposits of Moscovian and Bashkirian Stages (type-area Moscow platform and Lower to Middle Volga respectively) with the standard subdivisions of the Carboniferous in NW Europe. According to Aisenverg *et al.* (1960) and Gorsky and Stepanov *et al.* (1960) the Moscovian Stage would correlate with the Upper Westfalian (Westfalian C + D) and the Bashkirian Stage with the Lower Westfalian (Westfalian A + B) and Namurian C. As for the Bashkirian, Russian students apparently are not unanimous with respect to the lower limit of this stage. Some are inclined to lower this limit to include strata correlable with the Namurian B of NW Europe, whereas the Namurian A, having definite Lower Carboniferous faunal assemblages, should be united to the Viséan to form an upper Lower Carboniferous stage [Aisenverg *et* Brazhnikova (1955) and Einor (1957)] (fig. 12). As far as the present writer knows there is yet no name for this stage. Apparently reference is being made to a Viséan Stage which includes what must be correlated with the Namurian A. This, however, is not permissible in stratigraphical procedure. Apparently most of the Russian students adhere to a time-stratigraphic column as presented by Aisenverg *et al.* (1960) and Gorsky and Stepanov *et al.* (1960). This column, however, is confusing in that regional as well as standard Carboniferous stages appear. This procedure, moreover, resulted in a Namurian Stage of the U.S.S.R. only partly comparable with the standard Namurian of NW Europe.

Whenever in the present paper fusulinid faunas from Spanish strata are compared with those of the Bashkirian Stage, it is always used in the sense of Aisenverg and Brazhnikova (1955) i.e. including the C^5_1 suite of the Donetz basin (= Namurian B).

The Carboniferous of the Cantabrian mountains offers a similar possibility to that in the Donetz basin for the correlation of the U.S.S.R. subdivisions, i.e. Moscovian and Bashkirian, since there is also a succession of marine to paralic strata in NW Spain somewhat similar in its overall characteristics to those of the Donetz basin. This possibility makes the Carboniferous of NW Spain of special interest with respect to the general stratigraphy of the Carboniferous System (fig. 11). In the following lines it will be shown how the correlation as presented by Aisenverg *et al.* compares with palaeontological and stratigraphical data from the Carboniferous of NW Spain. Our efforts will be concentrated upon the location in the stratigraphical column of NW Spain of the following stage limits:

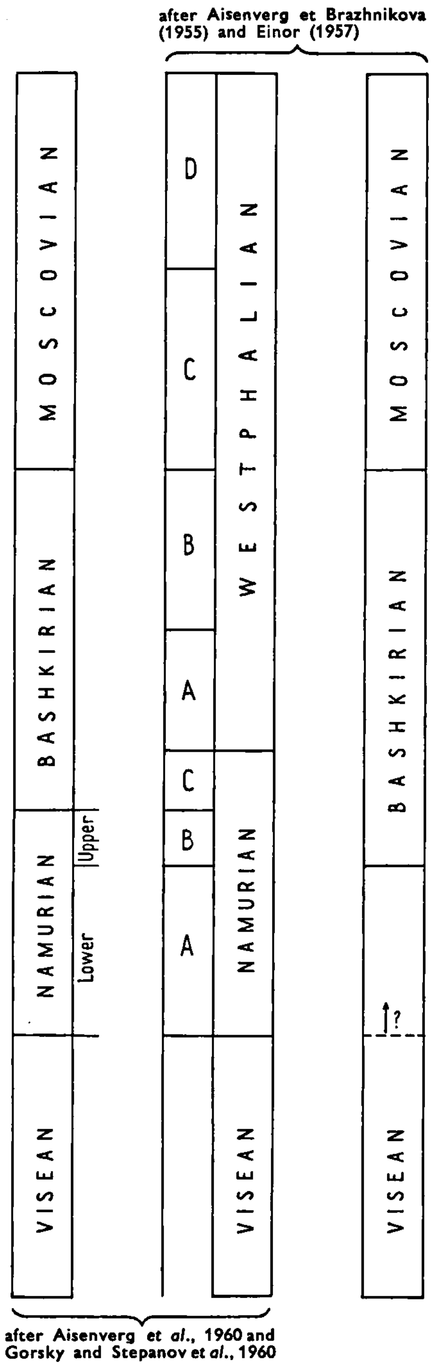

after Aisenverg et Brazhnikova (1955) and Einor (1957)
MOSCOVIAN
BASHKIRIAN
NAMURIAN
Upper
Lower
VISEAN
D
C
B
A
C
B
A
WESTPHALIAN
NAMURIAN
VISEAN
MOSCOVIAN
BASHKIRIAN
?
VISEAN
after Aisenverg *et al.*, 1960 and Gorsky and Stepanov et *al.*, 1960

Fig. 12

a. lower limit of the Bashkirian
b. limit between the Bashkirian and the Moscovian
c. limit between the Moscovian and the Gzhelian.

This will be done by comparison of fusulinid faunas from Spain with those from the U.S.S.R. In addition an attempt is made to establish a correlation of these three limits in terms of the NW European standard by comparison with described floras whenever they were found in reasonably close association with fusulinid faunas. This procedure holds good as far as the upper part of the Carboniferous sequence is concerned. For the lower part we have to rely on results obtained by studies on goniatites since good floras have not been found. The results of this comparison are very interesting in that the correlations in the Donetz presented by Aisenverg *et al.* do not hold in NW Spain. Our data are scanty and not always firmly based so that it is quite possible that with more extensive palaeontological evidence from Spain the total picture may approach more closely that of Russia (fig. 13). The relationship of known floral or goniatite localities with those where fusulinids were encountered should fulfil the following conditions, in order that the age of fusulinid assemblages is established in terms of NW European stages:

a. the age of the goniatite or fusulinid faunas and floras should be firmly established (down to substage level) either by overlapping stratigraphic ranges of a large number of species or by presence of preferably more than one typical species,
b. there must be no doubt as to the stratigraphic position of the fossil localities in the sedimentary rock sequence,
c. one of the fossil levels should be of different flora or fauna to another two occurring respectively above and below the first level while the two latter yield fauna of a single substage — the whole occurring in an undoubted stratigraphic sequence in as small an area as possible.

It is very unfortunate that there is not yet a single record in NW Spain in which all these conditions are adequately fulfilled simultaneously.

Approximately synchronous occurrences of goniatite and fusulinid faunas

Faunas and floras that have been identified from reasonably closely correlable localities are listed below. The long-distance correlations implied by the fossil identifications are shown in fig. 13 where the corresponding numbers identify rectangles in the diagrams which illustrate the degree of uncertainty of the correlations implied by these identifications.

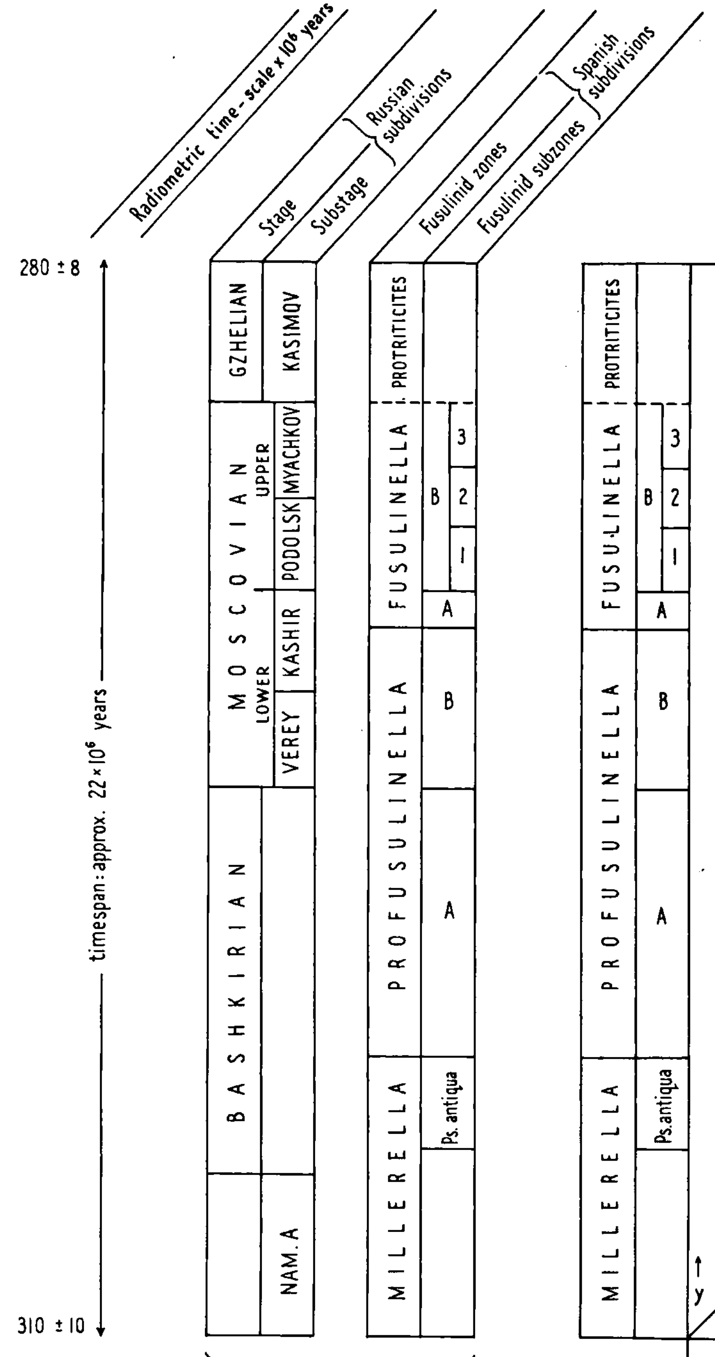
1. a. Near Ruesga (Palencia, Sierra del Brezo, Loc. P 94) massive limestones are exposed which probably belong to the Escapa Formation. Locality P 94 yielded a single fusulinid specimen similar to *Pseudostaffella praegorskii* Raus. This species has never been found in pre-Bashkirian strata.

b. Recently a fusulinid fauna has been found in the uppermost part of the Escapa Formation 180 m stratigraphically above the Alba Griotte (1 km SW of San Emiliano, León). This fauna has not yet been studied in detail and therefore is not included in this paper. It is, however, definitely of Bashkirian type.

c. The Mudá Formation which is believed to be a near-shore time-equivalent

Fig. 13 CORRELATION DIAGRAMS

The numbers within the correlation rectangles refer to those of the list of Synchronous occurrences given in Chapter IV



(Determined in NW Europe)

Correlation of Russian and Spanish subdivisions based on the occurrence of corresponding fusulinid associations in both areas.

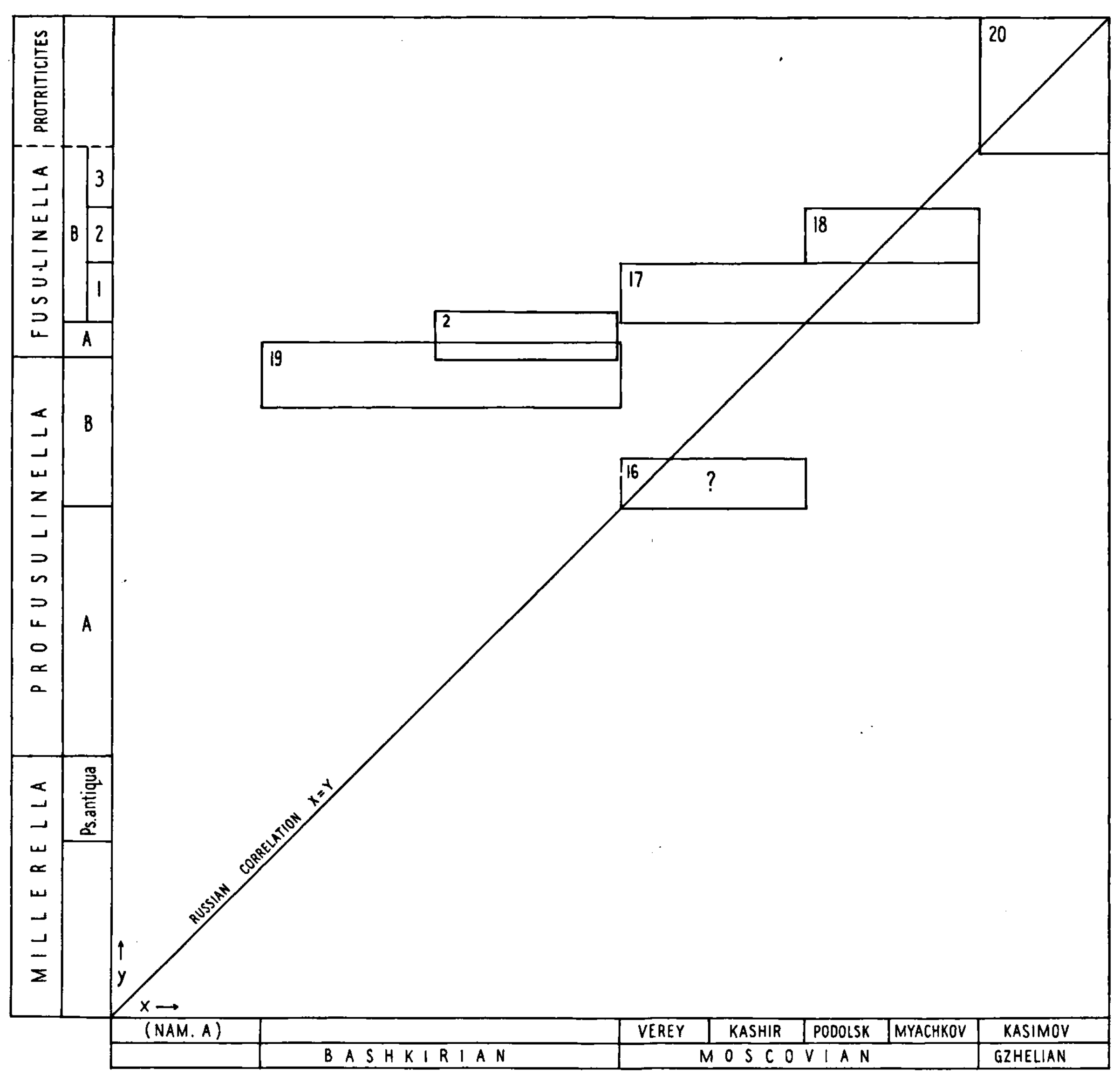


Diagram showing the correlation of Spanish faunas, other than fusulinids, with the corresponding faunas of Russian type sequences (x-axis) in relation to the Spanish subdivisions in which they have been found (y-axis)

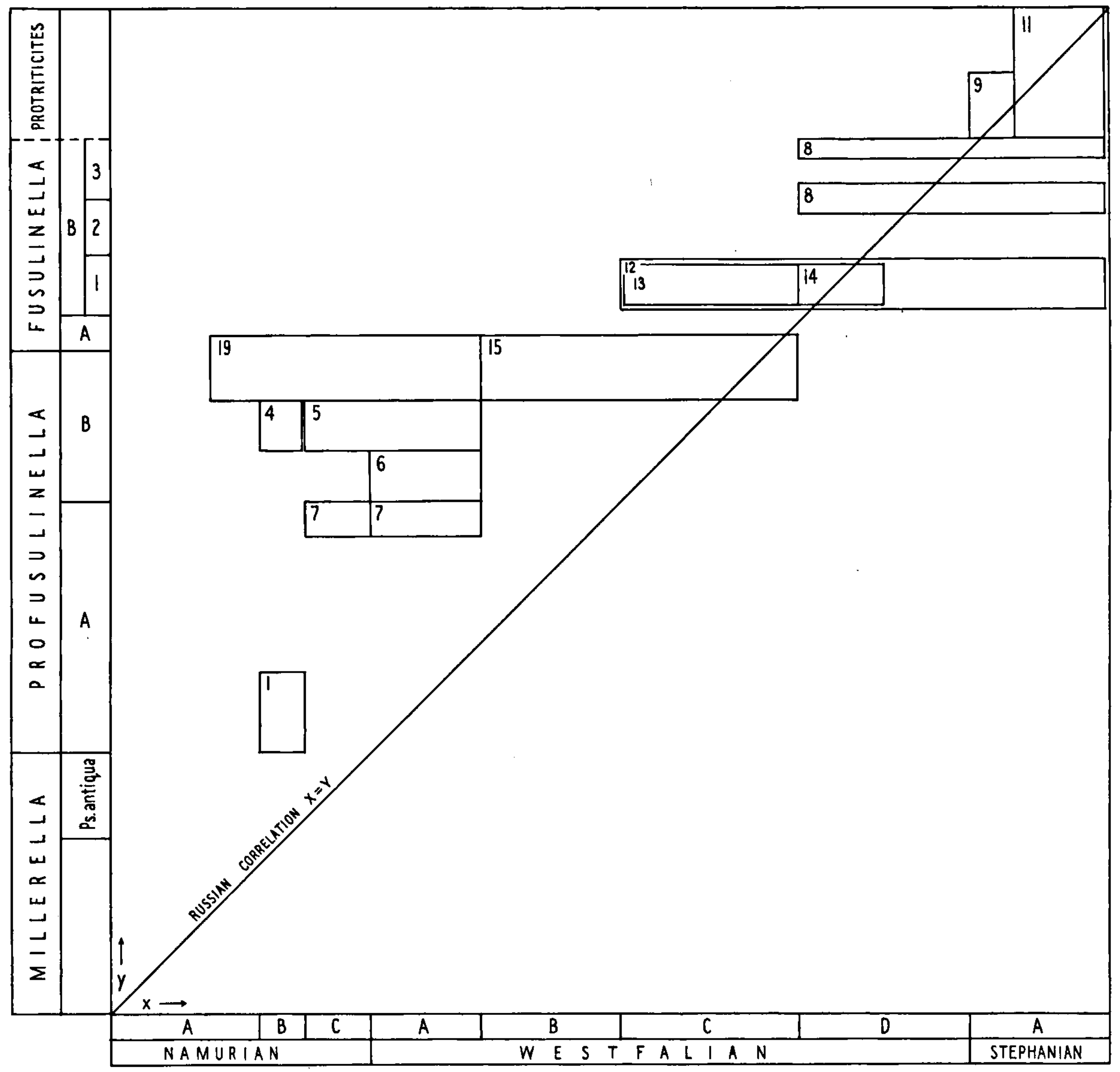
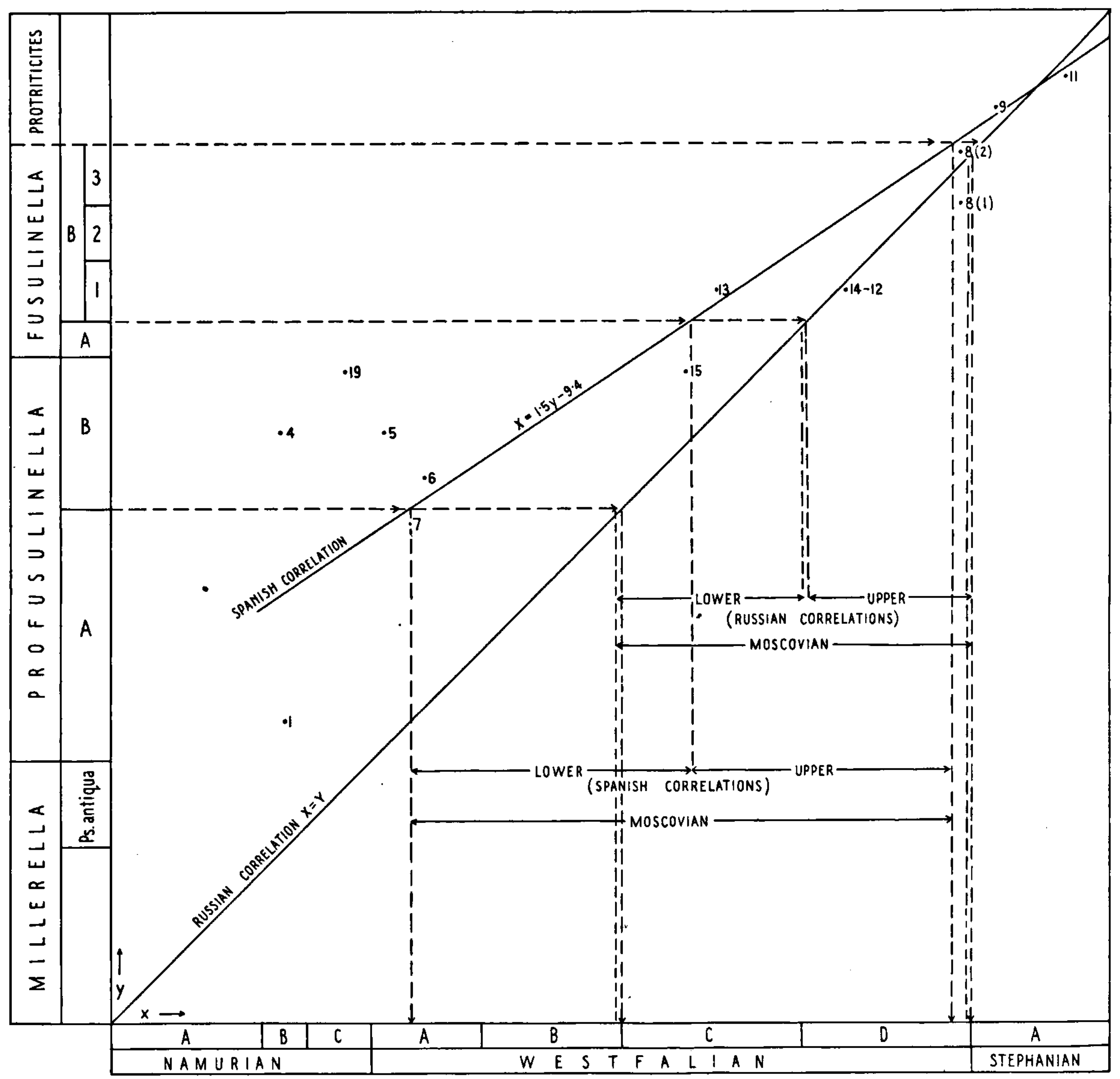


Diagram showing the correlation of Spanish floras and faunas, other than fusulinids, with the corresponding floras and faunas of NW European type sequences (x-axis) in relation to the Spanish subdivisions in which they have been found (y-axis).
Standard Russian Correlation based on that between the fusulinid faunas and the floras of Russia correlated through the latter to the NW European type sequences.



Correlation diagram of the Spanish subdivisions with those of NW Europe, showing the deviation of correlations based on fusulinids through the Standard Russian Correlation from those of other floras and faunas directly comparable with NW European assemblages.

of the Escapa Formation in Palencia, yielded a fusulinid fauna comparable to faunas from the lower part of the Bashkirian in the U.S.S.R.
The correlation of the Escapa Formation in terms of NW European stages is only poorly substantiated at present. The most recent and as it seems most reliable results were achieved by Kullmann (1962) in his study on goniatite faunas from NW Spain. He states that the majority of Namurian goniatites have been found in transition beds between the "Marbre griotte" (= Alba Formation) and the "Cañon Kalk" (= Escapa Formation). These goniatite species should point to the upper part of the Eumorphoceras Zone (E_2). We quote from p. 363: "Die einzigen wahrscheinlichem Mittel-Namur Nordspaniens angehörenden Goniatitenreste wurden in dunklen kalkig-schiefrigen Schichten im Hangenden des Cañonkalkes bei San Felix de Candás in der Nähe von Perlora (Provinz Asturien) gefunden. Die Bruchstücke die nur mit Vorbehalten als *Reticuloceras?* sp. und *Proshumardites* cf. *karpinskii* Rauz.-Chern. anzusprechen waren, sind am ehesten in die untere Reticuloceras-Stufe zu stellen . . . der Cañon Kalk wäre somit an der mittelasturischen Küste zwischen der oberen Eumorphoceras-Stufe und der unteren Reticuloceras-Stufe abgelagert, seine Bildung würde demnach in die Homoceras-Stufe gefallen sein". More recently goniatites from the Reticuloceras Zone (Dr. J. Kullmann; written comm.) were also found in León, 1.8 km SSW of Vegamián. These specimens came from the top of the Escapa Formation. It thus follows from Kullman's studies that the Escapa Formation in the Cantabrians should be correlated with the Namurian A substage. The top of this formation may locally reach or pass into the Reticuloceras Zone which indicates the early Namurian B substage.

2. The Mesao Limestone Member (León; Loc. L 11) of the Pando Formation has yielded a fusulinid fauna of either upper Lower Moscovian or lowermost Upper Moscovian type. Approximately 100 m higher in the section a well preserved goniatite has been found by the present writer which Kullmann (written comm.) determined as *Pseudoparalegoceras* cf. *russiense* which apparently occurs in the upper part of the Bashkirian Stage of the U.S.S.R.

3. A limestone member near Las Brañas (León) approximately 500 meters above the Panda Limestone Member has yielded a fusulinid fauna of Podolskian (Upper Moscovian) type. It has also yielded a single goniatite (collection Mr. H. Teer; sample no. H 71) which according to Kullmann (written comm.) may be referred to *Bisatoceras* (*Phanoceras*) cf. *williamsi* = "*Pseudoparalegoceras kesslerense*". This implies that — quoting Kullmann — "die nächsten Verwandten dieser Art lediglich in Nord Amerika auftreten: die Fundschicht von *Pseudoparalegoceras kesslerense* ist "late Morrow".

With respect to this species and the species mentioned in example 2 Kullmann comments: "Man wird die beiden Goniatiten nicht mit Sicherheit für eine genaue Alters-Einstufung verwenden können, solange sie so wenig bekannt sind. Es könnte sich auch um langlebige Formen handeln, die im Unter-Westfal beginnen und bis ins Ober-Westfal weiterlebten".

4. Rather badly preserved goniatite faunas have been found by Verwoerd in a sequence of clastic rocks 1.3 km SW of Puebla de Lillo (León) (Samples 88 and 88A; collection H. Verwoerd). According to Kullmann (written comm.) this fauna is probably correlable with faunas from the Reticuloceras Zone (= Namurian B). The limestone samples S 13* and S 19 (Rácz, 1965) respectively from below and above these goniatite localities, have yielded fusulinid faunas of Lower Moscovian type:

* S 13 is erroneously given as S 2 on the map of Rácz (1965).

S 13 = Profusulinella Zone, subzone B
Probably lower Kashirian.
S 19 = Profusulinella Zone, uppermost part of subzone B
Kashirian.

The first example (1) presented above shows that the lower limit of the Bashkirian Stage probably runs at a certain level through the Escapa Formation (= Caliza de Montaña = Calcaire des Cañons). Moreover, it leads to the preliminary conclusion that the lower limit of the Bashkirian might correspond to the boundary between the Namurian A and B or is even somewhat lower thus falling within the Namurian A substage.

Approximately synchronous occurrences of floras and fusulinid faunas

5. The Piedras Luengas Limestone Member of the similarly named formation which is situated in the northernmost part of Palencia yielded a rich fusulinid fauna of upper Vereyan (Lower Moscovian) type (Loc. P 1). Further west near Dobres a florule is according to Wagner (1959) of Namurian C or perhaps lower Westfalian A age. Unfortunately not only is the flora from this locality poor but also the stratigraphic position uncertain. It is not known whether this flora is stratigraphically below or above the fusulinid locality P 1. The Dobres flora is either from a conglomerate-shale member of the Piedras Luengas Formation or from the base of the overlying Curavacas Formation.

6. North of Arbejal (Palencia, Loc. P 63) a small outcrop of limestone yielded a fusulinid fauna of lower Vereyan (Lower Moscovian) type. Unfortunately the exact stratigraphic position is subject to doubt. The present writer believes that this thin lens of limestone is interbedded in basal strata of the Curavacas Formation. Yet the possibility that this thin limestone belongs to underlying strata and sticks through an unconformable blanket of conglomerates of the Curavacas Formation cannot be denied. Further west of Loc. P 63, near Cardaño de Arriba, Mr. J. van Veen collected a flora from basal layers of the Curavacas Formation, which has been determined to belong to the Westfalian A substage (Dr. F. Stockmans, written comm.).

7. The top of the San Emiliano Formation near San Emiliano (León, Loc. L 16) has yielded a fusulinid fauna of uppermost Bashkirian type. Stratigraphically higher and separated by approximately 400 m of shale and sandstone, a carbonaceous shale has yielded a flora which, according to Stockmans (written comm.) belongs to the Westfalian A substage. Wagner (1959) collected a flora from the same locality which in his opinion could belong either to the Namurian C or to the lower Westfalian A substages.

8. The Lores Limestone Member of the Corisa Formation (Palencia; Casavegas sub-basin of the Pisuerga basin; Loc. P 10) yielded a rich fusulinid fauna definitely correlable with the Myachkovian (Upper Moscovian). Stratigraphically below (Casavegas Coal Member) as well as above (Areños Coal Member) the Lores Limestone, rather poor floras have been collected by the present writer which according to Wagner (oral. comm.) are neither distinctive for the Westfalian D nor for the Stephanian A. Both floras may occur in upper Westfalian D or lower Stephanian A (Wagner and Wagner-Gentis, 1963).

9. The Sierra Corisa Limestone Member of the Corisa Formation (Palencia; Sierra Corisa sub-basin of the Pisuerga basin) has yielded rich fusulinid faunas. The localities P 22-2 and P 22-3 from the respectively middle and higher parts of this member provided assemblages of definitely Myachkovian (Upper Moscovian) type.

Near the base of the locally unconformably overlying Cristóbal Formation, a flora has been collected by Breimer from the San Cristóbal Coal Member. This flora is considered by Wagner to be of lowermost Stephanian A age (Wagner and Breimer, 1958). Stratigraphically somewhat higher in the section (Loc. P 36) a fusulinid fauna has been found which is comparable with faunas from the lower substage (Kasimovian) of the Gzhelian Stage.

10. Fusulinid faunas have been collected from a limestone near the village Brañosera (Palencia; Barruelo area, Loc. P 38). These faunas have been correlated with fusulinids from the Myachkovian of the U.S.S.R. Stratigraphically approximately 1300 m higher in the section and in a wholly conformable sequence the coal seams of Peña Corba are found. They provided a flora which is considered to be of probably middle Stephanian A age (Wagner, 1955; Wagner and Wagner-Gentis, 1963).

11. The Corros Limestone Member of the Caldero Formation (Palencia; Redondo sub-basin of the Pisuerga basin; Loc. P 52) has yielded a fusulinid fauna which may be compared with faunas from either the lowermost Kasimovian or uppermost Myachkovian. Stratigraphically above the Corros Limestone and separated by a succession of conformable strata approximately 400 m thick occurs the Redondo Coal Member of the Barruelo Formation. The floras from the Barruelo Formation in this sub-basin are correlated with the Stephanian A substage (Wagner, 1959).

12. The Panda Limestone Member has yielded a fusulinid fauna of Podolskian (Upper Moscovian) type which was found on top of the Coriscao mountain (León; Loc. L 21) within a few meters of a flora. This flora has affinities to higher Westfalian as well as to Stephanian floras (Dr. F. Stockmans, written comm.).

13. Near the pass of Pajares on the Leonese-Asturian boundary, Wagner (1962) collected a flora from the mine Inés which he considers to be of Westfalian C age from the presence of *Sphenopteris rotundifolio*. Approximately 900 m lower in the section some thin limestones occur containing algae which according to Dr. L. Rácz (oral comm.) may be compared with the algal content of the Panda Limestone (See above). The algal assemblages of these limestones should point to the upper part of his Zone III or the lower part of his Zone IV (Rácz, 1965). As has been mentioned above the Panda Limestone Member has yielded fusulinid faunas of Podolskian type.

14. The Socavón Limestone Member of the Corisa Formation (Palencia; Sierra Corisa sub-basin of the Pisuerga basin; Loc. P 82) has yielded a fusulinid fauna of Podolskian type. Approximately 200 m higher in the section is the San Cebrián Coal Member. According to Wagner and Wagner-Gentis (1963) it contains a flora of lowermost Westfalian D age.

15. At various levels below the Mesao Limestone Member (León) a fossil flora has been found by Mr. J. F. Savage. According to Mr. H. W. H. van Amerom (oral comm.) this flora consists almost exclusively of species of *Linopteris* which he considers to be close to *Linopteris neuropteroides* (Pot.). This species should have its main development in the Westfalian B and C. As far as the fusulinid fauna is concerned reference is made to example 19.

Although the facts presented are meagre, examples 5, 6 and 7 give the impression that fusulinid assemblages of upper Bashkirian type are found associated with floral assemblages of older type in NW Spain than in the U.S.S.R. Thus comparison of Spanish fusulinid and floral assemblages shows that the upper limit of the Bashkirian apparently correlates approximately with the boundary between the Namurian and Westfalian Stages rather than with the Westfalian B-Westfalian C boundary.

It follows from a comparison of floras and fusulinid faunas presented above in examples 8—11 that in NW Spain the limit between the Moscovian and the Gzhelian may correspond approximately to that between the Westfalian and the Stephanian. This would coincide with the results obtained by Russian authors for the U.S.S.R. (Aisenverg *et al.*, 1960; Gorsky and Stepanov *et al.*, 1960). However, if palaeobotanists should decide to place the limit between the Westfalian D and Stephanian A where the first lower Stephanian A elements appear in the flora, part of the Moscovian, approximately corresponding with the Myachkovian substage, would correlate with the lower Stephanian A.

Approximately synchronous occurrences of fusulinids and micro-floras or other faunas

Rugose corals. — de Groot (1963) has emphasized the unsuitability of the rugose corals for detailed regional or continental correlation. Species are apparently relatively long-ranging and particularily sensitive to environmental changes. In addition the majority of the species found in NW Spain have not been described from elsewhere. Nevertheless, some species known in Russia do occur and these Cantabrian localities have also been sampled for fusulinids which have enabled the following comparisons to be made:

16. One of the fourteen species of rugose corals listed by de Groot (1963) from the reef-knolls of the Perapertú Formation (Palencia) has been recorded in Russia, ten of the others are entirely new species. A single specimen has been determined as *Lithostrotion reticulatum* (Fom.) which has also been recorded from the Lower Moscovian (Vereyan-Kashirian) of the Donetz basin. The Perapertú Formation has been sampled at two localities (e.g. Loc. P 70) and found to contain Lower Moscovian (Vereyan) assemblages of fusulinids.

17. de Groot (1963) has recorded species of rugose corals from the Socavón Limestone Member (Palencia) that also occur in the U.S.S.R. as follows:

Axolithophyllum quiringi (Weiss)
Corwenia longiseptata (Fomichev)
Arachnostraea molli (Stuckenberg).

This assemblage, according to de Groot (oral comm.) is definitely of Moscovian type. The fusulinid assemblage from the same limestone (Loc. P 82) is definitely of an Upper Moscovian (Podolskian) type.

18. According to de Groot (1963) the association of species of corals, known from Russia, in the Cotarazo Limestone (Palencia) compares well with those of the Upper Moscovian. This is in close harmony with the present writer's opinion which, after examining the fusulinid content, is that they are comparable with faunas from the Upper Moscovian (upper Podolskian or lower Myachkovian) of the U.S.S.R.

Trilobites.

19. At various levels below the Mesao Limestone Member (León) trilobites were found by Mr. J. F. Savage and Dr. H. M. Helmig. Dr. G. Hahn (written comm.) has commented that they belong to *Weberides mucronatus* (McCoy) and *W.* aff. *eichwaldi* (Fischer) whereas others belong to the form-group *Ditomopyge weberi-granulatum.* The former two species, which were found in association, should point to the lower part of the Namurian. *D. weberi* has been cited from the "Lower parts of the Middle Carboniferous of the W Urals" whereas *D. granulatum* is present in the C_2^2 suite of the Donetz basin. The stratigraphic levels of *Ditomopyge weberi-granulatum* in Russia as given by Hahn are probably all within the Bashkirian Stage.

The stratigraphic position in Spain of all these trilobite finds is between the Mesao Limestone, which on fusulinid evidence is of probably upper Kashirian age (probably Zone of Fusulinella, subzone A) and limestone lenses providing fusulinids of probably Vereyan age (Zone of Profusulinella, subzone B). This implies that, bearing in mind the results obtained by fusulinid examination, the above mentioned trilobites should be all of Lower Moscovian age.

Gastropods.

20. A fauna of gastropods is known from the Estalaya beds of the Cristóbal Formation which according to Dr. Butusova (written comm.) indicates a Lower Gzhelian (Kasimovian) age for these strata. At about the same stratigraphic level the present writer collected fusulinid containing samples (Loc. P 36) which after examination also led to the conclusion that the Estalaya beds may be of Kasimovian age.

Crinoids. — Very few data are available on the occurrence of Carboniferous crinoids in NW Spain. Breimer (1962) lists the following species from Rabanal de los Caballeros (Palencia):

Nunnacrinus stellaris (De Koninck *et* Le Hon)
Pimlicocrinus latus (Wright)
Aorocrinus sp.
Platycrinus sp. (ex gr. *bollandensis*).

Breimer (1962) did not consider this assemblage representative for any particular stage of the Carboniferous. Yet he mentions that hitherto *Pimlicocrinus latus* (Wright) was only known from the Tournaisian of England. Fusulinid assemblages from Rabanal de los Caballeros (Loc. P 23) point to either uppermost Bashkirian or lowermost Moscovian.

Algae. — Recently a study of the calcareous algae has been accomplished by Rácz (1965). Promising and rather unsuspected was the result that algal assemblages seem to be very useful for correlation purposes though perhaps in a rather restricted area. A second advantage is the areal as well as numerical abundancy of these micro-plant fossils in NW Spain. They, moreover, are frequently found in close association with fusulinid faunas. For all these reasons it is very unfortunate that the algal zonation as given by Rácz gives no clue as to the age in terms of Russian or NW European stages and substages (Rácz, 1965, p. 79).

There does not exist a modern and detailed study on the locally abundant occurrences of brachiopods, trilobites and gastropods from the Carboniferous of NW Spain. This holds also for the smaller foraminiferal fauna. Moreover, a systematic study of pollen and spores for the whole Cantabrian area is still needed. Conodonts are apparently only common enough to be important in Devonian and Lower Carboniferous rocks.

Conclusions

The amount of work done so far is by no means adequate to bring forward definite conclusions. However, it does seem to be reasonably certain that the correlation of the Carboniferous stages of NW Europe and Russia now firmly established through the Donetz basin (Aisenverg *et. al.*, 1960; Gorsky and Stepanov *et al.*, 1960) do not hold through NW Spain. Contradictions occur with respect to the different levels at which NW European floras and faunas occur in relation to Russian marine faunas (fig. 13). It is believed that these discrepancies are of so great order that they can only be reasonably explained by differences in evolutionary rates in the various groups of fossils in the various regions. Without some correlation to the radiometric time scale it is not possible to resolve this problem further. However, it may be worth while noting that the general values of radiometric ages given for Carboniferous rocks are usually quoted to an accuracy of $\pm$ 10 million years. Since the whole of the Carboniferous period was probably of the order of 60 million years, long stages such as the Moscovian must only have taken about 15 million years. Consequently radiometric dating does not yet fix our time-framework closer than more than one stage. In fact the correlations from the palaeontological data quoted above all lie within this latitude of inaccuracy so that no improvement is as yet possible.

V SUMMARY AND GENERAL CONCLUSIONS

1. The evolution of fusulinid faunas within the Carboniferous of NW Spain allows the identification of the upper part of the Millerella Zone followed respectively by the Profusulinella, Fusulinella and Protriticites Zones.

2. There are no faunal breaks in the succession of fusulinid faunas which can be traced through the entire Cantabrian Mountain Chain. Therefore, despite the complicated stratigraphic picture, it is believed that upheaval and subsequent erosion in a given area resulted either in an increased rate of sedimentation or renewed sedimentation in another area.

3. A period of intensified tectonic disturbance towards the end of the Namurian or/and in the lower half of the Westfalian (Curavacas phase of Kanis, 1956) is accepted. But whatever the extension and nature of this phase might have been, it did not result in an uniform widespread break in sedimentation throughout the Cantabrian area from middle Westfalian A to upper Westfalian B time as is held by Wagner (1959, p. 415) on floral evidence.

4. The evolution of fusulinid faunas from the Bashkirian into the Kasimovian Stage are well expressed in NW Spain in a number of good sections and areas as follows:

a. Bashkirian. The Escapa Formation (upper part) and the San Emiliano Formation in the valley of the river Luna (León) together represent the whole of the Bashkirian. The thick massive limestones of the former are barren but the numerous relatively thin limestone horizons of the latter yield fusulinids in profusion.

b. Lower Moscovian is most completely represented by the Lena Formation between the rivers Porma and Huerna (Caudal) north of the thrust-folded Leonides (León).

c. Upper Moscovian is most completely represented by the Corisa Formation in the Sierra Corisa and Casavegas sub-basins (Palencia).

d. Kasimovian is represented in part by the Cristóbal Formation, a paralic sequence in the Sierra Corisa sub-basin of the Pisuerga basin (Palencia) and is not known elsewhere.

5. Rapid facies changes and great variation in thickness over relatively short distances characterized sedimentation in NW Spain during the Carboniferous. This characteristic renders the recognition of useful lithostratigraphic units very difficult. It easily leads to confusion by the introduction of too many formations. Contrarily it may lead also to the recognition of only a few loosely defined formations, which as a consequence are less indicative for environment of deposition and do obscure palaeogeographic features. A balance between these two extremes enables the general progression of depositional history to be followed while appreciating the different variations introduced by changing palaeogeographic patterns.

6. The occurrence together in NW Spain of faunas similar to those from Russian Carboniferous stages with floras and faunas of NW European type is of utmost importance. It means that not only in the Donetz basin of Russia but also in NW Spain there are good opportunities to correlate the Carboniferous stages as distinguished in Russia with the standard Carboniferous stages of NW Europe. It has been shown in the last chapter of this paper that this correlation through NW Spain apparently differs from that presented by Aisenverg *et al.* (1960) and Gorsky and Stepanov *et al.*(1960) through the Donetz basin. The discrepancies are believed to be ultimately caused by different rates of evolution of faunas and floras in the various regions.

7. The discrepancies between Carboniferous faunas and floras from approximately the same stratigraphic levels amount to a maximum of one stage in NW Spain e.g. a flora of Westfalian type may occur at the same stratigraphic level as a fauna of Namurian type or a Moscovian type fusulinid fauna may occur together with a Bashkirian type goniatite or trilobite fauna. Such errors are still within the range of inaccuracy of radiometric age determinations so that this technique does not yet permit the resolution of the problem.

SUMARIO Y CONCLUSIONES GENERALES

1. La evolución de la fauna de Fusulinidae en el Carbonífero del NO. de España, permite la identificación de la parte superior de la Zona de Millerella, seguida respectivamente por las Zonas de Profusulinella, Fusulinella y Protriticites.

2. No existen faltas en la sucesión de la fauna de las Fusulinidae que se puede encontrar en toda la región de los Montes Cantábricos. Por lo cual, a pesar de las complicaciones en la estratigrafía, se cree que el levantamiento y la erosión sucesiva en una cierta región, dan como resultado un aumento de velocidad en la sedimentación o una sedimentación renovada en otra región.

3. Ha sido aceptado un período de intensificación en los disturbios tectónicos al final del Namuriense, y/o en la parte inferior del Westfaliense (fase de Curavacas según Kanis, 1956). Pero cualquiera que sea la extensión y la naturaleza de esta fase, no resultaba en la sedimentación una falta uniformemente extendida en la zona Cantabro-Astúrica desde el Westfaliense A medio, hasta el Westfaliense B superior según Wagner (1959, p. 415) por indicaciones de la flora.

4. La evolución de la fauna de las Fusulinidae, desde el Bashkiriense hasta el Kasimoviense, está bien representado en el NO. de España por un número de secciones y regiónes buenas, según sigue:

a. Bashkiriense. La formación de Escapa (parte superior) y San Emiliano, en el valle del Rio Luna (León), representan juntas todo el Bashkiriense. Las calizas masivas y espesas de la primera son estériles, pero los numerosos horizontes de caliza relativamente finos de la última, producen gran cantidad de Fusulinidae.

b. El Moscoviense inferior es lo mejor representado completamente por la Formación de Lena entre los ríos Porma y Huerna (Caudal), al Norte de los Leónides con pliegues de cobijadura (León).

c. El Moscoviense superior es lo mejor representado completamente por la Formación de Corisa, en las subcuencas de la Sierra Corisa y de Casavegas (Palencia).

d. El Kasimoviense es representado parcialmente por la Formación de Cristóbal, una serie parálica en la subcuenca de Sierra Corisa en la cuenca del Pisuerga (Palencia) y que no es conocida en otras partes.

8. Cambios rápidos en facies y variaciones grandes en el espesor por distancias relativamente cortas, caracterizaba la sedimentación en el NO. de España durante el Carbonífero. Estas características dificultan mucho el reconocimiento de unidades litoestratigráficas útiles. Esto facilmente da lugar a confusiones por la introducción de excesivas formaciones. Por el contrario, puede llevar tambien al reconocimiento de solamente unas formaciones definidas de manera imprecisa, las cuales en consecuencia indican menos las circunstancias de deposición y oscurecen las características paleogeográficas. Un equilibrio entre estos dos extremos da a entender el progreso general de la historia de la sedimentación, apreciando las distintas variaciones introducidas por el patrón paleogeográfico que está cambiando.

