A C T A   P A L A E O N T O L O G I C A   P O L O N I C A

Vol. 25 1980 No. 1

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TURONIAN AND CONIACIAN FORAMINIFERA FROM THE NYSA TROUGH, SUDETES, POLAND

GAWOR BIEDOWA E.: 1980. Turonian and Coniacian foraminifera from the Nysa Trough, Sudetes, Poland. Acta Palaeont. Polonica, 25, 1, 3—54, May, 1980.

Turonian to Coniacian foraminifera from the Nysa Trough, Sudetes, are investigated. Totally, 55 species are recorded; 42 species in the Turonian, 49 species in the Coniacian. Most species are benthic forms. Two new species are described from the Turonian: *Dicarinella sudetica* sp. n. and *Dicarinella radwanskae* sp. n. Wall microstructure and alternation of generations are studied in the genus *Gavelinella*. Six foraminiferal zones are recognized; 4 of them in the Turonian (*Dicarinella sudetica* Zone, *Tappanina eouvigeriniformis* Zone, *Archaeoglobigerina cretacea* Zone, and *Dicarinella concavata* Zone), and the remaining 2 in the Coniacian (*Epistomina spinulifera polypioides* Zone and *Gaudryina sudetica* Zone). Changes in composition of the foraminiferal assemblages were caused by changes in water depth and presence/absence of interconnections between the basin and open sea.

Key words: Foraminifera, Turonian, Coniacian, stratigraphy, Sudetes, Poland.

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INTRODUCTION

Cretaceous deposits occur in the Sudetes in the North-Sudetic synclinorium, Intra-Sudetic synclinorium, and Nysa Trough. The Intra-Sudetic synclinorium passes southeastwards into some minor depressions, the largest of which is the Nysa Trough. The borehole Pisary IG has been situated in the vicinity of Międzylesie (fig. 1), close to the trough margin. Thus far, the borehole is the only section in the Nysa Trough from which the whole Upper Cretaceous foraminiferal assemblage has been