6. La aparición de la fauna en el NO. de España, semejante a aquella de los pisos carboníferos Rusos junto con la flora y fauna de tipo NO. Europeo, es de muchísima importancia. Significa que no sólo en la cuenca de Donetz (Rusia), sino también en el NO. de España hay buenas oportunidades de relacionar los pisos carboníferos distinguidos en Rusia con los pisos carboníferos en el NO. de Europa. Se ha demostrado en el último capítulo de este artículo, que esta correlación en el NO. de España difiere evidentemente de aquella presentada por Aisenverg y otros (1960), y Gorsky y Stepanov (1960), en la cuenca de Donetz. Las discrepancias se creen causadas por último, por distintas velocidades en la evolución de la fauna y flora en varias regiones.

7. Las discrepancias entre fauna y flora carbonífera desde aproximadamente los mismos horizontes estratigráficos suben al máximo hasta un piso en el NO. de España, v. gr. una flora del tipo Westfaliense puede ocurrir en el mismo horizonte estratigráfico que la fauna del tipo Namuriense, y también puede ocurrir un tipo Moscoviense de la fauna de Fusulinidae junto con un tipo Bashkiriense de la fauna goniatites o trilobites. Estas faltas estan todavía dentro de un margen causado por la inexactitud de la determinación de la edad radiométrica, de manera que esta técnica no permite todavía la solución del problema.

РЕЗЮМЕ И ОБЩИЕ ЗАКЛЮЧЕНИЯ

1 Эволюция фаун фузулинид в каменноугольном периоде северо-западной Испании позволяет выделить верхнюю часть *Millerella* зоны, и следующие за ней зоны *Profusulinella*, *Fusulinella* и *Protriticites*.

2 Нет фаунистических перерывов в последовательности фаун фузулинид, что можно проследить по всему хребту Кантабрянских Гор. Поэтому полагают — несмотря на всю сложность стратиграфической картины — что поднятие и последовательный размыв в данной области вызвали или более интенсивное осадконакопление или обновленное осадконакопление в другой области.

3 Период интенсивных тектонических нарушений к концу намюра или/и в нижней части вестфаля (Куравакаская фаза, Kanis (1956)) принят. Но как бы то ни было распространение и характер этой фазы, она не вызвала широкого обще-распространенного перерыва в осадконакоплении от средневестфаля А до верхневестфаля В, как это полагается Вагнером (1959, стр. 415) по характеристикам флоры.

4 Самыми пригодными разрезами и областями в северо-западной Испании для изучении эволюции фаун фузулинид от башкирского до касимовского ярусов являются следующие:
а. Башкирский ярус в целом представлен Escapa формацией (верхняя часть) вместе с san Emiliano формацией в долине реки Luna (León). Плотные известняки первой лишены фузулинид, в то время как они изобилуют в многочисленных, относительно немощных известняковых горизонтах последней.
б. Нижнемосковский ярус лучше всего представлен Lena формацией между реками Porma и Huerna (Caudal) к северу от Leonides (León) — область с надвиговой складчатостью.
в. Верхнемосковский ярус лучше всего представлен Corisa формацией в суб-бассейнах Sierra Corisa и Casavegas (Palencia).
г. Касимовский ярус частью представлен Кристобальской формацией, паралической последовательностью в Sierra Corisa суб-бассейне Pisuerga бассейна (Palencia) и не найден в других местах.

5 Частая изменчивость фаун и значительное колебание мощности в относительно небольших горизонтах характеризуют осадконакопление в северо-западной Испании в каменноугольном периоде. Это обстоятельство очень затрудняет определение пригодных образцов пород и легко ведет к неясности при введении слишком многих формаций. С другой стороны оно может привести к определению только нескольких неясно описанных формацией, которые последовательно менее характерны для осадочной среды и скрывают палеогеографические черты. Равновесие между этими двумя крайностями способствует общему развитию истории осадконакопления, так как оно обращает внимание на различные типы осадконакопления, вызванные изменяющей палеографической картиной.

6 Совместное нахождение в северо-западной Испании фаун, сходных с фаунами русских каменноугольных ярусов, и флор и фаун северо-западного европейского типа имеет большое значение. Это значит, что не только в Донецком бассейне в СССР, но тоже в северо-западной Испании есть хорошие возможности чтобы коррелировать каменноугольные ярусы — как они уставлены в СССР — с каменноугольными ярусами единой стратиграфической шкалы в северо-западной Европе. В последной главе этой работы показано, что эта корреляция через северо-западную Испанию очевидно отличается от той, данной Айсенбергом *et. al.* (1960) и Горским и Степановом (1960) через Донецкий бассейн. Разницы между ними — по мнению автора — в основе возникли разными темпами эволюции фаун и флор в разных областях.

7 Разницы между каменноугольными фаунами и флорами приблизительно того же стратиграфического уровня достигают максимально один ярус в северо-западной Испании. Так например флора вестфальского типа встречается на том же стратиграфическом уровне как фауна намюрского типа или фауна фузулинид московского типа находится наряду с фауной гониатитов или трилобитов башкирского типа. Такие разницы еще в пределах аккуратности радиологического метода определения возраста, так что этот метод еще не позволяет решить вопроса.

REFERENCES

ADRICHEM BOOGAERT, H. A. VAN, *et al.*, 1963. A new stratigraphic interpretation of Palaeozoic sections in the region between San Isidro Pass and Tarna Pass (Province of León, Spain). Not. y Comuns. Inst. Geol. y Min. de España, No. 70, pp. 131—135.

AISENVERG, D. E., and BRAZHNIKOVA, N. E., 1955. In Lexique Stratigraphique International, Vol. II, U.S.S.R., Étage de Bachkirie, p. 137.

AISENVERG, D. E., *et al.*, 1960. Carboniferous stratigraphy of the Donetz basin. C.R. 4me Congr. Carb., Heerlen (1958), Tome 1, pp. 1—13.

ALEXANDER, R. D., 1954. Desmoinesian fusulinids of north-eastern Oklahoma. Oklahoma Geol. Survey, Circ. 31, pp. 1—67, 4 pls.

ALVARADO, A. DE, and SAMPELAYO, A. H., 1945. Zona occidental de la cuenca del Rubagón (datos para su estudio estratigráfico). Bol. Inst. Geol. y Min. de España, Tomo 58, pp. 1—44.

Amer. Comm. on Strat. Nomencl., 1961. Code of stratigraphic nomenclature. Bull. A.A.P.G., Vol. 45, No. 5, pp. 645—655.

BARROIS, CH., 1882. Recherches sur les terrains anciens des Asturies et de la Galice. Mém. Soc. Géol. du Nord, Tome II, No. 1, 630 pp.

BEEDE, J. W., 1916. New species of fossils from the Pennsylvanian and Permian rocks of Kansas and Oklahoma. Indiana Univ. Studies, Vol. 3, pp. 5—15.

BRAZHNIKOVA, N. E., 1939. On the examination of foraminifers from the Central Donbass (in Ukrainian). Akad. Nauk S.S.S.R., Journ. Geol., Tom VI, 1—2, pp. 245—263, 4 pls.

—— 1951. Material for the examination of the foraminiferal fauna from the western parts of the Donbass (in Russian). Trudy, Akad. Nauk Ukr., Geol. Inst., Strat. and Palaeont. Sér., Tom 5, pp. 73—99, 2pls.

BRAZHNIKOVA, N. E. and POTIEVSKAJA, B. D., 1948. Results of the examination of foraminifers from borehole samples in western parts of the Donbass (in Ukrainian). Trudy, Akad. Nauk. Ukr., Geol. Inst., Strat. and Palaeont. Sér., Tom 1, vypusk 2, pp. 76—101, 1 pl.

BREIMER, A., 1962. A monograph on Spanish Palaeozoic Crinoidea. Leidse Geol. Med., Deel 27, pp 1—189.

BROUWER, A. and GINKEL, A. C. VAN, 1964. La succession Carbonifère dans la partie méridionale des montagnes Cantabriques (Espagne Nord-Ouest). C.R. 5me Congr. Carb., Paris (1963), pp. 307—319.

BUDINGER, P. and KULLMANN, J., 1964. Zur Frage von Sedimentations unterbrechungen im Goniatiten und Conodonten-führenden Oberdevon und Karbon des Kantabrischen Gebirges (Nordspanien). Neues Jhrb. Min. Geol. und Pal., H. 7, pp. 414—429.

CHEN, S., 1934. Fusulinidae of South China; Part I. China Geol. Surv., Pal. Sinica, Peiping, China, Ser. B, Vol. 4, Fasc. 2, 185 pp., 16 pls.

CHERNOVA, E. I., 1954. On the stratigraphy of the Carboniferous in the vicinity of Zhirnoje (district Stalingrad) (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 2, pp. 255—267, 3 pls.

—— 1961. Biostratigraphy (based on foraminifers) of the Middle Carboniferous at the right bank of the Volga near Saratov (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp. 261—286, 1 pl.

COLANI, M., 1924. Nouvelle contribution à l'étude des Fusulinidés de l'Extreme-Orient. French Indochina, Serv. Géol., Mém., Hanoi Indochine Française. Vol. 11, Fasc. 1, 191 pp., 29 pls.

COMTE, P., 1959. Recherches sur les terrains anciens de la Cordillère Cantabrique. Mem. Inst. Geol. y Min. de España, No. 60, pp. 1—440.

COOPER, C. L., 1947. Upper Kinkaid (Mississippian) microfauna from Johnson County, Illinois. Journ. Pal., Tulsa, Okla., Vol. 21, pp. 81—94, pls. 19—23.

CUSHMAN, J. A., 1955. Foraminifera: their classification and economic use. Cambridge, Massachusetts; Harvard Univ. Press, 4th ed., 478 pp., 55 pls.

DALMATSKAJA, I. I., 1951. A new genus of fusulinids from the lower part of the Middle Carboniferous of the Russian platform (in Russian). Trudy, Moskovsk. Obshch. Ispytatel. Prirody, otdel Geol., Tom I, pp. 194—196, 1 pl.

—— 1961. Stratigraphy and Foraminifera from the Middle Carboniferous of the Volga region near Gorki and Uljanovsk (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp. 7—54, 2 pls.

DELÉPINE, G., 1943. Les faunes marines du Carbonifère des Asturies. Acad. de Sci., Mém., Paris, Ser. 2, Vol. 66, No. 3, pp. 1—122.

DEPRAT, J., 1912. Étude géologique du Yun-Nan oriental; Partie III- Étude des Fusulinidés de Chine et d' Indochine et classification des calcaires à Fusulines. French Indochina, Serv. Géol., Mém., Hanoi-Haiphong, Indochine Française, Vol. 1, Fasc. 3, pp. 1—76, pls. 1—9.

—— 1913. Les Fusulinidés des calcaires Carbonifériens et Permiens du Tonkin, du Laos et du Nord-Annam. French Indochina, Serv. Géol., Mém., Hanoi-Haiphong, Indochine Française, Vol. 2, Fasc. 1, pp. 1—74, pls. 1—10.

—— 1915. Les Fusulinidés des calcaires Carbonifériens et Permiens du Tonkin, du Laos et du Nord-Annam. French Indochina, Serv. Géol., Mém., Hanoi-Haiphong, Indochine Française, Vol. 4, Fasc. 1, pp. 1—30, pls 1—3.

DUNBAR, C. O. and CONDRA, G. E., 1927. The Fusulinidae of the Pennsylvanian System in Nebraska. Nebraska Geol. Surv., Bull., Lincoln, Nebr., U.S.A., Ser. 2, No. 2, 135 pp., 15 pls.

DUNBAR, C. O. and HENBEST, L. G., 1942. Pennsylvanian Fusulinidae of Illinois. State Geol. Surv., Illinois, Bull., No. 67, 218 pp., 23 pls.

DUNBAR, C. O. and SKINNER, J. W., 1937. The geology of Texas. Vol. III, Part 2: Permian Fusulinidae of Texas. Univ. Texas Bull. No. 3701, Bur. Econ. Geol., Austin, Texas, U.S.A., pp. 517—825, pls. 42—81.

DUTKEVITCH, G. A., 1934 a. Some new species of Fusulinidae from the Upper and Middle Carboniferous of Verkhnechussovskye Gorodki on the Chussovaya River (western slope of the middle Ural) (Russian with English summary). Geol. Oil Inst., Trans., Leningrad, U.S.S.R., Ser. A, Vol. 36, pp. 1—98, pls. 1—6.

—— 1934 b. Sur la stratigraphie du Carbonifère moyen de l'Oural (Russian with French summary). Neftianyi geologorazvedochnyi Inst., Trudy (Transactions of the Oil Geological Institute), Leningrad, Ser. A, Fasc. 55, pp. 1—41, 1 pl.

EHRENBERG, C. G., 1842. Der Bergkalk am Onega-See aus Polythalamien bestehend. K. Preuss Akad. Wiss. Ber., Berlin, pp. 198—219.

EINOR, O. L., 1957. The limit between the Middle and Lower Carboniferous and the position of the Namurian Stage of Western Europe in the Carboniferous of the U.S.S.R. in: Transactions of the conference on the question of the stratigraphic limits of the Namurian stage and its position within the Carboniferous System, Akad. Nauk Ukr. S.S.R. (in Russian).

FISCHER DE WALDHEIM, G., 1829. Sur les Céphalopodes fossiles de Moscou et de ses environs, en montrant des objets en nature. Imp. Soc. Nat. Moscou, Bull., Vol. 1, pp 300—331.

FRETS, D. C., 1965. The geology of the southern part of the Pisuerga Basin and the adjacent area of Santibañez de Resoba, Palencia, Spain. Leidse Geol. Med., Deel 31, pp. 113—162.

FUJIMOTO, H., and IGÔ, H., 1955. *Hidaella*, a new genus of Pennsylvanian fusulinids from the Fukuji District, eastern part of the Hida mountain land, central Japan. Pal. Soc. Japan, Trans., Proc., N.S., No. 18, pp. 45—48, pl. 7.

GALLOWAY, J. J., 1933. A manual of Foraminifera. Principia Press, Bloomington, Indiana, U.S.A., pp. 1—450, pls. 1—42.

GANELINA, R. A., 1951. *Eostaffella* et *Millerella* du Viséen et du Namurien (Carbonifère inférieur) du flanc occidental de la dépression de Moscou (in Russian; trad. B.R.G.M. 2441). Trudy V.N.I.G.R.I., S.S.S.R., N.S., vypusk 56, pp. 179—210, 3 pls.

—— 1956. Foraminifères du Viséen de la partie nord-oest du bassin de Moscou (in Russian; trad. B.R.G.M. 1626). Trudy V.N.I.G.R.I., S.S.S.R., Leningrad. In Mikrofauna of the U.S.S.R., Sbornik 8, pp. 61—159, 12 pls.

GIGNOUX, M., 1950. Géologie stratigraphique. 4ieme ed., 735 pp.

GINKEL, A. C. VAN, 1957. *Fusulinella branoserae*, a new species. Proc. Kon. Ned. Akad. Wetensch., Ser. B, Vol. 60, No. 3, pp. 182—200, 1 pl.

—— 1959. The Casavegas section and its fusulinid fauna. Leidse Geol. Med., Deel 24, No. 2, pp. 705—720.

GORSKY, I. I. and STEPANOV, D. L., *et al.* 1960. The Carboniferous system and its main stratigraphic subdivisions. C. R. 4me Congr. Carb., Heerlen (1958), Tome 3, pp. 645—656.

GROOT, G. E. DE, 1963. Rugose Corals from the Carboniferous of northern Palencia (Spain). Leidse Geol. Med., Deel 29, pp. 1—123.

GROZDILOVA, L. P. and LEBEDEVA, N. S., 1950. Some species of *Staffella* from the Middle Carboniferous of the western slopes of the Ural Mountains (in Russian). Trudy, V.N.I.G.R.I., N.S., vypusk 50, pp. 5—44.

—— 1954. Foraminifera from the Lower Carboniferous and the Bashkirian Stage of the Middle Carboniferous of the Kolva-Vishera region (in Russian). Trudy, V.N.I.G.R.I., N.S., vypusk 81, Sbornik 7, pp. 112—281 (= systematic descriptions of fusulinids), 7 pls.

—— 1960. Foraminifera from the Carboniferous of the western slopes of the Ural and Timan Mountains (in Russian) (Atlas of the most characteristic species). Trudy, V.N.I.G.R.I., N.S., vypusk 150, pp. 3—264.

HAYASAKA, I., 1924. On the fauna of the Anthracolithic limestone of Omi-Mura in the western part of Echigo. Tôhuko Imp. Univ., Sci. Repts., Sendai, Japan, Ser. 2 (Geol.), Vol. 8, pp. 1—83, pls. 1—7.

HELMIG, H. M., 1965. The geology of the Valderrueda, Tejerina, Ocejo and Sabero Coal basins (Cantabrian Mountains Spain). Leidse Geol. Med., Deel 32, pp. 77—149.

HIGGINS, A. C., 1962. Conodonts from the griotte limestone of northwest Spain. Not. y Comuns. Inst. Geol. y Min. de España, No. 65, pp. 5—22.

HIGGINS, A. C., WAGNER—GENTIS, C. H. T., and WAGNER, R. H., 1964. Basal Carboniferous strata in part of northern León, NW Spain: Stratigraphy, Conodont and Goniatite faunas. Bull. Soc. Belge, Geol. Pal. et Hydr., Tome 72/2, pp. 205—248.

IGÔ, H., 1957. Fusulinids of Fukuji, Southeastern Part of the Hida Massif, Central Japan. Science Reports of the Tokyo Kyoiku Daigaku, Sect. C, Vol. 5, Nos. 47, 48, pp. 153—247, 10 pls.

ISHII, K., 1958. On the Phylogeny, Morphology and Distribution of *Fusulina*, *Beedeina* and allied fusulinid genera. Journ. Inst. Polytechnics, Osaka City Univ., Ser. G, Vol. 4, pp. 29—71.

—— 1962. Fusulinids from the middle Upper Carboniferous Itadorigawa Group in Western Shikoku, Japan. Part II: Genus *Fusulinella* and other fusulinids. Journ. of Geosciences, Osaka City Univ., Vol. 6, Art. 1, pp. 1—46, 7 pls.

JONGMANS, W. J., 1928. Discussion Générale. C.R. 1er Congr. Carb., Heerlen (1927), pp. XLIII and XLIV.

—— 1951. Las floras carboníferas de España. Est. Geol. Inst. "Lucas Mallada", No. 14, pp. 281—330.

—— 1952. Documentación sobre las floras hulleras españolas. Primera contribución: Flora carbonífera de Asturias. Est. Geol. Inst. "Lucas Mallada", No. 15, pp. 7—20.

JONGMANS, W. J., and Wagner, R. H., 1957. Apuntes para el estudio geológico de la zona hullera de Riosa (Cuenca central de Asturias). Est. Geol., No 13, pp. 7—26.

JULIVERT, M. 1961. Estudio geológico de la cuenca de Beleño. Valles altos del Sella, Ponga, Nalón y Esla, de la Cordillera Cantábrica. Bol. Inst. Geol. y Min. de España, Tomo LXXI (1960), pp. 1—346.

KANIS, J., 1956. Geology of the eastern zone of the Sierra del Brezo (Palencia, Spain). Leidse Geol. Med., Deel 26, pp. 375—445.

KANMERA, K., 1954. Fusulinids from the Yayamadake limestone of the Hikawa valley, Kumamoto Prefecture, Kyushu, Japan; Part I. Fusulinids of the upper Middle Carboniferous. Japanese Journ. Geol. Geogr., Tokyo, Vol. 25, No. 1,2 (Trans.), pp. 117—144, 3 pls.

KIREEVA, G. D., 1949. Some new species of fusulinids from the Carboniferous of central Donbass (in Russian). Trudy, Geol. Inst. for Coal Exploration, vypusk 6, pp. 25—54, 2 pls.

—— 1950. Nouvelles espèces de Fusulinidae des calcaires des séries C_3^1 et C_3^2 du bassin du Donetz (in Russian; trad. B.R.G.M. 4373). Dep. for Coal Exploration (Ugletekhizdat), Mater. Stratigr. Paleontol. Donetz basin, pp. 193—214, 4 pls.

KOOPMANS, B. N., 1962. The sedimentary and structural history of the Valsurvio dome (Cantabrian Mountains). Leidse Geol. Med., Deel 26, pp. 121—232.

KULLMANN, J., 1960. Die Ammonoidea des Devons im Kantabrischen Gebirge (Nordspanien). Akad. Wissensch. Lit., Abh. Math. Naturwiss. Kl., No. 7, 105 pp.

—— 1961. Die Goniatiten des Unterkarbons im Kantabrischen Gebirge (Nordspanien). Neues Jhrb. Min. Geol. und Pal., Teil 113, No. 3, pp. 219—326.

—— 1962. Die Goniatiten der Namur-Stufe (Oberkarbon) im Kantabrischen Gebirge, Nord Spanien. Akad. Wissensch. Lit., Abh. Math. Naturwiss. Kl., No. 6, pp. 263—377.

—— 1963. Las series Devónicas y del Carbonífero inferior con ammonoides de la Cordillera Cantábrica. Est. Geol. de España, Tomo 19, pp. 161—191.

LEE, J. S., 1927. Fusulinidae of North China. China Geol. Surv., Pal. Sinica, Peiping, China, Ser. B, Vol. 4, Fasc. 1, pp. 1—123, pls. 1—24.

—— J. S., 1937. Foraminifera from the Donetz basin and their stratigraphical significance. Geol. Soc. China, Bull., Vol. 16, pp. 57—107, 2 pls.

—— J. S., CHEN, S., and CHU, S., 1930. The Huanglung limestone and its fauna. Acad. Sinica, Nat. Res. Inst. Geol., Mem., Shanghai, China, No. 9, pp. 85—143, pls. 2—15.

MANUKALOVA, M. F., 1950 a. Description of some new species of fusulinids from the Middle Carboniferous of the Donetz basin (in Russian). Dep. for Coal Exploration (Ugletekhizdat), S.S.S.R., Moscow, Charkow, pp. 175—189, 2 pls.

—— 1950 b. New fusulinid species from the Middle Carboniferous of the Donetz basin (in Russian). Dep. for Coal Exploration (Ugletekhizdat), S.S.S.R., Moscow, Charkow, pp. 219—233, 2 pls.

MEEK, F. B., and HAYDEN, F. V., 1859. Remarks on the Lower Cretaceous beds of Kansas and Nebraska, together with descriptions of some new species of Carboniferous fossils from the valley of Kansas River. Acad. Nat. Sci. Philadelphia, Proc., Philadelphia, Pa., Vol. 10 (1858), pp. 256—264.

MIKLOUCHO—MACLAY, A. D., 1959. Valeur stratigraphique, systématique et phylogénie des foraminifères staffelloïdes (in Russian; trad. B.R.G.M. 2234). Doklady Akad. Nauk S.S.S.R., Tom 125, No. 3, pp. 628—631.

MIKLOUCHO—MACLAY, A. D., *et al.*, 1958. Systématique et Phylogénie des Fusulinidés (in Russian; trad. B.R.G.M.). Questions de micropaléontologie (Voprosy Micropal.), Tom 2, pp. 7—26.

MIKLOUCHO—MACLAY, A. D., *et al.*, 1959. Ordre des Fusulinida (in Russian; trad. B.R.G.M. 2333) Osnovy Paleontologii, Moscou, pp. 201—215.

MOELLER, V. VON, 1877. Ueber Fusulinen und aehnliche Foraminiferen-Formen des russischen Kohlenkalkes (Vorläufige Notiz.). Neues Jhrb. Min. Geol. und Pal., Stuttgart, Deutschland, pp. 139—146.

—— 1878. Die spiral-gewundenen Foraminiferen des russischen Kohlenkalks. Acad. Imp. Sci. St. Pétersbourg, Mém., Sér. 7, Tome 25, pp. 1—147, pls. 1—15.

—— 1879. Die Foraminiferen des russischen Kohlenkalks. Acad. Imp. Sci. St. Pétersbourg, Mém., Sér. 7, Tome 27 (1880), No. 5, pp. 1—131, pls. 1—7.

MOORE, R. C., ed. 1964. Treatise on Invertebrate Paleontology. Part C: Protista 2 Vol. 1. Univ. of Kansas.

NEDERLOF, M. H., 1959. Structure and sedimentology of the Upper Pisuerga valleys, Cantabrian Mountains, Spain. Leidse Geol. Med., Deel 24, No. 2, pp. 603—703.

—— and SITTER, L. U. DE, 1957. La cuenca carbonífera del río Pisuerga (Palencia). Bol. del Inst. Geol. y Min. de España, Tomo 68, pp. 1—44.

NEEDHAM, C. E., 1937. Some New Mexico Fusulinidae. New Mexico School of Mines, Socorro. State Bur. Mines Min. Resources, Bull., Socorro, New Mexico, U.S.A., No. 14, pp. 1—88, pls. 1—12.

NIKITINA, T. N., 1961. Sur la paroi onduleuse de quelques *Fusulinella* (in Russian; trad. B.R.G.M. 3578—9) Questions de micropaléontologie (Voprosy Micropal.), Tom 5, pp. 143—146, 1 pl.

OZAWA, Y., 1925 a. On the classification of Fusulinidae. Tokyo, Imp. Univ., Vol. 45, Art. 4, pp. 1—26, pls. 1—4.

—— 1925 b. Paleontological and stratigraphical studies on the Permo-Carboniferous limestone of Nagato. Part II: Paleontology. Tokyo, Imp. Univ., Vol. 45, Art. 6, pp. 1—90, pls. 1—14.

PAILLETE, A., 1855. Estudio químico-mineralógico sobre la caliza de montaña de Asturias. Rev. Minera, Tomo 6, p. 282.

PIVETEAU, J. ed. 1952. Traité de Paleontologie. Tome I: Protistes. Masson et Cie, Paris.

POKORNY, V., 1958. Grundzüge der zoologischen mikropaläontologie. Band I. D.V.W., Berlin.

PUTRYA, F. S., 1948. *Protriticites*, nouveau genre de Fusulinidés (in Russian; trad. B.R.G.M. 2232). L'vovsk. Obshch. Geol. Pal., Ser. No. 1, pp. 89—96, 1 pl.

—— 1956. Stratigraphie et Foraminifères du Carbonifère moyen du Donbass oriental (in Russian; trad. B.R.G.M. 1627). Trudy, V.N.I.G.R.I. S.S.S.R., in Mikrofauna of the U.S.S.R., Sbornik 8, Tom 98, pp. 333—485, 17 pls.

—— and LEONTOVITCH, G. E., 1948. Contribution to the study of the Fusulinidae from the Middle Carboniferous in the Volgian region of Saratov (in Russian). Bjull., Moskovks. Obshch. Ispytatel. Prirody, otdel Geol., Tom. 23, pp. 11—45, 4 pls.

RÁCZ, L., 1965. Carboniferous calcareous algae and their associations in the San Emiliano and Lois-Ciguera Formations (León, NW Spain). Leidse Geol. Med., Deel 31, pp. 1—112.

RADIG, F., 1964. Beitrag zur Kenntnis der Grenzschichten Devon-Karbon im Kantabrischen Gebirge (Nordspanien). Neues Jhrb. Geol. Pal. Mh., Hft. 3, Stuttgart, pp. 150—162.

RAUSER—CHERNOUSSOVA, D. M., 1948. Contributions to the foraminiferal fauna of the Carboni. ferous deposists of central Kazakhstan (in Russian). Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Trudy, Moscow, Fasc. 66, Geol. Ser., No. 21, pp. 1—26, 3 pls.

—— 1949. On the primordial developmental stage of some palaeozoic foraminifers (in Russian). Trudy, Akad. Nauk, Pal. Inst., Tom 20, pp. 339—353, 1 pl.

—— 1961. a. The Middle Carboniferous of the district of Vozhgaly (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp 55—79.

—— 1961 b. Some Middle Carboniferous fusulinids of the Kama and Volga regions (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp. 213—217, 1 pl.

—— 1962. Limite des horizons de Vereja et de Kashira (Carbonifère moyen) du district pétrolifère Volga-Oural (in Russian; trad. B.R.G.M. 4213). Bjull., Moskovsk. Obshch. Ispytatel. Prirody, otdel Geol., Tom 37, No. 2, pp. 85—102.

RAUSER—CHERNOUSSOVA, D. M., BELJAEV, G. M., and REITLINGER, E. A., 1936. Die Ober-Paläozoischen Foraminiferen aus dem Petschoralande (der Westabhang des Nord-Urals) (Russian with German summary). Akad. Nauk S.S.S.R., Bjull. Poliarnaja Komissia (Trans. of the Polar Commission of the Acad. of Sci. of the U.S.S.R.), Leningrad, pp. 159—232, pls. 1—6.

—— 1940. On the Carboniferous Foraminifera of the Samara Bend (Russian with English summary). Neftianyi geologorazvedochnyi Inst., Trudy (Transactions of the Oil Geological Institute), Leningrad, U.S.S.R., N.S., Fasc. 7, pp. 1—88, pls. 1—9.

RAUSER—CHERNOUSSOVA, D. M. and FURSENKO, A. V., 1937. Guide to the Foraminifera of the oil-bearing regions of the U.S.S.R., Part I (in Russian). Leningrad and Moscow: O.N.T.I. (United Scientific and Technical Press).

RAUSER—CHERNOUSSOVA, D. M. *et al.*, 1948. Stratigraphy and Foraminifera of the Lower Carboniferous of the Russian Platform and the Cis-Ural region (in Russian). Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Trudy, Moscow, Fasc. 62 (Geol. Ser., No. 19), pp. 102—142, 2 figs.

RAUSER—CHERNOUSSOVA, D. M. *et al.*, 1951. Middle Carboniferous fusulinids of the Russian Platform and adjacent regions (in Russian). Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Minist. Neftianoi Prom. S.S.S.R., pp. 1—339, 58 pls.

REITLINGER, E. A., 1961. Stratigraphy of the Middle Carboniferous in the section of bore-hole no. 1 (Krasnaja Poljana, Middle Volga) (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp. 218—259, 4 pls.

RJAZANOV, G. F., 1958 a. Le genre *Pseudotriticites* PUTRYA, 1940 (in Russian; trad. B.R.G.M. 2083). Doklady Akad. Nauk S.S.S.R., Tom 123, No. 5, pp. 933—936, 1 pl.

—— 1958 b. Morphologie et systématique du genre *Protriticites* PUTRYA, 1948 (in Russian; trad. B.R.G.M. 2117). Doklady Akad. Nauk S.S.S.R., Tom 123, No. 4, pp. 752—755, 1 pl.

ROJO, R. M., 1933. El horizonte marina del techo de la capa "Angelita" (Langreo) y la *Fusulinella sphaeroidea* von Moeller. Boll. Inst. Geol. y Min. de España, Tomo 53, pp. 1—6.

ROSS, C. A., and DUNBAR, C. O., 1962. Faunas and correlation of the Late Paleozoic rocks of Northeast Greenland. Part II: Fusulinidae. Medd. Grönland, Danm., Vol. 167, No. 5, 55 pp., 7 pls.

ROTH, R., and SKINNER, J., 1930. The fauna of the McCoy formation, Pennsylvanian of Colorado. Journ. Pal., Menasha, Wis., U.S.A., Vol. 4, pp. 332—352, pls. 28—31.

ROZOVSKAJA, S. E., 1941. On some Middle Carboniferous species of Fusulinidae of the Moscow depression (in Russian). Doklady Akad. Nauk S.S.S.R., Moscow, N.S., Vol. 31, pp. 190—192, 2 text-figs.

RUPKE, J., 1965. The Esla Nappe, Cantabrian Mountains (Spain). Leidse Geol. Med., Deel 32, pp. 1—74.

SCHELLWIEN, E., 1908. Monographie der Fusulinen. Teil I: Die Fusulinen des russisch-arktischen Meeresgebietes. Palaeontogr., Stuttgart, Deutschland, Band 55, Lief. 33, pp. 145—194, pls. 13—20.

SEMIKHATOVA, E. N., 1961. The significance of Foraminifera for the study of the Middle Carboniferous of the Medveditza-Don tektogene (in Russian). Akad. Nauk S.S.S.R., Geol. Inst., Reg. Strat. S.S.S.R., Tom 5, pp. 297—356, 2 pls.

SHLYKOVA, T. I., 1948. Upper Carboniferous fusulinids from the Samara Bend (in Russian) Trudy, V.N.I.G.R.I., N.S., vypusk 31, Sbornik 1, pp. 109—135, 7 pls.

—— 1951. Viséan and Namurian Foraminifera from the west flank of the Moscow depression (in Russian). Trudy, V.N.I.G.R.I., N.S., vypusk 56, pp. 109—176, 6 pls.

SITTER, L. U. DE, 1949. The development of the paleozoic in north-west Spain. Geol. en Mijnbouw, IIe jaarg., No. 11, pp. 312—319, No. 12, pp. 325—340.

—— 1955. Nota previa sobre la geología de la cuenca carbonífera del río Pisuerga (Palencia). Est. Geol. Inst. "Lucas Mallada", Tomo 13 (No. 26), pp. 115—126.

—— 1957. The structural history of the S.E. corner of the Paleozoic core of the Asturian Mountains. Neues Jhrb. Min. Geol. und Pal., Teil 105, No. 1, pp. 1—10.

—— 1962. The structure of the southern slope of the Cantabrian Mountains: explanation of a geological map with sections, scale 1:100.000. Leidse Geol. Med., Deel 26, pp. 255—264.

—— 1965. Explanation to the geological map of the Cantabrian Mountains, sheet Pisuerga, scale 1 : 50.000. Leidse Geol. Med., Deel 31.

SKINNER, J. W., 1931. New Permo-Pennsylvanian Fusulinidae from northern Oklahoma. Journ. Pal., Menasha, Wis., U.S.A., Vol. 5, No. 1, pp. 16—22, pls. 3,4.

STAFF, H. VON, 1912. Monographie der Fusulinen. Teil III: Die Fusulinen (Schellwienien) Nordamerikas. Palaeontogr., Band 59, pp. 157—192, pls. 15—20.

STAFF, H. VON, and WEDEKIND, R., 1910. Der Oberkarbone foraminiferensapropelit Spitzbergens. Uppsala, Univ., Geol. Inst., Bull., Uppsala, Sverige, Vol. 10 (1910—1911), No. 19—20, pp. 81—123, pls. 2—4.

STEWART, W. J., 1958. Some fusulinids from the upper Strawn, Pennsylvanian of Texas. Journ. Pal., Tulsa, Okla., Vol. 32, Mo. 6, pp. 1051—1070, 6 pls.

SULEIMANOV, I. S., 1949. Nouvelles espèces de Fusulinidés de la sousfamille des Schubertellinae SKINNER du Carbonifère et du Permien inférieur du pré- Oural Bachkir (in Russian; trad. B.R.G.M. 740). Akad. Nauk S.S.S.R., Inst. Geol. Nauk, Trudy, Moscow, Tom 105, Geol. Ser. No. 35, pp. 22—43, 1 pl.

THOMAS, N. L., 1931, New early fusulinids from Texas. Texas Univ. Bull., (Bur. Econ. Geol.) Austin, Texas, U.S.A., No. 3101, pp. 27—33, 1 pl.

THOMPSON, M. L., 1935 a. Fusulinids from the Lower Pennsylvanian Atoka and Boggy formations of Oklahoma. Journ. Pal., Menasha, Wis., U.S.A., Vol. 9, No. 4, pp. 291—306, pl. 26.

—— 1935 b. The fusulinid genus *Staffella* in America. Journ. Pal., Menasha, Wis., U.S.A., Vol. 9, No. 2, pp. 111—120, 13 pls.

—— 1936. Fusulinids from the Black Hills and adjacent areas in Wyoming. Journ. Pal., Menasha, Wis., U.S.A., Vol. 10, pp. 95—113, pls. 13—16.

—— 1937. Fusulinids of the subfamily Schubertellinae. Journ. Pal., Menasha, Wis., U.S.A., Vol. 11, No. 2, pp. 118—125, pl. 12.

—— 1942. New genera of Pennsylvanian fusulinids. Am. Journ. of Sci., New Haven, Conn., 5th Ser., Vol. 240, pp. 403—420.

—— 1944. Pennsylvanian Morrowan rocks and fusulinids of Kansas, Kansas Geol. Survey, Bull., Lawrence, Kansas, No. 52, pp. 409—431, pls. 1,2.

—— 1945 a. Pennsylvanian rocks and fusulinids of East Utah and northwest Colorado correlated with Kansas sections, Kansas Geol. Surv., Bull. 60, pp. 17—84, pls. 1—6.

—— 1945 b. Upper Desmoinesian Fusulinids. Am. Journ. of Sci., New Haven, Conn., 5th Ser., Vol. 243, pp. 443—445, pls. 1, 2.

—— 1947. Stratigraphy and fusulinids of pre-Desmoinesian Pennsylvanian rocks, Llano uplift, Texas. Journ. Pal., Tulsa, Okla., Vol. 21, pp. 81—94, pls. 19—23.

—— 1948. Studies of American Fusulinids. Univ. Kansas, Pal. Contr., Lawrence, Kansas, No. 4 (Protozoa, Art. 1), 184 pp., 38 pls.

—— 1951. New genera of fusulinid Foraminifera. Cushman Found. Foram. Res., Contr., Washington, D. C., Vol. 2, Pt. 4, pp. 115—119, pls. 13, 14.

THOMPSON, M. L. and FOSTER, C. L., 1937. Middle Permian fusulinids from Szechuan, China. Journ. Pal., Menasha, Wis., U.S.A., Vol. 11, pp. 126—144, pls. 23—25.

THOMPSON, M. L., and MILLER, A. K., 1944. The Permian of southernmost Mexico and its fusulinid fauna. Journ. Pal., Tulsa, Okla., Vol. 18, pp. 481—504, pls. 79—84.

—— 1949. Permian fusulinids and cephalopods from the vicinity of the Maracaibo Basin in northern South America. Journ. Pal., Tulsa, Okla., Vol. 23, pp. 1—24, pls. 1—8.

THOMPSON, M. L., and WHEELER, H. E., and HAZZARD, J. C., 1946. Permian fusulinids of California. Part III. Geol. Soc. of Am., Mem., New York, No. 17, 77 pp., 18 pls.

TORIYAMA, R., 1945. Studies on the Yasuba conglomerate and its allies in the Titibu group in the Island of Sikokuij. Part III: The fusulinids in the limestone conglomerates of Inomine in the Province of Tosa. Jap. Journ. Geol. and Geogr., Tokyo, Vol. 20, No. 1, Trans., pp. 1—11, 1 pl.

—— 1953. New peculiar fusulinid genus from the Akiyoshi limestone of south-western Japan. Journ. Pal., Tulsa, Okla., Vol. 27, No. 2, pp. 251—256, pls. 35, 36.

—— 1958. Geology of Akiyoshi. Part III: Fusulinids of Akiyoshi. Mem. of the Fac. of Sci., Kyushu Univ., Ser. D, Geol., Vol. VII, pp. 1—261, 48 pls.

VERNEUIL, E. DE, and COLLOMB, ED., 1852. Coup d'oeil sur la constitution géologique de quelques provinces de l'Espagne. Bull. Soc. Géol. de France, 2me Sér., Tome X, pp. 61—147.

WAGNER, R. H., 1955. Rasgos estratigráfico del Palaozóico Superior de Barruelo (Palencia). Est. Geol. Inst. "Lucas Mallada", Tomo 11 (No. 26), pp. 145—202.

—— 1959. Flora fósil y estratigrafía del Carbonífero de España NO y Portugal. Est. Geol. Inst. "Lucas Mallada", Tomo 15 (No. 41—44), pp. 393—420.

—— 1960 a. A brief review of the stratigraphy and floral succession of the Carboniferous in NW Spain. C.R. 4me Congr. Carb., Heerlen (1958), Tome III, pp. 3382—3384.

—— 1960 b. Middle Westphalian floras from northern Palencia (Spain). Est. Geol. Inst. "Lucas Mallada", Tomo 16 (2), pp. 55—92.

—— 1962. An upper Westfalian flora from the mine „Inés" near the Pass of Pajares on the Leonese-Asturian boundary (NW Spain). Not. y Comuns. Inst. Geol. y Min. de España, No. 68, pp. 79—102.

—— 1964. Stephanian floras in NW Spain, with special reference to the Westphalian D-Stephanian A boundary. C.R. 5me Congr. Carb., Paris (1963), pp. 835—851.

WAGNER, R. H. and BREIMER, A., 1958. Una flora del Estefaniense inferior en el monte de San Cristóbal (Palencia, España). Est. Geol. Inst. "Lucas Mallada", Tomo 14 (No. 37), pp. 5—30.

WAGNER, R. H. and WAGNER—GENTIS, C. H. T., 1952. Aportación al conocimiento de la geologia de la zona de Barruelo (Palencia). Est. Geol. Inst. "Lucas Mallada", Tomo 8 (No. 16), pp. 301—344.

—— 1963. Summary of the stratigraphy of Upper Palaeozoic rocks in NE Palencia, Spain. Proc. Kon. Ned. Akad. Wetensch., Ser. B, Vol. 66, No. 3, pp. 149—163.

WAGNER—GENTIS, C. H. T., 1960. On *Nautellipsites hispanicus* (Foord and Crick). Est. Géol. Inst. „Lucas Mallada", Tomo 16 (No. 1), pp. 43—51.

—— 1963. Lower Namurian Goniatites from the griotte limestone of the Cantabrian Mountain Chain. Not. y Comuns. Inst. Geol. y Min. de España,No. 69, pp. 5—42.

WHITE, M. P., 1932. Some Texas Fusulinidae. Texas Univ. Bull. (Bur. Econ. Geol.), Austin, Texas, U.S.A., No. 3211, pp. 1—104, pls. 1—10.

YABE, H. and HAYASAKA, I., 1920. Palaeontology of southern China. Tôkyô Geogr. Soc., Geogr. Res. in China 1911—1916, Repts., Vol 3.

ZELLER, D. E. N., 1953. Endothyroid Foraminifera and ancestral fusulinids from the type Chesteran (Upper Mississippian). Journ. Pal., Tulsa, Okla., Vol. 27, No. 2, pp. 183—199, pls. 26—28.

APPENDICES

APPENDIX 1

SPECIES LISTS OF LOCALITIES

Loc. A1 = Ribadesella

Schubertella ? sp.
Profusulinella prisca (Deprat) subsp. *guebleri* subsp. nov.
Beedeina cf. *schellwieni* (Staff)
Eofusulina cf. *triangula* (Rauser–Chernoussova *et* Beljaev)
Fusulinella delepinei van Ginkel
Fusulinella ex gr. *pulchra* Rauser-Chernoussova

Loc A 3 = Lena Formation (near Pola de Lena)

Millerella compressa (Brazhnikova)
Millerella cf. *acutissima* (Kireeva)
Millerella cf. *samarica* Reitlinger
Millerella spinulosa (Grozdilova *et* Lebedeva)
Millerella ex gr. *evoluta* (Grozdilova *et* Lebedeva)
Millerella ex gr. *acuta* et *mutabilis* (Rauser–Chernoussova)
Ozawainella cf. *vozhgalica* Safonova
Ozawainella ex gr. *tingi* (Lee)
Pseudostaffella ex gr. *gorskyi* (Dutkevitch)
Pseudostaffella sp. (4)
Beedeina bona (Chern. *et* Raus.) subsp. *lenaensis* subsp. nov.
Eofusulina cf. *binominata* Putrya
Eofusulina (*Paraeofusulina*) sp.

Loc. A 5 = Escalada Limestone Formation (near Campo de Caso)

Pseudostaffella ozawai (Lee *et* Chen)
Profusulinella prisca (Deprat) subsp. *rauserae* subsp. nov.
? *Profusulinella* ex gr. *librovitchi* (Dutkevitch)
Beedeina sp.
Hidaella kameii Fuj. *et* Igô subsp. *nalonensis* subsp. nov.
Fusulinella ex gr. *pulchra* Rauser–Chernoussova

Loc. A 6 = Escalada Limestone Formation (Cuenca de Beleño)

Schubertella cf. *pseudoobscura* Chen
Fusulinella ex gr. *bocki* Moeller

Loc. A 7 = near base of Fito Formation (Cuenca de Beleño)

Millerella acuta (Grozd. *et* Leb.) var. *lata* (Kireeva)
Millerella cf. *mutabilis* (Raus.) var. *postera* (Kireeva)
Ozawainella cf. *krasnokamski* Saf. var. *kirovi* Dalmatskaja
Pseudostaffella cf. *larionovae* Rauser–Chernoussova *et* Safonova
Schubertella cf. *pseudoobscura* Chen
Fusiella praetypica Safonova
Fusulina agujasensis sp. nov.

Loc. A 8 = near top of Fito Formation (Cuenca de Beleño)

Ozawainella sp. (1)
Schubertella spp.
(ex gr. *obscura* Lee *et* Chen
ex gr. *lata* Lee *et* Chen)
Profusulinella ex gr. *librovitchi* (Dutkevitch)
Fusulinella sp.

Loc. L 11 = Mesao Limestone Member

Staffella cf. *pseudosphaeroidea* Dutkevitch
Parastaffella sp. (4)
Pseudostaffella ex gr. *parasphaeroidea* (Lee *et* Chen)
Schubertella cf. *subkingi* Putrya
Hemifusulina ex gr. *moelleri* Rauser–Chernoussova
Fusiella cf. *praecursor* Rauser–Chernoussova

Loc. L 16 = top of San Emiliano Formation (near San Emiliano)

Staffella cf. *moelleri* Ozawa
Parastaffella cf. *timanica* Rauser–Chernoussova
Millerella breviscula (Ganelina)
Millerella cf. *acuta* (Grozdilova *et* Lebedeva)
Millerella cf. *mutabilis* (Rauser–Chernoussova)
Millerella sp. (2)
Profusulinella ex gr. *pararhomboides* Rauser–Chernoussova
Verella sp.

Loc. L 21 = Panda Limestone Member

Fusulinella agujasensis sp. nov.
Fusulinella ex gr. *bocki* Moeller

Loc. L 24 = base of San Emiliano Formation (near San Emiliano)

Millerella breviscula (Ganelina)
Millerella ex gr. *ikensis* (Vissarionova)
Millerella ex gr. *parva* (Moeller)
Ozawainella leonensis sp. nov.
Pseudostaffella antiqua (Dutkevitch)
Pseudostaffella ex gr. *gorskyi* (Dutkevitch)
Pseudostaffella sp. (3)
Profusulinella ex gr. *pararhomboides* Rauser–Chernoussova

Loc. L 25 = San Emiliano Formation (1.5 km W of Carmenes)

Staffella ex gr. *expansa* Thompson
Staffella breimeri sp. nov.
Parastaffella preobrajenskyi (Dutkevitch)
Millerella sp. (3)
Pseudostaffella ex gr. *variabilis* Reitlinger
Schubertella cf. *obscura* Lee *et* Chen var. *mosquensis* Rauser–Chernoussova
Profusulinella ex gr. *parva* (Lee *et* Chen)
Aljutovella wagneri sp. nov.

Loc. L 353 = San Emiliano Formation (between Villanueva and Golpejar)

Parastaffella cf. *timanica* Rauser–Chernoussova
Parastaffella sp. (3)
Ozawainella sp. (2)
Pseudostaffella cf. *needhami* Thompson
Schubertella cf. *pseudoglobulosa* Safonova

Loc. L 408 = Panda Limestone Member

Fusulina rossoschanica Putrya subsp. *kamerlingi* subsp. nov.

Loc. L 426 = Panda Limestone Member

Hemifusulina ex gr. *moelleri* Rauser–Chernoussova
Fusulinella pandae sp. nov.

Loc. P 1 = Piedras Luengas Limestone Member

Staffella ex gr. *pseudosphaeroidea* Dutkevitch
Parastaffella vlerki sp. nov.
Millerella cf. *pseudostruvei* (Raus. *et* Belj.) var. *angusta* (Kireeva)
Millerella acuta (Grozdilova *et* Lebedeva)
Millerella mutabilis (Rauser–Chernoussova)
Millerella acuta forma *nana* (Kireeva)
Millerella variabilis (Rauser–Chernoussova)
Millerella cf. *mutabilis* (Rauser–Chernoussova)
Millerella cf. *carbonica* (Grozdilova *et* Lebedeva)
Millerella exilus (Grozdilova *et* Lebedeva)
Millerella monstrosa (Kireeva)
Millerella cf. *donbassica* (Kireeva)
Millerella ex gr. *parva* (Moeller)
Millerella sp. (5) (6) (7)
Schubertella spp.
(cf. *obscura* Lee *et* Chen var. *mosquensis* Rauser–Chernoussova
cf. *obscura* Lee *et* Chen var. *plana* Kireeva
ex gr. *obscura* Lee *et* Chen
cf. *acuta* Rauser–Chernoussova
ex gr. *pauciseptata* Rauser–Chernoussova)
Profusulinella ex gr. *rhomboides* (Lee *et* Chen)
Profusulinella cf. *prisca* (Deprat)
Profusulinella sp.
Eofusulina (*Paraeofusulina*) *rasdorica* sp. nov.

Loc. P 2 = Corisa Formation (near Lores)

Beedeina ex gr. *distenta* (Roth *et* Skinner)

Loc. P 3 = Albas Limestone Member

Profusulinella albasensis sp. nov.
Eofusulina cf. *paratriangula* (Putrya)

Loc. P 4 = Camasobres Limestone Member

Ozawainella adducta Manukalova
Pseudostaffella parasphaeroidea (Lee *et* Chen)
Pseudostaffella sp. (5) (6) (7)
Schubertella cf. *pseudoobscura* Chen
Beedeina ? ex gr. *ozawai* (Rauser–Chernoussova *et* Beljaev)
Fusiella sp.
Fusulinella ex gr. *bocki* Moeller

Loc. P 7 = Maldrigo Limestone Member

Schubertella spp.
Fusiella ex gr. *typica* Lee *et* Chen
Fusulinella maldrigensis sp. nov.

Loc. P 10 = Lores Limestone Member

Parastaffella sp. (5)
Millerella ex gr. *acuta* et *mutabilis* (Rauser–Chernoussova)
Schubertella ex gr. *kingi* Dunbar *et* Skinner
Schubertella sp.
Profusulinella ex gr. *librovitchi* (Dutkevitch)
Fusiella praelancetiformis Safonova
Fusulinella loresae sp. nov.

Loc. P 22—1 = Sierra Corisa Limestone Member (near base)

Fusulinella ex gr. *mosquensis* Rauser–Chernoussova *et* Safonova

Loc. P 22—2 = Sierra Corisa Limestone Member (stratigraphically above Loc. P 22—1)

Schubertella ex gr. *kingi* Dunbar *et* Skinner
Fusulinella schwagerinoides (Deprat) subsp. *alvaredoi* subsp. nov.

Loc. P 22—3 = Sierra Corisa Limestone Member (statigraphically above Loc. P 22—2)

Ozawainella cf. *leei* Putrya
Pseudostaffella cf. *sphaeroidea* (Ehr). var. *cuboides* Rauser–Chernoussova
Fusulinella soligalichi Dalm. subsp. *archedensis* Semikhatova *et* Melnikova

Loc. P 23 = Mudá Formation ? (Rabanal de los Caballeros)

Staffella rabanalensis sp. nov.
Parastaffella hispaniae sp. nov.
Profusulinella sp.

Loc. P 36 = San Cristóbal Formation (near Vañes)

Beedeina ? ex gr. *conspecta* (Rauser–Chernoussova)
Fusiella cf. *lancetiformis* Putrya
Obsoletes ? sp. (aff. *O. mirabilis* Kireeva)

Loc. P 38 = Brañosera Limestone Member

Millerella cf. *acuta* forma *nana* (Kireeva)
Schubertella ex gr. *kingi* Dunbar *et* Skinner
Schubertella spp.
(ex gr. *obscura* Lee *et* Chen)
Profusulinella ex gr. *librovitchi* (Dutkevitch)
Beedeina ex gr. *elegans* (Rauser–Chernoussova *et* Beljaev)
Fusiella cf. *pulchella* Safonova
Fusulinella branoserae van Ginkel

Loc. P 40 = Cotarazo Limestone Member (Peña Cotarazo)

Staffella ? sp. (3)
Pseudostaffella cf. *sphaeroidea* (Ehrenberg)
Fusulina cotarazoe sp. nov.
Fusulinella sp.

Loc. P 52 = Corros Limestone Member

Beedeina ? ex gr. *acuta* (Lee)
Protriticites sp.

Loc. P 54 = near Río Rubagón; 1 *km E of Santa Maria*

Parastaffella ex gr. *mathildae* (Dutkevitch)
Millerella breviscula (Ganelina)
Millerella cf. *parastruvei* (Rauser–Chernoussova)
Millerella cf. *mosquensis* (Viss.) var. *acuta* (Rauser–Chernoussova)
Millerella cf. *pseudostruvei* (Rauser–Chernoussova *et* Beljaev)
Millerella ex gr. *acuta* et *mutabilis* (Rauser–Chernoussova)
Millerella ? sp.
Pseudostaffella cf. *antiqua* var. *grandis* Shlykova
Profusulinella sp.

Loc. P 57 = Sierra Corisa Limestone Member (Valley of Río Castillería)

Fusulinella ex gr. *colaniae* Lee *et* Chen

Loc. P 58 = Cotarazo Limestone Member (Valley of Río Castillería)

Fusulina cotarazoe sp. nov.
Fusulinella ex gr. *bocki* Moeller

Loc. P 63 = base of Curavacas Formation (?) (*1 km N of Arbejal*)

Staffella cf. *pseudosphaeroidea* Dutkevitch
Parastaffella irinovkensis (Leontovitch) subsp. *kanisi* subsp. nov.
Parastaffella cf. *timanica* Rauser–Chernoussova
Millerella acuta (Grozdilova *et* Lebedeva)
Millerella ex gr. *ikensis* (Vissarionova)
Millerella sp. (4)
Ozawainella brazhnikovae sp. nov.
Schubertella cf. *obscura* Lee *et* Chen
Profusulinella cavis Dalmatskaja subsp. *arbejalensis* subsp. nov.
Profusulinella cf. *rhombiformis* Brazhnikova *et* Potievskaja

Loc. P 70 = Perapertú Formation (W of Devonian of San Julian)

Staffella cf. *pseudosphaeroidea* Dutkevitch
Staffella sp. (1)
Parastaffella bradyi (Moeller) subsp. *cantabrica* subsp. nov.
Millerella cf. *compressa* (Brazhnikova)
Millerella ex gr. *acuta* et *mutabilis* (Rauser–Chernoussova)
Profusulinella ex gr. *pararhomboides* Rauser–Chernoussova
Profusulinella cf. *parva* (Lee *et* Chen)
Profusulinella ? sp.

Loc. P 72 = Agujas Limestone Member

Pseudostaffella ex gr. *sphaeroidea* (Ehrenberg)
Profusulinella cf. *librovitchi* (Dutkevitch)
Fusulina agujasensis sp. nov.
Fusulinella sp.

Loc. P 73 = Abismo Limestone Member

Fusulina cotarazoe sp. nov.
Fusulinella mosquensis Raus *et* Saf. subsp. *abismoe* subsp. nov.

Loc. P 76 = Mudá Formation (E of Mudá village)

Parastaffella sp. (2)
Millerella cf. *breviscula* (Ganelina)
Millerella cf. *varvariensis* (Brazhnikova *et* Potievskaja)
Millerella ? ex gr. *protvae* (Rauser–Chernoussova)
Millerella ex gr. *acuta* et *mutabilis* (Rauser–Chernoussova)
Pseudostaffella antiqua (Dutkevitch)
Pseudostaffella ex gr. *antiqua* (Dutkevitch)
Pseudostaffella sp. (1)

Loc. P 82 = Socavón Limestone Member

Millerella cf. *acutissima* (Kireeva)
Beedeina ex gr. *rauserae* (Chernova)

Loc. P 94 = Escapa Formation (Sierra del Brezo; W of Ruesga)

Parastaffella sp. (1)
Pseudostaffella sp. (2)

Loc. P 95 = Escapa Formation (Sierra del Brezo; N of San Martin)

Millerella sp. (1)
Profusulinella ex gr. *staffelloides* Manukalova

Loc. P 97 = Escapa Formation (Sierra del Brezo; Peña Redondo)

Millerella ex gr. *ikensis* (Vissarionova)

Loc. P 98 = Sierra Corisa Limestone Member (NNW of Vergaño)

Beedeina corisaensis sp. nov.

Loc. P 99 = San Cristóbal Formation (1300 m E of Vañes)

Staffella mochaensis sp. nov.
Staffella cf. *moelleri* Ozawa
Staffella sp. (2)

APPENDIX 2

GEOGRAPHIC AND STRATIGRAPHIC DATA OF LOCALITIES

Loc. No.	Map No.	Prov. or reg.	Geographic location	Stratigraphic level	Biozone	Age
A 1		Asturias	Río Sella; a quarry on the left side of the Sella river estuary not far from the bridge over the Sella river at Ribadesella (= type locality of *Fusulinella bocki* Moeller var. *delepinei* Gübler).	Escalada Formation	Zone of Fusulinella subzone A	Moscovian; Lower Moscovian; Kashirian; upper part of Kashirian.
A 3		Asturias	Río Caudal; 250—300 m N of Pola de Lena and about 50 m up the hill immediately E of the railroad mark 109 (a small outcrop of limestone with an exposed area of about 3 m^2).	Lena Formation	either Zone of Fusulinella subzone A or Zone of Profusulinella subzone B	Moscovian; Lower Moscovian; Kashirian.
A 5		Asturias	Río Nalón; about 2 km W of Campo de Caso, along the road of Campo de Caso to Pola de Laviana (km 52).	Escalada Formation	Zone of Fusulinella subzone A	Moscovian; Lower Moscovian; Kashirian; upper part of Kashirian.
A 6		Asturias	"Cuenca de Beleño", head waters of Río Sella, Nalón and Esla.	Escalada Formation	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian.
A 7		Asturias	See A6	near base of Fito Formation	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian. Probably middle part to upper part of Podolskian.
A 8		Asturias	See A6	near top of Fito Formation	Zone of Fusulinella subzone B, subdivision B_2	Moscovian; Upper Moscovian.

Loc. No.	Map No.	Prov. or reg.	Geographic location	Stratigraphic level	Biozone	Age
L 11	7	León	Río Cea; "Puerto de Pando"; 3.5 km N of Prioro.	Pando Formation; Mesao Limestone Member	probably Zone of Fusulinella subzone A	Moscovian; Kashirian or lower part of Podolskian; probably upper part of Kashirian.
L 16	9	León	Río Luna; about 100 m SE of Villargusan, a hamlet near San Emiliano.	near top of San Emiliano Formation	Zone of Profusulinella, top of subzone A	Bashkirian; uppermost Bashkirian.
L 21	6	León	Río Yuso, head waters; watershed, provincial boundary León-Santander; right on the top of the Coriscao mountain; 3 km NW of San Glorio Pass.	Panda Limestone Member	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian. Probably middle to upper part of Podolskian.
L 24	9	León	Río Luna; about 1400 m E of Villargusan, a hamlet near San Emiliano.	near base of San Emiliano Formation	Zone of Profusulinella, subzone A	Bashkirian; middle part of Bashkirian; not older than the C_2^2(G) suite of the Donetz Basin (U.S.S.R.).
L 25	8	León	Río Torio; 1.5 km W of Carmenes, along the road toVillamanin.	San Emiliano Formation	Zone of Profusulinella, top of subzone A	Bashkirian; uppermost Bashkirian.
L 353	8	León	Río Bernesga; between the villages Golpejar and Villanueva (± 750 m S of Villanueva).	See L25	See L25	See L25
L 408	6	León	Río Yuso, 2.5 km WSW of the "Puerto de Pandatrave" and 6.5 km N of Portilla de la Reina.	Panda Limestone Member	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian. Probably middle to upper part of Podolskian.
L 426	6	León	Río Yuso, 2.5 km E of the "Puerto de Pandatrave" near the watershed which here forms the geographical boundary between León and Santander.	See L408	See L408	Moscovian; Upper Moscovian; Podolskian.

P 1	*1*		*Río Pisuerga; along the main* road from Cervera de Pisuerga to Potes. In the big gorge just S of the pass of Piedras Luengas.	*Piedras Luengas* Formation Piedras Luengas Limestone Member	*Zone of Profusulinel*-la, subzone B	*Moscovian; Lower Moscovian;* Upper Vereyan or Lower Kashirian. Presumably Upper Vereyan.
P 2	1		In the valley of the Río Lores, a right-hand tributary of the Río Pisuerga; about 200 m E of Lores and immediately S of the road to Urbaneja.	Corisa Formation	Zone of Fusulinella subzone B, subdivision B_3	Moscovian; Upper Moscovian; Myachkovian.
P 3	1		Río Pisuerga; along the main road from Cervera de Pisuerga to Potes; just S of the big gorge near the "Puerto de Piedras Luengas"; 1300 m NE of Camasobres.	Curavacas Formation Albas Limestone Member	Zone of Profusulinella subzone B	Moscovian; Lower Moscovian; Kashirian; Lower or Middle Kashirian.
P 4	1	Palencia	Río Pisuerga; about 500 m NE of Camasobres; W of the road Cervera - Potes.	Corisa Formation Camasobres Limestone Member	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian; Probably Lower Podolskian.
P 7	1		Río Pisuerga; on the ridge (watershed) between Lores and Casavegas, 2 km N of Lores.	Corisa Formation Maldrigo Limestone Member	Zone of Fusulinella subzone B, subdivision B_2	Moscovian; Upper Moscovian; either top of Podolskian or base of Myachkovian.
P 10	1		Río Pisuerga; on the ridge (watershed) between Lores and Casavegas, 1600 m NE of Lores.	Corisa Formation Lores Limestone Member	Zone of Fusulinella subzone B, subdivision B_3	Moscovian; Upper Moscovian; Myachkovian.
P 22-1	4		Río Pisuerga; 2-2.5 km NE of Rabanal de los Caballeros.	Corisa Formation Sierra Corisa Limestone Member (near base)	Zone of Fusulinella subzone B, top of subdivision B_2	Moscovian; Upper Moscovian; probably base of Myachkovian, perhaps still top of Podolskian.
P 22-2	4		See 22-1	See 22-1, but stratigraphically somewhat higher in the section.	Zone of Fusulinella subzone B, subdivision B_3	Moscovian; Upper Moscovian; Myachkovian.
P 22-3	4		See 22-1	Corisa Formation top of Sierra Corisa Limestone Member	Zone of Fusulinella subzone B, subdivision B_3	See 22-2
P 23	4		Río Pisuerga; immediately S of Rabanal de los Caballeros.	Mudá Formation?	Zone of Profusulinella, subzone A	Upper part of Bashkirian or Lower Moscovian (Vereyan).

Loc. No.	Map No.	Prov. or reg.	Geographic location	Stratigraphic level	Biozone	Age
P 36	4		Río Pisuerga; a small outcrop of marly limestone along the road from Vañes to San Felices about 375 m E of the bridge over the lake of Vañes.	Cristóbal Formation	Zone of Protriticites	Kasimovian; middle part of Kasimovian. (cf. upper part of the C_3^1 (N) suite of the Donetz Basin (U.S.S.R.)).
P 38	3		Río Rubagón, a limestone outcrop in the riverbank, 450 m W of Brañosera.	Corisa Formation Brañosera Limestone Member	Zone of Fusulinella subzone B, subdivision B_3	Moscovian; Upper Moscovian; Myachkovian.
P 40	4		Río Pisuerga; Peña Cotarazo, 2.5 km NE of Herreruela de Castilleria.	Corisa Formation Cotarazo Limestone Member	Zone of Fusulinella subzone B, subdivision B_2	Moscovian; Upper Moscovian; either top of Podolskian or base of Myachkovian.
P 52	2		Arroyo de La Varga; a right hand tributary of the Río Pisuerga; 1800 m NNE of Santa Maria de Redondo (a limestone outcrop of only a few m^2).	Caldero Formation Corros Limestone Member	Zone of Protriticites	Either uppermost Moscovian (top Myachkovian) or lower part of Kasimovian.
P 54	3		Río Rubagón; 1 km E of Santa Maria de Nava.		Zone of Profusulinella, subzone A	Bashkirian; lower to middle part of Bashkirian; compare with the C_2^2 (G) suite of the Donetz Basin (U.S.S.R.).
P 57	4		Valley of Río Castilleria a tributary of the Río Pisuerga; 600 m ENE of Herreruela de Castilleria.	Corisa Formation Sierra Corisa Limestone Member	Zone of Fusulinella subzone B, top of subdivision B_2	Moscovian; Upper Moscovian; probably base of Myachkovian, perhaps still uppermost Podolskian.
P 58	4		Valley of Río Castilleria, tributary of the Río Pisuerga; 1400 m about E of Herreruela de Castilleria and 850 m E of P57.	Corisa Formation Cotarazo Limestone Member	Zone of Fusulinella subzone B, subdivision B_2	Moscovian; Upper Moscovian; either top of Podolskian or base of Myachkovian.
P 63	5		Río Pisuerga; eastern part of the Sierra del Brezo; about 1 km N of Arbejal.	A small limestone outcrop which is either at the base of the Curavacas Formation or just sticks through it.	Zone of Profusulinella. Probably base of subzone B	Moscovian; Lower Moscovian; Vereyan; lower part of Vereyan.

P 70	4	Palencia	Between drainage basins of Río Pisuerga and Río Rubagón; 1400 m SE of San Martin de Perapertú immediately W of the Devonian structures of San Julian.	*Perapertú Formation*	Zone of Profusulinella, subzone B. Probably base of this subzone	Moscovian; Lower Moscovian; Vereyan. Probably lowermost Vereyan.
P 72	2		Upper course of the "arroyo de la Varga"; drainage basin of Río Pisuerga; about 1500 m SSE of the "Peña de los tres Aguas"; (Sierra Peña Labra) altitude 1700 m; 5 km NE of Santa Maria de Redondo.	Corisa Formation Agujas Limestone Member	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian. Probably middle to upper part of Podolskian.
P 73	2		Arroyo de la Varga; a right hand tributary of Río Pisuerga; about 2500 m SSW of the "Peña de los tres Aguas" (Sierra Peña Labra); about 3 km NNE of Santa Maria de Redondo; altitude 1400 m.	Corisa Formation Abismo Limestone Member	Zone of Fusulinella subzone B, subdivision B_2	Moscovian; Upper Moscovian; Either top of Podolskian or base of Myachkovian.
P 76	4		Río Pisuerga. A huge and dominating limestone outcrop immediately E of Mudá.	Mudá Formation	Either Zone of Profusulinella, subzone A or Zone of Millerella. Probably high in the latter zone.	Bashkirian; lower part of Bashkirian. Compare with the C_1^5 (E) and C_2^1 (F) suites of the Donetz Basin (U.S.S.R.).
P 82	4		Río Pisuerga; about 1 km WNW of San Cebrián de Mudá.	Corisa Formation Socavón Limestone Member	Zone of Fusulinella subzone B, subdivision B_1	Moscovian; Upper Moscovian; Podolskian.
P 94	5		Río Pisuerga; along the roadside 250 m W of Ruesga; Sierra del Brezo.	Escapa Formation ("Caliza de Montaña")	Zone of Profusulinella, subzone A	Bashkirian.
P 95	5		Río Rivera, a right hand tributary of Río Pisuerga. 500 m N of San Martin; Sierra del Brezo.	See P94	See P94	Bashkirian; Probably middle part of Bashkirian.
P 97	5		Peña Redonda; 2 km NE of Villanueva de la Peña; Sierra del Brezo.	See P94	Either Zone of Profusulinella, subzone A or Zone of Millerella	Bashkirian or perhaps even older.
P 98	4		Río Pisuerga; 650 m NNW of Vergaño.	Corisa Formation Sierra Corisa Limestone Member	Zone of Fusulinella subzone B, base of subdivision B_3 or top of subdivision B_2	Moscovian; Upper Moscovian; Myachkovian.
P 99	4		Río Pisuerga; 1300 m E of Vañes.	Cristóbal Formation	Zone of Protriticites	Probably lower to middle part of Kasimovian.

Locality Maps 1—9

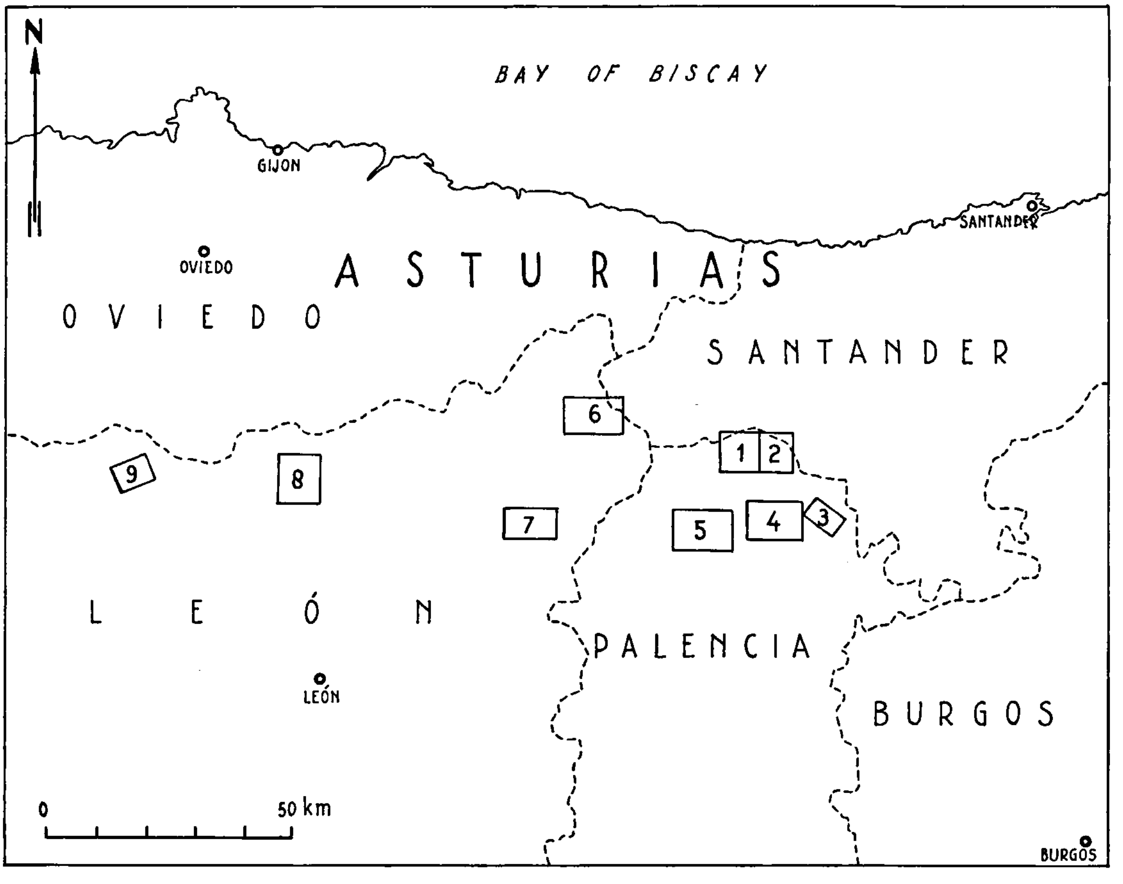
Scale of maps 1 : 50.000

Map 1	Casavegas sub-basin	modified after	de Sitter 1965
2	Redondo sub-basin	id.	
3	Barruelo area	id.	
4	Sierra Corisa sub-basin	id.	
5	Sierra del Brezo		Kanis, 1956 Koopmans, 1962 and Frets, 1965
6	Headwaters of Yuso River		Kamerling, 1962 (unpublished)
7	Headwaters of Cea River		Rupke, 1965 and Helmig, 1965
8	Leonides (Bernesga River)		Rácz, 1965
9	Leonides (Luna River)		Blom, 1964 (unpublished)

Abbreviations:

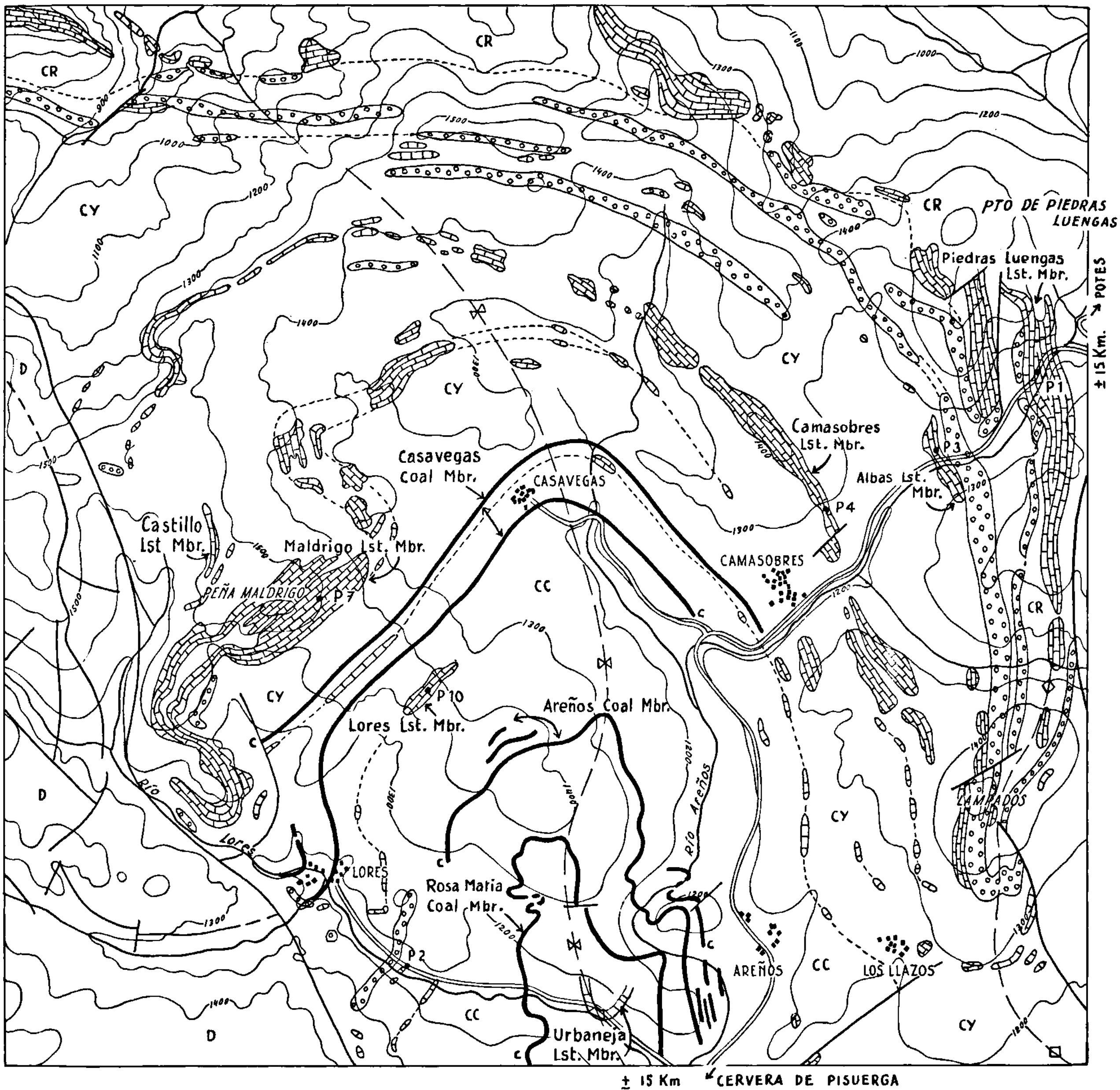
Tr Triassic
C Carboniferous
CC Cea Formation
CY Yuso Group as defined by Koopmans, 1962
CR Ruesga Group as defined by Koopmans, 1962
D Devonian
LP Lower Palaeozoic

c Coal seam
T Terraces

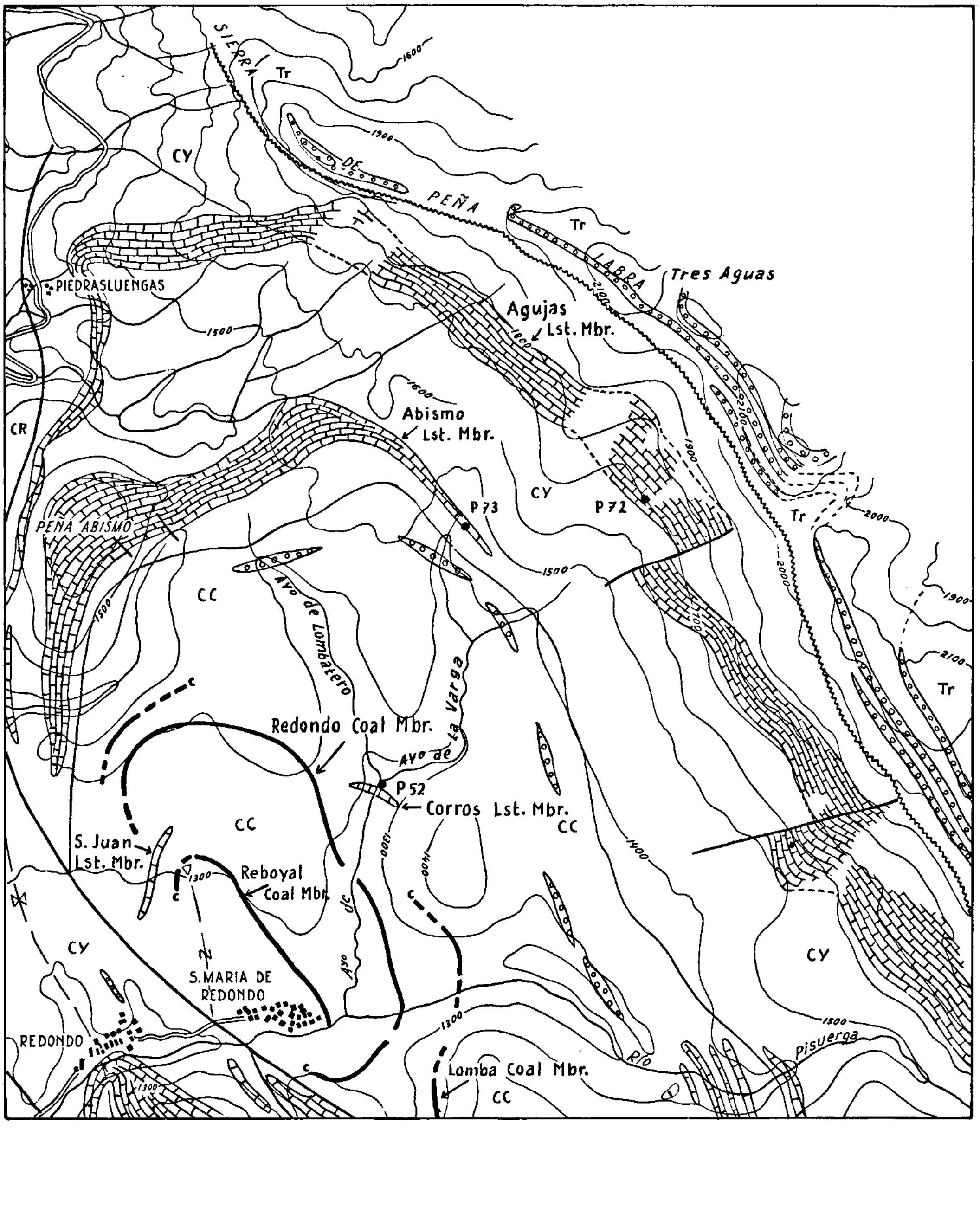


N
BAY OF BISCAY
GIJON
SANTANDER
OVIEDO
ASTURIAS
OVIEDO
SANTANDER
6
1
2
9
8
7
5
4
3
LEÓN
PALENCIA
LEÓN
BURGOS
0
50 km
BURGOS

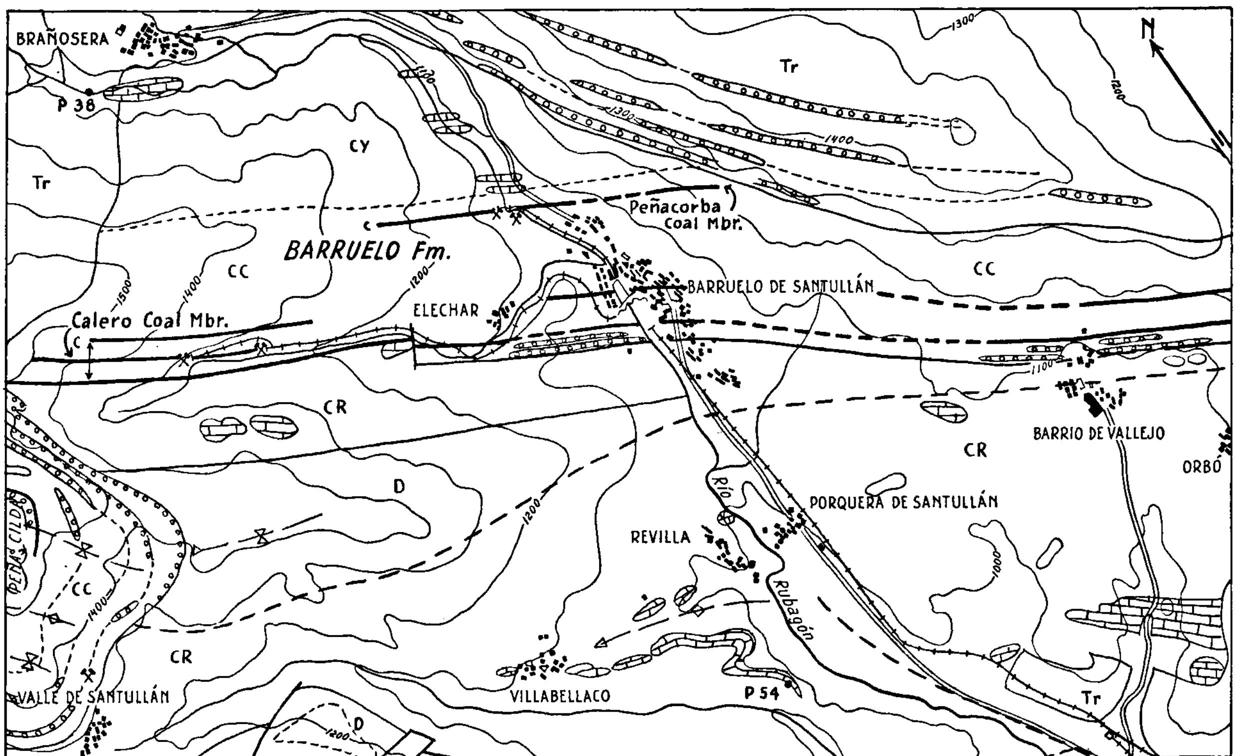
MAP 1


CR
CY
D
CC
PTO DE PIEDRAS LUENGAS
Piedras Luengas Lst. Mbr.
± 15 Km. → POTES
P1
P3
Albas Lst. Mbr.
Camasobres Lst. Mbr.
P4
CAMASOBRES
Casavegas Coal Mbr.
CASAVEGAS
Castillo Lst Mbr.
Maldrigo Lst. Mbr.
PEÑA MALDRIGO
P7
P10
Lores Lst. Mbr.
Areños Coal Mbr.
Río Lores
LORES
Rosa Maria Coal Mbr.
P2
Río Areños
AREÑOS
LOS LLAZOS
CAMPADOS
Urbaneja Lst. Mbr.
± 15 Km
CERVERA DE PISUERGA

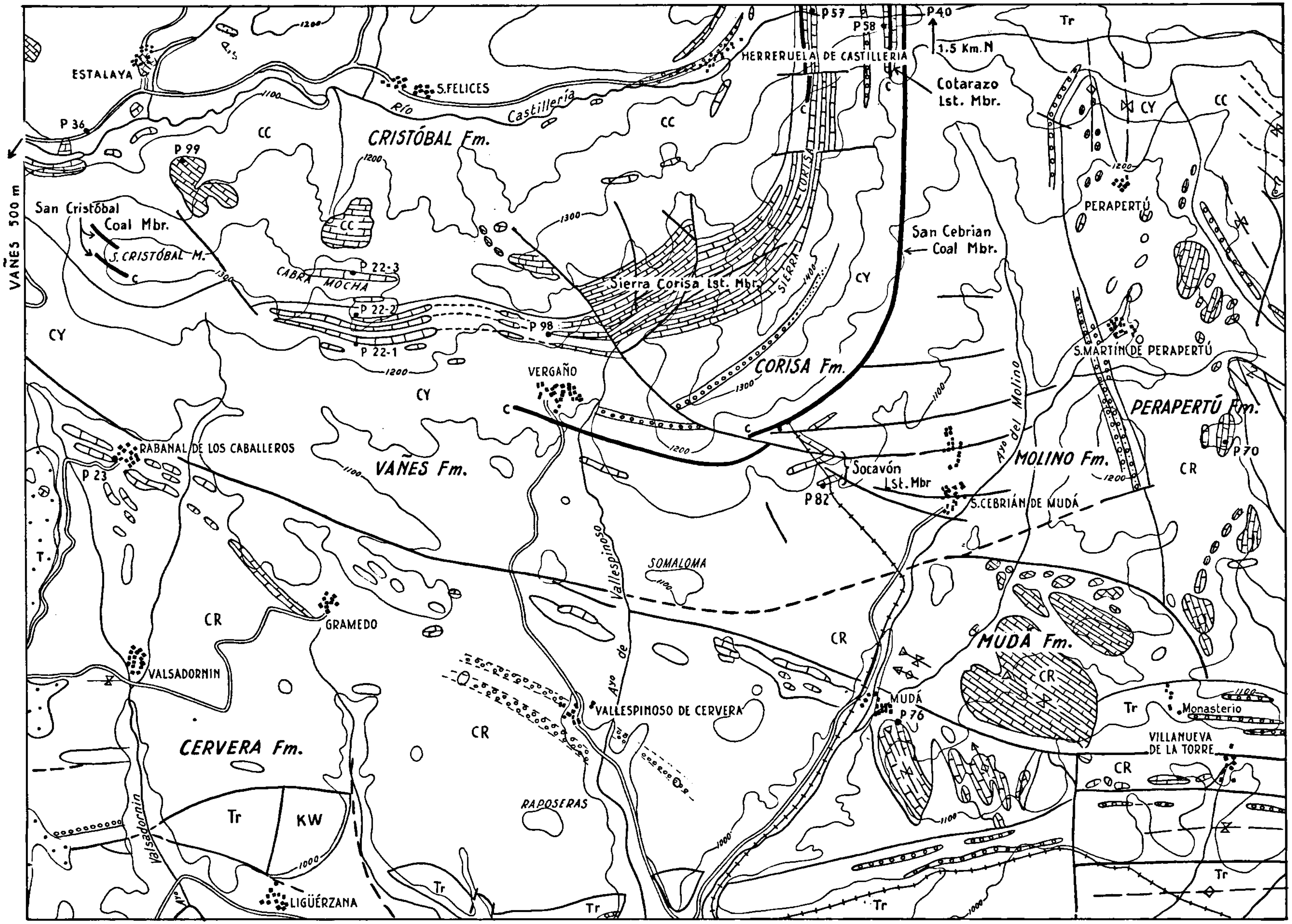
MAP 2


SIERRA DE PEÑA LABRA
Tr
CY
PIEDRASLUENGAS
Tres Aguas
Agujas
Lst. Mbr.
Abismo
Lst. Mbr.
CR
PEÑA ABISMO
P 73
P 72
CC
Ayo de Lombatero
Ayo de la Varga
Redondo Coal Mbr.
P 52
Corros Lst. Mbr.
S. Juan
Lst. Mbr.
Reboyal
Coal Mbr.
S. MARIA DE
REDONDO
REDONDO
Ayo de
Lomba Coal Mbr.
Río Pisuerga
1300
1400
1500
1600
1800
1900
2000
2100

MAP 3

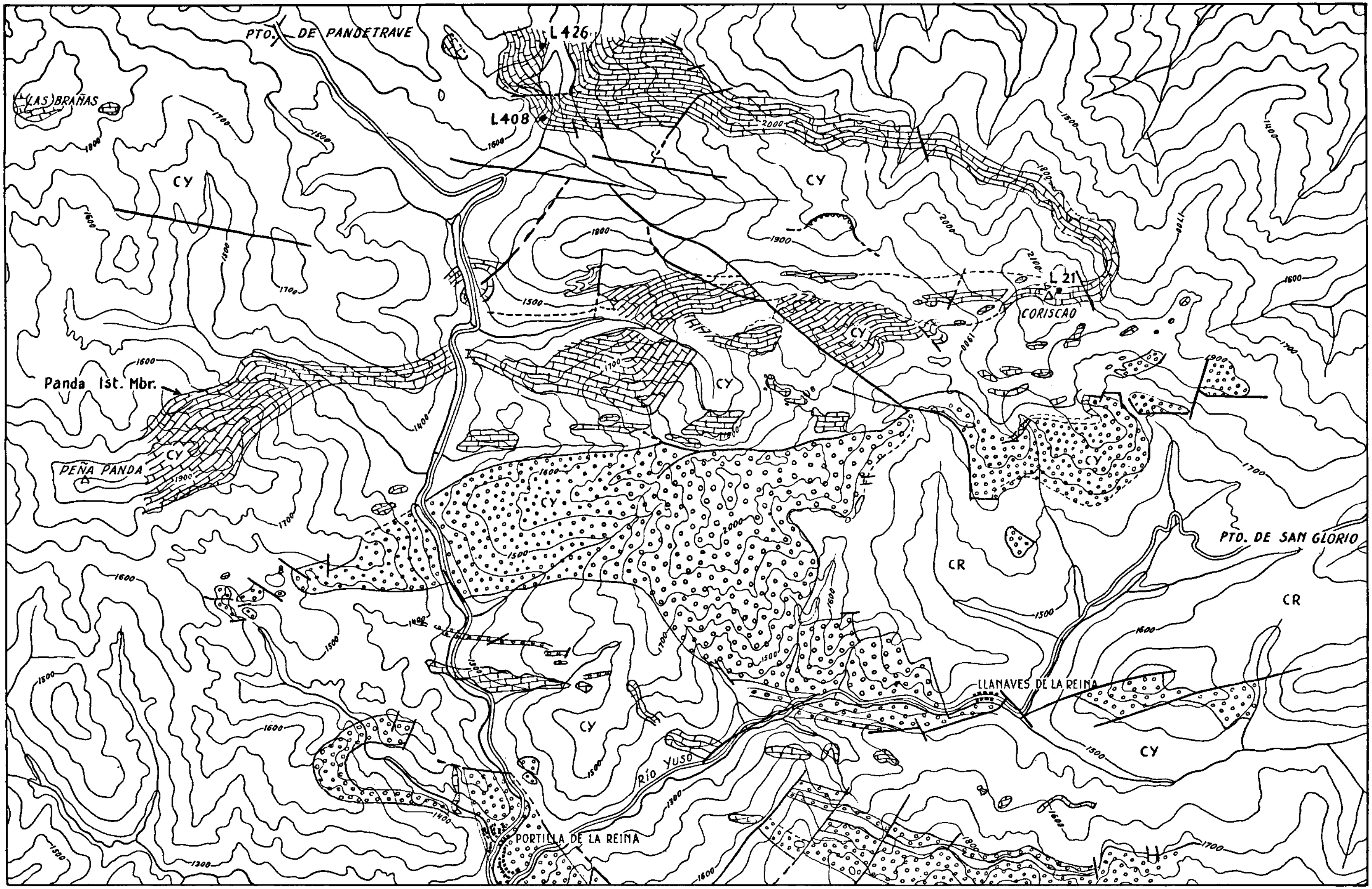


↙ 250 m , STA. MARIA DE NAVA

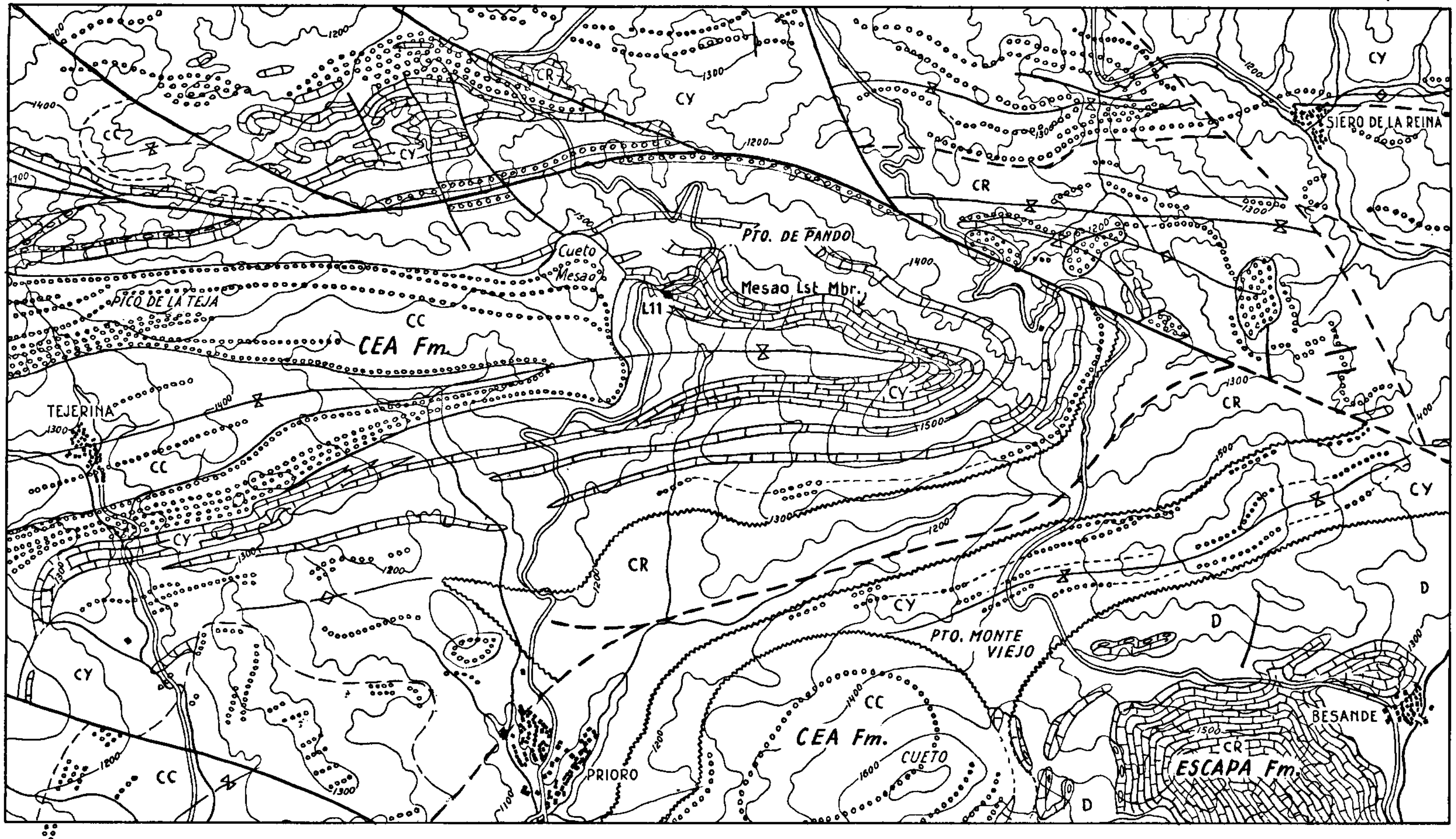

ESTALAYA
S.FELICES
Río Castillería
CRISTÓBAL Fm.
HERRERUELA DE CASTILLERIA
P 57
P 58
P 40
1.5 Km. N
Cotarazo
Lst. Mbr.
P 36
P 99
San Cristóbal
Coal Mbr.
S. CRISTÓBAL M.
CABRA MOCHA
P 22-3
P 22-2
P 22-1
P 98
Sierra Corisa Lst. Mbr.
SIERRA CORISA
San Cebrian
Coal Mbr.
CORISA Fm.
PERAPERTÚ
S.MARTÍN DE PERAPERTÚ
PERAPERTÚ Fm.
P 70
VERGAÑO
RABANAL DE LOS CABALLEROS
P 23
VAÑES Fm.
Socavón
Lst. Mbr
P 82
S.CEBRIÁN DE MUDÁ
MOLINO Fm.
Ayo del Molino
SOMALOMA
Ayo de Vallespinoso
GRAMEDO
VALSADORNIN
VALLESPINOSO DE CERVERA
MUDÁ
P 76
MUDÁ Fm.
Monasterio
VILLANUEVA
DE LA TORRE
CERVERA Fm.
RAPOSERAS
Valsadornin
LIGÜÉRZANA
VAÑES 500 m
CC
CY
CR
Tr
KW
T
1000
1100
1200
1300
1400

MAP 5

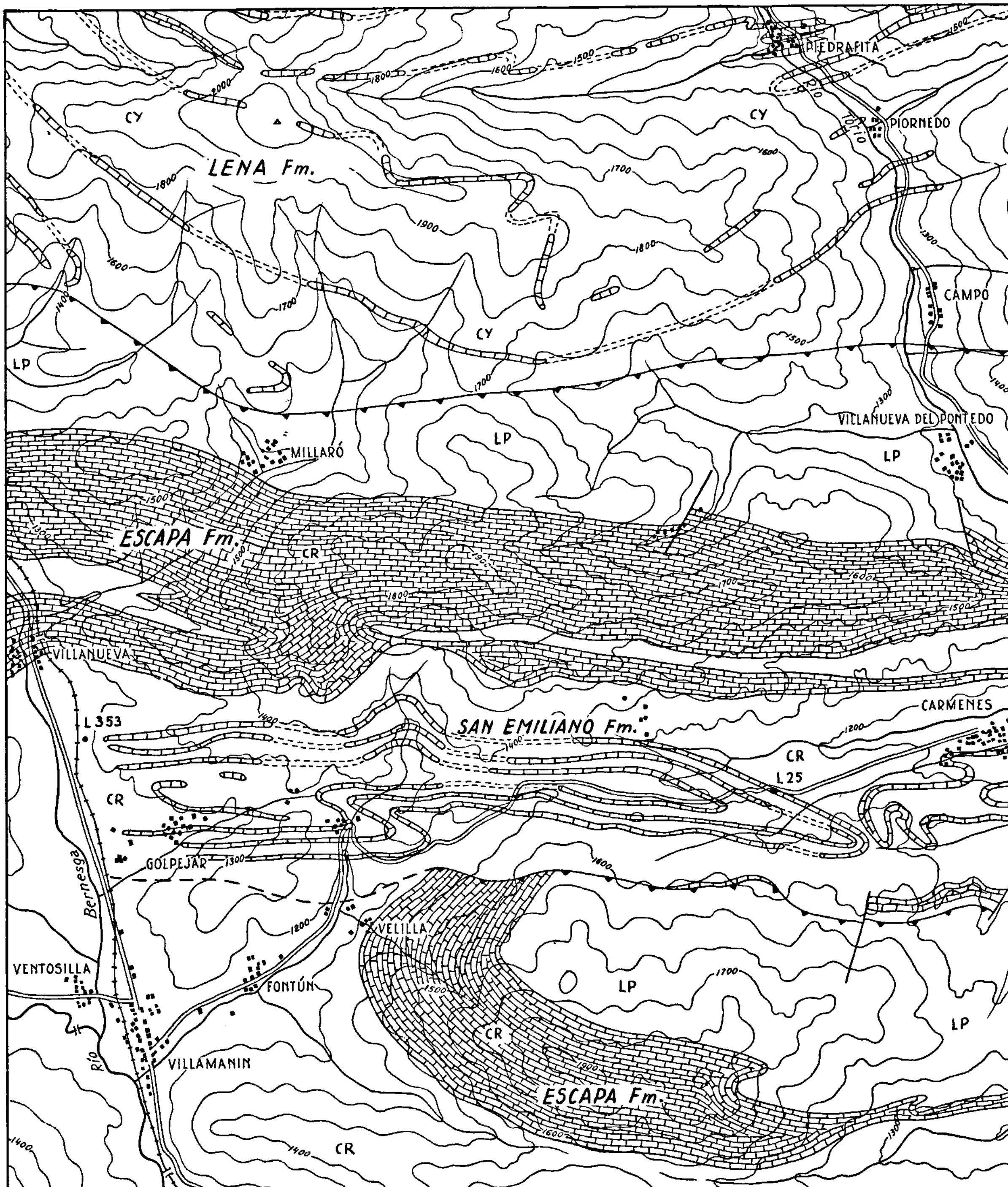
↙ 2 Km VILLANUEVA DE LA PEÑA


PTO. DE PANDETRAVE
L 426
L408
(LAS) BRAÑAS
CY
L 21
CORISCAO
Panda lst. Mbr.
PEÑA PANDA
PTO. DE SAN GLORIO
CR
LLANAVES DE LA REINA
Río Yuso
PORTILLA DE LA REINA

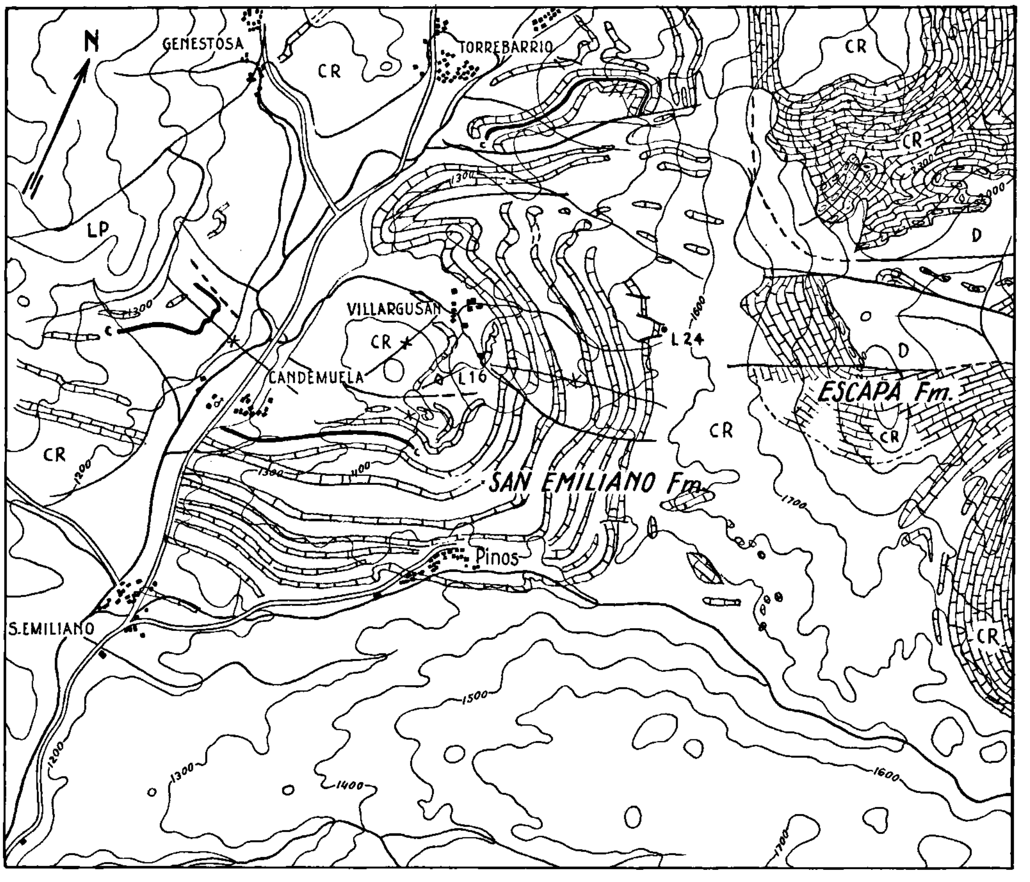
MAP 7


SIERO DE LA REINA
CY
CR
PTO. DE PANDO
Mesao Lst. Mbr.
L11
Cueto Mesao
PICO DE LA TEJA
CC
CEA Fm.
TEJERINA
PRIORO
PTO. MONTE VIEJO
CEA Fm.
CUETO
D
BESANDE
ESCAPA Fm.

MAP 8


PIEDRAFITA
Río Torío
PIORNEDO
CY
CY
LENA Fm.
CAMPO
CY
LP
VILLANUEVA DEL PONTEDO
LP
MILLARÓ
LP
ESCAPA Fm.
CR
VILLANUEVA
L 353
SAN EMILIANO Fm.
CARMENES
CR
L 25
CR
GOLPEJAR
Bernesga
VELILLA
VENTOSILLA
FONTÚN
LP
LP
Río
VILLAMANIN
CR
ESCAPA Fm.
CR

MAP 9


N
GENESTOSA
TORREBARRIO
CR
LP
VILLARGUSAN
CR
CANDEMUELA
L16
L24
CR
CR
D
D
ESCAPA Fm.
CR
SAN EMILIANO Fm.
Pinos
S.EMILIANO
CR
1300
1400
1500
1600
1700
1200

APPENDIX 4

TABLES OF MEASUREMENTS

Values with a dotted suffix (e.g. 363°) apply to measurements of one-half of a whorl less than the row in which they are placed.

Table 1 Measurements of *Staffella* cf. *moelleri* Ozawa

Axial sections

Specimen:		22(3)	18	11	30	34(3)	20(3)	35	20(1)	33	16(3)	40	36	20(5)	RANGE	AVERAGE
	0	34	33	31	31	30	30	28	27	26	24	24	24	20	20-34	28
	1	81	73	76	56	83	65	56	77	60	65	60	46	60	46-83	66
	2	138	120	116	101	150	111	114	129	103	119	103	86	113	86-150	116
	3	203	187	170	172	217	185	180	221	159	187	159	133	194	133-221	182
R.v.	4	302	255	234	245	336	302	263	314	242		243	207	280	207-336	269
	5	400	370	292*	336	463	416	357	459.	331		344	268	400	268-463	377
	6	527	510		442		544		---	450		433	391		391-544	471
	7	629*	569*		574					595			544		544-595	571
	8				697								---*		---	---
	1	71	65	53	81	82	72	104	67	71	83	71	86	88	53-104	76
	2	48	55	47	70	44	67	58	71	54	57	54	55	72	44-72	58
	3	49	36	38	43	55	63	46	42	52		53	56	44	36-63	48
G.r.	4	32	45		37	38	38	35	46	37		42	29	43	29-46	38
	5	32	38		32		31			36		26	46		26-46	30
	6				30					32			39		30-39	34
	7				21										---	--
	8															
	1	0.56	0.60	0.52	0.42	0.43	0.67	0.54	0.53	0.32	0.48	0.46	0.47	0.63	0.32-0.67	0.51
	2	0.55	0.59	0.48	0.46	0.50	0.56	0.47	0.47	0.40	0.52	0.44	0.47	0.54	0.40-0.59	0.50
	3	0.71	0.53	0.57	0.48	0.63	0.55	0.55	0.58	0.47	0.62	0.58	0.48	0.56	0.47-0.71	0.56
F.r.	4	0.68	0.68	0.58	0.61	0.61	0.70	0.65	0.65	0.56		0.65	0.53	0.67	0.53-0.70	0.63
	5	0.74	0.74	0.61*	0.66	0.69	0.71	0.63	0.59	0.59		0.64	0.65	0.73	0.59-0.74	0.67
	6	0.75	0.72		0.64	0.	0.61			0.62		0.67	0.73		0.61-0.75	0.68
	7	0.72*	0.84*		0.64					0.60			0.67		0.60-0.67	0.64
	8				0.57										-----	---
	1	9	8		6	8	11	5	6	4		6	4	7	4-11	7
	2	9	13		10	8	12	6	17	4		9	6	10	4-17	9
	3	12	13		11	11	11	13	13	6		9	6	11	6-13	11
W.th.	4	12	14		9	9	14	11	13	6		11	13	15	6-15	12
	5	16	23		12	9	18	12	17	13		13	11	15	9-23	14
	6	21	—		16		18			14		15	21		14-21	17.5
	7	24*	—*		13					14			--		---	--
	8				19										---	--
	1	0.26				0.34	0.30	0.29		0.23				0.33	0.23-0.34	0.29
	2	0.25	0.20	0.22	0.15	0.20	--	--	0.37	0.20	0.25		0.31	0.33	0.15-0.37	0.25
		0.27	--	0.35	0.22	--	0.29	0.33	--	--	0.28	0.37	0.21	0.48	0.21-0.48	0.31
	3	0.38	0.26	0.38	0.42	0.25	0.48	--	0.29	0.40	0.33	0.28	0.20	0.38	0.20-0.48	0.34
		--	0.45	0.28	0.23	0.33	0.33	0.34	0.34	0.41		0.49	0.29	0.37	0.23-0.49	0.35
Ch.h.	4	0.26	0.28	0.27	0.29	0.30	0.47	0.32	0.27	0.46		--	0.26	0.31	0.26-0.47	0.32
		0.28	0.28	0.34	0.35	0.28	0.22	0.42	0.31	0.44		0.43	0.32	0.23	0.22-0.44	0.32
	5	0.28	0.32		0.27	0.29	0.23	0.24	0.17	0.39		--	0.35	0.22	0.17-0.39	0.28
		0.24	0.29		0.52		0.31			0.30		0.28	0.31		0.24-0.52	0.32
	6	0.36	0.37		0.22		0.19			0.49		abs.	0.33		0.00-0.49	0.28
		0.29	0.40		0.45					0.34			0.33		0.29-0.45	0.36
	7				0.28					0.25					0.25-0.28	0.26
					abs.										-----	--
	8				0.13										-----	--

Table 1 Measurements of *Staffella* cf. *moelleri* Ozawa

Sagittal sections

Specimen:		44	42	1	5	24(1)	46	43	RANGE	AVERAGE
	0	38	33	30	30	28	28	26	26-38	30
	1	85	90	73	64	80	69	67	64-90	75
	2	144	142	125	120	133	125	120	120-144	130
	3	224	217	198	189	217	209	195	189-224	207
R.v.	4	336	289	254	276	289	261	280	254-336	284
	5	425	382	348	404	400	323	344	323-425	375
	6	552	493	463	570	544	425	484	425-570	504
	7		612	612		638*			---	612
	8			765					---	---
	1	69	58	71	88	66	81	79	58-88	73
	2	56	53	58	57	63	67	62	53-67	59
	3	50	33	28	46	33	25	44	25-50	37
G.r.	4	26	32	37	46	38	24	23	23-46	32
	5	30	29	33	41	36	32	41	29-41	35
	6		24	32					24-32	28
	7			25					---	--
	8									
	1	8	13	8	9	9	6	9	6-13	9
	2	8	11	9	11	10	8	9	8-11	9
	3	10	13	13	14	13	11	11	10-14	12
W.th.	4	16	12	11	20	10	13	13	10-20	14
	5	18	17	13	18	14	15	13	13-18	15
	6	19	18	19	--	15	23	15	15-23	18
	7			19					---	--
	8			26					---	--
	1	7	-	9	7	8	7	8	7-9	7.5
	2	15	14	12	12	12	11	13	11-15	13
	3	16	18	14	12	13	14	15	12-18	15
S.c.	4	17	18	16	17	16	18	15	15-18	17
	5	20	21	18	17	20	17	17	17-21	19
	6	19	25	17	18	21	19	21	17-25	20
	7		27	20					20-27	23.5
	8			24					---	--

Table 2 Measurements of *Staffella breimeri* sp. nov.

Axial sections

Specimen:		14	19	21	25	34	27	1	12	15	22	2	20	18(1)	28	29	31	12(2)	29(1)	18(2)	29(2)
R.v.	0	39	28	28	28	27	27	27	27	26	26	26	26	25	25	25	24	24	24	23	21
	1	99	86	64	77	82	88	56	62	69	64	60	86	60	62	92	70	56	69	54	54
	2	187	153	107	120	159	129	99	103	125	108	108	153	120	107	138	135	120	120	99	110
	3	285	255	167	174	280	195	151	155	198	173	162	263	195	170	255	212	204	203	170	178
	4	455	399	264	255	425	336	204	238	289	262	259	442	314	280	433	345	323	310	272	297
	5	654	586	400	342	561	510	306	306	442	384	416	689	391•	357•	646	540	502		348•	412
	6	816•	680•	573			---•	467	365•	544•	522	595						612•			569
	7			665•				637			630•										
G.r.	1	89	78	67	56	95	46	77	66	81	69	79	78	100	72	49	93	115	74	84	103
	2	52	67	56	45	76	51	52	50	59	60	50	72	63	59	85	57	70	69	72	62
	3	60	57	58	46	52	72	35	54	46	51	61	68	61	65	70	63	58	53	60	67
	4	44	47	52	34	32	52	50	29	53	47	61	56			49	57	56			39
	5			43				52			36	43									38
	6							36													
	7																				
F.r.	1	0.50	0.58	0.58	0.53	0.55	0.43	--	0.66	0.50	--	0.61	0.45	0.57	0.62	0.47	0.47	0.62	--	0.64	0.52
	2	0.59	0.81	0.45	0.71	0.66	0.52	0.65	0.75	0.62	0.55	0.56	0.72	0.73	0.84	0.72	0.56	0.61	0.78	0.78	0.69
	3	0.69	0.90	0.69	0.90	0.64	0.72	0.57	0.76	0.70	0.70	0.68	0.76	0.87	0.95	0.77	0.89	0.71	0.87	0.96	0.71
	4	0.82	0.79	0.89	0.75	0.74	0.67	0.75	--	0.74	0.82	0.85	0.77	0.86	0.92	0.78	0.83	0.82	0.98	0.97	0.83
	5	0.82	0.70	0.87	0.84	0.76	0.73	0.75	0.89	0.77	0.90	0.76	0.65	0.93•	0.88•	0.78	0.69	0.88		0.93•	0.85
	6	0.71•	0.68•	0.82				0.69	0.88•	0.69•	1.00	0.64						0.72•			0.88
	7			0.70•				0.79			0.86•										
Ch.h.	1																				
																0.26					0.23
	2		0.29	0.26	0.35	0.15										--	0.19		0.19		--
			--	--	--	0.29				0.21			0.27			0.16	--		0.22		--
	3	0.26	--	0.21	0.31	0.28	0.20		0.17	--			--	0.23	0.24	0.28	--		0.26	0.13	--
		--	0.18	--	--	--	--		--	0.19	0.37		0.25	0.29	0.27	0.18	0.35	0.28	0.24	--	0.22
	4	0.24	0.23	0.31	0.42	0.26	0.21		0.24	0.23	--		0.23	0.16	0.19	--	--	--		0.22	0.33
			0.27	--	0.30	0.18	0.16		--	0.21	0.20	0.31	0.34	0.17	0.20	0.18	0.36	0.23		0.27	0.29
	5		--	0.29	0.26		0.32	0.28	0.26	0.24	0.22	0.27				0.26	0.27	0.27			0.30
			0.16	--				0.22	0.17	0.23	0.24	0.25									0.23
	6			0.23				0.23			0.22										
				0.21																	
	7																				

Table 2 Measurements of *Staffella breimeri* sp. nov.

Sagittal sections

		42	35	31	3	5	RANGE	AVERAGE	4	20	8	33	19	26	25	31	16	RANGE	AVERAGE
R.v.	0	21	21	20	19	--	19–39	25	37	30	30	26	26	26	25	24	24	24–37	28
	1	69	54	56	54	56	54–99	68	90	73	73	67	69	64	64	69	54	54–90	69
	2	116	127	115	101	112	99–187	123	148	131	127	129	125	110	112	116	92	92–148	121
	3	187	200	182	157	186	151–285	198	262	213	204	217	183	196	185	191	163	163–262	202
	4	323	289	282	246	310	204–455	314	408	366	340	357	272	319	288	297	263	263–408	323
	5	510	493	334•	357	500	306–689	478	612	561	527	544	400	433	442	476	416	400–612	490
	6	595•	697		535	610•	467–697	565		782	731	731	620	595	595	705	612	595–782	671
	7						——	——					680•					---	---
G.r.	1	69	135	105	88	100	46–135	83	64	79	74	94	81	70	73	69	72	64–94	75
	2	61	57	58	55	66	45–85	61	77	63	61	68	46	78	65	65	77	46–78	67
	3	72	45	55	57	67	35–72	58	56	72	67	65	49	63	56	55	61	49–72	60
	4	58	71		45	61	29–71	50	50	53	55	52	47	36	53	60	58	36–60	52
	5		41		50		36–52	43		39	39	34	55	37	35	48	47	34–55	42
	6						——	--											
	7																		
F.r.	1	0.47		--	0.56	0.45	0.43–0.66	0.54											
	2	0.57		--	0.60	0.50	0.45–0.84	0.65											
	3	0.80		0.92	0.90	0.73	0.57–0.96	0.78											
	4	0.82		0.97	0.93	0.76	0.67–0.98	0.83											
	5	0.85		1.07	0.87	0.73	0.65–1.07	0.79											
	6	0.79•			0.78	0.71•	0.64–1.00	0.80											
	7						——	--											
Ch.h.	1																		
							——	--											
	2			0.23			0.15–0.35	0.24											
				--			0.16–0.29	0.22											
	3		0.25	--		0.19	0.13–0.31	0.23											
		0.38	--	0.21		--	0.18–0.38	0.27											
	4	0.20	0.26	0.23	0.21	0.13	0.13–0.42	0.23											
		0.27	0.30	0.26	--	0.26	0.16–0.36	0.25											
	5	0.29	0.21		0.30	0.21	0.21–0.32	0.25											
		0.15	0.24		--	0.17	0.15–0.30	0.21											
	6				0.25		0.22–0.25	0.23											
							——	--											
	7																		
S.o.	1								6	7	-	6	7	6	6	8	6	6–8	6.5
	2								9	9	9	10	9	11	10	11	10	9–11	10
	3								11	10	10	9	12	10	11	11	11	9–12	11
	4								12	11	13	12	14	13	12	13	12	11–14	12
	5								14	13	15	14	14	17	13	13	14	13–17	14
	6									17	18	17	16	19	20	17	18	16–20	18

Table 3 Measurements of *Staffella* ex gr. *pseudosphaeroidea* Dutkevitch

		Axial sections							Sagittal sections					
Specimen:		129	117(1)	62	137	31	48	117(2)	92	8	109	62	RANGE	AVERAGE
R.v.	0	—	29	22	19	17	—	—	23	18	18	15	15-29	20
	1	64	76	62	69	43	47	68	56	52	45	65	43-76	59
	2	129	118	95	112	86	112	119	99	84	73	108	73-129	103
	3	206	181	150	151	142	150	208	146	142	105	172	105-208	159
	4	323	264	238	204	209	251	314	204	219	191	238	191-323	241
	5	493	365	343	289	306	391	459	306	340	289	340	289-493	356
	6	697	505	470	417	442	—	629	438	493	459	485	417-697	504
	7	918•	660	629		612		867	629	680	646	646	612-867	671
	8										—•	867	—	—
G.r.	1	100	55	52	62	100	138	75	77	62	62	66	52-138	77
	2	60	53	59	35	65	34	75	47	69	44	60	34-75	55
	3	57	46	57	35	47	67	51	40	55	82	39	35-82	53
	4	53	38	44	42	46	56	46	50	60	51	43	38-60	48
	5	41	38	37	44	44	—	37	43	45	59	42	37-59	43
	6		31	34		38		38	44	38	41	33	31-44	37
	7											34	—	—
	8													
F.r.	1	0.70	0.60	0.35	0.47	0.52	0.64	0.57					0.35-0.70	0.55
	2	0.70	0.67	0.45	0.46	0.42	0.62	0.64					0.42-0.70	0.57
	3	0.75	0.76	0.43	0.54	0.48	0.89	0.80					0.43-0.89	0.66
	4	0.92	——	0.61	0.69	0.60	0.81	0.89					0.60-0.92	0.75
	5	0.91	0.83	0.56	0.79	0.68	0.76	0.85					0.56-0.91	0.77
	6	0.90	0.94	0.66	0.76	0.84	——	0.81					0.66-0.94	0.82
	7	0.73•	0.87	0.77		0.81		——					0.77-0.87	0.82
W.th.	1	-	6	6	4	4	-	-	5	6	6	9	4-9	6
	2	-	9	9	7	5	8	9	6	9	9	13	5-13	8
	3	21	11	13	11	6	16	11	10	11	11	17	6-21	13
	4	19	12	18	13	11	18	18	11	13	18	17	11-19	15
	5	36	16	20	21	17	24	21	13	22	20	24	13-36	21
	6	34	—	25	28	21	—	27	19	30	20	28	19-34	26
	7	39•	26	34		22		30	33	30	26	32	22-34	29
	8											30	—	—
S.c.	1								7	6	-	-	6-7	6.5
	2								12	10	-	-	10-12	11
	3								14	10	-	-	10-14	12
	4								14	12	-	16	12-16	14
	5								14	12	11	14	11-14	13
	6								15	14	13	12	12-15	13.5
	7								14	16	13	15	13-16	14.5
	8											18	—	—
Ch.h.	2		0.25			0.32							0.25-0.32	0.28
			—			0.25							——	——
	3		0.17		0.18	—	0.42						0.17-0.42	0.26
			—		—	0.48	0.52						0.48-0.52	0.50
	4		0.14		—	—	0.32	0.39					0.14-0.39	0.28
			0.32		0.17	0.28	0.15	0.23					0.15-0.32	0.23
	5	0.25	0.39		0.26	0.27	0.38	0.50					0.25-0.50	0.34
		—	0.29		0.16	0.30	0.17	0.35					0.16-0.35	0.25
	6	0.29	0.30		0.26	0.28		0.20					0.20-0.30	0.27
						0.38		0.17					0.17-0.38	0.27
	7					0.43		abs.					0.00-0.43	0.21

Table 4 Measurements of *Staffella mochaensis* sp. nov.

		Axial sections											Sagittal sections						
Specimen:		10(2)	26(1)	15	14(2)	26(2)	12	16	10(1)	14(1)	RANGE	AVERAGE	1	6	26	17	8	RANGE	AVERAGE
R.v.	0	36	29	26	26	24	24	22	—	—	22-36	27	32	29	28	25	—	25-32	28
	1	102	84	85	81	90	77	73	102	65	65-102	84	86	82	88	73	81	73-88	82
	2	178	158	166	150	161	170	155	187	136	136-187	162	176	153	161	136	136	136-178	153
	3	272	259	251	263	306	272	238	268	251	238-306	264	268	238	255	212	234	212-268	241
	4	400	375	382	400	442	612	391	408	365	365-442	401	400	357	370	302	323	302-400	350
	5	595	518	561	578	476•	—•	535	578	493	493-612	559	595	527	523	425	484	425-595	511
	6	764	700	833	697•			748	812	697	697-833	759	850	654	688	578	659	578-850	686
	7	969		1037				816•	1037		969-1037	1014	1080	901•	901	765	850	765-1080	899
	8												1275•		1139	901•		——	—
G.r.	1	75	88	95	87	79	121	112	83	109	75-121	94	107	87	83	86	68	68-107	86
	2	52	64	51	75	89	60	54	43	84	43-89	64	50	56	58	56	72	50-72	58
	3	47	45	53	52	44	63	64	52	46	44-64	52	49	50	45	42	38	38-50	45
	4	49	38	47	45		38	37	42	35	35-49	41	49	48	41	41	50	41-50	46
	5	30	35	48				40	40	41	30-48	39	43	24	32	36	36	24-43	34
	6	25		24					28		24-28	26	27		31	32	29	27-32	30
	7														26			—	—
	8																		
F.r.	1	0.50	——	0.45	0.51	0.50	0.67	——	0.58	0.40	0.40-0.67	0.52							
	2	0.57	0.49	0.51	0.53	0.53	0.48	0.47	0.50	0.47	0.47-0.57	0.51							
	3	0.72	0.51	0.64	0.58	0.53	0.66	0.64	0.57	0.54	0.51-0.72	0.60							
	4	0.83	0.76	0.80	0.77	0.68	0.85	0.72	0.79	0.72	0.68-0.85	0.77							
	5	0.89	0.82	0.91	0.79	0.75•	0.92•	0.86	0.88	0.86	0.79-0.92	0.87							
	6	0.90	0.84	0.88	0.79•			0.82	0.86	0.87	0.82-0.90	0.86							
	7	0.93		0.89				0.90•	0.86		0.86-0.93	0.89							
S.c.	1												—	7	6	—	—	6-7	6.5
	2												—	12	11	—	—	11-12	11.5
	3												12	12	12	—	13	12-13	12
	4												17	15	14	16	15	14-17	15
	5												17	14	16	19	14	14-19	16
	6												15	15	18	22	15	15-22	17
	7												18		19	23	17	17-23	19
	8														20			—	—
Ch.h.	2				0.31						——	——							
		0.39			—		0.37				0.37-0.39	0.38							
	3	0.39			0.29		0.43				0.29-0.43	0.37							
		0.24		0.33	—	0.29	0.32		0.33		0.24-0.33	0.30							
	4	—	0.33	—	0.27	—	—		—	0.41	0.27-0.41	0.34							
		0.36	—	0.25	0.19	0.29	—		0.38	0.33	0.19-0.38	0.30							
	5	0.25	0.36	0.21	0.39		0.29		0.34	0.21	0.21-0.39	0.29							
		0.29	0.30	0.21	0.24				0.25	0.29	0.21-0.30	0.26							
	6	0.33		0.19					—	0.34	0.19-0.34	0.29							
		0.31		0.13					0.23		0.13-0.31	0.22							
	7	0.28		0.49							0.28-0.49	0.38							

Table 5 Measurements of *Parastaffella vlerki* sp. nov.

Axial sections

Specimen:		3	6	4	40	40(2)	99	42A(2)	132	43	54	15	6(2)	49	136	93	15(2)	103	14	59	117
	0	39	32	32	30	30	30	30	29	28	28	27	26	26	26	26	26	26	26	25	25
	1	95	90	89	82	60	82	90	69	107	73	62	56	52	90	60	71	84	69	56	56
	2	189	170	170	163	125	159	167	133	172	133	125	116	99	150	110	135	159	129	99	112
R.v.	3	305	288	290	310	224	288	290	236	301	267	228	211	185	267	200	220	262	232	181	202
	4	430	451	458	486	357	417		365	499		400	408	335	447	348	365	396	357	348	355
	5	611			611•	391•			499	675		623	591	495	593	516	560	546	562	456	548
	6									710•			680•	629•		546•	690•		620•	632	
	1	100	88	91	100	108	95	85	94	60	82	100	108	90	67	82	90	90	87	77	100
	2	61	70	71	89	79	81	74	77	75	101	83	81	86	77	82	63	65	80	82	81
G.r.	3	41	56	58	56	60	45		55	66		75	94	81	67	74	66	51	54	92	75
	4	42							37	35		55	45	47	33	48	53	38	52	30	54
	5																				
	1	0.57	0.52	0.44	0.55	0.68	0.53	0.50	0.56	0.44	0.59	0.48	0.54	0.58	0.36	0.64	0.64	0.51	0.44	0.50	0.69
	2	0.47	0.51	0.46	0.61	0.52	0.42	0.46	0.50	0.35	0.56	0.47	0.52	0.67	0.37	0.61	0.50	0.59	0.57	0.52	0.50
F.r.	3	0.56	0.50	0.43	0.41	0.50	0.43	0.45	0.45	0.43	0.49	0.44	0.53	0.56	0.40	0.54	0.54	0.49	0.59	0.56	0.55
	4	0.47	0.43	0.39	0.28	0.44	0.36		0.41	0.27		0.39	0.47	0.49	0.37	0.49	0.55	0.44	0.49	0.50	0.41
	5	0.40			0.25•	0.43•			0.42	0.35		0.36	0.43	0.43	0.35	0.43	0.46	0.40	0.43	0.49	0.42
	6									0.26•			0.33•	0.36•		0.38•	0.36•		0.42•	0.39	

Table 5 Measurements of *Parastaffella vlerki* sp. nov.

Axial sections

99(2)	36	42A	2	31(4)	31(3)	38	103	31(5)	93(2)	31(2)	31	99(3)	40(3)	40(4)	41	RANGE	AVERAGE
25	25	25	24	24	23	23	—	22	20	20	19	—	—	24	—	19–39	26
56	65	60	56	56	69	56	56	58	56	54	47	56	95	52	43	43–107	67
112	138	125	103	120	129	112	116	112	107	103	99	129	168	104	82	82–189	130
209	245	215	189	204	232	198	198	245	198	185	181	262	249	185	150	150–310	232
366	417	262•	331	349	340	348	271•	387	348	305	280	271•	383	292	230	230–499	374
546	611		542	357•		533			473•				473•		297•	456–675	558
																—	—
100	112	107	85	115	88	100	108	93	92	91	109	131	77	100	90	67–131	94
86	78	72	83	70	80	77	71	119	85	80	83	103	48	78	84	48–119	79
75	70		75	71	47	76		58	76	65	55		54	58	53	47–94	64
	46		64			53										30–55	46
0.54	0.53	0.79	0.54	0.65	0.50	0.58	0.46	0.48	0.54	0.60	0.73	0.65	0.52	0.66	0.40	0.36–0.79	0.55
0.65	0.52	0.69	0.52	0.55	0.53	0.62	0.46	0.69	0.62	0.58	0.57	0.57	0.51	0.56	0.61	0.35–0.69	0.54
0.57	0.46	0.66	0.47	0.54	0.64	0.54	0.58	0.52	0.50	0.50	0.56	0.45	0.53	0.53	0.54	0.40–0.66	0.51
0.39	0.41	0.54•	0.43	0.45	0.59	0.40	0.54	0.47	0.41	0.55	0.50	0.54•	0.51	0.49	0.64	0.27–0.64	0.45
0.35	0.35		0.38	0.45•		0.30			0.39				0.50•		0.56•	0.35–0.49	0.40
																—	—

Table 5 Measurements of *Parastaffella vlerki* sp. nov.

Sagittal sections

Specimen:		3(2)	122(1)	122(2)	122(3)	122(4)	RANGE	AVERAGE
	0	30	30	28	25	24	24–30	27
	1	82	75	95	60	67	60–95	76
	2	138	133	174	120	116	116–174	136
R.v.	3	230	221	301	215	185	185–301	230
	4	366	—	473	333	314	314–473	372
	5	578		641	522	577	522–641	579
	6	638•			—•		—	—
	1	68	77	83	100	73	68–100	80
	2	67	66	73	79	59	59–79	69
G.r.	3	59		57	55	70	55–70	60
	4	58		36	57	52	36–58	51
	5							
	1	6	7	6	6	7	6–7	6.5
	2	13	10	10	12	10	10–13	11
S.o.	3	17	13	12	13	16	12–17	14
	4	15	18	17	18	20	15–20	18
	5	18		21	20	18	18–21	19

Table 6 Measurements of *Parastaffella hispaniae* sp. nov.

Specimen:		Axial sections 28	31	17(2)	4	15(2)	2	28(2)	28(4)	6(2)	28(3)	17	18	25(2)	26	26(2)	25	29	9	24	31(2)	6	RANGE	AVERAGE
	0	30	—	—	27	26	26	24	24	24	23	—	—	22	21	21	21	20	—	19	19	—	19–30	23
	1	73	73	69	60	60	62	77	82	57	63	56	73	58	77	69	58	47	69	77	56	56	47–82	66
	2	146	172	129	129	120	120	148	159	112	120	116	150	131	151	155	108	107	142	138	138	103	103–172	133
R.v.	3	255	314	289	238	221	204	272	306	193	208	206	272	219	238	255	194	198	272	238	272	238	193–314	242
	4	400	527	493	374	400	281	450	476	340	329	340	459	365	400	401	315	323	459	382	476	391	281–527	397
	5			731	—•	—		586	552•	470	385•	391•	663	586	510	510•	—•	493	544	544			470–731	570
	6									530•								680		714•			—	—
	1	100	135	87	114	100	93	92	95	96	90	108	106	126	94	125	85	127	106	78	146	85	78–146	104
	2	75	83	124	84	84	70	84	92	72	73	78	81	67	58	65	80	84	92	72	97	131	58–131	83
G.r.	3	57	68	71	57	81	38	66	56	76	58	65	69	67	68	57	62	63	69	61	75	64	38–81	64
	4			48				30		38			44	60	28			53	18	42			18–60	40
	5																	38					—	—
	6																							
	1	0.56	0.57	0.56	0.57	0.54	0.48	0.42	0.53	0.63	0.57	0.62	—	—	0.58	0.53	0.56	0.55	0.59	0.53	0.54	0.62	0.42–0.63	0.56
	2	0.46	0.50	0.57	0.52	0.48	0.59	0.43	0.53	0.78	0.44	0.48	—	0.48	0.46	0.44	—	0.48	0.58	0.42	0.55	0.56	0.42–0.78	0.51
F.r.	3	0.50	0.54	0.53	0.68	0.58	0.50	0.53	0.33	0.70	0.41	0.54	0.59	0.50	0.62	0.43	0.62	0.43	0.47	0.57	0.50	0.50	0.33–0.70	0.53
	4	0.40	0.43	0.50	0.64	0.65		0.55	0.37	0.55	0.45	0.56	0.56	0.53	0.51	0.51	0.54	0.58	0.46	0.49	0.45	0.46	0.37–0.65	0.51
	5			0.41		0.53•		0.52	0.43•	0.60	0.48•	0.52•	0.42	0.43	0.60	0.43•	0.51•	0.54	0.53	0.42			0.41–0.60	0.50
	6									0.59•								0.45		0.30•			—	—

Table 7 Measurements of *Parastaffella bradyi* (Moell.) subsp. *cantabrica* subsp. nov.

Specimen:		Axial sections 22	20	42	18	36	10	12	17	Sagittal sections 25	3(1)	3(2)	RANGE	AVERAGE
	0	27	23	19	16	—	15	13	—	23	18	16	13–27	19
	1	60	60	52	43	41	47	45	47	60	52	47	41–60	50
	2	112	99	107	77	82	103	107	99	103	105	86	77–112	98
R.v.	3	204	170	187	138	178	181	284	176	176	181	150	138–284	184
	4	348	255	340	215	289	323	301*	289	289	275	224	215–348	285
	5	595	433	485	275*		493		502	374*		365	365–595	479
	6	714	578	—*			—						578–714	646
	1	86	64	108	80	100	118	138	109	71	104		64–138	96
	2	82	72	75	78	117	75	164	78	71	71		71–164	87
G.r.	3	71	50	82	56	62	78		64	64	52		49–82	63
	4	71	70	42			53		74				42–74	62
	5	20	33										20–33	27
	6													
	1	—	—	0.58	—	0.47	—	—	—				0.47–0.58	0.52
	2	0.54	—	0.50	—	0.55	—	0.52	—				0.50–0.55	0.53
F.r.	3	0.48	0.50	0.59	—	0.48	0.57	0.42	0.63				0.42–0.63	0.52
	4	0.49	0.63	0.52	0.49	0.44	0.63	0.44*	0.50				0.44–0.63	0.53
	5	0.51	0.55	0.49	0.49*		0.53		0.49				0.49–0.55	0.51
	6	0.55	0.60	—*			—						0.55–0.60	0.57
	1									-	-	5	—	—
	2									11	11	11	—	11
S.c.	3									12	12	11	11–12	12
	4									15	14	17	14–17	15
	5											18	—	—

Table 8 Measurements of *Parastaffella? irinovkensis* (Leont.) subsp. *kanisi* subsp. nov.

Specimen:		Axial sections B	32	13(2)	5	Sagittal sections 19	3	13	34	10	20	RANGE	AVERAGE
	0	21	21	19	—	28	21	19	—	—	16	16–28	21
	1	54	52	60	58	73	54	64	60	60	43	43–73	58
	2	86	103	128	125	150	112	118	120	133	86	86–150	116
R.v.	3	133	200	224	246	236	236	211	221	217	170	133–246	209
	4	238	340	341	382	327	370	322	357	374	—	238–382	339
	5	323	476	485	535	433	510	416*	450*	450*	—	323–535	460
	6				595*	586						—	—
	1	59	100	113	115	106	107	84	100	121	100	59–121	100
	2	55	94	75	97	57	112	79	84	63	98	55–112	81
G.r.	3	79	70	52	55	39	57	53	62	72	—	39–79	60
	4	36	40	42	40	32	38				—	32–42	38
	5					35						—	—
	6												
	1	—	—	—	—							—	—
	2	—	—	—	—							—	—
F.r.	3	0.79	—	0.55	0.66							0.55–0.79	0.67
	4	0.64	0.65	0.66	0.56							0.56–0.66	0.63
	5	0.61	0.59	0.61	0.48							0.48–0.61	0.57
	6				0.47*							—	—
	1					5	6	5	5	-	7	5–7	5.5
	2					10	8	8	7	7	9	7–10	8
S.c.	3					12	10	9	10	11	13	9–13	11
	4					15	15	11	14	14	15	11–15	14
	5					20	17				19	17–20	19
	6					21						—	—

Table 9 Measurements of *Parastaffella? carmenesensis* sp. nov.

Specimen:		Axial sections 10	34	39	31	19	13	37	28	RANGE	AVERAGE
	0	28	27	-	-	22	-	22	22	22–28	24
	1	64	77	67	47	69	52	62	54	47–77	62
	2	123	150	129	92	135	107	139	118	92–150	124
R.v.	3	170	252	221	178	212	204	258	189	170–258	211
	4	263	415	340	263	365	331	430	336	263–430	343
	5	416	620	544	391	586	518	680	544	391–680	537
	6	612		765	629	816	697		718*	612–816	704
	7				731					—	—
	1	90	95	94	95	97	108	124	120	90–124	103
	2	38	68	71	93	57	90	86	60	38–93	70
	3	55	65	54	48	72	63	67	78	48–78	63
G.r.	4	58	49	60	48	60	56	58	62	48–62	56
	5	47		41	61	39	34			34–61	44
	6				16					—	—
	7										
	1	0.45	0.57	—	0.45	0.62	0.58	—	0.68	0.45–0.68	0.56
	2	0.46	0.59	0.70	0.51	0.57	0.54	0.57	0.62	0.46–0.70	0.57
	3	0.55	0.60	0.73	0.51	0.60	0.60	0.60	0.61	0.51–0.73	0.60
F.r.	4	0.60	0.59	0.65	0.61	0.63	0.56	0.62	0.63	0.56–0.65	0.61
	5	0.69	0.64	0.59	0.61	0.61	0.58	0.60	0.52	0.52–0.69	0.61
	6	0.63		0.50	0.57	0.58	0.59		0.46*	0.50–0.63	0.57
	7				0.51					—	—
	2		0.30						0.23	0.23–0.30	0.26
			—			0.19			—	—	—
	3		0.41	0.23	0.28	0.24	0.25		0.25	0.23–0.41	0.28
			—	—	—	0.21	—		—	—	—
Ch.h.	4	0.24	0.32	—	0.20	0.30	0.19		0.23	0.19–0.32	0.25
		—	—	0.34	—	0.23	—		0.23	0.23–0.34	0.27
	5	—	0.30	0.32	0.27	—	0.41		—	0.27–0.41	0.32
		—		0.32	0.27	0.21			0.21	0.21–0.32	0.25
	6	0.21		0.39	0.29					0.21–0.39	0.30
					0.23					—	—
	7				0.33					—	—

Table 10 Measurements of *Millerella* ex gr. *ikensis* (Vissarionova)

Specimen:		24	10(1)	19	29(1)	29(3)	23	11	15	10(2)	13(1)	20	7	8	13(2)	14	RANGE	AVERAGE
		Axial sections																
R.v.	0	12	12	15	15	14	17	13	12	15	16	13	11	11	13	15	11–17	14
	1	28	39	38	45	40	60	30	42	37	36	32	30	44	34	56	28–60	39
	2	52	64	60	78	78	107	56	80	62	62	60	54	80	64	86	52–107	69
	3	82	101	107	142	134	189	95	140	100	110	107	98	130	110	138	82–189	119
	4	110*	125*	176		178*	289	155	175*	170	189	201	151	207	189	225	151–289	195
	5							258*					264	305	277	278*	264–305	282
	6												323*				—	—
G.r.	1	85	67	60	73	95	79	86	90	68	72	87	80	82	88	54	54–95	78
	2	58	57	79	82	72	76	69	75	61	77	79	81	63	70	60	57–82	71
	3			64			53	64		70	72	87	54	59	73	63	53–87	66
	4												75	47	47		47–75	56
	5																	
F.r.	1	0.46	0.42	0.34	0.47	0.50	0.50	0.46	0.52	0.40	0.44	0.40	0.38	0.38	0.37	0.47	0.34–0.52	0.43
	2	0.48	0.37	0.45	—	0.55	0.52	0.40	0.47	0.39	0.45	0.45	0.40	0.34	0.43	0.49	0.34–0.55	0.44
	3	0.47	0.43	0.42	0.49	0.54	0.54	0.45	0.46	0.45	0.43	0.42	0.44	0.44	0.45	0.57	0.42–0.57	0.47
	4	0.46*	0.50*	0.40		0.54*	0.50	0.47	0.47*	0.44	0.38	0.38	0.40	0.45	0.42	0.52	0.38–0.52	0.44
	5							0.39*					0.44	0.48	0.49	0.51*	0.44–0.49	0.47
	6												0.42*				—	—

Table 11 Measurements of *Ozawainella leonensis* sp. nov.

Specimen:		34	18	29(2)	4	8(2)	20	26	25(2)	RANGE	AVERAGE
		Axial sections						Sag. sect.			
R.v.	0	18	18	17	—	—	15	15	13	13–18	16
	1	52	39	54	—	44	45	40	38	38–54	45
	2	103	67	88	119	78	82	71	64	64–119	84
	3	181	112	142	170	123	138	133	103	103–181	138
	4	221	180	204	221	225	195	199	176	176–225	103
	5	331	254	272	306	300	306	270	275	254–331	288
	6	463*	357	306*	408		438	320*	329*	357–438	401
	7						561*			—	—
G.r.	1	100	72	64	—	77	81	78	68	64–100	77
	2	75	68	61	43	58	68	87	61	43–87	65
	3	23	61	44	30	83	41	50	71	23–83	50
	4	50	41	33	38		57	36	56	33–57	44
	5		41		32		43			32–43	39
	6										
F.r.	1	0.33	0.39	0.36	—	0.36	0.43	0.36		0.33–0.43	0.37
	2	0.42	0.45	0.41	0.46	0.49	0.36	0.51		0.36–0.51	0.44
	3	0.39	0.40	0.48	0.57	0.51	0.37	0.42		0.37–0.57	0.45
	4	0.46	0.51	0.48	0.60	0.49	0.37	0.49		0.37–0.60	0.49
	5	0.45	0.54	0.59	0.65	0.41*	0.42	0.57		0.42–0.65	0.54
	6	0.42*	0.48	0.58*	0.62		0.45	0.52*		0.45–0.62	0.52
	7						0.41*			—	—

Table 12 Measurements of *Ozawainella* cf. *leei* (Putrya)

Specimen:		20	18	15	19	16	17	23	22	RANGE	AVERAGE
		Axial sections									
R.v.	0	18	18	17	16	15	14	14	13	13–18	16
	1	49	47	41	54	41	45	30	30	30–54	42
	2	92	92	88	97	82	82	62	69	62–97	83
	3	170	160	161	168	144	129	123	125	123–170	148
	4	268	240	272	251	234	204	204	204	204–272	235
	5	408	339	395	387	357	306	302	340	302–408	354
	6	536*				493	323*	459	493	459–493	482
	7					574*		510*	629*	—	—
G.r.	1	87	96	116	80	100	81	107	129	80–129	100
	2	84	74	83	73	76	58	97	81	73–97	78
	3	58	50	69	49	63	58	66	63	49–69	60
	4	52	41	45	54	53	50	48	67	41–67	51
	5					38		52	45	38–52	45
	6										
F.r.	1	0.39	0.61	0.47	0.44	0.39	0.38	0.43	0.64	0.38–0.64	0.47
	2	0.40	0.48	0.39	0.38	0.34	0.38	0.38	0.42	0.34–0.48	0.40
	3	0.40	0.45	0.44	0.42	0.37	0.43	0.38	0.40	0.37–0.45	0.41
	4	0.43	0.47	0.39	0.41	0.40	0.46	0.48	0.40	0.39–0.48	0.43
	5	0.38	0.45	0.37	0.38	0.40	0.44	0.45	0.41	0.37–0.45	0.41
	6	0.33*				0.38	0.45*	0.39	0.37	0.37–0.39	0.38
	7					0.39*		0.37*	0.32*	—	—

Table 13 Measurements of *Pseudostaffella* ex gr. *gorskyi* (Dutkevitch) (2nd assemblage)

		Axial sections												
		macrospheres						microspheres			macrospheres		microspheres	
Specimen:		46	41	26	22	10	16	2	4	50	RANGE	AVERAGE	RANGE	AVERAGE
R.v.	0	46	45	49	43	32	26	-	18	14	32–46	43	14–26	19
	1	107	99	95	82	80	82	77	41	43	80–107	93	41–82	61
	2	187	168	187	126	136	152	159	90	73	126–187	161	73–159	118
	3	289	264	297	204	238	270	263	146	146	204–297	258	146–270	206
	4	357•	374		289	357	430	400	246	255	289–374	340	246–430	333
	5				416•		660	527	374				374–660	520
	6						—	672•	433•				—	—
G.r.	1	75	70	97	54	70	85	106	121	70	54–97	73	70–121	95
	2	55	57	59	60	75	78	65	62	100	55–75	61	62–100	76
	3		42		42	50	59	52	68	75	42–50	45	52–75	64
	4						53	32	52				32–53	46
	5													
F.r.	1	0.90		1.09		0.81		1.25	—	—	0.81–1.09	0.93	—	—
	2	1.05		1.14		1.12		1.14	0.74	0.91	1.05–1.14	1.10	0.74–1.14	0.93
	3	1.03		1.20		1.07		1.16	1.03	1.09	1.03–1.20	1.10	1.03–1.16	1.09
	4	1.00•				1.10		1.13	1.03	1.07	—	—	1.03–1.13	1.08
	5							1.10	0.93				0.93–1.10	1.01
	6							0.99•	0.96•				—	—
T.a.	1	22	14	14	13	8		26	-		8–22	14		
	2	19	20	15	18	19		24	16		15–20	18		
	3	22	24	-	30	20		24	16		20–30	24		
	4		23		25	-		28	19		23–25	24		
	5							57	32		—	—		
Ch.h.	1	0.54		0.45		0.36					0.36–0.54	0.45	—	—
		0.53		—		0.42					0.42–0.53	0.47	—	—
	2	—		—	0.50	0.40					0.40–0.50	0.45	—	—
		0.54	0.57	0.57	—	0.40		0.50		0.51	0.40–0.57	0.52	0.50–0.51	0.50
	3	0.64	0.50		—	0.62		0.54	0.58	—	0.50–0.64	0.59	0.54–0.58	0.56
					0.54	0.61	0.34	0.55	—	0.55	0.54–0.61	0.57	0.34–0.55	0.48
	4						—	0.57	0.49	0.37			0.37–0.57	0.48
							—	—	—				—	—
	5						0.38	0.26	0.47				0.26–0.47	0.37
									0.44				—	—
	6													

Table 14 Measurements of *Pseudostaffella* cf. *sphaeroidea* (Ehrenberg)

		Axial sections				Sagittal sections				
Specimen:		25	29	28	27	30	31	32	RANGE	AVERAGE
R.v.	0	45	41	35	33	43	42	37	33–45	39
	1	101	108	101	95	107	95	86	86–108	99
	2	174	174	187	144	187	176	140	140–187	169
	3	255	249	268	238	255	255	219	219–268	248
	4	340	335	357	357	348	340	306	306–357	340
	5	442	460	510	497	476	484	425	425–510	471
	6	595	605	586•	671	637	646	540	540–671	616
	7	765	680•		807	790	803	705	705–807	774
	8	867•			973	918•			—	—
G.r.	1	72	61	85	52	74	86	62	52–86	70
	2	46	43	43	65	36	45	57	36–65	48
	3	33	35	33	50	37	33	40	33–50	37
	4	30	37	43	39	37	42	39	30–43	38
	5	35	32		35	34	33	27	27–35	33
	6	29			20	24	24	31	20–31	26
	7				21				—	—
	8									
F.r.	1	0.88	0.75	0.79	—				0.75–0.88	0.81
	2	0.83	0.88	0.80	0.98				0.80–0.98	0.37
	3	0.93	0.90	0.83	0.96				0.83–0.96	0.91
	4	0.97	0.90	0.88	0.96				0.88–0.97	0.93
	5	0.99	0.90	0.83	0.94				0.83–0.99	0.92
	6	0.94	0.87	0.87•	0.90				0.87–0.94	0.90
	7	0.88	0.88•		0.91				0.88–0.91	0.90
	8	0.84•			0.85				—	—
S.o.	1					10	9	7	7–10	9
	2					14	13	13	13–14	13
	3					19	16	15	15–19	17
	4					21	22	20	20–22	21
	5					26	24	21	21–26	24
	6					27	24	24	24–27	25
	7					33	29	24	24–33	29
T.a.	1	12	11	-	-				11–12	11.5
	2	13	13	-	15				13–15	14
	3	13	12	9	10				9–13	11
	4	15	13	16	18				13–18	15.5
	5	12	17	14	12				12–17	14
	6	19	19		13				13–19	17
	7	17			17				—	17
Ch.h.	0.5			0.30					—	—
	1	0.43		—					—	—
		0.47	0.50	0.50					0.47–0.50	0.49
	2	0.54	0.47	—	0.46				0.46–0.54	0.49
		0.61	0.48	—	0.55				0.48–0.61	0.55
	3	—	—	0.57	0.36				0.36–0.57	0.46
		0.48	—	0.46	0.40				0.40–0.48	0.45
	4	0.64	—	0.43	0.38				0.38–0.64	0.48
		—	0.35	0.45	0.35				0.35–0.45	0.38
	5	0.54	0.37	0.41	0.46				0.37–0.54	0.44
		0.44	0.43	0.34	0.47				0.34–0.47	0.42
	6	0.35	0.33		0.51				0.33–0.51	0.40
		0.47	0.35		0.34				0.34–0.47	0.39
	7	—			0.39				—	—
		0.23			0.18				0.18–0.23	0.20
	8									

Table 15 Measurements of *Pseudostaffella* ex gr. *parasphaeroidea* (Lee *et* Chen)

		Axial sections				Sag. sect.			
Specimen:		4	1	15	7	6(1)	17	RANGE	AVERAGE
	0	47	32	—	28	41	35	28–47	37
	1	99	82	—	64	95	90	64–99	86
	2	159	133	114	103	153	142	103–159	134
R.v.	3	221	204	189	187	234	229	187–234	211
	4	323	306	285	285	319	340	285–340	310
	5	455	416	408	433	476	476	408–476	444
	6	612	591	578	599	544*	646	578–646	605
	1	61	63	-	60	61	57	57–63	60
	2	39	53	66	82	53	61	39–82	59
G.r.	3	46	50	51	52	36	48	36–52	47
	4	41	36	43	52	49	40	36–52	44
	5	35	42	42	38		36	35–42	39
	6								
	1	—	0.74	—	0.80			0.74–0.80	0.77
	2	1.00	1.00	0.77	0.96			0.77–1.00	0.93
F.r.	3	1.15	1.00	0.98	0.88			0.88–1.15	1.00
	4	0.97	0.90	1.01	0.93			0.90–1.01	0.95
	5	0.92	0.90	0.96	0.93			0.90–0.96	0.93
	6	0.85	0.81	0.87	0.83			0.81–0.87	0.84
					6(2)				
	1				-	-	7	–––	––
	2				11	-	12	11–12	11.5
S.c.	3				12	12	14	12–14	13
	4				16	12	16	12–16	15
	5				18	18	19	18–19	18
	6						23	–––	––
	1	13	-	-	-			–––	––
	2	15	21	-	19			15–21	18
T.a.	3	15	17	15	14			14–17	15
	4	23	19	21	14			14–23	19
	5	21	28	28	21			21–28	24
	6	-	43	31	22			22–43	32
	1	0.43						–––––	––
		0.40	0.33					0.33–0.40	0.36
	2	0.32	0.42					0.32–0.42	0.37
		0.53	0.35	0.41	0.46			0.35–0.53	0.44
Ch.h.	3	––	0.48	0.37	—			0.37–0.48	0.42
		—	0.47	0.36	0.44			0.36–0.47	0.42
	4	0.49	0.33	0.35	––			0.33–0.49	0.39
		0.44	0.39	0.35	0.32			0.32–0.44	0.37
	5	0.39	0.33	0.25	0.36			0.25–0.39	0.33
		––	0.29	0.27	0.38			0.27–0.38	0.31
	6	abs.	0.23	0.31	0.41			0.00–0.41	0.24

Table 16 Measurements of *Profusulinella* ex gr. *pararhomboides* Rauser-Chernoussova (1st assemblage)

		Ax. sect.		Sagittal sections					
Specimen:		31	30	12	27	29	16	RANGE	AVERAGE
	0	22	––	25	21	19	16	16–25	21
	1	73	64	65	58	54	40	40–73	59
	2	107	112	118	90	107	73	73–118	101
R.v.	3	193	195	224	155	181	123	123–224	178
	4	310	305	374	244	272	212	212–374	286
	5	459	435	531	331	–––	289	289–531	409
	6				400*		408*	–––	––
	1	47	75	83	56	99	89	47–99	75
	2	80	74	89	71	68	68	68–89	75
G.r.	3	61	56	67	58	50	72	50–72	61
	4	48	43	42	36		36	36–48	41
	5								
	1	––––	0.68					–––––	––––
	2	1.42	1.36					1.36–1.42	1.39
F.r.	3	1.89	1.60					1.60–1.89	1.75
	4	2.14	2.05					2.05–2.14	2.10
	5	2.30	2.07					2.07–2.30	2.19
	1	9	9	12	9	9		9–12	10
	2	––	13	21	15	11		11–21	15
W.th.	3	––	17	31	18	15		15–31	20
	4	26	26	25	24	14		14–26	23
	5	––	17	19	17			17–19	17
	6				12*			–––	––
	1			––	––	––	––	–––	––
	2			––	––	––	9	–––	––
S.c.	3			17	13	13	13	13–17	14
	4			––	16	––	17	16–17	16.5
	5			––	20			–––	––
	1								
		0.45	––––					–––––	
	2	0.53	0.45					0.45–0.53	0.49
		0.55	0.44					0.44–0.55	0.49
Ch.h.	3		0.45					–––––	––––
		0.50	––––					–––––	––––
	4	0.44	0.39					0.39–0.44	0.41
		0.45	0.48					0.45–0.48	0.46
	5	0.48	0.33					0.33–0.48	0.40
			0.51					–––––	––––
	6								

Table 17 Measurements of *Profusulinella* ex gr. *parva* (Lee *et* Chen)

		Axial sections			Sagittal sections				
Specimen:		14	40	33	27	36	30	RANGE	AVERAGE
	0	40	30	30	42	26	24	24–42	32
	1	93	96	69	119	75	73	69–119	87
	2	162	188	110	229	153	123	110–229	161
R.v.	3	289	302	204	425	246	221	204–425	261
	4	450	470	340	620	400	404	340–620	447
	5	663	575	578		595	595•	575–663	603
	6		595•	620•		714•		——	——
	1								
	2	73	96	59	93	104	68	59–104	82
G.r.	3	79	61	85	85	61	80	61–85	75
	4	56	56	67	46	62	83	46–83	62
	5	47	22	70				22–70	47
	1	1.00	1.14	0.62				0.62–1.14	0.92
	2	1.21	1.31	1.31				1.21–1.31	1.28
F.r.	3	1.26	1.37	1.46				1.26–1.46	1.36
	4	1.34	1.27	1.55				1.27–1.55	1.39
	5	1.21	1.35	1.29				1.21–1.35	1.28
	6			1.32•				——	——
	1	13	—	9	17	13	11	9–17	13
	2	19	21	19	26	17	15	15–26	19
W.th.	3	26	22	26	30	24	26	22–30	26
	4	—	24	34	43	32	34	24–43	33
	5	—	34	34		39	43•	34–39	36
	6		32•	32•				——	—
	1				—	6	5	5–6	5.5
	2				10	12	9	9–12	10
S.o.	3				15	15	12	12–15	14
	4				23	17	15	15–23	18
	5					21		——	—
	2	16	16	19				16–19	17
	3	25	24	25				24–25	25
T.a.	4	30	29	27				27–30	29
	5	—	32	39				32–39	35
	2	0.39	—	0.36					
		—	0.47	—					
Ch.h.	3	0.36	—	0.41					
		—	0.32	0.44					
	4	0.37	—	0.37					
		0.41	—	0.39					
	5	—	—	0.29					

Table 18 Measurements of *Profusulinella cavis* Dalm. subsp. *arbejalensis* subsp. nov.

		Axial sections								Sag. sect.			
Specimen:		121^{B}	27	32	28	1	12	35	16	30	10	RANGE	AVERAGE
	0	22	19	—	—	19	18	17	16	17	17	16–22	18
	1	56	60	60	58	52	52	54	53	67	36	36–67	55
R.v.	2	129	116	120	129	111	97	90	107	144	60	60–144	110
	3	238	191	234	238	222	204	146	200	254	133	133–254	206
	4	400	340	408	408	370	391	289	357	391	237	237–408	359
	5		535		544•		459•	476	421•	450•	391	391–535	467
	1												
	2	131	93	100	122	113	87	68	104	116	67	67–131	100
G.r.	3	85	65	95	84	100	100	62	87	76	'121	62–121	89
	4	68	78	75	71	67	92	98	79	54	77	54–98	76
	5		57								65	57–65	61
	1	—	—	—	—	0.59	—	0.48	—			0.48–0.59	0.54
	2	1.33	0.74	1.02	1.07	1.00	0.78	0.57	—			0.57–1.33	0.93
F.r.	3	1.54	1.33	1.24	1.46	1.40	1.17	1.18	1.32			1.17–1.54	1.33
	4	1.49	1.52	1.18	1.40	1.33	1.20	1.28	1.43			1.18–1.52	1.35
	5		1.56				1.22•	1.27	1.45•			1.27–1.56	1.42
	1	6	-	8	9	8	6	6	9	-	6	6–9	7
	2	17	16	14	17	17	9	19	14	16	10	9–19	15
W.th.	3	22	26	26	26	26	21	19	21	26	21	19–26	23
	4	19	28	20	30	24	34	26	23	32	30	19–34	27
	5		22		21•		32•	26	27•	23•	20	20–26	23
	1									—	—		
	2									7	—		
S.o.	3									12	7		
	4									17	10		
	5										14		
	2	24	19	12	24	11	—	—	25			11–25	19
T.a.	3	34	22	32	44	33	30	27	37			22–44	32
	4	45	31	—	47	44	—	36	46			31–47	41
	5		35				—	34	—			34–35	34
	2	—	0.29	0.28	0.27	0.20	—	—	0.23			0.20–0.29	0.25
		0.31	0.31	0.26	0.19	0.19	—	0.33	0.28			0.19–0.33	0.27
Ch.h.	3	0.29	0.40	0.20	0.30	0.27	—	0.30	0.29			0.20–0.40	0.29
		—	0.32	0.20	0.35	0.25	—	0.34	0.21			0.20–0.35	0.28
	4	0.15	0.27	—	0.24	0.30	—	0.18	0.29			0.15–0.30	0.24
			0.35		0.17		—	0.27	0.27			0.17–0.35	0.26
	5		0.24					0.26				0.24–0.26	0.25

Table 19 Measurements of *Profusulinella* cf. *rhombiformis* Brazhnikova *et* Potievska

		Axial sections					Sag. sect.			
Specimen:		121A	31	29(2)	15	29(1)	25	15(2)	RANGE	AVERAGE
	0	24	19	13	—	—	28	23	13–28	21
	1	52	66	47	—	48	73	52	47–73	56
	2	86	122	95	—	80	129	95	80–129	101
R.v.	3	151	206	176	—	138	215	159	138–215	174
	4	221	326	323	289	223	340	280	221–340	286
	5	357	495	357*	442	345		425	345–495	413
	6	476*			578*					
	1									
	2	67	85	100	—	67	76	83	67–100	80
G.r.	3	75	69	86	—	73	67	68	67–86	73
	4	46	58	84	—	62	58	76	46–84	64
	5	54	52		53	55		51	51–55	53
	1	—		—	—	—			—	—
	2	—		0.98	—	0.85			0.85–0.98	0.92
F.r.	3	1.52		1.27	—	1.20			1.20–1.52	1.33
	4	1.73		1.34	1.65	1.60			1.34–1.73	1.58
	5	1.71		1.57*	1.63	1.72			1.63–1.72	1.69
	6	1.52*			1.41*					
	1	8	11	6	—	7	9	6	6–11	8
	2	13	19	9	12	13	13	10	9–19	13
W.th.	3	21	23	17	21	17	25	19	17–25	20
	4	26	25	21	30	23	24	24	21–30	25
	5	30	23	19*	32	24		21	23–32	26
	6	26*								
	1						-	6		
	2						9	10		
S.c.	3						11	14		
	4						12	—		
	5							—		
	1	—	—	—	—	—			—	—
	2	—	18	14	13	10			10–18	14
T.a.	3	20	22	17	20	19			17–22	20
	4	28	29	—	24	21			21–29	25
	5	26	—		—	21			21–26	23
	1	—	0.26	—	—	—			—	—
		—	0.26	—	—	—			—	—
	2	—	0.45	0.35	0.36	0.32			0.32–0.45	0.37
		0.45	0.37	0.27	0.42	—			0.27–0.45	0.38
Ch.h.	3	0.37	0.50	0.42	0.50	0.30			0.30–0.50	0.42
		—	0.54	0.43	0.47	—			0.43–0.54	0.48
	4	0.38	0.47	0.56	0.47	0.40			0.38–0.56	0.46
		—	0.50	0.39	0.33	—			0.33–0.50	0.41
	5	0.41	—		—	0.43			0.41–0.43	0.42
		0.40			0.43				0.40–0.43	0.41
	6									

Table 20 Measurements of *Profusulinella* ex gr. *rhomboides* (Lee *et* Chen)

Specimen:		92	91	20	131	RANGE	AVERAGE
	0	28	—	23	—	23–28	26
	1	—	69	60	56	56–69	62
	2	99	129	90	82	82–129	100
R.v.	3	163	215	142	145	142–215	166
	4	255	314	212	247	212–314	257
	5	383	476	365	289*	365–476	408
	6	561		544		544–561	552
	7			595*			
	1						
	2	—	87	50	46	46–87	61
G.r.	3	65	67	57	77	57–77	66
	4	56	46	49	70	46–70	55
	5	50	51	72		50–72	58
	6	46		49		46–49	48
	1	—	—	—	0.62	—	—
	2	1.14	1.20	—	1.21	1.14–1.21	1.18
F.r.	3	1.58	1.56	1.39	1.29	1.29–1.58	1.46
	4	1.73	1.73	1.68	1.59	1.59–1.73	1.68
	5	1.91	1.68	1.72	1.71*	1.68–1.91	1.77
	6	1.89		1.70		1.70–1.89	1.80
	7			1.84*			
	1	—	—	11	9	9–11	10
	2	—	—	13	13	—	13
W.th.	3	13	15	15	17	13–17	15
	4	26	17	24	21	17–26	22
	5	30	22	26	15*	22–30	26
	6	—		30		—	—
	7			24*		—	—
	2	—	30	—	27	27–30	28
	3	30	42	25	29	25–42	32
T.a.	4	23	35	31	31	23–35	30
	5	30	—	34		30–34	32
	6	35		34		34–35	34
	7			36*			
	2						
		—	0.38	—	0.29	0.29–0.38	0.33
	3	0.33	—	—	0.35	0.33–0.35	0.34
		—	0.48	0.33	0.29	0.29–0.48	0.36
Ch.h.	4	0.38	0.45	0.48	0.52	0.38–0.52	0.46
		0.33	0.42	0.39	—	0.33–0.42	0.38
	5	0.41	—	0.40		0.40–0.41	0.40
		—		0.25		—	—
	6	0.44		0.36		0.36–0.44	0.40

Table 21 Measurements of *Profusulinella* cf. *prisca* (Deprat)

Specimen:		2	122	136	27	37	RANGE	AVERAGE
	0	32	30	—	—	28	28–32	30
	1	69	67	64	60	71	60–71	66
	2	116	95	97	129	133	95–133	114
R.v.	3	212	161	163	212	204	161–212	190
	4	340	264	258	340	306	258–340	302
	5	493	374	370	510	425	370–510	436
	6	697	553	565	671•	612	553–697	607
	7					680•	—	—
	1							
		69	42	52	115	88	42–115	73
	2							
		83	69	68	64	53	53–83	67
G.r.	3							
		60	63	58	60	50	50–63	58
	4							
		45	42	47	50	39	39–50	45
	5							
		41	48	49		44	41–49	45
	6							
	1	0.75	—	—	—	—	—	—
	2	1.20	—	1.29	1.42	1.07	1.07–1.42	1.25
F.r.	3	1.24	1.32	1.35	1.56	1.08	1.08–1.56	1.31
	4	1.30	1.68	1.50	1.70	1.17	1.17–1.70	1.47
	5	1.41	1.68	1.53	1.58	1.32	1.32–1.68	1.50
	6	1.38	1.48	1.30		1.25	1.25–1.48	1.35
	7					1.47•	—	—
	1	—			—	—	—	—
	2	—			17	—	—	—
W.th.	3	21			17	—	17–21	19
	4	30			24	19	19–30	24
	5	30			28	26	26–30	28
	6	30				30	—	30
	7					26•		
	2					24	—	—
	3	23	26		28	14	14–28	23
T.a.	4	23	40	25	29	19	19–40	27
	5	33		42	39	24	24–42	34
	6	50					—	—
	7					49•		
	2							
		0.35			0.33		0.33–0.35	0.34
	3	0.36		0.33	—		0.33–0.36	0.34
		0.47		0.42	0.46		0.42–0.47	0.45
Ch.h.	4	0.56		0.40	0.39		0.39–0.56	0.45
		0.37		—	0.47	0.38	0.37–0.47	0.41
	5	0.34		0.37	0.35	—	0.34–0.37	0.35
		0.19		—		0.28	0.19–0.28	0.23
	6	0.24		0.44		0.37	0.24–0.44	0.35

Table 22 Measurements of sagittal sections of *Profusulinella* from the Piedras Luengas Limestone Member

		Sagittal sections									
Specimen:		64	15	132	36	31	79	12	68	RANGE	AVERAGE
	0	39	37	34	34	33	31	28	27	27–39	33
	1	80	80	82	82	86	67	77	73	67–86	78
	2	129	150	138	138	131	110	133	125	110–150	132
R.v.	3	209	234	232	224	211	176	232	202	176–234	215
	4	—	340	331	323	340	271	365	306	271–365	325
	5	—	536	473	476	357•	406	510	467	406–536	478
	6	718	589				550		552•	550–718	619
	7						620				
	1										
		62	87	68	68	52	65	72	71	52–87	68
	2										
		62	57	69	62	61	60	76	62	57–76	64
G.r.	3										
			48	43	44	61	53	57	53	43–61	51
	4										
			57	43	44		50	39	53	39–57	48
	5										
			34	25			35			25–35	31
	6										
	1	9	11	9	12		9	13	9	9–13	10
	2	13	13	13	14		13	15	13	13–15	13
W.th.	3	13	17	19	21		17	19	19	13–21	18
	4		26	26	24	22	26	30	24	22–30	25
	5		32	26	26		22	28	26	22–32	27
	6		22	26			17			17–26	22
	1	5	6	-	8	6	7	4	6	4–8	6
	2	10	9	11	11	12	10	9	9	9–12	10
S.c.	3	11	13	12	12	13	13	12	11	11–13	12
	4	-	13	17	17	16	14	12	14	12–17	15
	5		16	18	22		16	18	18	16–22	18
	6		20	20			17			17–20	19

Table 23 Measurements of *Profusulinella prisca* (Depr.) subsp. *guebleri* subsp. nov.

		Axial sections				Sagittal sections							
Specimen:		36	37	35	45	31	28	32	33	30	29	RANGE	AVERAGE
	0	26	26	—	19	30	—	24	23	23	22	19–30	24
	1	71	62	56	47	77	67	63	49	54	58	47–77	60
	2	119	99	98	80	119	116	107	97	90	99	80–119	102
R.v.	3	204	153	166	133	195	187	185	161	153	153	133–204	169
	4	331	263	276	236	302	289	289	268	255	251	236–331	276
	5	501	408	442	387	459	455	467	425	400	391	387–501	433
	6	722	599	663	608	552•	663	714	637	620	591	591–722	646
	7		833	790•			731•		756•	761•		——	—
	1												
	2	68	59	75	68	55	74	69	96	67	71	55–96	70
	3	71	55	70	68	64	61	72	66	70	55	55–72	65
G.r.	4	63	72	67	77	54	55	56	66	67	64	54–77	64
	5	51	55	60	64	52	57	62	59	57	56	51–64	57
	6	44	47	50	57		46	53	50	55	51	44–57	50
	7		39								—	—	—
	1	—	0.52	—	0.50							0.50–0.52	0.51
	2	1.14	—	1.00	1.00							1.00–1.14	1.05
	3	1.08	1.28	1.28	1.52							1.08–1.52	1.29
F.r.	4	1.23	1.42	1.32	1.33							1.23–1.42	1.33
	5	1.46	1.44	1.35	1.45							1.35–1.46	1.43
	6	1.39	1.55	1.29	1.43							1.29–1.55	1.42
	7		—									——	—
	1	11	7	8	5	8	-	6	6	8	6	5–11	7
	2	13	12	13	11	11	12	11	11	9	12	9–13	11
	3	21	20	19	15	17	13	15	12	13	15	12–21	16
W.th.	4	34	27	26	21	30	22	29	18	23	19	18–34	25
	5	34	31	42	26	32	38	33	30	32	30	26–42	33
	6	43	43	33	28•	—	45	45	34	34	34	33–45	39
	7		32	37•							25	25–32	28
	1					—	—	6	—	—	—	—	—
	2					13	—	—	—	—	—	—	—
	3					14	13	11	13	11	12	11–14	12
S.c.	4					14	14	15	15	13	16	13–16	14
	5					18	20	18	19	15	18	15–20	18
	6						24	21	21	19	26	19–26	22
	7									25			
	2	0.27	0.38									0.27–0.38	0.32
		0.33	0.40	0.38								0.33–0.40	0.37
	3	0.28	—	0.36	0.29							0.28–0.36	0.31
		0.37	0.27	0.46	—							0.27–0.46	0.37
Ch.h.	4	0.40	—	—	0.54							0.40–0.54	0.47
		—	0.45	0.40	—							0.40–0.45	0.42
	5	0.51	0.44	0.21	0.39							0.21–0.51	0.39
		0.33	0.44	0.40	0.33							0.33–0.44	0.37
	6	0.31	0.47	0.28	0.26							0.26–0.47	0.33
			0.42	0.26								0.62–0.42	0.34
	7												

Table 24 Measurements of *Profusulinella prisca* (Depr.) subsp. *rauserae* subsp. nov.

		Axial sections								Sag. sect.				
Specimen:		34	9	32	31	5	8	16	42	25	7	10	RANGE	AVERAGE
	0	21	21	—	—	—	16	16	14	—	21	17	14–21	18
	1	52	41	52	43	39	37	37	37	47	47	47	37–52	44
	2	99	64	86	90	77	64	58	60	77	73	82	58–99	75
R.v.	3	146	120	142	150	116	116	95	112	112	140	138	95–150	126
	4	229	183	238	238	187	170	142	179	206		230	142–238	200
	5	348	289	370	357	297	255	181•	259	331		297•	255–370	313
	6	510	408	544	518	442	374		374				374–544	453
	7	578•	—		569•	544•	472•		438•				——	—
	1													
	2	92	58	67	110	100	76	58	65	64	55	73	55–110	74
G.r.	3	48	87	65	67	50	80	63	63	44	91	68	44–91	66
	4	57	52	68	59	61	47	50	53	85		67	47–85	60
	5	52	58	55	50	59	50		50	61			50–61	54
	6	46	41	47	45	49	47		40				40–49	45
	2	0.61	—	1.07	—	0.78	—	—	1.00				0.78–1.07	0.87
	3	1.06	1.00	1.06	0.99	1.00	0.93	—	1.00				0.93–1.06	1.01
F.r.	4	1.15	1.12	1.18	1.11	1.09	1.20	1.06	1.25				1.06–1.25	1.15
	5	1.12	1.21	1.40	1.19	1.17	1.47	1.10•	1.19				1.12–1.47	1.25
	6	1.18	1.23	1.25	1.28	1.12	1.32		1.25•				1.12–1.32	1.23
	7	1.22•	—		—•	1.13•	1.33•						——	—
	1	6	6	9	4	6	4	6	7				4–9	6
	2	11	9	11	6	9	6	7	10				6–11	9
	3	13	11	17	11	13	9	9	14				9–17	12
W.th.	4	21	17	21	19	17	13	10	18				10–21	17
	5	22	21	26	30	17	21		—				17–30	23
	6	24	28	26	—	21	24		25				21–28	25
	7	28•	28•		22•	28•	28•						——	—
	1									—		5		
	2									—		11		
S.c.	3									13		12		
	4									14		15		
	5									16				
	3	14	12	17	19	16	—	—	—				12–19	16
	4	11	22	27	17	14	22	19	13				11–27	18
	5	15	22	15	12	20	16		17				12–22	17
	6	15	26	15	23	16	21		17				15–26	19
	7		25										——	—
	2				0.30	0.38							0.30–0.38	0.34
	3		0.43		0.37	—							0.37–0.43	0.40
			0.46	0.30	—	—	0.33	0.30	0.38				0.30–0.46	0.35
Ch.h.	4	0.45	—	0.28	—	—	—	0.42	—				0.28–0.45	0.38
		—	—	0.38	0.33	0.38	0.36	0.35	0.35				0.33–0.38	0.36
	5	0.38	0.38	0.37	0.47	0.38	0.27		—				0.27–0.47	0.37
		0.45	0.42		0.43	0.48	0.40		0.38				0.38–0.48	0.43
	6	—	0.46		0.33		0.32		0.45				0.32–0.46	0.39
		0.50	0.37				0.25		0.30				0.25–0.50	0.35
	7													

Table 25 Measurements of *Profusulinella albasensis* sp. nov.

		Axial sections									Sagittal sections					
Specimen:		39	38	1	19	7	33	29	24	12	10	37	36	4	RANGE	AVERAGE
R.v.	0	31	29	23	23	23	22	--	--	21	33	28	27	24	21–33	26
	1	67	58	66	62	47	52	52	49	69	72	62	69	58	47–72	60
	2	112	97	110	90	77	86	86	77	112	125	119	123	86	77–125	100
	3	187	176	177	159	138	166	150	138	193	199	212	207	138	138–212	172
	4	272	289	280	258	241	275	245	215	301	309	348	357	218	215–357	278
	5	374	442	410	391	366	416	374	340	434	408•	527	518	328	328–527	410
	6	531	595	565	561		578	569	450			744	629•	475	450–744	563
	7	654•			680•		714•	782	578					679	578–782	680
	8								713•							
G.r.	1															
	2	68	67	67	45	64	65	65	57	62	78	92	78	47	45–92	66
	3	67	82	61	77	79	93	74	79	72	59	79	68	60	59–93	73
	4	45	64	58	62	75	66	63	56	56	55	64	75	58	45–75	61
	5	38	53	46	52	52	51	53	58	44		51	45	50	38–58	49
	6	42	35	38	43		39	52	32			41		45	32–52	41
	7							37	28					43	28–43	36
F.r.	1	--	--	--	0.52	0.50	0.58	--	--	--					0.50–0.58	0.53
	2	1.12	1.11	--	0.95	1.00	0.95	1.03	--	1.06					0.95–1.12	1.03
	3	1.32	1.41	1.33	1.30	1.31	1.25	1.17	1.05	1.19					1.05–1.41	1.26
	4	1.38	1.65	1.62	1.43	1.30	1.51	1.36	1.22	1.36					1.22–1.65	1.43
	5	1.50	1.62	1.81	1.48	1.33	1.51	1.41	1.24	1.45					1.24–1.81	1.48
	6	--	1.59		1.44		1.44	1.52	1.49						1.44–1.59	1.50
	7				1.45•		1.37•	1.57	1.41						1.41–1.57	1.49
	8								1.31•							
W.th.	1	9	9	11	8	-	9	-	-	6	10	9	11		6–11	9
	2	-	12	13	-	9	11	6	-	11	19	19	19		6–19	13
	3	21	17	15	17	13	19	11	-	15	23	26	25		11–26	18
	4	26	29	17	-	19	24	-	-	17	-	31	41		17–41	25
	5	25	27	26	26	26	-	-	17	17	-	35	57		17–57	28
	6	31	19	32	30		26	24	-			28			19–32	27
	7								24							
	8								14•							
T.a.	2	-	-	18	-	-	-	-	-	14					14–18	16
	3	15	-	20	22	20	21	22	19	18					15–22	20
	4	17	22	21	24	20	20	22	17	28					17–28	21
	5	18	22	29	23	21	20	25	23	24					18–29	23
	6	27	29	27	29		32	-	-						27–32	29
	7							-								
S.c.	1										5	-	-	-	---	--
	2										12	9	10	-	9–12	10
	3										14	12	14	11	11–14	13
	4										19	15	17	16	15–19	17
	5										-	19	20	16	16–20	18
	6											21		18	18–21	19.5
	7													22		
Ch.h.	2			0.31												
		0.33	0.37	0.34	0.35	0.33	0.40	0.38	--	--					0.33–0.40	0.36
	3	0.42	0.46	0.47	--	0.35	--	--	--	0.30					0.30–0.47	0.40
		--	--	0.48	0.39	0.30	0.43	0.40	0.43	0.40					0.30–0.48	0.40
	4	0.44	0.38	0.45	--	0.48	0.48	0.38	--	--					0.38–0.48	0.43
		0.47	--	0.47	0.33	0.31	0.33	--	0.31	0.40					0.31–0.47	0.37
	5	--	0.56	0.38	0.31	0.36	0.41	0.36	0.44	--					0.31–0.56	0.40
		0.26	--	--	--		0.35	0.25	0.34						0.25–0.35	0.30
	6	0.39	0.26	0.28	0.45		0.59								0.26–0.59	0.39
							0.36	0.51	0.40						0.36–0.51	0.42
	7								0.46							

Table 26 Measurements of *Aljutovella wagneri* sp. nov.

	Sagittal sections														
	8(1)	9	22(1)	15	22(2)	19(1)	6	26	19(2)	32	25	8(2)	24	RANGE	AVERAGE
	58	49	49	43	41	41	40	40	40	39	39	39	37	37–58	43
	129	116	108	112	95	90	103	88	88	107	99	92	96	88–129	102
	212	224	198	209	209	181	198	170	150	198	193	181	172	150–224	192
	357	374	289	357	357	323	353	289	258	348	323	319	272	258–374	325
			442	527	544	518	527	442	374	510	489	476	370	370–544	474
										646•		629•		---	--
	64	93	84	87	120	100	92	93	71	84	96	97	80	64–120	89
	68	67	46	71	71	78	78	70	71	76	67	76	58	58–78	69
			53	48	52	61	49	53	45	46	51	49	38	36–61	49
	16	14	11	13	12	13	10	13	9	13	13	10	17	9–17	13
	14	17	16	13	21	17	17	16	13	18	19	14	21	13–21	17
	19	22	23	15	23	25	21	22	16	21	19	19	18	15–25	20
	17•		18		23	-	19	23	17	20		24	13	13–24	19
										23•		19•			
S.o. 1	9	7	8	8	8	8	7	8	9	9	7	6	7	6–9	8
2	15	14	15	13	15	11	13	11	12	13	12	11	14	11–15	13
3	19	18	16	18	16	14	16	14	14	16	15	15	15	14–19	16
4	-		21	24	21	19	20	20	20	22	-	23	20	19–24	21

Table 26 Measurements of *Aljutovella wagneri* sp. nov.

		Axial sections																						
Specimen:		18	22(3)	29	27	33	23	34	16	21(1)	19(3)	20	3	1	26	7	12(1)	12(2)	2	4	22(4)	21(2)	RANGE	AVERAGE
	0	55	54	52	52	49	48	47	46	43	43	—	42	42	—	40	39	38	38	33	32	27	27–55	43
	1	103	103	99	119	82	107	82	95	82	77	77	77	90	86	77	107	80	98	82	73	69	69–119	89
	2	187	204	185	251	150	204	142	183	161	146	153	150	159	170	162	200	168	190	149	133	138	133–251	171
R.v.	3	319	340	306	425	255	348	255	331	289	263	255	238	251	289	302	336	289	320	255	238	238	238–425	292
	4	484	459•	459	510•	391	527	425	416•	459	408	421	382	374	450	459	493	433	510	438	391	289•	374–527	441
	5			620						527•	527	523•	501•		544•	484•	710			493•	612		527–710	617
	1	82	98	87	111	84	91	74	92	96	89	97	94	77	98	110	87	111	94	82	82	100	74–111	93
	2	70	67	65	69	70	71	80	81	80	80	67	59	58	70	86	68	72	68	71	79	72	58–86	72
G.r.	3	52		50		53	51	67		59	55	65	61	49	56	52	47	50	59	72	64		47–72	57
	4			35							29						44				57		29–57	41
	5																							
	1	1.25	1.15	1.30	1.14	1.11	1.12	1.08	1.09	1.05	1.14	1.06	1.17	0.95	0.95	1.19	1.20	1.05	1.04	0.95	1.31	1.00	0.95–1.31	1.11
	2	1.73	1.46	1.37	1.19	1.43	1.58	1.58	1.44	1.32	1.47	1.23	1.36	1.51	1.45	1.68	1.53	1.54	1.58	1.37	1.55	1.50	1.19–1.73	1.47
F.r.	3	2.13	1.60	1.89	1.76	1.58	1.90	1.87	1.85	1.68	1.74	1.50	1.75	1.90	1.74	1.92	1.67	2.24	1.74	1.83	1.82	1.46	1.46–2.24	1.79
	4	2.04	1.61•	2.11	1.80•	1.80	2.00	1.84	1.71•	2.06	1.71	1.86	2.09	2.23	1.92	2.02	1.86	2.37	1.90	1.88	2.02		1.71–2.37	1.98
	5			2.05						1.95•	—	1.89•	2.02•		1.97•	2.14•	1.72			1.93•			1.72–2.05	1.88
	1	13	15	9	16	12	16	13	15	8	9	9	13	14	13	13	15	9	14	9	10	9	8–16	12
	2	-	21	17	24	17	30	15	21	26	17	15	17	15	17	15	22	21	14	17	17	13	13–30	19
W.th.	3	19	24	21	28	24	29	19	21	22	23	24	21	19	24	19	26	19	23	27	21	17	17–29	22
	4	-		22		30	26			32	21	-	22	-	25		22	-	18	32	26		18–32	25
	5			-						-	22						26				-		22–26	24
	1	-	25	27	-	25	23	25	-	20	24	18	27		-	30	20	-		30	-	-	18–30	24
	2	32	30	30	38	26	30	36	43	25	31	34	35		33	38	21	35		36	23	21	21–43	31
T.a.	3	40	29	46	45	44	43	38	35	33	43	34	36		36	46	30	37		38	35	26	26–46	38
	4	59	-	44		46		56	-	47	50	32	44		40	62	38	53		47	42		32–62	47
	5			-						58							-				-		—	—
	1	0.45	0.45	0.40		0.30	0.40		0.30	0.40	0.25		0.33	0.23		0.38			0.38	0.41		0.36	0.23–0.45	0.36
		—	—	0.40		0.34	—	0.31	0.39	0.43	0.24	0.30	0.42	0.38	0.29	0.28		0.43	—	—	0.32	—	0.24–0.43	0.35
	2	—	0.30	0.40		0.44	0.39	0.47	0.46	—	0.28	0.37	—	0.41	0.41	0.45	0.54	0.33	0.41	0.39	0.43	0.43	0.28–0.54	0.41
		—	—	0.42	0.40	0.44	—	0.35	0.48	0.40	—	0.39	0.44	—	0.28	—	0.56	0.24	0.40	—	0.44	0.43	0.24–0.56	0.40
Ch.h.	3	0.53	0.39	0.35	0.34	0.32	0.46		0.47	0.38	0.43	0.26	0.43	0.54	—	0.31	0.36	0.50	—	—	—	0.54	0.26–0.54	0.41
		0.36		—	0.36	0.40	0.49		0.35	0.46	—	—	0.47		0.49	0.44	—	—	0.46	—	—	0.54	0.35–0.54	0.44
	4	0.19		0.45		0.25				0.33	0.19	0.39	0.29		0.19	0.28	0.50	0.43	0.38	0.44	0.48		0.19–0.50	0.34
										0.40	0.35		0.27		0.40	0.25			0.29	0.37	0.38		0.25–0.40	0.34
	5																—							

Table 27 Measurements of *Hemifusulina* ex gr. *moelleri* Rauser-Chernoussova (1st assemblage)

Axial sections

Specimen:		14	15	9	1(2)	4	10	11	1	RANGE	AVERAGE
	0	51	48	48	44	44	41	38	32	32–51	43
	1	108	79	76	89	76	89	58	53	53–108	79
	2	180	130	146	133	152	140	100	108	100–180	136
R.v.	3	281	210	254	241	229	216	160	177	160–281	221
	4	382	301	—	349	330	—	227	267	227–382	309
	5	—	422	—	476	445	—	318	368	318–476	406
	6						—	404	—	—	—
	7										
	1	67	65	92	50	100	57	72	104	50–104	76
	2	56	62	74	81	50	55	60	64	50–81	63
G.r.	3	36	43		45	44		42	51	36–51	44
	4		40		36	35		40	38	35–40	38
	5							27		—	—
	6										
	1	1.67	2.19	2.11	1.67	2.60	1.67	1.66	—	1.66–2.60	1.94
	2	2.22	2.46	2.97	2.23	2.11	1.77	2.47	2.80	1.77–2.97	2.38
F.r.	3	2.67	2.79	2.97	2.15	2.27	2.29	2.66	2.59	2.15–2.97	2.55
	4	2.84	3.09		—	2.70		2.67	2.77	2.67–3.09	2.81
	5		3.23		2.83	3.06		2.86	3.15	2.83–3.23	3.03
	6								3.07*	—	—
	1	-	-	14	14	-	-	-	-	—	14
	2	10	-	10	26	-	15	-	-	10–26	15
W.th.	3	14	10	17	29	12	20	14	10	10–29	16
	4	12	15	17	20	17	20	15	17	12–20	17
	5	20	14	15	19		20	14	14	14–20	17
	6		15				15		22	15–22	17
	1		-	-	-	-	-	-	47	—	—
	2		54	46	25	40	-	50	39	25–54	42
T.a.	3		47	-	34	42	42	46	49	34–49	43
	4		57	-	47	44	51	46	55	44–57	50
	5		67	-	-	-	42	53	48	42–67	53
	6						47			—	—
	1										
	2										
S.c.	3										
	4										
	5										
	6										
	1									—	—
				0.25		0.31				0.25–0.31	0.28
	2	0.31		—		0.45		0.29		0.29–0.45	0.35
		—		—	0.50	—	0.36	—		0.36–0.50	0.42
Ch.h.	3	0.24	0.33	0.38	—	0.71	0.33	0.40	0.35	0.24–0.71	0.39
		—	—		0.35	0.46	—	—	—	0.35–0.46	0.40
	4	0.25	0.54		—	—	0.43	0.33	0.46	0.25–0.54	0.40
	5	0.10	0.47		abs.	abs.	0.10	0.31	0.43	0.00–0.47	0.20
			—		0.10		0.44	—	—	0.10–0.44	0.27
	6		0.10				0.24	0.05	0.10	0.05–0.24	0.12

Sagittal sections

Specimen:		18(1)	16	12(2)	18(2)	12(1)	17	12	12(3)	13	18(3)	RANGE	AVERAGE
	0	63	51	44	44	44	38	35	35	32	29	29–63	42
	1	108	83	89	83	76	64	76	70	76	70	64–108	80
	2	197	140	152	133	114	108	133	127	114	127	108–197	135
R.v.	3	292	210	267	229	191	159	203	191	165	203	159–292	211
	4		318	362	343	292	248	311	260	229	305	229–362	296
	5		—	527	—		330	445	—	298	464	298–527	413
	6			—						375	—	—	—
	7									—		—	—
	1	82	69	71	62	50	70	75	82	50	82	50–82	69
	2	48	50	75	71	67	47	52	50	44	60	44–75	56
G.r.	3		52	36	50	53	56	53	37	38	50	36–56	47
	4			46			33	43		31	52	31–52	41
	5									26		—	—
	6												
	1												
	2												
F.r.	3												
	4												
	5												
	6												
	1	7	9		-	-	7	5	-	12	-	5–12	8
	2	10	10		9	9	7	9	9	9	10	7–10	9
W.th.	3	15	14		15	10	12	12	15	10	14	10–15	13
	4	19*	15		17	14	12	15	10	9	15	9–17	13
	5		17		19		14	17	14	9	-	9–19	15
	6									14*	22	—	—
	1												
	2												
T.a.	3												
	4												
	5												
	6												
	1	7	7	6	6	-	6	6	6	-	-	6–7	6
	2	10	9	9	-	-	8	9	9	-	-	8–10	9
S.c.	3	13	12	13	12	14	10	12	11	10	12	10–14	12
	4		14	17	16	14	13	16	13	15	15	13–17	15
	5		-	-	-		18	17	-	17	20	17–20	18
	6			-						17	17	—	17

Table 28 Measurements of *Hemifusulina* ex gr. *moelleri*. Rauser-Chernoussova (2nd assemblage)

Specimen:		14	11	3	5	2	9	10	23	13	RANGE	AVERAGE
		Axial sections						Sagittal sections				
R.v.	0	47	46	—	44	44	41	43	40	34	34–47	42
	1	86	82	—	77	67	95	90	86	77	67–95	82
	2	144	125	153	123	112	166	155	141	124	112–166	138
	3	213	202	255	215	192	246	238	232	202	192–255	222
	4	290	289	370	306	297	349	357	340	277	277–370	319
	5	384	382	476	442	425	459	501	493	357	357–501	435
	6	540	476	561•	574	578	629	612	535•	476	476–629	555
	7		557•		637•	—	816	782		637	637–816	745
	8									—•	——	—
G.r.	1	64	53	-	58	68	75	71	64	60	53–75	64
	2	51	62	67	75	72	48	54	65	63	48–75	62
	3	36	43	45	42	55	41	50	47	37	36–55	44
	4	32	32	29	44	43	32	40	45	29	29–45	36
	5	41	24		30	36	37	22		33	22–41	32
	6					-	30	28		34	28–34	31
	7											
F.r.	1	1.33	0.91	—	1.25	1.23	1.18				0.91–1.33	1.18
	2	1.67	1.38	1.35	1.86	1.58	1.77				1.35–1.86	1.60
	3	2.00	1.89	1.80	2.13	1.94	2.21				1.80–2.21	2.00
	4	2.25	2.29	2.30	2.50	2.69	2.73				2.25–2.73	2.46
	5	2.49	2.51	2.88	2.69	3.16	3.28				2.49–3.28	2.84
	6	2.83	2.79	3.18•	2.79	3.15	3.51				2.79–3.51	3.01
	7		3.05•		2.99•		3.27				——	—
W.th.	1	13	9	-	9	9	-	8	9	9	8–13	9
	2	13	8	-	13	13	17	10	12	13	8–17	12
	3	16	21	18	16	17	14	13	15	13	13–21	16
	4	16	16	15	24	21	16	19	17	20	15–24	18
	5	26	24	19	23	20	19	24	23	15	15–26	21
	6	17	26	17•	18	23	29	21	16•	18	17–29	22
	7		19•		-•	24•	17	23		27	17–27	22
	8									24•	——	—
T.a.	1	14	15	-	21	-	17				14–21	17
	2	25	39	20	23	22	33				20–39	27
	3	36	40	32	33	29	37				29–40	34
	4	31	46	43	47	44	47				31–47	43
	5	44	45	51	43	57	54				43–57	49
	6	52	56		-	39	71				39–71	54
	7						-				——	—
S.c.	1							9	8	7	7–9	8
	2							12	11	12	11–12	12
	3							13	15	13	13–15	14
	4							17	19	18	17–19	18
	5							19	21	21	19–21	20
	6							22		24	22–24	23
	7							22		26	22–26	24
Ch.h.	0.5	0.17		0.25	0.28		0.34				0.17–0.34	0.26
	1	—		—	0.30	0.17	—				0.17–0.30	0.23
		0.39	0.24	0.33	0.30	0.26	—				0.24–0.39	0.30
	2	—	0.37	—	0.37	0.37	0.31				0.31–0.37	0.35
		0.42	0.39	0.40	0.46	0.39	0.62				0.39–0.62	0.45
	3	0.37	0.30	0.46	—	0.28	0.40				0.28–0.46	0.36
		0.37	0.36	0.41	0.39	0.48	0.47				0.36–0.48	0.41
	4	0.47	0.44	—	0.42	0.24	0.38				0.24–0.47	0.39
		0.51	0.49	—	0.37	—	0.31				0.31–0.51	0.42
	5	0.21	—	0.28	0.36	0.35	0.35				0.21–0.36	0.31
		0.51	0.39	abs.	0.23	0.35	—				0.00–0.51	0.30
	6	abs.			0.24	0.42	—				0.00–0.42	0.33
					abs.	abs.	abs.				——	0.00
	7											

Table 29 Measurements of *Beedeina bona* (Chern. *et* Raus.) subsp. *lenaensis* subsp. nov.

Specimen:		51(1)	29(1)	17	29(2)	42	62	27	41	59	58	23	51(2)	RANGE	AVERAGE
		Axial sections													
R.v.	0	72	72	71	71	—	66	58	54	52	51	43	—	43–72	61
	1	157	153	161	153	170	142	119	120	121	107	86	85	85–170	131
	2	238	238	272	255	306	255	230	204	215	193	153	177	153–306	228
	3	357	382	425	408	459	408	357	323	340	310	255	289	255–459	359
	4	561		697	646	731	569	544	434•	537	459	442	442	442–731	563
	5	697•		765•	——	850•		782		835	629	688	697	629–835	726
	6												—•	——	—
G.r.	1	51	56	68	67	80	80	93	70	78	80	78	110	51–110	76
	2	50	61	56	60	50	60	56	58	58	61	67	62	50–67	58
	3	57		64	58	59	40	52		58	48	73	53	40–73	56
	4							44		55	37	56	58	37–58	50
	5														
F.r.	1	1.35	1.11	1.11	1.50	1.50	1.45	1.50	1.39	1.11	1.00	0.95	1.30	0.95–1.50	1.27
	2	1.86	1.43	1.78	1.63	1.56	1.63	1.52	1.83	1.37	1.24	1.44	1.33	1.24–1.86	1.55
	3	2.00	1.36	2.08	1.92	1.78	1.83	1.62	1.84	1.51	1.48	1.70	1.47	1.36–2.08	1.72
	4	2.03		1.83	1.84	1.65	2.03	1.63		1.63	1.83	1.75	1.75	1.63–2.03	1.80
	5	1.93•		2.09•	——	1.74•		1.63		1.56	2.11	1.95	1.73	1.56–2.11	1.80
W.th.	1	—			—	—	21	—	21	16	13	13	—	13–21	17
	2	22			—	—	22	32	24	24	—	24	24	22–32	25
	3	26			—	—	39	26	22	32	32	30	39	22–39	31
	4	26			34	32	24	28	17•	41	26	24	41	24–41	31
	5	24:			34•			—		26	24	26	39	24–39	29
T.a.	1	16		15	17	11	12	15		22	—	20	—	11–22	16
	2	18		17	18	12	10	16		14	13	18	21	10–21	16
	3	19		20	24	23	17	18		23	11	21	17	11–24	19
	4	26		26	29	28	25	20		25	19	26	25	19–29	25
	5				—			25		40	44	38	23	23–44	34
Ch.h.	0,5						0.51				0.36			0.36–0.51	0.43
	1						0.55				0.45			0.45–0.55	0.50
							0.52				0.52			——	0.52
	2						0.48					0.47		0.47–0.48	0.47
				0.47			0.55				0.62			0.47–0.62	0.55
	3		0.46		0.44		0.37	0.44		0.42	0.49		0.37	0.37–0.49	0.43
		0.57		0.53	0.51		0.47	0.41		0.48	0.53			0.41–0.57	0.49
	4	0.47					0.53			0.31	0.47	0.35	0.32	0.31–0.53	0.41
		0.38			0.43	0.39		0.32		0.55	0.50			0.32–0.55	0.43
	5									0.15	0.28		0.47	0.15–0.47	0.30

Table 30 Measurements of *Beedeina corisaensis* sp. nov.

		Axial sections						Sagittal sections					
Specimen:		2	4	3	8	14	10	1	13	5	11	RANGE	AVERAGE
	0	109	106	98	89	85	76	70	119	98	64	64–119	91
	1	187	195	170	166	149	136	170	221	195	119	119–221	171
	2	306	289	255	289	238	221	302	344	314	204	204–344	276
	3	442	459	391	433	357	323	425	506	442	340	323–506	412
R.v.	4	620	663	578	595	510	459	586	671	625	399	399–671	571
	5	833	892	816	829	697	646	761	867	799	663	646–892	780
	6	1088	1122	1045	1088	901	901	986	1045•	935•	867	867–1122	1000
	7	1207•	1258•	1156•	----	1122	1122				---	-----	1122
	8					1241•						-----	----
	1	64	48	50	74	60	63	78	56	61	71	48–78	62
	2	44	59	53	50	50	46	41	47	41	67	41–67	50
	3	40	44	48	37	43	42	38	33	41	44	33–48	41
G.r.	4	34	35	41	39	37	41	30	29	28	36	28–41	35
	5	31	26	28	31	29	39	30			31	26–39	31
	6					25	25					---	25
	7												
	1	1.45	1.30	1.50	1.59	1.48	1.31	1.30				1.30–1.59	1.42
	2	1.50	1.50	1.70	1.74	1.75	1.46	1.41				1.41–1.75	1.58
	3	1.69	1.59	1.78	1.84	1.74	1.58	1.48				1.48–1.84	1.67
F.r.	4	1.89	1.51	1.97	1.97	1.77	1.76	1.62				1.51–1.97	1.78
	5	2.14	1.66	1.93	1.89	1.83	1.84	1.79				1.66–2.14	1.87
	6	2.11	1.82	1.90	2.03	1.92	1.85	2.21				1.82–2.21	1.98
	7	2.22•	1.95•	2.02•		2.02	1.95					1.95–2.02	1.99
	8			1.97•								-----	----
	1	17	—	17	26	—	20	—	25	19	18	17–26	20
	2	—	—	—	37	26	20	30	32	30	22	20–37	28
	3	30	—	26	41	26	30	43	34	39	—	26–43	34
W.th.	4	40	37	33	45	30	39	43	43	41	—	30–49	39
	5	34	43	47	49	34	45	47	30	43	34	30–49	41
	6	34	41	43	56	43	—	—	34•	28•		34–56	43
	7	30•	30•	47•	—	42	32					32–42	37
	8					39•						---	--
	1								9	8	10	8–10	9
	2								18	13	14	13–18	15
S.c.	3								20	19	19	19–20	19
	4								26	25	23	23–26	25
	5								—	27	29	27–29	28
	6										—	---	--
	1	9	12	18	11	17	8	14				8–18	13
	2	17	9	16	14	16	11	17				9–17	14
T.a.	3	19	13	19	15	16	11	15				11–19	15
	4	19	17	21	17	18	22	21				17–22	19
	5	20	14	21	—	25	26	21				14–26	21
	6	20	23	21	—	19	27	21				19–27	22
	0.5			0.40	0.50							0.40–0.50	0.45
	1	0.53	0.47	0.44	—							0.44–0.53	0.48
		—	—	0.43	0.50	0.55		0.46				0.43–0.55	0.48
	2	0.64	0.44	0.44	—	0.54	0.53	—				0.44–0.64	0.52
		—	—	—	—	—	—	—					
Ch.h.	3	0.59	—	—	0.47	0.48	0.46	0.50				0.46–0.59	0.50
		—	0.55	0.50	0.50	—	—	0.59				0.50–0.59	0.53
	4	0.64	0.69	0.55	—	0.40	—	0.55				0.40–0.69	0.56
		—	—	C.51	0.23	0.55	0.63	0.57				0.23–0.63	0.50
	5	0.45	—	—		0.46	0.44	0.50				0.44–0.50	0.46
		0.32	0.36	—		0.65	0.43					0.32–0.65	0.44
	6	0.37	0.37	0.29								0.29–0.37	0.34
			0.43									-----	----
	7												

Table 31 Measurements of *Beedeina* ex gr. *rauserae* (Chernova)

		Ax. sect.			Sag. sect.					
Specimen:		2	3	7	5	6	4	1	RANGE	AVERAGE
	0	108	94	191	161	153	140	123	94–191	139
	1	187	170	340	306	314	272	251	170–340	263
	2	314	280	493	459	480	442	382	280–493	407
R.v.	3	476	452	714	680	680	646	552	452–714	600
	4	663	688	1011	935	969		756	663–1011	837
	5	714•	875•	1275	1209			1003	1003–1275	1162
	6							1209•		
	1	68	65	45	50	53	62	53	45–68	57
	2	51	61	45	48	42	46	44	42–61	48
G.r.	3	39	53	42	38	42		37	37–53	42
	4			26				33	26–33	29
	5									
	1	1.36	1.45							1.41
	2	1.68	1.82							1.75
F.r.	3	2.43	2.17							2.30
	4	3.00	2.46							2.73
	5	3.75•	2.69•							----
	1	21	17	19	21	29	26	23	17–29	22
	2	41	28	28	22	30	23	26	22–41	28
W.th.	3	41	37	37	35	43	24	34	24–43	36
	4	47	49	54	56	33		39	33–54	46
	5	47•	54•	49	34			47	34–47	43
	6							39•	---	--
	1			12	10	8	9	10	8–12	10
	2			24	22	22	23	22	22–24	23
S.c.	3			28	29	26	27	26	26–29	27
	4			32	35	32		33	32–35	33
	5			36	37			35	35–37	36

Table 32 Measurements of *Beedeina?* ex gr. *ozawai* (Rauser-Chernoussova *et* Beljaev)

	Specimen:	1	3	6	2	RANGE	AVERAGE	11	14	12	4	21	8	13	5	RANGE	AVERAGE
		Axial sections						Sagittal sections									
	0	140	138	130	100	100–140	127	181	172	161	155	144	140	127	123	123–181	150
	1	280	204	221	178	178–280	221	323	391	306	306	272	263	238	238	238–391	292
	2	497	306	353	289	289–497	361	493	544	476	459	408	382	357	408	357–544	441
R.v.	3	717	501	510	455	455–717	546	693	761	714	680	578	561	544	595	544–761	641
	4	943	714	612•	612	612–943	756	952	969	960	986	825	790	778	816	778–986	884
	5	1045•	1020			-----	---	1113•	1088•			1037	935•	986•	1088	1037–1088	1063
	6														1343•	-----	----
	1																
	2	77	50	60	62	50–77	62	53	39	56	50	67	45	50	71	39–71	54
G.r.	3	44	64	45	57	44–64	52	41	40	50	48	42	47	48	46	40–50	45
	4	32	42		35	32–42	36	37	27	35	45	43	41	43	37	27–45	38
	5		43		35	35–43	39					26		27	33	26–33	29
	1	1.32	1.50	1.42	1.10	1.10–1.50	1.34										
	2	1.70	2.00	2.07	1.74	1.70–2.07	1.88										
F.r.	3	2.03	2.34	3.00	2.19	2.03–3.00	2.39										
	4	2.36	2.71	3.00•	2.79	2.36–2.79	2.62										
	5	2.83•	2.90		3.34	2.90–3.34	3.12										
	1	25	23	31	19	19–31	25	22	27	31	32	19	17	24	—	17–32	25
	2	36	23	32	24	23–36	29	27	33	38	32	22	23	27	—	22–38	29
W.th.	3	40	28	30	31	28–40	32	28	35	35	32	26	26	27	28	26–35	30
	4	45	45	30•	29	29–45	40	38	46	31	30	28	37	41	39	28–46	36
	5				30	----	--		30•			37	31•	25	52	25–52	38
	1	18	21	—	—	18–21	19										
	2	26	19	16	21	16–26	20										
T.a.	3	23	24	27	25	23–27	25										
	4	29	34		—	29–34	31										
	5	29	44		—	29–44	36										
	0.5	0.46				-----	--										
	1	0.59	0.55		0.47	0.47–0.59	0.54										
		0.47	—	0.64	0.43	0.43–0.64	0.51										
	2	0.44	0.57	0.51	0.51	0.44–0.57	0.51										
		0.42	—	—	0.62	0.42–0.62	0.52										
Ch.h.	3	—	—	0.36	0.45	0.36–0.45	0.40										
		0.37	0.62	0.30	0.42	0.30–0.62	0.43										
	4	0.44	0.55		—	0.44–0.55	0.49										
		0.37	—		0.33	0.33–0.37	0.35										
	5		0.23			-----	----										
	1							8	11	9	10	9	7	-	8	7–11	9
	2							20	24	23	20	21	17	20	20	17–24	21
S.c.	3							25	28	32	27	27	22	22	22	22–32	26
	4							27	34	30	27	30	29	26	30	26–34	29
	5											36		31	35	31–36	34

Table 33 Measurements of *Beedeina?* ex gr. *acuta* (Lee)

	Specimen:	22	15	16	19	RANGE	AVERAGE
		Ax. sect.			Sag. sect.		
	0	138	128	119	111	111–138	124
	1	225	204	204	204	204–225	209
	2	328	306	276	323	276–328	308
R.v.	3	469	408	382	484	382–484	436
	4	645	574	527	680	527–680	607
	5	850	782	697	850	697–850	795
	6	980•	994	875	---	875–994	934
	7		1139•	1118•		-----	---
	1						
	2	46	50	35	58	35–58	47
G.r.	3	43	33	38	50	33–50	41
	4	38	41	38	40	38–41	39
	5	32	36	32	25	25–36	31
	6		27	26		26–27	27
	1	1.53	1.46	1.29		1.29–1.53	1.43
	2	2.10	1.81	1.82		1.81–2.10	1.91
	3	2.30	2.40	2.34		2.30–2.40	2.35
F.r.	4	2.49	2.47	2.48		2.47–2.49	2.48
	5	2.91	3.13	3.05		2.91–3.13	3.03
	6	2.92•	3.00	3.76			
	7		3.02•	3.16•			
	1	15	18	26	19	15–26	19
	2	20	21	27	23	20–27	23
W.th.	3	31	26	30	27	26–31	28
	4	29	31	28	45	28–45	33
	5	28	43	41	43	28–43	39
	6		47	28	58	28–58	44
	1	23	11	16		11–23	17
	2	20	13	17		13–20	17
T.a.	3	26	18	23		18–26	22
	4	24	23	36		23–36	28
	5	26	23	29		23–29	26
	6	--	--	29		---	--

Table 34 Measurements of *Beedeina*? ex gr. *conspecta* (Rauser-Chernoussova)

		Axial sections			Sag. sect.		
Specimen:		10	11	12	1	RANGE	AVERAGE
R.v.	0	132	—	—	112	112–132	122
	1	204	178	—	183	178–204	188
	2	297	263	238	263	238–297	265
	3	416	357	340	374	340–416	372
	4	578	493	472	535	472–578	520
	5	782	654	612	731	612–782	695
	6	901•	858	833		833–858	846
	7		1071	986•		—	—
G.r.	1–2	46	48		44	44–48	46
	2–3	40	35	43	42	35–43	40
	3–4	39	38	39	43	38–43	40
	4–5	35	33	30	37	30–37	34
	5–6		31	36		31–36	33
	6–7		25			—	—
F.r.	1	—	1.52	—		—	—
	2	2.46	2.29	—		2.29–2.46	2.38
	3	2.88	2.48	—		2.48–2.88	2.68
	4	2.91	3.24	—		2.91–3.24	3.08
	5	3.19	4.32	3.79		3.19–4.32	3.77
	6	3.31•	4.24	3.70		3.70–4.24	3.97
	7		4.15	3.84•		—	—
W.th-	1	24	-	-	16	16–24	20
	2	24	-	30	17	17–30	24
	3	24	21	30	21	21–30	24
	4	28	32	43	24	24–43	32
	5	39	32	26	31	26–39	32
	6	34•	39	25		25–39	32
	7		30	25•		—	—
T.a.	1	17	14	-		14–17	15
	2	27	15	13		13–27	18
	3	31	18	18		18–31	22
	4	40	19	20		19–40	26
	5	46	28	-		28–46	37
	6		34	-		—	—
	7		46	-		—	—

Table 35 Measurements of *Verella* sp.

		Axial sections							Sagittal sections					
Specimen:		27	48	28	41	45	26	29	6	37	4	30	RANGE	AVERAGE
R.v.	0	82	78	71	61	59	-	52	-	66	59	-	52–82	66
	1	138	119	112	127	115	102	86	137	125	135	102	86–138	118
	2	224	200	204	221	195	183	159	225	206	234	187	159–234	203
	3	357	289	323	374	323	289	272	346	325	374	306	272–374	325
	4	523	429	467	501•	370•	387•	459	420•	442	570	400•	429–570	482
	5		595•	629•						535•			—	—
G.r.	1–2	62	68	82	74	70	79	85	64	66	73	83	62–85	73
	2–3	59	45	58	69	65	58	71	54	57	60	64	45–71	60
	3–4	46	49	45				69		36	52		36–69	49
F.r.	1	2.25	2.43	2.62	2.98	2.22	3.33	2.65					2.22–3.33	2.64
	2	2.92	3.15	3.37	3.69	3.52	3.91	3.11					2.92–3.91	3.29
	3	3.14	4.41	3.26	4.52	3.68	4.12	3.78					3.14–4.52	3.84
	4	3.40	4.67	3.58	4.10•	3.91•	3.85•	3.89					3.40–4.67	3.89
	5		4.31•	3.08•									—	—
W.th.	1	15	-	17	19	-	14	13		12	13		12–19	15
	2	17	20	24	19	20	21	13		16	17		13–24	19
	3	21	17	26	28	22	23	17		17	21		17–28	21
	4	28	28	32	27•	24•	24•	30		21	24		21–32	27
	5		26•	30•									—	—
S.c.	1									-	10	-	—	—
	2									13	14	13	13–14	13
	3									18	18	17	17–18	18
	4									25	27	-	25–27	26
Ch.h.	0.5	0.25		0.23	0.21	0.27							0.21–0.27	0.24
	1	—		—	0.27	—							—	—
		0.41		—	0.38	0.32		0.27					0.27–0.41	0.32
	2	—	0.21	0.33	0.32	—		—					0.21–0.33	0.29
		0.36	0.32	0.31	0.30	0.29	0.26	0.30					0.26–0.36	0.31
	3	0.23	0.28	0.22	0.41	0.30	0.25	0.42					0.22–0.42	0.30
		0.31	0.24	—	0.19	0.34	0.44	0.31					0.19–0.44	0.30
	4		0.32	0.16									0.16–0.32	0.24
			0.19										—	—
	5												—	—

Table 36 Measurements of *Eofusulina* cf. *triangula* (Rauser-Chernoussova *et* Beljaev)

		Axial sections			Sagittal sections								
Specimen:		50	53	46	42	47	52	51	48	49	42(2)	RANGE	AVERAGE
R.v.	0	195	—	157	229	191	187	138	125			125–229	175
	1	323	272	263	493	382	421	272	221			221–493	331
	2	672	467	425	714	625	680	476	408			408–714	558
	3	756*	671	646	850*	867	731*	722	646			646–867	710
	4			880*					918*				
G.r.	1	108	72	61	45	63	62	75	85			45–108	71
	2		44	52		39		52	58			39–58	49
	3												
F.r.	1	3.11	3.00	2.84								2.84–3.11	2.98
	2	3.36	3.78	3.04								3.04–3.78	3.39
	3	4.07*	4.86	4.25								4.25–4.86	4.56
	4			4.18*									
W.th.	1	22	24	-	19	26	30	17	19	27	23	17–30	23
	2	30	34	28	24	34	26	27	33	32	35	24–35	30
	3	38*	25	39	31*	33	32*	25	37	30	34	25–39	32
	4			37*					37*				
S.c.	1				13	12	13	9	9	11	10	9–13	11
	2				25	27	24	20	22	22	22	20–27	23
	3					-		-	26	-	29	26–29	27.5

Table 37 Measurements of *Eofusulina* cf. *paratriangula* (Putrya)

		Axial sections							
Specimen:		3	5	18	21	1	2	RANGE	AVERAGE
R.v.	0	145	144	136	136	113	98	98–145	129
	1	293	229	238	212	210	204	204–293	231
	2	482		365	391	373	382	365–482	399
	3	725		493	578	620	595	493–725	602
	4			620*	697*				
G.r.	1	65		54	84	78	87	54–87	74
	2	50		35	48	66	56	35–66	51
	3								
F.r.	1	2.85	2.15	2.40	—	2.85	3.42	2.15–3.42	2.73
	2	3.50		3.98	4.96	3.90	4.73	3.50–4.96	4.21
	3	4.10		5.96	6.18	5.10	4.86	4.10–6.18	5.24
	4			5.83*	6.51*				
W.th.	1	17	16	15	14	17	24	14–24	17
	2	24		17	24	20	22	17–24	21
	3	24		23	32	23	24	23–32	25
	4			25*	27*				
T.a.	1	42				-	26	26–42	34
	2	44				72	72	44–72	63
	3	-				62	52	52–62	57

Table 38 Measurements of *Eofusulina* (*Paraeofusulina*) *rasdorica* sp. nov.

		Axial sections						Sagittal sections						
Specimen:		71	12	10	42	81	58	6	48	26	10	47	RANGE	AVERAGE
R.v.	0	119	110	102	98	—	81	—	111	102	90	85	81–119	100
	1	179	165	174	170	136	136	229	212	204	170	178	136–229	178
	2	298	238	290	281	255	221	391	348	357	264	314	221–391	296
	3	476	357	455	476	425	357	646	629	544	450	459	357–646	479
	4	646	544	660	722	612	527*			799	697	671	544–799	669
	5		731*		884*	799					782*		---	—
G.r.	1	67	47	67	65	87	62	70	72	75	55	76	47–87	68
	2	60	50	57	70	67	69	65	72	52	71	46	46–72	62
	3	36	52	45	52	44				47	55	46	36–55	47
	4													
F.r.	1	2.95	2.95	3.38	2.00	2.38	4.12						2.00–4.12	2.80
	2	3.02	4.00	3.95	3.59	3.67	4.32						3.02–4.32	3.75
	3	4.11	5.57	4.90	3.67	5.17	3.86						3.67–5.57	4.55
	4	4.29	5.62	5.45	4.82	5.11	3.10*						4.29–5.62	5.06
	5		5.00*		5.44*	—							----	—
W.th.	1	17	21	13	17	17	17	13	13	21	15	13	13–21	16
	2	24	19	19	24	22	22	22	24	22	22	21	19–24	22
	3	28	20	22	32	33	28	33	26	30	26	24	20–33	27
	4		32	34	39	39				34	32	22	22–39	33
	5		43*		43*	39							---	—
S.c.	1							13	12	9	11	11	9–13	11
	2							20	22	21	16	17	16–22	19
	3							24	26	25	21	25	21–26	24
	4									31	27	27	27–31	28
T.a.	1	26	36	35	17	-	-						17–36	28
	2	65	42	81	59	54	34						34–81	56
	3	85	75	103	65	40	57						40–103	71
	4	-	61	94	88	79							61–94	80
	5					-							---	—

Table 39 Measurements of *Fusulina rossoschanica* Putrya subsp. *kamerlingi* subsp. nov.

		Axial sections										Sagittal sections						
Specimen:		9	11	6	12	5	7	8	10	RANGE	AVERAGE	3	1	2	14	10	RANGE	AVERAGE
	0	203	184	168	168	165	162	162	159	159–203	171	171	171	162	--		162–171	168
	1	384	—	305	299	303	359	293	359	293–384	329	347	297	322	260		260–347	307
	2	569	500	451	436	452	532	453	532	436–569	491	532	483	470	408		408–532	473
R.v.	3	755	710	630	640	655	792	646	767	630–792	699	743	755	668	606		606–755	693
	4	1002	—	820	—	895	1040	860	1064	820–1064	947	990		916	842		842–990	916
	5	—		1030		1040•	1312			1030–1312	1171			—	1077		———	—
	1	48	-	48	46	49	48	55	48	46–55	49	54	63	46	57		46–63	55
	2	33	42	40	47	45	49	43	44	33–49	43	40	56	42	48		40–56	47
G.r.	3	33	-	30		37	31	33	39	30–39	34	33		37	39		33–39	36
	4			26			26			———	26				28		———	—
	5																	
	1	1.43	—	1.87	3.68	2.41	3.71	1.78	2.61	1.43–3.71	2.50							
	2	2.59	3.12	3.47	4.39	3.25	3.90	2.17	—	2.17–4.39	3.27							
F.r.	3	4.04	4.46	4.02	5.41	4.20	4.74	3.37	3.99	3.37–5.41	4.28							
	4	4.69	—	—	—	—	5.51	4.19	4.55	4.19–5.51	4.74							
	5	—		—			—			—————	—							
	1	-	22	24	20	20	29	-	-	20–29	23	34	14	27	24	31	14–34	26
	2	34	39	26	20	17	37	32	39	17–39	31	32	24	26	19	37	19–37	28
W.th.	3	32	53	31	26	31	54	36	46	26–54	39	54	58	43	44	41	41–58	48
	4	55	60	51	39	32	39	41	39	32–60	45	60	48•	46	48	39•	46–60	51
	5	-		-		26•	-			———	—			-	34		———	—
	1											9	12	10	14	-	9–14	11
	2											23	23	-	19	23	19–23	22
S.c.	3											-	27	30	28	25	25–30	28
	4											-		36	34		34–36	35
	5													-	-		———	—
	0.5						0.30	0.23		0.23–0.30	0.26							
	1					0.31	0.36	0.44		0.31–0.44	0.37							
		0.30				—	—	—		—————	—							
	2	0.33				0.25	0.22	0.25		0.22–0.33	0.26							
		—				0.19	0.18	—		0.18–0.19	0.18							
Ch.h.	3	0.16				0.15	0.17	0.18		0.15–0.18	0.16							
		—				0.06	0.08	0.15		0.06–0.15	0.10							
	4	0.14				0.08	0.13	0.16		0.08–0.16	0.13							
		0.16				abs.	abs.	0.10		0.00–0.16	0.06							
	5	abs.				0.16	abs.	abs.		0.00–0.16	0.04							

Table 40 Measurements of *Fusulina agujasensis* sp. nov. (1st assemblage)

		Axial sections										Sagittal sections					
Specimen:		17	4	9	22	10	15	2	8	RANGE	AVERAGE	1	12	16	20	RANGE	AVERAGE
	0	174	170	170	161	140	132	—	—	132–174	158	--	—	—	140	———	—
	1	289	306	315	280	272	315	289	314	272–315	297	306	255	306	323	255–323	298
	2	459	493	540	459	442	490	493	561	442–561	492	459	425	510	502	425–510	474
R.v.	3	680	765	740	731	671	760	748	824	671–824	740	714	629	748	714	629–748	701
	4	952	1020	1020	1045	850•	1025	1003	1096	952–1096	1023	986	884	1020	994	884–1020	971
	5	1054•	1275	1224•	1147•		1270	1173•	1207•	1270–1275	1272	1224	1190	1326	—	1190–1326	1247
	1	59	61	72	64	63	56	71	78	56–78	65	50	67	67	55	50–67	60
	2	48	55	37	59	52	55	52	47	37–59	51	56	48	47	42	42–56	48
G.r.	3	40	33	38	43		35	34	33	33–43	37	38	41	36	39	36–41	39
	4		25				24			24–25	24	24	35	30		24–35	30
	5																
	1	1.33	1.08	—	1.52	1.41	1.07	—	1.67	1.07–1.67	1.35						
	2	2.44	1.75	—	1.94	1.77	1.79	2.00	2.00	1.75–2.44	1.96						
F.r.	3	—	2.50	1.69	2.43	2.18	2.10	2.36	2.50	1.69–2.50	2.25						
	4	—	2.87	2.85	2.64	2.42•	2.55	2.84	3.00	2.55–3.00	2.79						
	5	—•	3.06	2.83•	2.93•		3.30	3.11•	2.90•	3.06–3.30	3.18						
	1	34		26	21	26	30	26	-	21–34	27	30	22	-	32	22–32	28
	2	34		32	37	29	31	30	34	29–37	32	30	30	30	32	30–32	31
W.th.	3	43		52	43	47	31	47	56	31–56	46	39	34	37	33	33–39	36
	4	52		69	56	56•	54	60	-	52–69	58	47	45	43	49	43–49	46
	5	-•		-•			56•	-•	-•	———	—	-	47	-	-	———	—

Table 41 Measurements of *Fusulina agujasensis* sp. nov. (2nd assemblage)

		Axial sections								Sagittal sections								
Specimen:		9	18	28	23	26	17	RANGE	AVERAGE	5	3	4	8	32	12	27	RANGE	AVERAGE
	0	217	195	157	140	132	---	132–217	168	178	178	170	141	140	136	125	125–178	153
	1	358	352	323	272	250	306	250–358	310	348	340	310	306	306	297	272	272–348	311
	2	585	548	510	433	390	510	390–585	496	527	544	433	484	493	476	391	391–544	478
R.v.	3	850	800	756	676	567	782	567–850	738	782	816	663	684	680	765	612	612–816	715
	4	1160	1055	935·	977	782	1088	782–1160	1012	—	1122	892	952		1028	910	892–1122	981
	5				1207	1000		1000–1207	1104	---		1122	---			1130	1122–1130	1126
	1	63	56	58	59	56	67	56–67	60	51	60	40	58	61	60	44	40–61	53
	2	45	46	48	56	45	53	45–56	49	48	50	53	41	38	61	57	38–61	50
G.r.	3	36	32		45	38	39	32–45	38		38	35	39		34	49	34–49	39
	4				23	28		23–28	25			26				24	24–26	25
	5																	
	1	—	1.00	1.58	1.44	1.39	1.53	1.00–1.58	1.39									
	2	--	1.55	2.00	1.67	1.65	1.82	1.55–2.00	1.74									
F.r.	3	2.64	1.90	2.57	2.09	2.40	2.66	1.90–2.66	2.38									
	4	3.38	2.50	2.76	2.54	2.90	3.01	2.50–3.38	2.87									
	5				2.86	3.45	3.26	2.86–3.45	3.15									
	1	36	23	30	-	27	32	23–36	30	32	30	24	28	21	24	30	21–32	27
	2	40	37	37	32	24	35	24–40	34	31	29	30	39	32	25	32	25–39	31
W.th.	3	52	50	43	39	41	33	33–52	43	37	32	31	41	34	47	41	31–47	38
	4	51		30	64	37	48	37–64	50	38	30	56	55			49	30–56	46
	5				24	30	34	24–30	27	-		30				30	---	30
	1									12	11	8	11	-	-	10	8–12	10
	2									25	23	21	20	18	20	19	18–25	21
S.c.	3									31	23	26	23	23	22	24	22–31	25
	4									32	31	29	31			33	29–33	31
	5											31				37	31–37	34
	1		21	16	21	-	-	16–21	19									
	2		28	22	26	32	-	22–32	27									
T.a.	3		27	21	31	31	39	21–39	30									
	4		-		33	30	-	30–33	31									
	5				-	41		—	—									
	0.5			0.40		0.39		0.39–0.40	0.39									
	1		0.38	--		--		———	--									
			--	--		0.66		———	--									
	2		--	--	0.28	--	0.23	0.23–0.28	0.25									
			--	0.15	--	0.55	--	0.15–0.55	0.35									
Ch.h.	3		0.23	0.23	0.18	--	0.10	0.10–0.23	0.18									
			0.12	0.21	--	--	0.23	0.12–0.23	0.19									
	4		abs.		abs.	0.38	0.11	0.00–0.38	0.12									
			abs.		abs.	0.22		0.00–0.22	0.07									
	5				abs.	abs.		———	--									

Table 42 Measurements of *Fusulina cotarazoe* sp. nov. (1st assemblage)

		Axial sections				Sag. sect.			
Specimen:		3	4	1	2	5	6	RANGE	AVERAGE
	0	208	181	174	162	183	179	162–208	181
	1	323	297	319	272	357	357	272–357	321
	2	493	561	518	459	535	629	459–629	532
R.v.	3	697	790	765	731	748	892	697–892	770
	4	935	1062	1054	1003	1011	986·	935–1062	1013
	5	1156·	1317	1275				1275–1317	1296
	6			1334·				———	—
	1	53	89	63	69	50	76	50–89	67
	2	41	41	48	59	40	42	40–59	45
G.r.	3	34	34	38	37	35		34–38	36
	4		24	21				21–24	22
	5								
	1	1.55	1.66	1.36	1.28			1.28–1.66	1.46
	2	2.09	1.97	1.79	1.96			1.79–2.09	1.95
F.r.	3	3.13	2.27	2.31	2.52			2.27–3.13	2.56
	4	3.92	3.02	3.10	2.86			2.86–3.92	3.23
	5	3.70·	3.02	3.67				3.02–3.67	3.35
	6			3.74·				———	—
	1	29	24	30	24	20	34	20–34	27
	2	30	31	37	34	19	37	19–37	31
W.th.	3	35	37	39	49	39	47	35–49	41
	4	43	40	47	-	28		28–47	40
	5	-	-	64				—	—
	1					15	13		
	2					23	25		
S.c.	3					27	32		
	4					33			
	1	15	25	22	13			13–25	19
	2	31	-	-	18			18–31	24
T.a.	3	30	24	-	28			24–30	27
	4	36	36	34	abs.			34–36	35
	5	abs.	abs.	42				—	—

Table 43 Measurements of *Fusulina cotárazoe* sp. nov. (2nd assemblage)

	Specimen:	Axial sections: 8	7	25	23	29	RANGE	AVERAGE	Sagittal sections: 22	8	17(1)	18	3	28	17(2)	RANGE	AVERAGE
R.v.	0	221	212	161	157	—	157–221	188	276	217	196	195	191	183	174	174–276	205
	1	375	297	336	272	238	238–375	304	498	416	370	323	340	353	323	323–498	375
	2	582	510	544	408	400	400–582	489	637	646	552	493	544	510	510	493–646	556
	3	815	731	816	595	578	578–816	707	935	884	782	731	816	748	748	731–935	806
	4	1100	884•	1037	850	850	850–1100	959	1182	1003•	1062	1020	1088	1003	1020	1003–1182	1063
	5	1225•		1309	1147	1071•	1147–1309	1228			1190•	1309		1241	1292	1241–1309	1281
	6													1377•		———	——
G.r.	1	55	71	62	50	68	50–71	61	56	55	49	53	60	45	58	45–60	54
	2	40	43	50	46	45	40–50	45	47	37	41	48	50	47	47	37–50	45
	3	35		27	43	47	27–47	38	26		36	39	33	34	36	26–39	34
	4			26	35		26–35	30				28		24	27	24–28	26
	5																
F.r.	1	1.40	1.26	1.32	1.28	1.11	1.11–1.40	1.27									
	2	1.82	2.10	2.11	1.81	1.72	1.72–2.11	1.91									
	3	2.07	2.57	2.75	2.42	2.47	2.07–2.75	2.46									
	4	2.53	2.71•	3.12	2.52	3.30	2.52–3.30	2.87									
	5	2.76•		3.19	2.73		2.73–3.19	2.96									
W.th.	1	30	30	24	20	26	20–30	26	26	30	29	27	21	30	17	17–30	26
	2	26	43	24	23	32	23–43	30	40	37	24	28	37	34	26	24–40	32
	3	45	34	41	38	45	34–45	41	60	52	35	37	49	35	48	35–60	45
	4	52	49•	75	39	64	39–75	57	-	-•	32	44	-	56	63	32–63	49
	5			34	30	32•	30–34	32			26•	32		49	47	32–49	43
S.c.	1								15	11	10	11		9	10	9–15	11
	2								31	24	25	21		21	21	21–31	24
	3								28	29	29	31		22	27	22–31	28
	4								-	-	37	34		27	38	27–38	34
	5											40		32	43	32–43	38
T.a.	1	24	25	20	20		20–25	22									
	2	25	-	19	25		19–25	23									
	3	31	28	31	32		28–32	30									
	4	-		40	35		35–40	37									
	5			abs.	abs.		———	——									
Ch.h.	0.5	0.30	0.36	0.38			0.30–0.38	0.35									
	1	—	0.36	0.52	0.29	0.37	0.29–0.52	0.38									
		0.50	0.41	0.26	0.30	—	0.26–0.50	0.37									
	2	0.26	—	0.21	—	—	0.21–0.26	0.23									
		0.18	—	0.14	0.22	—	0.14–0.22	0.18									
	3	0.10	0.17	—	0.08	—	0.08–0.17	0.12									
		abs.		0.27	—	0.28	0.00–0.28	0.18									
	.4			—	0.20	0.23	0.20–0.23	0.21									
				0.14	0.24	abs.	0.00–0.24	0.13									
	5			abs.	abs.		———	0.00									

Table 44 Measurements of *Hidaella kameii* Fuj. *et* Igo subsp. *nalonensis* subsp. nov.

	Specimen:	Axial sections: 31	8(1)	12	26	5(1)	24	39	13	Sag. s.: 31(2)	RANGE	AVERAGE
R.v.	0	26	24	—	24	23	22	19	19	21	19–26	22
	1	60	60	56	52	43	47	54	60	58	43–60	54
	2	86	92	90	75	67	86	86	86	101	67–101	85
	3	136	146	157	129	112	146	153	129	159	112–159	141
	4	221	217	221	195	195	212	238	178	241	178–241	213
	5	340	357	408	340	314	382	340•	276	425	276–425	355
	6	493•				518	—•				———	——
G.r.	1	43	53	62	46	55	82	60	43	74	43–82	58
	2	58	58	74	71	68	70	78	50	57	50–78	65
	3	62	49	40	51	74	45	55	38	51	38–74	52
	4	54	65	85	74	61	80		55	76	54–85	69
	5					65					———	——
	6											
F.r.	1		0.57		0.50	0.55					0.50–0.57	0.54
	2	1.30		1.48	1.17	1.16	1.60	1.32	0.98		0.98–1.60	1.43
	3	1.94	2.24	2.16	1.80	1.85	2.35	2.16	1.47		1.47–2.16	2.05
	4	3.23	3.41	3.54	2.57	2.61	2.64	3.43	2.81		2.57–3.54	3.03
	5	3.50	3.81	—	3.05	3.35	2.78	3.55•	3.23		2.78–3.81	3.29
	6					3.37					———	——
W.th.	1	9	4	-	6	4	-	9	9		4–9	7
	2	13	6	9	9	11	-	11	-		6–13	10
	3	11	13	15	9	13	13	17	11		9–17	13
	4	16	17	17	13	17	15	19	11		11–19	16
	5	21	24	19		17	17	21•	15		15–24	19
	6	25•				21					———	——
S.c.	2									10		
	3									12		
	4									15		
	5									14		
T.a.	2	13	-	25	-	-	-	-	-		13–25	19
	3	29	27	29	25	35	24	33	-		24–35	27
	4	37	35	51	35	31	49	51	38		31–51	41
	5	74	-	-	58	57	56	86	-		56–86	66
Ch.h.	2											
		0.26				0.33					0.26–0.33	0.29
	3	—	0.37	0.47	0.35	—		0.36			0.35–0.47	0.39
		0.45	0.39	0.36	—	0.42	0.38	—			0.36–0.45	0.40
	4	—	—		0.46	—	—	0.42	0.44		0.42–0.46	0.44
		0.50	0.50			0.43	0.38	0.30			0.30–0.50	0.42
	5					0.45					———	——
						0.45					———	——
	6					0.33					———	——

Table 45 Measurements of *Fusulinella pandae* sp. nov.

Axial sections

Specimen:		15	2	4	13	9	7	11	5	RANGE	AVERAGE
R.v.	0	51	50	43	42	42	40	40	39	39–51	43
	1	113	107	82	88	88	77	68	85	68–113	89
	2	190	195	155	161	144	142	132	136	132–195	157
	3	322	323	272	272	221	232	212	221	212–323	259
	4	518	510	472	429	374	374	357	374	357–518	426
	5	800	850	748	663	544	574	561	578	544–850	665
	6		1020•	1062	833•	773	799	799	782	773–1062	843
	7										
	8										
G.r.	1										
	2	68	82	89	83	64	83	94	60	60–94	78
	3	69	66	75	68	53	64	61	63	53–75	65
	4	61	58	73	58	69	61	68	69	58–73	65
	5	54	67	59	54	45	53	57	55	45–67	55
	6			42			39	42	35	35–42	40
	7										
F.r.	1	1.14	0.96	1.11	1.22	0.95	1.00	1.12	1.00	0.95–1.22	1.06
	2	1.42	1.35	1.39	1.53	1.38	1.52	1.61	1.31	1.31–1.61	1.44
	3	1.65	1.63	1.69	1.59	1.62	1.74	1.88	1.62	1.59–1.88	1.68
	4	2.00	2.00	1.77	1.84	1.75	1.84	2.02	1.91	1.75–2.02	1.89
	5	2.06	1.78	1.89	1.99	2.25	1.96	2.27	1.96	1.78–2.27	2.02
	6		1.80•	1.98	2.04•	2.68	1.98	2.64	2.43	1.98–2.68	2.34
W.th.	1	—	17	12	13	11	15	10	13	10–17	13
	2	—	28	—	21	19	24	21	17	17–28	22
	3	28	37	—	30	—	25	30	28	25–37	30
	4	55	34	41	38	54	35	—	—	34–55	43
	5	38	33	56	32	34	39	37	—	32–56	38
	6	38	24•	26	29•	47	26	30	39	26–47	34
	7										
	8										
T.a.	2	21	21	15	20	26	22	20	18	15–26	20
	3	32	21	24	25	30	26	33	20	20–33	26
	4	37	26	34	25	40	32	39	27	25–40	32
	5	—	40	45	31	53	37	41	32	31–53	40
	6			—		66	54	67	47	47–67	58
	1				0.27		0.38			0.27–0.38	0.32
		0.36			—	0.30	0.25			0.25–0.36	0.30
	2	0.38	0.44	0.41	0.27	0.31	0.32	0.32		0.27–0.44	0.35
		0.39	0.43	0.47	0.44	0.30	0.32	0.42	0.38	0.30–0.47	0.39
	3	0.44	0.40	0.39	0.38	0.40	0.40	0.41	0.41	0.38–0.44	0.40
		0.42	0.40	0.47	0.32	0.39	0.36	0.37	0.38	0.32–0.47	0.39
	4	0.36	0.39	0.42	0.36	0.41	—	0.41	0.51	0.36–0.51	0.41
		0.30	0.36	0.42	0.32	0.45	0.35	0.35	0.42	0.30–0.45	0.37
	5	—	0.34	0.36	0.33	0.30	0.31		0.33	0.30–0.36	0.33
			0.18	0.48	0.27	0.3[illegible]	0.45		0.40	0.18–0.48	0.35
	6					0.21	0.36		0.47	0.21–0.47	0.35

Sagittal sections

Specimen:		14	1	3	12	8	10	6	RANGE	AVERAGE
R.v.	0	49	46	44	40	38	37	35	35–49	41
	1	99	95	99	77	93	90	90	77–99	92
	2	176	183	170	153	153	153	155	153–183	163
	3	314	306	306	255	221	272	272	221–314	278
	4	557	501	493	391	348	433	459	348–557	455
	5	816	765	748	612	535	629	697	535–816	686
	6		1054	884•	884	773	956	943	773–1054	922
	7					1122	1105•		—	—
	8					1258•			—	—
G.r.	2	78	93	72	99	64	69	71	64–99	78
	3	78	67	80	67	44	78	75	44–80	70
	4	77	64	61	53	58	59	69	53–77	63
	5	47	53	52	57	54	45	52	45–57	51
	6		38		44	44	52	35	35–52	43
	7					45			—	—
W.th.	1	13	15	—	10	—	9	13	9–15	12
	2	19	26	20	15	17	17	19	15–26	19
	3	43	32	33	17	24	21	31	17–43	29
	4	47	60	37	34	—	39	45	34–60	44
	5	30	61	39	47	60	40	39	30–61	45
	6		40	29•	33	64	62	26	26–64	45
	7					84	37•		—	—
	8					45•			—	—
S.o.	1	-	9	8	7	7	7	7	7–9	7.5
	2	10	12	10	12	12	11	11	10–12	11
	3	12	13	11	11	16	11	13	11–16	12
	4	15	13	15	14	19	13	12	12–19	14
	5	17	14	15	13	15	15	14	13–17	15
	6		18		15	18	16	16	15–18	16.5
	7					18			—	—

Table 46 Measurements of *Fusulinella maldrigensis* sp. nov.

Sagittal sections

Specimen:		31	56	7	55	14	61	1	44	58	13	54	51	• 6	9	4	RANGE	AVERAGE
	0	49	45	43	42	42	40	39	38	35	34	34	33	30	25	21	21–49	37
	1	129	107	110	97	97	107	77	97	105	85	82	95	68	59	51	51–129	91
	2	220	189	204	176	157	189	136	172	161	153	142	168	119	102	85	85–220	158
R.v.	3	372	302	340	276	251	323	264	276	272	264	234	272	204	170	153	153–372	265
	4	620	493	544	408	400	480	476	467	459	442	391	476	391	272	280	272–620	440
	5	890	748		620	603	731	714	714	637	714	637	—	629	366•	425	425–890	672
	6				—•	714•	1003		910	765•	867•	986		901		663	663–1003	893
	7											1211		1020•			———	—
	1	71	76	85	82	62	76	78	78	53	80	74	77	75	71	67	53–85	74
	2	69	60	67	57	60	71	94	60	68	72	65	62	71	67	80	57–94	68
	3	67	63	60	48	59	49	81	69	69	68	67	75	92	60	83	48–92	67
G.r.	4	44	52		52	51	52	50	53	39	62	63		61		52	39–63	53
	5						37		27			55		43			27–55	41
	6											23					———	—
	7																	
	1	15	13	17	-	12	11	9	13	-	13	11	12	9	6	9	6–17	12
	2	30	21	23	-	20	18	17	28	15	22	19	18	14	13	17	13–30	20
W.th.	3	47	35	41	21	24	25	29	45	28	39	29	27	28	22	24	21–47	31
	4	52	37	17	35	43	30	39	44	39	41	37	37	39	27	30	17–52	36
	5	43	26		29	52	38	45	52	30	39	48		43	19•	43	26–52	41
	6						27		30	24•	56•	86		32		26	26–86	40
	7											39					———	—
	1	8	7	7	6	7	7	-	7	6	7	6	6	-	6		6–8	7
	2	12	13	12	11	12	10	10	10	10	10	11	10	10	11		10–13	11
S.c.	3	14	13	14	14	14	12	10	12	13	13	14	12	12	11		10–14	13
	4	15	15	18	15	13	15	13	15	14	15	14	14	13	14		13–18	14.5
	5	18	15		19	17	17	16	16	16	17	17	-	18			15–19	17
	6						21		18			20		17			17–21	19
	7											24					———	—

Table 46 Measurements of *Fusulinella maldrigensis* sp. nov.

Axial sections

Specimen:		60	59	15(1)	12	53	62	5	16	RANGE	AVERAGE
	0	47	46	45	41	40	38	37	27	27–47	40
	1	90	90	90	90	82	69	77	65	65–90	82
	2	187	163	159	159	140	133	136	110	110–187	148
R.v.	3	348	289	238	263	217	221	221	187	187–348	248
	4	595	493	391	408	378	391	357	306	306–595	415
	5	—•	731	570	646	629	629	459•	510	510–731	619
	6		884•	799	790•		910		833	799–910	847
	7			1016•			1130			———	———
	1	108	81	76	76	71	94	78	69	69–108	82
	2	86	77	50	65	55	66	63	70	50–86	66
	3	71	71	64	55	74	77	62	64	55–77	67
G.r.	4		48	46	58	66	61		67	46–67	58
	5			40			45			40–45	42
	6						24			———	—
	7										
	1	1.24	1.10	1.00	1.10	0.95	1.19	1.00	0.70	0.70–1.24	1.04
	2	1.68	1.63	1.51	1.30	1.35	1.29	1.19	1.12	1.12–1.68	1.38
F.r.	3	1.80	1.66	1.79	1.68	1.96	1.81	1.65	1.50	1.50–1.96	1.73
	4	1.89	1.83	2.07	2.03	2.13	1.85	1.98	2.11	1.83–2.13	1.99
	5	—•	2.01	2.24	2.17	2.45	1.89	2.04•	2.51	1.89–2.51	2.21
	6		2.35•	2.33	2.29•		1.85		2.57	1.85–2.57	2.25
	7			2.13•			1.83			———	—
	1	17	17	15	13	9	9		9	9–17	13
	2	21	21	24	13	-	21		14	13–24	19
W.th.	3	32	33	39	28	19	32		26	19–39	30
	4	34	59	45	34	30	49		39	30–59	41
	5		70	46	52	32	52		45	32–70	49
	6		39•	69	37•		77		—	69–77	73
	7			—•			43			———	—
	2	27	25	31	25	23	19	29	20	19–31	25
	3	33	31	36	34	25	32	30	20	20–40	31
T.a.	4	28	28	47	40	46	30	42	36	28–47	37
	5		37	59	49	—	34		55	34–59	47
	6						28		48	28–48	38
	1	0.26								———	—
		0.38	0.42	0.25	0.26	0.35				0.25–0.42	0.33
	2	0.46	0.43	—	0.30	0.39			0.32	0.30–0.46	0.38
		—	0.39	0.35	—	0.45	0.37		—	0.35–0.45	0.39
Ch.h.	3	0.40	0.40	0.30	0.32	—	—		0.38	0.30–0.40	0.36
		0.35	0.44	0.41	0.37	0.37	—		0.39	0.35–0.44	0.39
	4	0.51	0.46	0.50	0.46	0.37	0.35		0.37	0.35–0.51	0.43
			0.55	0.42	0.48	—	0.46		0.34	0.34–0.55	0.45
	5		0.50	0.36	0.33	0.45	0.48		0.37	0.33–0.50	0.41
			0.43	0.50	0.28		0.44		0.42	0.28–0.50	0.41
	6			0.31			0.38			0.31–0.38	0.34
				0.40			0.44			0.40–0.44	0.42
	7									———	—

Table 47 Measurements of *Fusulinella loresae* sp. nov.

Sagittal sections

Specimen:		8	19	6	7	27	5	22	29	11	21	25	4	RANGE	AVERAGE
	0	41	37	35	35	34	33	32	26	26	26	25	22	22–41	31
	1	93	82	111	89	90	68	71	67	68	71	71	60	60–111	78
	2	170	136	186	153	150	111	118	123	127	110	120	122	110–186	136
R.v.	3	323	255	314	246	251	187	204	204	212	179	238	221	179–323	236
	4	578	467	561	391	425	416	357	353	365	264	433	391	264–578	417
	5		833	969	518*	710		629	518	620	425	807	663	425–969	686
	6		1033*	1020*		867*		—*	650*	969	710	1207	986	710–1207	968
	7									1292*	1088			—	—
	8										—*			—	—
	1	83	66	68	72	67	63	67	84	87	55	70	103	55–103	74
	2	90	88	68	61	67	68	73	66	67	63	98	81	61–98	74
	3	79	83	79	59	69	122	75	73	72	48	82	77	48–122	76
G.r.	4		78	73		67		76	47	70	61	86	70	47–86	70
	5									56	67	49	49	49–67	55
	6										53			—	—
	7														
	1	13	11	-	11	12	6	8	10	9	-	9	11	6–13	10
	2	21	17	-	17	17	13	13	14	13	-	-	13	13–21	15
W.th.	3	21	21	24	21	21	19	21	25	19	17	26	17	17–26	21
	4	34	48	34	30	39	19	28	30	41	32	38	29	19–48	33
	5		49	60		62		32	40	43	40	56	43	32–62	47
	6					67*				64	56	47	73	47–73	60
	7										-			—	—
	1	-	7	-	-	-	-	5	-	6	-	-	-	5–7	6
	2	10	11	-	-	9	-	10	-	10	-	11	-	9–11	10
S.c.	3	12	11	14	13	11	-	10	10	12	-	13	9	9–14	11.5
	4	13	14	13	13	13	-	12	11	11	11	14	13	11–14	13
	5		-	14	17	13	-	15	-	-	14	17	15	13–17	15
	6										15	17	16	15–17	16
	7										16			—	-

Table 47 Measurements of *Fusulinella loresae* sp. nov.

Axial sections

Specimen:		12	18	26	3	10	8	28	2	30	RANGE	AVERAGE
	0	39	39	—	36	36	26	26	24	21	21–39	31
	1	86	80	75	68	68	60	63	56	64	56–86	69
	2	172	138	127	127	119	102	99	103	100	99–172	121
R.v.	3	289	245	200	229	195	170	168	181	170	168–289	205
	4	459	416	308	425	323	289	289	306	280	280–459	344
	5	646	654	460	748	527	544	476	557	477	460–748	565
	6	—*	816*	625		748*	901	646*	—	760	625–901	762
	7									920*	—	—
	1	100	73	69	87	75	70	57	85	56	56–100	75
	2	68	78	57	80	64	67	70	75	70	57–80	70
G.r.	3	59	70	54	86	66	70	72	69	65	54–86	68
	4	41	57	49	76	63	88	65	82	70	41–88	66
	5			36			66			59	36–66	54
	6											
	1	0.85	1.08	—	0.88	1.00	0.86	0.60	—	0.64	0.60–1.08	0.84
	2	1.30	1.37	1.20	1.53	1.50	1.33	1.30	1.17	1.29	1.17–1.53	1.33
F.r.	3	1.76	1.58	1.45	2.26	2.04	1.80	1.82	1.95	1.74	1.45–2.26	1.82
	4	2.48	2.16	1.95	2.44	2.26	1.91	2.34	2.50	2.05	1.91–2.50	2.23
	5	2.82	2.42	2.30	2.27	2.20	2.03	2.68	2.46	2.25	2.03–2.82	2.38
	6		—*	—		2.07*	2.24	2.64*	—	2.28	2.24–2.28	2.26
	7									2.47*	—	—
	1	13	13	12	12	9	9	6	11	9	6–13	10
	2	21	17	15	17	11	17	15	15	9	9–21	15
W.th.	3	22	34	26	26	17	21	28	24	9	9–34	23
	4	32	43	29	32	34	28	30	30	26	26–43	32
	5	34	41	34	34	39	33	47	38	32	32–47	37
	6		34*	-		34*	49	39*	-	58	49–58	54
	7									62	—	—
	8									62*	—	—
	2	24	29	20	26	30	—	23	—	24	20–30	25
	3	29	32	21	39	26	34	28	50	24	21–50	31
T.a.	4	41	42	36	52	45	41	42	52	44	36–52	44
	5	63	46	43	57	49	—	55	51	54	43–63	52
	6			—						46	—	—
	1										—	—
		0.38	0.32	0.27	0.13						0.13–0.38	0.27
	2	0.36	0.40	0.36	0.40		0.20		0.36	0.34	0.20–0.40	0.35
		0.46	0.30	—	0.30		0.38	0.38	—	0.35	0.30–0.46	0.36
Ch.h.	3	0.41	0.36	0.44	0.31		0.34	—	0.33	0.30	0.30–0.44	0.36
		0.47	—	0.48	0.29	0.37	—	0.32	—	0.25	0.25–0.48	0.36
	4	0.50	0.31	0.28	0.46	0.55	0.43	0.31	0.57	0.28	0.28–0.57	0.36
		—	0.32	0.43	—	0.24	0.44	0.37	—	0.33	0.24–0.44	0.35
	5	0.58		0.28	0.24	—	0.27	—	0.37	0.42	0.24–0.58	0.36
				0.46		0.47	0.31	0.39		0.20	0.20–0.47	0.36
	6						0.14			0.26	0.14–0.26	0.20
										0.30	—	—
	7											

Table 48 Measurements of *Fusulinella schwagerinoides* (Depr.) subsp. *alvaredoi* subsp. nov.

Sagittal sections

Specimen:		23	24	18	19	2	11	13	RANGE	AVERAGE
	0	25	25	24	24	21	20	20	20–25	23
	1	64	60	56	52	69	58	54	52–69	59
	2	107	99	90	92	110	101	103	90–110	100
R.v.	3	204	161	170	163	208	170	200	161–208	182
	4	391	259	357	297	416	331	357	259–416	344
	5	671	493	680	603	731	576	714	493–731	638
	6	1105	952	1232	1071	1224	1037	858•	952–1232	1104
	7		1326	1394•	1241•				—	—
	1									
		67	64	61	79	59	74	92	59–92	71
	2									
		91	62	89	77	89	68	94	62–94	81
	3									
		92	61	110	82	100	95	79	61–110	88
G.r.	4									
		72	90	90	103	76	77	100	72–103	87
	5									
		65	93	81	77	67	77		65–93	77
	6									
			39						—	—
	7									
	1	9	10	9	9	-	9	9	9–10	9
	2	15	12	12	11	9	11	17	9–17	12
W.th.	3	20	13	17	15	23	16	19	13–23	18
	4	34	27	28	25	45	26	39	25–45	32
	5	64	41	48	47	48	47	58	41–64	50
	6	30	61	56	47	43	39	-•	30–61	46
	7		34	-•	39•				—	-
	1	-	-	6	6	6	-	-	—	6
	2	9	7	10	11	9	-	8	7–11	9
S.c.	3	12	11	10	10	12	15	11	10–15	12
	4	13	13	11	13	13	13	12	11–13	13
	5	15	14	14	14	15	16	15	14–16	15
	6	14	15	19	17	20	18		14–20	17

Table 48 Measurements of *Fusulinella schwagerinoides* (Depr.) subsp. *alvaredoi* subsp. nov.

Axial sections

Specimen:		29	14	4	30	3	8	7	9	6	17	RANGE	AVERAGE
	0	31	30	29	25	24	23	22	21	21	19	19–31	24.5
	1	73	73	60	64	69	49	49	65	49	47	47–73	60
	2	145	135	103	114	113	77	99	92	88	77	77–145	104
R.v.	3	240	235	178	206	190	150	173	172	150	129	129–240	182
	4	412	470	340	365	358	255	325	323	272	221	221–470	334
	5	612•	880	646	680	740	510	600	618	561	391	391–880	625
	6		1100•	867•	1020	1200	850		935•	773	748	748–1200	918
	7										1071	—	—
	1												
		98	85	71	77	64	57	102	43	78	64	43–102	74
	2												
		66	74	73	81	68	94	75	86	70	67	66–94	75
	3												
		72	100	90	77	88	70	88	88	81	71	70–100	82
G.r.	4												
			87	90	86	107	100	85	91	106	77	77–107	92
	5												
					50	62	67			38	91	38–91	62
	6												
											43	—	—
	7												
	1	0.89	0.75	0.71	—	—	—	—	0.53	—		0.53–0.89	0.72
	2	1.37	1.17	1.54	1.70	1.53	1.22	1.38	1.40	1.27		1.17–1.70	1.40
F.r.	3	2.09	1.72	2.00	2.02	2.20	1.79	2.04	2.50	1.81		1.72–2.50	2.02
	4	2.43	2.06	2.37	2.32	2.48	2.13	2.16	2.97	2.25		2.06–2.97	2.35
	5	2.00•	2.08	2.30	2.50	2.11	2.35	2.01	2.77	2.36		2.01–2.77	2.31
	6		2.24•	2.27•	3.00	2.28	2.78		2.50•	3.01		2.28–3.01	2.77
	1	11	7	9	9	9	4	6	-	5	6	4–11	7
	2	19	11	13	13	11	6	13	-	13	9	6–19	12
W.th.	3	26	39	17	24	21	15	24	-	17	17	15–39	22
	4	34	41	27	32	29	32	29	39	27	-	27–41	32
	5	52•	54	52	52	67	45	20	56	47	-	20–67	49
	6			26•	-	34	-		28•	35	95	34–95	55
	7									-•	60	—	—
	2	28	29	-	39	28	22	-	42	-	30	22–42	31
	3	48	37	33	51	48	22	42	48	33	31	22–51	39
T.a.	4	61	50	43	58	56	53	56	48	38	44	38–61	51
	5	70	71	66	71	63	52	63	66	54	59	52–71	63
	6				72		57			52	87	52–87	67
	1												
			0.29	0.22				0.23				0.22–0.29	0.25
	2		—	—		0.34	0.29	0.22		0.28		0.22–0.34	0.28
			—	0.25	0.36	0.35	—	—	0.25	0.26		0.25–0.36	0.29
Ch.h.	3	0.22	0.40	0.33	—	0.32	0.32	0.38	0.34	0.31		0.22–0.40	0.33
		—	0.34	0.21	0.36	0.28	0.29	0.23	—	0.33		0.21–0.36	0.29
	4	0.27	0.36	0.35	0.40	0.26	0.38	0.45	0.31	0.23		0.23–0.45	0.33
		—	0.27	0.27	0.28	0.24	0.19	—	0.40	0.26		0.19–0.40	0.27
	5	0.18	0.18	0.31	0.18	0.32	0.37	0.21	0.37	0.17		0.17–0.37	0.25
			0.33	0.27	0.27		—		0.28	0.28	0.30	0.27–0.33	0.29
	6		0.14		0.27		0.29			0.16	0.23	0.14–0.29	0.22
											—	—	—
	7										0.30	—	—

Table 49 Measurements of *Fusulinella mosquensis* Raus. *et* Saf. subsp. *abismoe* subsp. nov.

Sagittal sections

		2	43	28	20	45	34	9	38	41	4	16	40	27	22	10	6	1	5	21	42	RANGE	AVERAGE
		59	50	47	47	46	45	45	43	41	41	41	40	40	40	40	39	30	34	32	30	30–59	42
		131	127	112	97	110	112	101	95	—	110	87	99	92	95	95	82	77	73	69	95	69–131	98
		221	221	168	172	187	157	176	150	—	170	140	155	159	178	159	170	135	127	112	155	112–221	164
		374	365	289	314	289	272	297	246	340	272	221	268	246	285	263	306	242	200	161	255	161–374	275
		612	603	493	510	459	425	510	408	535	433	353	455	459	510	416	501	370	331	280	382	280–612	452
		816•	910	731		765	629	799	671	773	680	569	697	663	833		—	570	—•	442	586	442–910	688
			—•	—•		816•	909		782•		799•	850	833•	850•						731	867	731–909	893
																				910•		—	—
		69	73	50	78	69	40	74	59	—	55	61	57	72	89	68	107	75	74	62	64	40–107	68
		69	65	72	83	55	73	69	64	—	60	58	73	55	60	65	80	79	57	44	65	44–83	66
		64	65	71	62	59	56	71	66	58	59	60	70	86	79	58	64	53	66	74	50	50–86	65
			51	48		67	48	57	65	44	57	61	53	44	63			54		58	53	44–67	55
							45					49								65	48	45–65	52
		14		9			15		14		—	11		11		13			11	—		9–15	12
		30		24			20		26		18	13		18	19	--			15	10		10–30	19
		34		34			34		41		28	20		28	30	--			27	17		17–41	29
		—		49			47		55		41	30		45	38	--			29	37		29–55	41
		45•		47			53		82		47	31		41	37					43		31–82	48
				30			56		—			46								52		30–56	46
S.c.	1	8	7	7	-	6	6	6	7	7	6	6	8	6	7	8	7	8	7	7	6	6–8	7
	2	11	10	11	9	10	11	10	10	11	8	10	9	10	9	10	10	11	9	10	10	8–11	10
	3	13	11	14	11	13	14	11	11	11	10	12	10	9	10	12	11	13	11	12	13	9–14	12
	4	15	13	16	13	15	14	12	13	13	11	15	12	12	12	13	13	14	12	16	14	11–16	13
	5		13	18		—	17	13	16	13	14	15	14	15	14		15	18		16	19	13–19	15
	6						17		18			15								18	18	15–18	17

Table 49 Measurements of *Fusulinella mosquensis* Raus. *et* Saf. subsp. *abismoe* subsp. nov.

Axial sections

Specimen:		30	32	39	13	15	18	3	25	37	29	8	11	31	36	26	RANGE	AVERAGE
	0	60	52	52	49	46	45	44	44	44	42	42	42	41	40	39	39–60	45
	1	99	97	87	93	102	96	77	97	98	82	105	83	68	72	107	68–107	91
	2	170	183	153	170	170	167	145	200	187	127	170	136	119	123	187	119–200	160
R.v.	3	319	323	268	306	285	264	234	272	336	200	289	246	204	170	306	170–336	268
	4	510	565	425	510	493	430	391	510	570	336	476	306•	348	276	459	276–570	450
	5	782	705•	650	600•	816	645	527•			565			544	442	—	442–816	635
	6	—•		765•		935•	800•				—				710		—	—
	7														841•		—	—
	1																	
	2	72	89	76	83	67	74	87	106	91	55	62	64	75	70	75	55–106	76
G.r.	3	87	77	75	80	67	58	61	36	80	57	70	81	71	38	64	36–87	67
	4	60	75	59	67	73	63	67	87	70	68	65		71	63	50	50–87	67
	5	53		53		66	50				68			56	60		50–68	58
	6														61		—	—
	1	1.22	1.20	1.26	1.05	1.17	1.28	1.17	1.27	1.26	0.92	1.14	0.99	1.06	0.78	—	0.78–1.28	1.13
	2	1.90	1.91	1.61	1.65	1.40	1.85	1.54	1.96	1.59	1.29	1.65	1.72	1.50	0.93	1.55	0.93–1.96	1.60
F.r.	3	1.95	2.26	2.03	1.89	1.58	2.10	1.96	2.58	2.19	2.00	1.62	1.97	1.71	1.60	1.92	1.58–2.58	1.96
	4	2.05	2.48	2.18	2.18	1.76	2.28	2.04	2.73	2.28	2.28	1.93	2.00•	2.00	1.75	2.28	1.75–2.73	2.16
	5	2.29	2.41•	—	2.30•	1.75	2.25	2.02•			2.26			2.13	2.00	2.20•	1.75–2.29	2.11
	6			2.63•		2.00•	2.30•				2.26•			—•	2.16		—	—
	7														2.24•		—	—
	1	13	11	13	11	11	15	13	11	10	11	13	15	11	9	13	9–15	12
	2	29	32	21	17	26	30	21	30	30	14	20	21	22	15	26	14–32	24
W.th.	3	39	33	30	32	32	52	33	27	39	29	34	22	29	15	49	15–52	33
	4	49	35	-	34	-	60	30	33	28	-	-	19•	32	28	40	28–60	37
	5	80	33•	-	-•	64	42	-•			49			42	40	60•	40–80	53
	6			-•		60•					-•				43		—	—
	7														29•		—	—
	2	17	24	25	30	33	31	37	27	43	43	30	21	28	29	26	17–43	30
	3	26	42	26	38	33	36	38	38	34	51	35	26	44	-	33	26–51	36
T.a.	4	52	51	48	33	39	48	51	38	33	47	39		33	31	47	31–52	42
	5	55		53		46	52				56			48	45	45	45–56	50
	6														58		—	—
	1	0.30	0.50	0.37		0.23	0.42		0.35	0.33	0.28		0.36	0.28	0.20		0.20–0.50	0.33
		0.33	0.34	—	0.23	0.22	0.41		0.31	0.35	—		0.29	—	0.22	0.31	0.22–0.41	0.30
	2	0.38	0.36	0.41	0.42	0.40	—	0.23	0.29	0.40	0.30	0.28	0.40	0.31	0.32	—	0.23–0.42	0.35
		0.28	0.42	0.39	0.31	0.27	—	0.23		0.30	—	0.28	0.33	—	0.26	0.33	0.23–0.42	0.31
Ch.h.	3	0.35	0.40	0.44	0.28	0.36	0.37	0.31		0.40	0.27	0.28	0.43	0.32	—	0.32	0.27–0.44	0.35
		0.40	—	0.39	0.35	—	0.26	0.36			—	0.37	0.30	0.47	0.28	0.32	0.26–0.47	0.35
	4	0.30	0.28	0.35	0.39	—	0.40	0.30			—	0.38		0.38	0.45	0.33	0.28–0.45	0.36
		0.33	0.31	0.28	0.21	0.39	0.21				0.32			0.43	0.40	0.32	0.21–0.43	0.32
	5	0.27		0.45		0.24	—				0.32			0.37	0.33		0.24–0.45	0.33
				0.21		0.39	0.36								0.18		0.18–0.39	0.28
	6														0.36		—	—

Table 50 Measurements of *Fusulinella delepinei* Van Ginkel

Sagittal sections

Specimen:		10	7	6	4	5	8	1	3	2	9	RANGE	AVERAGE
	0	46	38	34	34	34	33	—	32	32	27·	27–46	34
	1	120	95	95	90	88	92	92	82	77	75	75–120	91
	2	198	155	168	153	148	146	151	133	116	127	116–198	149
R.v.	3	·340	272	272	272	255	247	247	221	187	196	187–340	251
	4	603	476	506	467	450	391	421	366	302	340	302–603	432
	5	1020	714·	867	816	714	459·	714	544	519	535	519–1o20	716
	6				952·	918·		1122	892	850	646·	850–1122	955
	7								1258				
	1	64	64	77	70	68	58	63	63	50	69	50–77	65
	2	72	75	62	78	72	69	64	66	61	54	54–78	67
G.r.	3	77	75	86	72	77	59	70	65	61	74	59–86	72
	4	69		71	75	58		70	49	72	57	49–75	65
	5							57	64	64		57–64	62
	6								41				
	7												
	1	16	11	11	10	11	13	13	11	9	8	8–16	11
	2	21	17	16	19	15	14	13	12	11	11	11–21	15
W.th.	3	35	27	26	26	25	26	26	30	13	21	13–35	25
	4	44	32	42	34	43	31	31	43	32	26	26–44	36
	5	34	23	47	45	54	27·	47	71	52	44	34–71	49
	6				28·	34·		26	90	26	45·	26–90	47
	7								26				
	1	6	6	-	6	6	6	-	-	5	6	5–6	6
	2	11	10	-	10	12	11	10	11	10	10	10-12	11
S.c.	3	11	12	11	10	12	12	13	12	11	12	10–13	12
	4	12	14	13	13	13	15	14	14	12	14	12–15	13
	5	15		15	14	16		14	16	12	14	12–16	14.5
	6							15	18	14		14–18	16
	7								25				

Table 50 Measurements of *Fusulinella delepinei* Van Ginkel

Axial sections

		microspherical type					macr. t.		
Specimen:		14	12	39	13	11	15	RANGE	AVERAGE
	0	29	29	28	27	25	40	25–40	30
	1	71	65	69	75	82	88	65–88	75
	2	129	110	127	134	108	155	108–155	137
R.v.	3	204	195	211	207	170	263	170–263	208
	4	319	340	370	340	276	450	276–450	349
	5	506	578	646	560	468	600·	468–646	552
	6	782	935	1020	842	816		782–1020	879
	7	986·			1050·	952·			
	1	82	70	84	79	32	75	32–84	71
	2	58	77	66	54	57	70	54–77	64
G.r.	3	56	74	75	64	62	71	56–75	67
	4	59	70	75	65	69		59–75	68
	5	55		58	50	75		50–75	60
	6								
	1	0.68	0.73	—	1.00	0.45	1.03	0.45–1.03	0.78
	2	0.97	—	1.42	1.22	1.16	1.82	0.97–1.82	1.32
R.r.	3	1.50	1.91	1.80	1.67	1.55	2.45	1.50–2.45	1.81
	4	1.92	2.10	1.95	1.79	1.82	2.57	1.79–2.57	2.03
	5	1.75	1.88	1.82	1.84	1.93	2.52·	1.75–1.93	1.84
	6	1.83	1.82	1.68	1.90	1.79		1.68–1.90	1.80
	7	1.84·			1.89·	2.01·			
	1	9	6	10	7	—	8	6–10	8
	2	12	11	17	14	—	24	11–24	16
W.th.	3	26	24	18	—	—	27	18–27	24
	4	31	27	45	40	27	45	27–45	36
	5	39	64	66	66	34	34	34–66	50
	6	56	31	30	76	—		30–76	48
	7	30·			32·	34·			
	2	18	28	14	—	—	29	14–29	22
	3	25	35	24	23	22	52	22–52	30
T.a.	4	30	45	42	46	30	57	30–57	42
	5	32	53	41	44	47	65·	32–53	43
	6	44	—	46	57	58		44–58	51
	1				0.33				
	2								
		0.27	0.26	0.32	0.41		0.34	0.26–0.41	0.31
Ch.h.	3	0.38	0.55	0.48	—		0.25	0.25–0.55	0.41
		0.40	0.29	—	0.50	0.36	0.19	0.19–0.50	0.35
	4	0.39	0.39	—	0.40	0.33	0.36	0.33–0.40	0.37
		0.34	—	0.38	0.39	0.32	0.24	0.24–0.39	0.33
	5	—	0.34	0.35	0.37	0.43		0.34–0.43	0.36
		0.31	0.28	—	0.24	0.35		0.24–0.35	0.30
	6	0.31		0.23	0.32	0.32		0.23–0.32	0.29
		0.17			—	0.29		0.00–0.29	0.15
	7								

Table 51 Measurements of *Fusulinella branoserae* Van Ginkel

Axial sections

Specimen:		96	13	20	59	21	21(2)	108	100	100(2)	67	53	88	150	28	124	RANGE	AVERAGE
	0	45	42	41	39	37	38	29	28	—	—	25	25	—	24	22	22–45	33
	1	90	73	73	77	86	69	69	68	70	62	64	58	58	65	52	52–90	69
	2	148	120	129	118	153	120	107	127	118	112	128	95	97	129	92	92–153	120
R.v.	3	255	204	206	204	263	193	166	211	192	206	208	180	172	213	176	172–263	203
	4	340•	348	340	357		251•	280	357	336	387	349•	312	289	353	297	280–387	332
	5		510	544	604			493	599	580	527		500	493	497	433	433–604	525
	6							714	748•		714•			663	—•		663–714	688
	1	64	65	76	53	77	75	56	87	69	79	100	64	67	100	79	53–100	74
	2	72	70	60	73	72	61	54	66	63	85	63	89	78	65	90	54–90	71
G.r.	3		71	65	75			69	69	75	88		73	68	66	69	65–88	72
	4		46	60	69			76	68	73	36		60	71	41	46	36–76	59
	5							45			—			34			34–45	40
	6																	
	1	1.24	1.00	1.18	0.83	—	0.86		1.08	—	0.72	—	0.70	0.81	0.80	0.67	0.67–1.24	0.90
	2	1.51	1.45	1.73	1.49	1.50	1.32	1.27	1.68	1.32	1.84	1.41	1.33	1.07	1.13	1.30	1.07–1.84	1.42
F.r.	3	1.77	2.29	1.88	1.75	1.94	1.64	1.30	2.25	1.92	2.28	2.04	2.09	1.70	2.39	1.95	1.30–2.39	1.95
	4	1.75•	2.73	2.40	2.24	—	1.93•	1.38	2.43	2.46	2.59	2.15•	2.60	2.26	2.77	2.40	1.38–2.77	2.39
	5		3.08	2.61	2.57•			1.81	2.78	3.08	3.35		3.67	2.93	3.26	3.14	1.81–3.67	2.97
	6							2.49	2.98•		3.08•			3.31	—•		2.49–3.31	2.90
	1	11	11	9	11	11	9	8	9	9	6	-	8	-	9	6	6–11	9
	2	13	17	13	13	13	10	11	17	16	13	16	12	15	12	14	10–17	14
W.th.	3	24	22	13	17	13	12	16	-	25	26	13	-	17	-	17	12–26	18
	4	19•	35	31	34	-	13•	19	-	35	41	15•	-	19	31•	24	19–41	30
	5		39	-	28			34	32	40	34		-	17	-	28	17–40	31
	6							30						-•	-•		—	—
	1																	
						0.24	0.37						0.30				0.24–0.37	0.30
	2	0.26		0.33	0.30	0.42	0.35	0.32					0.39		0.33	0.19	0.19–0.42	0.32
		0.32	0.34	—	0.53	—	0.21	—			0.30	0.29	—	0.27	—	0.32	0.21–0.54	0.32
Ch.h.	3	0.38	0.41	—	—	0.44	0.31	—			0.24		0.41	0.44	0.41	0.41	0.24–0.44	0.38
		0.40	0.36	0.30	0.34		0.50	0.30	0.42		—		—	0.35	0.26	0.25	0.25–0.50	0.35
	4		0.31	0.22	—			0.20	—		—		—	0.33	—	—	0.20–0.33	0.26
			0.31	0.27	0.45			0.19	0.26		0.25		—	—	0.36	0.33	0.19–0.45	0.30
	5		0.38		0.23			0.18	0.27		0.29		0.29	0.37			0.18–0.38	0.29
								0.24	0.20								0.20–0.24	0.22
	6							0.20									—	—

Table 51 Measurements of *Fusulinella branoserae* Van Ginkel

Sagittal sections

Specimen:		79	79(2)	71	138	118	21	4	4(2)	150	81	17	74	63	106	87	90	60	30	RANGE	AVERAGE
	0	42	42	40	39	39	38	34	33	33	33	31	30	30	28	27	26	24	24	24–42	33
	1	84	90	95	84	97	69	71	88	69	77	64	69	73	73	60	56	69	77	56–97	76
	2	148	133	170	144	155	120	129	150	123	146	125	122	120	129	107	95	133	138	95–170	132
R.v.	3	255	252	259	238	249	193	212	255	206	284	209	187	198	217	181	174	238	245	174–284	225
	4	336•	455		357	306•	251•	340	425	323	510	327	323	331	357	323	285	408	438	285–510	372
	5		603•						527•	527			527	493	578	544	467		697	467–697	548
	6									816			731•		816		578•			—	816
	7									1054•										—	—
	1	77	48	80	72	60	75	82	70	78	89	93	63	65	76	79	69	94	78	48–94	75
	2	72	89	52	65	61	61	64	70	68	94	67	67	64	68	68	84	79	78	52–94	71
G.r.	3		81		50			60	67	57	80	56	73	67	65	78	64	71	79	50–81	68
	4									63			63	49	62	68	64		59	49–68	61
	5									55					41					41–55	48
	6																				
	1	9	11	13	9	11	9	9	10	5	9	6	9	6	9	9	6	9	-	5–13	9
	2	17	15	17	17	16	10	15	20	14	17	10	12	12	13	13	12	16	-	10–20	14
W.th.	3	21	21	15	29	17	12	17	30	18	27	19	23	19	21	18	17	30	20	12–30	21
	4	28•	34			18•	13•	13	37	28	22	21	29	30	32	28	27	30	33	13–37	28
	5		41•						17•	39			37	35	39		26		39	26–39	36
	6									33			41•		48		47•			33–48	40
	1	7	7	7	7	7		6	6	6	7	7	-	6	-	8	6	-	-	6–8	7
	2	11	10	10	11	11		11	12	10	11	10	10	10	8	11	11	9	10	8–12	10
S.c.	3	12	11	11	13	16		11	14	11	10	10	11	12	12	12	11	12	11	10–16	12
	4		11		16			15	17	13	13	11	14	11	14	14	13	14	11	11–17	13
	5									15			14	12	15	17	16		12	12–17	14
	6									16					17					16–17	16.5

Table 52 Measurements of *Fusulinella* ex gr. *mosquensis* Rauser-Chernoussova *et* Safonova

	Specimen:	Axial sections 6	7	4	5	12	Sagittal sections 10	11	3	8	RANGE	AVERAGE
R.v.	0	43	41	—	38	37	52	40	33	28	28–52	39
	1	86	77	—	71	64	105	95	82	69	64–105	81
	2	172	131	146	125	116	189	168	163	120	116–189	148
	3	280	204	323	251	212	310	289	305	205	204–323	264
	4	502	370	561	450	357	518	510	535	342	342–561	461
	5	748	561	884	731	510•	671•	731	867	574	561–867	728
	6	—•		—•	935•						——	——
G.r.	1	100	69	—	76	80	80	77	100	75	69–100	82
	2	65	56	121	101	83	64	72	87	71	56–121	80
	3	79	81	74	79	68	68	76	75	66	66–81	74
	4	49	52	58	62			43	62	68	43–68	56
	5											
F.r.	1	1.03	1.14	—	0.79	1.07					0.79–1.14	1.01
	2	1.20	1.54	1.81	1.21	1.48					1.20–1.81	1.45
	3	1.61	2.25	1.66	1.49	2.12					1.49–2.25	1.83
	4	1.64	2.71	2.12	1.96	2.52					1.64–2.71	2.19
	5	2.00	2.67	2.38	2.16	2.78•					2.00–2.67	2.30
	6	—•		—•	2.40•						——	—
W.th.	1	13	10	—	13	9	13	11	11	11	9–13	11
	2	26	13	—	26	26	21	19	19	12	12–26	20
	3	32	19	34	34	34	34	34	40	17	17–40	31
	4	34	28	49	49	39	47	40	52	27	27–52	41
	5	28	26	54	44	34•	52•	43	40	41	26–54	39
	6	—•									——	
S.c.	1						7	7	-	6	6–7	7
	2						10	10	10	9	9–10	10
	3						13	11	13	10	10–13	12
	4						15	13	15	13	13–15	14
	5							16	19	14	14–19	16
T.a.	2	28	20	25	35	28					20–35	27
	3	27	41	36	35	34					27–41	35
	4	—	—	46	37	44					37–46	42
	5	50	56	52	51	—					50–56	52
Ch.h.	1	0.33			0.15						0.15–0.33	0.24
		0.43		0.38	—						0.38–0.43	0.40
	2	0.40	0.38	—	0.32	0.27					0.27–0.40	0.34
		0.32	0.40	—	0.36	0.44					0.32–0.44	0.38
	3	—	—	0.32	0.38	0.34					0.32–0.38	0.35
		0.57	—	—	0.37	0.39					0.37–0.57	0.44
	4	—	—	0.38	0.36	0.37					0.36–0.38	0.37
		—	—	—	—	0.29					——	—
	5	0.34	0.41	0.28	0.47						0.28–0.47	0.37
				0.42	0.44						0.42–0.44	0.43
	6											

Table 53 Measurements of *Fusulinella* ex gr. *colaniae* Lee *et* Chen

	Specimen:	Axial sections 2	1	5	8	14	3	6	4	10	RANGE	AVERAGE		Sagittal sections 11	15	12	9	13	RANGE	AVERAGE
R.v.	0	48	45	45	44	41	40	37	35	26	26–48	40		45	45	45	41	40	40–45	43
	1	82	90	82	82	86	92	78	80	58	58–92	81		103	102	90	88	90	88–103	95
	2	146	150	125	127	144	156	132	144	102	102–156	136		176	170	150	153	136	136–176	157
	3	245	238	212	221	238	245	229	259	178	178–259	229		272	272	238	255	225	225–272	252
	4	432	416	357	374	391	370	372	374	289	289–432	375		429	476	348	421	365	348–476	408
	5	637	671	540	552	535•	590	605	599	442	442–671	580		697	799	616	637	586	586–799	667
	6			782•			710•	1003	727•	663	663–1003	833		1037		782•	833•		——	——
	7									782•	——	——								
G.r.	1	79	67	53	54	67	70	89	80	76	53–80	58		71	66	67	73	51	51–73	66
	2	68	59	70	74	65	57	73	79	75	57–79	69		55	60	59	67	66	55–67	61
	3	76	75	68	69	64	50	62	44	62	44–76	63		58	75	46	65	62	46–75	61
	4	47	61	51	48		59	63	60	53	47–63	55		62	68	77	52	60	52–77	64
	5							66		50	50–66	58			30				——	—
	6																			
F.r.	1	1.26	1.05	1.13	1.05	1.00	0.82	—	1.11	0.80	0.80–1.26	1.03		8	6	9	6	7	6–9	7
	2	1.71	1.89	1.72	1.47	1.29	1.36	1.40	1.59	1.17	1.17–1.89	1.51		11	13	11	13	10	10–13	11
	3	2.10	2.32	1.60	1.88	1.93	1.69	1.90	1.87	1.76	1.60–2.32	1.89	S.c.	15	14	13	15	13	13–15	14
	4	2.18	2.20	2.24	2.00	2.09	1.87	2.11	2.07	1.94	1.87–2.24	2.08		-	13	13	15	14	13–15	14
	5	2.28	2.30	2.65	1.97	2.02•	1.96	2.28	2.18	2.12	1.96–2.65	2.22		-	15	12	17	17	12–17	15
	6			2.24•			2.43•	2.20	2.06•	2.10	2.10–2.20	2.15			21	17			17–21	19
	7									2.37•	——	—								
W.th.	1	12	11	10	9	9	9	11	12	11	9–12	10		11	9	11	9	9	9–11	10
	2	19	21	17	11	13	19	17	15	17	11–21	17		14	13	17	11	15	11–17	14
	3	32	26	21	30	24	34	25	26	-	21–34	27		26	32	30	26	26	26–32	28
	4	32	30	32	43	29	32	34	-	34	29–43	33		41	44	39	27	32	27–44	36
	5	22	41	34	22	-	45	42	39	34	22–45	35		45	59	43	38	22	22–59	41
	6			37•			43•	49	26•	39	39–49	44			37	-•			——	—
	7									34•	——	—								
T.a.	2	25	30	29	32	24	27		25	26	24–32	27								
	3	36	51	32	37	49	52		27	28	27–52	36								
	4	40	48	38	41	53	74		35	28	28–74	42								
	5	46	70	61	-				41	29	29–70	53								
	6									45	——	—								
Ch.h.	1										——	—								
			0.36			0.27	0.32	0.33			0.27–0.36	0.32								
	2	0.32	—	0.40	0.33	—	—	—	0.38		0.32–0.40	0.36								
		0.40	0.43	0.26	0.34	0.35	0.26	0.33	—		0.26–0.43	0.34								
	3	0.42	0.32	0.28	—	0.32	—	—	0.28		0.28–0.42	0.32								
		0.35	0.37	0.35	0.35	0.30	0.30	0.33	—	0.47	0.30–0.47	0.35								
	4	0.40	0.45	0.33	0.43	0.30	0.18	—	0.42	—	0.18–0.45	0.36								
		0.46	0.30	0.26	0.48	0.36	0.36	—	0.40	0.44	0.26–0.48	0.38								
	5	0.37	0.33	0.32			0.28	—	0.32	—	0.28–0.37	0.32								
							0.37	0.28	0.17	0.29	0.17–0.37	0.28								
	6									0.39	——	—								

Table 54 Measurements of *Fusulinella* ex gr. *bocki* Moeller (1st assemblage)

Axial sections

Specimen:		20	31	16	24	11	22	14	19	10	RANGE	AVERAGE
R.v.	0	61	55	53	53	51	49	44	43	41	41–61	50
	1	144	110	136	119	102	90	98	77	95	77–144	108
	2	255	187	255	204	204	178	168	153	172	153–255	197
	3	408	306	391	323	357	289	310	251	270	251–408	323
	4	629	527	620	493	557	476	563	391	445	391–629	522
	5	880	782	952	765	850	765	725•	654	745	654–880	799
	6	939•	1088	1071•	1164		1156		960	1105	960–1164	1095
	7				1351•		1351•		1241	—	——	—
G.r.	1	76	69	87	71	100	98	71	99	81	69–100	84
	2	60	64	53	58	75	62	85	64	57	53–85	64
	3	54	72	59	53	56	65	82	56	65	53–82	62
	4	40	48	53	55	53	61		67	67	40–67	56
	5		39		52		51		47	48	39–52	47
	6											
F.r.	1	1.18	1.15	1.19	1.14	1.17	1.24	1.10	1.28	0.95	0.95–1.28	1.16
	2	1.53	1.50	1.50	1.42	1.33	1.29	1.60	1.44	1.25	1.25–1.60	1.43
	3	1.65	1.67	1.78	1.61	1.43	1.56	1.65	1.76	1.50	1.43–1.78	1.62
	4	1.94	1.82	1.62	1.93	1.37	1.75	1.64	1.48	1.65	1.37–1.94	1.69
	5	2.32	2.41	1.73	2.12	1.50	1.79	1.81•	1.68	1.80	1.50–2.41	1.92
	6	2.76•	—	1.95•	2.24		1.88		1.97	2.11	1.88–2.24	2.05
	7				2.40•		2.12•		2.09		——	—
W.th.	1	-	11	17	-	-	-	15	13	10	10–17	13
	2	32	21	-	27	26	30	30	-	23	21–32	27
	3	34	34	47	27	-	37	31	-	29	27–47	34
	4	54	43	57	40	-	-	-	34	33	33–57	44
	5	37	58	56	67	-	54	35•	37	42	37–67	50
	6	28•	-	37•	86		60		67	35	35–86	62
	7				-•		28•		-		——	—
T.a.	2	31	18	29	25	18	22	23	20	32	18–32	24
	3	23	24	23	19	19	25	28	28	25	19–28	24
	4	43	42	23	23	21	25	33	18	25	18–43	28
	5	48	45	35	37	27	29	43	20	42	20–48	36
	6			37	53		36		36	38	35–53	40
Ch.h.	0											
			0.22		0.26		0.32	0.21			0.21–0.32	0.25
	1		—	0.27	0.25	0.42	—	—		0.30	0.25–0.42	0.31
		0.42	—	—	0.31	0.40	0.40	0.41		0.44	0.31–0.44	0.40
	2	—	—	0.43	0.46	0.39	—	0.41		0.47	0.39–0.47	0.43
		0.45	0.37	—	0.42	0.47	0.52	0.42	0.47	0.48	0.37–0.52	0.45
	3	0.49	—	0.48	—	—	0.48	0.36	—	0.51	0.36–0.51	0.46
		0.56	0.42	—	0.51	0.44	—	0.45	—	0.38	0.38–0.56	0.46
	4	0.41	0.34	—	0.29	—	—	0.44	0.51	—	0.29–0.51	0.40
		0.39	0.34	0.31	0.37	0.42	0.43		—	—	0.31–0.43	0.38
	5	0.33	—	0.41	0.40	0.59	0.34		—	0.31	0.31–0.59	0.40
		0.44	0.38	0.24	0.39		0.39		0.50	0.38	0.24–0.50	0.39
	6			0.32	0.30		0.48		0.45	0.30	0.30–0.48	0.37
					0.48		0.48		0.41		0.41–0.48	0.46
	7										——	—

Table 54 Measurements of *Fusulinella* ex gr. *bocki* Moeller (1st assemblage)

Sagittal sections

Specimen:		13	7	30	1	6	21	29	RANGE	AVERAGE
R.v.	0	54	48	45	44	41	38		38–54	45
	1	133	92	95	98	90	95		90–133	100
	2	263	161	176	187	163	176		161–263	188
	3	438	272	323	280	306	264		264–438	314
	4	714	459	595	425	442	408		408–714	507
	5	1003	765			646	680		646–1003	774
	6		1071			952	1028		952–1071	1017
	7					1266	1156•		——	—
G.r.	1	98	75	86	91	81	86		75–98	86
	2	66	69	84	50	88	50		50–88	68
	3	63	69	84	52	44	55		44–84	61
	4	40	67			46	67		40–67	55
	5		40			47	54		40–54	47
	6					33			——	—
	7									
W.th.	1	18	11	9	15	15	15	24	9–24	15
	2	40	17	17	26	25	26	42	17–42	28
	3	45	41	32	32	39	32	43	32–45	38
	4	60	45	34	13	39	35	47	13–60	39
	5	-	48			56	45	58	45–58	52
	6		37			43	51	-•	37–51	44
	7					30			——	-
S.c.	1	8	7	7	8	7	7	6	6–8	7
	2	13	-	11	11	11	11	13	11–13	12
	3	14	13	12	15	13	14	15	12–15	14
	4	18	16	15	20	18	17	17	15–20	17
	5	17	21			18	22	20	17–22	20
	6		24			18	21		18–24	21
	7					18			——	—

Table 55 Measurements of *Fusulinella* ex gr. *bocki* Moeller (2nd assemblage)

		Axial sections					Sagittal sections				
Specimen:		14	17	12	3	5	16	6	15	RANGE	AVERAGE
	0	38	37	37	35	-	43	43	41	35–43	39
	1	73	82	65	61	62	118	90	112	61–118	83
	2	161	153	102	111	111	195	172	176	102–195	148
R.v.	3	289	251	204	196	194	302	289	297	194–302	253
	4	493	391	314	357	329	476	476	497	314–497	417
	5	799	561	510	646	540	578*	680	816	510–816	650
	6	935*		731	867	823				731–867	807
	1	121	87	57	82	79	65	90	58	57–121	80
	2	80	64	100	77	75	54	68	69	54–100	73
G.r.	3	71	56	54	82	70	58	65	67	54–82	65
	4	62	43	62	81	64		43	64	43–81	60
	5			40	34	52				34–52	42
	6										
	1	1.35	1.00	1.00	1.07	0.87				0.87–1.35	1.06
	2	1.67	1.33	1.33	1.38	1.21				1.21–1.67	1.38
F.r.	3	2.06	1.66	1.50	1.65	1.46				1.46–2.06	1.67
	4	2.02	1.74	1.73	1.57	1.66				1.57–2.02	1.74
	5	2.10	2.21	2.02	1.74	1.83				1.74–2.21	1.98
	6	2.22*		2.16	2.00	1.93				1.93–2.16	2.03
	1	17	13	9	9	9	15	13	10	9–17	12
	2	19	17	13	13	13	26	19	21	13–26	18
W.th.	3	43	23	34	24	26	34	26	28	23–43	30
	4	52	39	43	28	-	27	37	-	27–52	38
	5	52	22	47	77	-	17*	-	-	22–77	49
	6	60*		39	-	-				—	—
	1						6	6	-	—	6
	2						10	10	12	10–12	11
S.c.	3						13	10	12	10–13	12
	4						14	13	13	13–14	13
	5							17	15	15–17	16
	1									—	—
			0.29							—	—
	2		0.23	0.26						0.23–0.26	0.24
			0.29	0.22	0.37					0.22–0.37	0.29
Ch.h.	3	0.40	—	0.28	0.40					0.28–0.40	0.36
		—	0.40	0.32	0.48					0.32–0.48	0.40
	4	0.41	0.35	0.47	0.34					0.34–0.47	0.39
		0.25	—	0.37	0.35					0.25–0.37	0.32
	5	0.35	0.27	0.35	0.27					0.27–0.35	0.31
		0.31		0.35	0.37					0.31–0.37	0.34
	6			0.39	0.29					0.29–0.39	0.34

Table 56 Measurements of *Fusulinella* ex gr. *bocki* Moeller (3rd assemblage)

		Axial sections				Sag. s.	C.obl.s.		
Specimen:		30	17	27	26	1	10	RANGE	AVERAGE
	0	56	43	39	—	47	43	39–56	46
	1	102	93	93	68	102	85	68–102	90
	2	187	153	153	136	170	153	136–187	159
R.v.	3	306	255	255	238	272	272	238–306	266
	4	450	425	442	391	323*	459	391–459	433
	5		561*	680	595		714	595–714	663
	1	83	64	64	100	67	80	64–100	76
	2	64	67	67	75	60	78	60–78	69
G.r.	3	47	67	73	64		69	47–73	64
	4			54	52		56	52–56	54
	5								
	1	1.33	1.09	—	1.50			1.09–1.50	1.31
	2	1.50	1.56	1.22	1.69			1.22–1.69	1.49
F.r.	3	1.69	1.90	1.37	1.71			1.37–1.90	1.67
	4	1.80	1.92	1.44	1.78			1.44–1.92	1.74
	5		1.94*	1.60	1.94			1.60–1.94	1.83
	1	13	15	13	16	16	-	13–16	15
	2	24	15	15	21	21	-	15–24	19
W.th.	3	28	24	25	25	28	43	25–43	29
	4	-	-	25	30		39	25–39	31
	5			30	-		-	—	—
	2	27	23	-	23		20	20–27	23
	3	31	30	22	35		33	22–35	30
T.a.	4	32	31	26	35		40	26–40	33
	5			31	-		43	31–43	37
	1								
		0.38	0.30				0.42	0.30–0.42	0.37
	2	0.33	0.44		0.38		—	0.33–0.44	0.38
		0.35	0.38		0.39		0.35	0.35–0.39	0.37
Ch.h.	3	0.35	0.35	0.44	0.34		0.44	0.34–0.44	0.38
		0.43	0.31	0.37	0.34		0.50	0.31–0.50	0.39
	4	0.32	0.47	0.47	0.31		0.48	0.31–0.48	0.41
			0.44	—	0.24		0.42	0.24–0.44	0.37
	5			0.34	0.33			0.33–0.34	0.33

Table 57 Measurements of *Fusulinella* ex gr. *bocki* Moeller (4th assemblage)

Specimen:		Axial sections 19	16	7	Sagittal sections 7(2)	26	24	21	RANGE	AVERAGE
	0	57	43	35	64	58	49	47	35–64	50
	1	120	107	54	153	120	112	110	54–153	111
	2	206	183	115	280	204	211	196	115–280	199
R.v.	3	366	280	195	518	374	357	327	195–518	345
	4	629	459	304	824	612	484	501	304–824	545
	5	696	761	500		901	744	795	500–901	733
	6	1084•	1071	750			1054	1113	750–1113	997
	7		1190•	1089			1250•		——	—
	8			---•					——	—
	1									
	2	71	71	113	83	70	88	78	70–113	82
	3	78	53	70	85	83	69	67	53–85	72
G.r.	4	72	64	56	59	64	36	53	36–72	58
	5	63	66	64		47	54	58	47–66	59
	6		41	50			42	40	40–50	44
	7			45					—	—
	1	1.07	1.00	—					1.00–1.07	1.04
	2	1.50	1.21	1.69					1.21–1.69	1.47
F.r.	3	1.58	1.64	2.04					1.58–2.04	1.75
	4	1.55	1.72	2.14					1.55–2.14	1.80
	5	1.55	1.71	1.96					1.55–1.96	1.74
	6	1.62•	1.81	2.05					1.81–2.05	1.93
	7		1.93•	1.97					——	—
	1	13	-	11	24	17	18	11	11–24	16
	2	24	19	17	39	18	22	22	17–39	23
	3	43	-	26	43	28	41	46	26–46	38
W.th.	4	34	-	32	34	52	29	49	29–52	38
	5	41	60	52		39	47	69	39–69	51
	6	26•	54	82			44	58	44–82	59
	7		25•	99			31•		—	—
	1				7	6	8	8	6–8	7
	2				11	12	10	14	10–14	12
S.c.	3				14	14	13	16	13–16	14
	4				16	16	-	19	16–19	17
	5					19	16	19	16–19	18
	6						19	22	19–22	20.5
	2	31	-	21					21–31	26
	3	30	22	21					21–30	24
T.a.	4	37	32	30					30–37	33
	5	36	34	31					31–36	34
	6	43	37	35					35–43	38
	7			-					—	—
	1	0.44								
		—	0.39							
	2	0.40	0.42							
		—	0.33							
	3	—	—							
		—	0.30							
Ch.h.	4	0.63	0.36							
		0.45	0.38							
	5	0.46	0.33							
		0.15	0.51							
	6		0.37							
			0.24							
	7									

Table 58 Measurements of *Fusulinella* ex gr. *pulchra* Rauser-Chernoussova (1st assemblage)

Specimen:		Axial sections 21	25	22	26	23	27	Sagittal sections 17	20	18	19	RANGE	AVERAGE
	0	70	67	63	61	51	45	61	60	57	48	45–70	58
	1	131	133	90	120	99	82	112	114	113	92	82–133	109
	2	187	217	166	210	170	140	195	195	174	153	140–217	181
	3	280	297	255	310	255	208	289	306	272	238	208–310	271
R.v.	4	404	416	374	440	408	323	408	433	400	340	323–440	395
	5	544	591	527	600	629	463	535	633	552	493	463–633	557
	6	761	799	705	795	833	646	740	850	718	671	646–850	752
	7	969	1033	926	1035	1045	744•	969		846•	863	863–1045	977
	8			1101•	1165•								
	1												
	2	43	63	84	75	72	71	74	71	54	66	43–84	67
	3	50	37	54	48	50	49	48	57	56	56	48–57	51
G.r.	4	44	40	40	42	60	55	41	42	47	43	40–60	45
	5	35	42	42	36	54	43	31	46	38	45	31–54	41
	6	40	35	35	33	32	39	38	34	30	36	30–40	35
	7	27	29	29	30	26		31			28	26–31	29
	1	1.05	1.10	1.33	1.00	1.30	1.29					1.00–1.33	1.18
	2	1.68	1.31	1.49	1.22	1.40	1.45					1.22–1.68	1.43
	3	1.52	1.49	1.55	1.40	1.57	1.43					1.40–1.57	1.49
F.r.	4	1.77	1.55	1.75	1.46	1.42	1.53					1.42–1.77	1.58
	5	1.92	1.78	1.61	1.52	1.39	1.61					1.39–1.92	1.64
	6	1.99	1.78	1.83	1.51	1.35	1.61					1.35–1.99	1.68
	7	2.04	1.86	1.62	1.62	1.48	1.60•					1.48–2.04	1.84
	8			1.83•	1.70•								
	1	13	13	13	14	13	11	15	17	-	11	11–17	13
	2	17	-	15	24	17	13	19	25	14	17	13–25	18
	3	34	30	21	26	26	26	31	30	29	22	21–34	26
W.th.	4	35	35	28	32	30	26	27	47	29	28	26–47	32
	5	45	40	28	38	43	37	34	35	33	32	28–45	36
	6	52	40	42	53	45	43	61	51	48	41	40–61	48
	7	53	39	-	54	46	43•	58		44•	35	35–58	47
	8			45•	52•								
	1							7	8	6	-	6–8	7
	2							13	16	12	13	12–16	13.5
	3							16	17	15	15	15–17	16
S.c.	4							22	19	17	18	17–22	19
	5							26	21	24	20	20–26	23
	6							25	23	23	20	20–25	23
	7							29			29		29
	1	0.32	0.30	0.30								0.30–0.32	0.31
		—	—	—								——	—
	2	0.40	0.25	0.45	0.25	0.39	0.41					0.25–0.45	0.36
		0.30	—	0.35	0.36	—	—					0.30–0.36	0.34
	3	0.40	0.37	0.39	0.33	0.39	0.44					0.33–0.44	0.39
		0.34	0.31	0.44	—	0.38	0.32					0.31–0.44	0.36
Ch.h.	4	0.34	0.40	—	0.35	0.37	0.43					0.34–0.43	0.38
		0.39	0.33	—	0.33	0.29	0.45					0.29–0.45	0.36
	5	0.32	—	0.36	0.38	0.32	0.38					0.32–0.38	0.35
		0.21	0.35	0.43	0.26	0.36	0.29					0.21–0.43	0.32
	6	0.30	0.43	0.20	0.31	0.35	—					0.20–0.43	0.32
		0.36	0.39	0.42	0.17	0.40	0.50					0.17–0.50	0.37
	7	0.17	0.20		0.35	0.26						0.17–0.35	0.25

Table 59 Measurements of *Fusulinella* ex gr. *pulchra* Rauser-Chernoussova (2nd assemblage)

Axial sections

Specimen:		38	29	22	12	43	16	7	19	36	31	28	20	33	17	RANGE	AVERAGE
	0	64	—	—	46	45	43	43	37	39	—	—	—	32	43	32–64	44
	1	112	95	86	82	77	90	73	73	69	73	—	82	67	105	67–112	83
	2	178	159	142	129	138	133	133	129	116	125	125	146	112	181	112–181	139
	3	263	246	219	206	204	221	195	187	202	204	217	238	166	282	166–282	218
R.v.	4	382	357	323	272	306	331	285	314	297	306	330	357	251	391	251–391	322
	5	442•	501	450	—	425	450	382	459	416	442	465	510	357	493•	357–510	442
	6		671	595			603	—	527•	552	527•	655	697	425•		552–697	629
	7		714•	765								750•				——	—
	8			—•												——	—
	1	59	68	65	58	78	48	82	76	69	71	-	79	68	71	48–82	69
	2	48	55	55	60	48	66	47	45	74	63	74	63	48	56	45–74	57
	3	45	45	47	32	50	50	46	68	47	50	52	50	51	39	32–68	48
G.r.	4		40	39		39	36	34	46	40	44	41	42	42		34–46	40
	5		33	32			34			33		41	37			32–41	35
	6			29												——	—
	7																
	1	1.19	1.18	—	1.08	1.22	—	1.18	—	1.06	1.41	—	—	0.97		0.97–1.41	1.16
	2	1.33	1.41	1.45	1.28	1.50	1.68	1.29	1.40	1.33	1.66	—	1.76	1.35		1.28–1.76	1.45
	3	1.48	1.52	1.65	1.37	1.62	1.77	1.65	1.64	1.53	1.58	1.54	1.79	1.38		1.37–1.79	1.58
F.r.	4	1.51	1.48	2.10	1.53	1.58	1.74	1.85	1.65	1.71	1.56	1.76	1.79	1.52		1.48–2.10	1.68
	5		1.71	2.08	1.39•	1.60	1.81	1.91	1.57	1.65	1.69	2.10	1.90	1.47		1.47–2.10	1.77
	6		1.71	1.91			1.98	1.86•	1.69•		1.68•	2.32	1.80			1.71–2.32	1.94
	7		1.79•									2.26•				——	—
	1	13	-	-	13	11	11		13	11	11	-	-	9		9–13	11.5
	2	13	17	-	15	19	17		17	13	19	22	21	13		13–22	17
	3	26	24	24	21	22	28		22	15	21	26	22	17		15–28	22
W.th.	4	-	30	26	-	26	24		28	26	26	34	26	26		24–34	27
	5		32	28	24	32	34		28	30		34	39	22		22–39	30
	6		39	32			-		32•	28		30	-	26•		28–39	32
	7											28•				——	—
	1	12	-	-	-	-	17	-	15	15	11	-	15	-		11–15	14
	2	11	15	15	-	-	12	12	13	12	18	-	19	10		10–19	14
	3	12	16	10	16	11	11	12	13	10	11	13	16	12		10–16	13
T.a.	4	11	10	10	11	8	14	15	10	13	15	14	16	11		8–16	12
	5		14	19	-	10	15	14	28	18	12	19	18	14		10–28	16
	6		10	27			-		-	10		34	19			10–34	20
	7			28												——	—
	1					0.47										——	—
						—		0.33		0.45	0.36					0.33–0.45	0.38
	2		0.47	0.40	0.32	0.50		—		—	—			0.40		0.32–0.50	0.42
			0.46	—	—	—		—	0.41	0.39	0.29	0.44		—		0.29–0.46	0.40
	3		0.50	0.44	—	—	0.50	0.35	0.47	—	—	0.45	0.48	0.36		0.35–0.50	0.44
			—	—	0.48	—	—	0.59	0.47	0.39	0.44	—	—	—		0.39–0.59	0.47
Ch.h.	4		—	0.36	0.43	0.45	0.49	0.54	0.46	0.42	—	—	0.43	—		0.36–0.54	0.45
			0.48	—	0.42	—	—	0.46	0.46	0.48	—	—	—	0.44		0.42–0.48	0.46
	5		—	0.34		0.44	0.38	—	—	—	—	—	0.43	0.48		0.34–0.48	0.41
			0.48	—			0.38	0.44	0.28	0.44	0.45	—	0.42			0.28–0.48	0.41
	6		0.29	0.48								0.44				0.29–0.48	0.40
			0.50													——	—
	7																

Table 60 Measurements of *Fusulinella* sp. 1

Axial sections

Specimen:		12(1)	8	14	12(2)	10	7	13	11	9	33	RANGE	AVERAGE
	0	56	53	51	47	46	46	45	41	37	37	37–56	46
	1	118	95	90	95	103	89	95	90	82	106	82–118	96
	2	187	166	187	183	178	161	187	148	133	180	133–187	171
	3	323	319	306	297	323	268	300	234	221	294	221–323	289
R.v.	4	535	497	510	493	502	476	425	383	340	470	340–535	463
	5	773	740	748	714	782	731	620	510•	603	755	603–773	718
	6		850•	986		1037				705•	1080	936–1080	1034
	7										1190•	——	—
	1	58	75	108	93	73	81	97	64	63	70	58–108	68
	2	73	92	64	63	81	66	60	58	66	63	58–92	69
G.r.	3	66	56	67	66	55	78	42	64	54	60	42–78	61
	4	44	49	47	45	56	54	46		77	61	44–77	53
	5			32		33					43	32–43	36
	6												
	1	1.18	1.27	1.52	1.18	1.29	1.06	1.17	0.79	0.87	—	0.79–1.52	1.15
	2	1.64	1.41	1.82	1.53	1.67	1.53	1.31	1.23	1.18	1.52	1.18–1.82	1.48
F.r.	3	1.61	1.32	1.93	1.69	1.58	1.75	1.92	1.64	1.42	1.74	1.32–1.93	1.66
	4	1.67	1.35	1.73	1.67	1.63	1.98	2.09	1.60	1.87	1.77	1.35–2.09	1.74
	5	1.71	1.54	2.04	1.86	1.52	2.06	2.20	1.46•	2.08	1.67	1.52–2.20	1.85
	6		1.54•	1.95		1.66				2.36	1.74	1.66–1.95	1.78
	7										1.86•		
	1	16	12	17	-	17	9	13	13	12	17	9–17	14
	2	28	21	22	19	22	13	17	21	15	26	13–28	20
W.th.	3	32	32	28	32	39	24	25	26	28	34	24–39	30
	4	53	45	43	58	45	37	25	34	38	56	25–58	43
	5	-	41	62	34	90	39	47	17•	67	60	34–90	55
	6					34•					-	——	—
	2	29	32	44	29	27	27	44	20	24	28	20–44	30
	3	34	36	44	27	30	35	43	27	28	25	25–44	33
T.a.	4	34	36	39	29	31	35	45	32	32	31	29–45	34
	5	-	35	54	47	33	47	57		43	36	33–57	41
	6					-					33	——	—
	1		0.23	0.27			0.29					0.23–0.29	0.26
		0.23	—	0.32		0.22	0.27	0.25		0.29	0.48	0.22–0.48	0.29
	2	0.31	0.28	0.30	0.37	0.43	0.40	0.27		0.29	—	0.27–0.43	0.34
		0.30	0.27	0.34	—	0.36	0.36	0.40	0.31	0.38	0.42	0.27–0.42	0.35
Ch.h.	3	0.31	0.21	0.31	0.41	0.27	0.41	0.22	0.24	0.28	0.45	0.21–0.45	0.31
		0.25	0.30	—	—	0.27	0.34	0.36	—	0.29	0.43	0.25–0.43	0.32
	4		0.28	0.43	0.27	0.42	0.29	0.24	—	0.51	0.40	0.24–0.51	0.35
			0.24	0.26	0.32	0.43	0.27	0.44	0.19	0.35	0.35	0.19–0.44	0.32
	5		0.38		0.20		0.23	0.09		0.38	0.33	0.09–0.38	0.27
			0.12					0.18		0.30	0.32	0.12–0.39	0.27
	6										0.30	——	—

Table 60 Measurements of *Fusulinella* sp. 1

Sagittal sections

Specimen:		23	18	21	22	17	16	15	20	19	RANGE	AVERAGE
R.v.	0	56	54	53	53	49	48	47	41	—	41–56	50
	1	107	110	131	118	116	125	116	114	—	107–131	117
	2	176	204	185	204	217	200	178	187	148	148–217	189
	3	289	323	297	340	357	306	297	289	238	238–357	304
	4	442	463	476	510	523	493	493	442	391	391–523	470
	5	608	680	544•	714	697	744	570•	646	574	574–744	666
	6	714•	765•			790•			748•	—	—	—
G.r.	1											
	2	64	85	41	73	87	60	53	64	-	41–87	66
	3	64	58	61	67	65	53	67	55	61	53–67	61
	4	53	43	60	50	46	61	66	53	64	43–66	55
	5	38	47		40	33	51		46	47	33–51	43
W.th.	1	9	13		15	13	16	12	15	11	9–16	13
	2	20	25		21	25	19	17	24	15	15–25	21
	3	-	47		19	28	32	38	27	24	19–47	29
	4	45	47		43	49	33	49	34	29	29–49	41
	5	34	62		47	60	-		44	44	34–62	49
	6	30•	59•			41•			43•	37•	—	—
S.c.	1	7	7	7	7	7	7	7	6	6	6–7	7
	2	10	12	12	10	9	11	12	10	10	9–12	11
	3	12	12	12	12	12	14	14	14	11	11–14	13
	4	17	17	15	13	13	16	13	14	14	13–17	15
	5	18	15		14	15	18		15	15	14–18	16

Table 61 Measurements of *Fusulinella* sp. 2

Axial sections

Specimen:		15	9	5	3	2	RANGE	AVERAGE
R.v.	0	45	42	42	41	31	31–45	40
	1	99	82	82	77	69	69–99	82
	2	153	144	138	133	120	120–153	138
	3	246	251	234	206	200	200–251	227
	4	374	408	348	306	316	306–408	350
	5	578	655	544	396•	493	493–655	568
	6	629•	876	748		740	740–876	788
	7			829•			—	—
G.r.	1							
	2	55	76	68	73	75	55–76	69
	3	61	74	70	55	67	55–74	65
	4	52	63	49	49	57	49–63	54
	5	55	60	56		57	55–60	57
	6		34	38		50	34–50	41
F.r.	1	1.30	1.18	0.97	1.00	0.94	0.94–1.30	1.08
	2	1.44	1.85	1.27	1.45	1.16	1.16–1.85	1.43
	3	1.66	2.37	1.60	2.00	1.66	1.60–2.37	1.86
	4	2.00	2.88	2.00	2.03	2.03	2.00–2.88	2.19
	5	2.06	2.73	2.13	1.85•	2.28	2.06–2.73	2.30
	6	2.46•	2.80	2.32		2.33	2.32–2.80	2.48
	7			2.26•			—	—
W.th.	1	15	13	11		9	9–15	12
	2	17	20	19		17	17–20	18
	3	32	24	21		28	21–32	26
	4	26	39	43		34	26–43	35
	5	41	41	39		43	39–43	41
	6	24•	41	49		49	41–49	46
	7							
T.a.	2	28	29	20	12	12	12–29	20
	3	34	30	26	29	23	23–34	28
	4	33	54	31	36	34	31–54	38
	5	39	-	45	-	45	39–45	43
	6			66		64	64–66	65
Ch.h.	1			0.30			—	—
		0.32		0.36			0.32–0.36	0.34
	2	0.43	0.30	0.35		0.25	0.25–0.43	0.34
		—	0.33	0.33		—	—	0.33
	3	0.35	0.35	0.30		0.46	0.30–0.46	0.36
		—	0.32	0.45		0.39	0.32–0.45	0.39
	4	—	0.42	0.35		0.32	0.32–0.42	0.36
		—	0.27	0,44		0.41	0.27–0.44	0.37
	5	0.31	0.29	0.36		0.61	0.29–0.61	0.39
		abs.	0.32			0.52	abs.–0.38	0.28
	6		0.30			0.38	0.30–0.38	0.34

Sagittal sections

Specimen:		13	4	1	6	11	12	3	RANGE	AVERAGE
R.v.	0	39	37	33	33	31	30	-	30–39	34
	1	99	82	86	80	82	73	64	64–99	81
	2	161	148	150	129	138	126	108	108–161	137
	3	255	221	245	230	238	200	172	172–255	223
	4	425	391	404	404	348	306	258	258–425	362
	5	637	646	586	676	561	489	391	391–676	569
	6	918	—	765•		807	765	578	578–918	767
	7						850•	680•	—	—
G.r.	1									
	2	63	82	75	62	68	72	68	62–82	70
	3	58	49	63	78	72	59	59	49–78	63
	4	67	77	64	76	46	53	50	46–77	62
	5	50	65	45	67	61	60	52	45–67	57
	6	44				44	57	48	44–57	48
W.th.	1	11	9	13	13	-	6	9	6–13	10
	2	17	15	19	17	-	11	13	11–19	15
	3	30	21	39	28	21	21	19	19–39	26
	4	34	37	43	30	32	31	26	26–43	33
	5	47	45	57	39	41	48	32	32–57	44
	6	30				26	44	32	26–44	33
	7						37•	22•	—	—
S.c.	1	-	6	7	6	-	6		6–7	6
	2	11	11	12	11	10	9		9–12	11
	3	13	12	12	11	11	11		11–13	12
	4	15	14	14	13	11	11		11–15	13
	5	17	19	19	13	14	15		13–19	16
	6	18				16	16		16–18	17

Table 62 Measurements of *Fusulinella* sp. 3

		Axial sections					C. obl. sect.				
Specimen:		23	11	18	9	21	20	14	5	RANGE	AVERAGE
	0	59	-	-	67	48	45	-	-	45–67	55
	1	105	102	82	136	115	110	108	88	82–136	106
	2	187	204	153	255	195	217	204	166	153–255	198
R.v.	3	332	331	289	417	320	363	323	285	285–417	332
	4	553	561	552	663	520	575	476	490	476–663	549
	5	858	884	850	918	858	840	731	782	731–918	840
	6	1207	1139	1309		1250	1195	1054	1148	1054–1309	1186
	7						——•	——		——	——
	1	78	100	87	88	70	97	89	89	70–100	87
	2	77	63	89	63	64	67	58	72	58–89	69
G.r.	3	67	69	91	59	63	58	47	72	47–91	66
	4	55	58	54	38	65	46	54	60	38–65	54
	5	41	29	54		46	42	44	47	29–54	43
	6										
	1	1.47	—	1.03						1.03–1.47	1.25
	2	1.50	1.75	1.39						1.39–1.75	1.55
F.r.	3	1.74	1.79	1.65						1.65–1.79	1.73
	4	1.75	1.94	1.82						1.75–1.94	1.84
	5	1.94	1.88	1.96						1.88–1.96	1.93
	6	1.86	2.04	2.01						1.86–2.04	1.97
	1	-	-	13	19	14	17		15	14–19	16
	2	19	26	26	32	20	-		25	19–32	25
W.th.	3	28	43	43	47	41	45		41	28–47	41
	4	49	47	56	52	53	50		50	47–56	51
	5	56	86	64		65	66		78	56–86	69
	6						· 78		78	——	78
	2	20	33	22						20–33	25
	3	25	30	25						25–30	27
T.a.	4	41	35	36						35–41	37
	5	39	34	35						34–39	36
	6	51	46	32						32–51	43
	1										
		0.51				0.52	0.44		0.47	0.44–0.52	0.48
	2	—			0.45	—	0.50		—	0.45–0.50	0.47
		0.56			0.44	0.50	—		0.41	0.41–0.56	0.48
Ch.h.	3	—		0.36	0.45	0.42	0.45		0.48	0.36–0.48	0.43
		—		0.44	0.44	0.43	0.51		0.41	0.41–0.51	0.45
	4	0.43	0.32	0.45	0.43	0.38	—		0.46	0.32–0.46	0.41
		0.49	0.32	0.36	0.50	—	0.43		0.41	0.32–0.50	0.42
	5	0.39	0.28	0.55	0.37	0.45	0.31		0.26	0.26–0.55	0.37
		0.46	0.31	0.34		0.46	0.36		0.26	0.26–0.46	0.36
	6	0.37		0.40		0.48	0.47			0.37–0.48	0.43
							0.50			——	—
	7										

Table 63 Measurements of *Protriticites* sp.

		Axial sections									Sagittal sections						
Specimen:		13	21	6	6(2)	12	17	10	20	23	18	14(1)	23	11	14(2)	RANGE	AVERAGE
	0	59	57	56	48	44	—	36	31	26	61	—	41	40	37	26–61	45
	1	107	107	127	85	85	60	76	56	60	136	119	90	85	85	56–136	91
	2	178	185	204	178	136	106	144	99	112	217	187	168	144	161	99–217	158
R.v.	3	306	323	319	289	238	200	255	172	187	327	289	297	238	272	172–327	265
	4	476	489	493	501	382	340	433	302	306	510	493	484	352	—	302–510	428
	5	663	701	765	799	578	612	561•	467	535	—	773	612•	595	578•	467–799	649
	6		795•	850•			—		646	722		—•		—•		646–722	684
	1	68	72	60	110	60	78	89	77	86	60	57	87	69	89	57–110	76
	2	71	75	56	61	75	88	76	74	67	51	55	77	65	69	51–88	69
G.r.	3	56	51	55	74	61	70	70	76	64	56	71	63	48	-	48–76	63
	4	39	43	55	59	51	80		55	75		57		69		39–80	58
	5																
	1	1.36	1.46	1.20		1.10	1.14	1.44	1.54	1.07						1.07–1.54	1.29
	2	1.90	1.59	1.62		1.43	1.60	1.94	1.74	1.37						1.37–1.94	1.65
F.r.	3	2.19	1.68	2.00		1.61	2.04	2.27	2.17	1.55						1.55–2.27	1.94
	4	2.68	2.10	2.41		1.89	2.35	2.84	2.52	1.92						1.89–2.84	2.34
	5	—	2.24	2.62			2.44		3.09	2.65						2.24–3.09	2.61
	6		3.32•	3.20•					3.63	3.64						3.63–3.64	3.63
	1	17	17	-	-	-	9	13	8	11	-	-	9	9	14	8–17	12
	2	21	24	30	17	-	21	-	12	14	18	21	18	17	17	12–30	19
W.th.	3	47	-	26	26	21	-	24	21	24	24	39	26	17	24	17–47	27
	4	30	26	30	34	19	-	26	30	26	34	39	31	22	34	19–39	29
	5	37	30	58	45	39	39	32•	27	40		52		43	37•	27–58	41
	6		-•	-•					31	31						——	31
	1										8	7	7	7	6	6–8	7
	2										15	14	11	14	11	11–15	13
S.o.	3										18	17	12	16	13	12–18	15
	4										16	12	15	16	16	12–16	15
	5											21		15		15–21	18
	2	36	40	-		33		29	29	28						28–40	32
	3	49	34	31		35		51	38	34						31–51	39
T.a.	4	46	37	40		47		62	47	38						37–62	45
	5	56	52	57		75			67	49						49–75	59
	6									70						——	—
	1							0.38		0.25						0.25–0.38	0.31
			0.47					—	0.26	—						0.26–0.47	0.36
	2		0.42	0.43				0.42	0.26	0.48						0.26–0.48	0.36
			0.43	—				—	0.26	0.34						0.26–0.43	0.34
Ch.h.	3	0.35	0.48	0.48		0.35		0.42	0.37	0.42						0.35–0.48	0.41
		0.52	—	—		0.52		0.43	0.34	0.35						0.34–0.52	0.43
	4	—	0.59	0.49	0.52	—		0.50	0.28	0.50						0.28–0.59	0.47
		0.45	0.48	—		0.45		0.58	0.28	0.55						0.28–0.58	0.47
	5		0.60	0.44			0.43		0.30	0.40						0.30–0.60	0.43
										0.62						——	—
	6									0.39						——	—

Abbreviations

t.sp. type specimen

a.s. axial section

s.s. sagittal section

The scale of the microphotographs in the Plates is indicated by a bar representing 500 μ. In general the enlargement in a single Plate is constant but variations are indicated by the insertion of an extra bar.

The specimen numbers quoted correspond to those of the slides in which the specimens have been found; the slides have been deposited under the same numbers in the collection of the Department of Stratigraphy and Palaeontology of the State University of Leiden.
Where more than one specimen of the same species or genus has been measured in the same slide these have been distinguished by affixing a subsiduary number e.g. 12(1) and 12(2).

LEIDSE GEOLOGISCHE MEDEDELINGEN DEEL 34

Errata

Fig. 6b should be after Fig. 6c (Part II, Chapter I)

Aljotovella wagneri should be added below the heading: Loc.L 353 = San Emiliano Formation (Appendix 1)

Profusulinella ex gr. *pararhomboides* Rauser-Chernoussova should be *Profusulinella* ex gr. *pararhomboides* Rauser-Chernoussova et Beljaev (Appendix I, Loc. L 24; Appendix 4, Table 16)

Fusulinella schwagerinoides (Depr.) subsp. *alvaredoi* subsp. nov. should be *Fusulinella schwagerinoides* subsp. *alvaradoi* subsp. nov. (Appendix I, Loc. P 22-2; Appendix 4, Table 48)

Profusulinella cf. *rhombiformis* Brazhnikova et Potievska should be *Profusulinella* cf. *rhombiformis* Brazhnikova et Potievskaja (Appendix 4, Table 19).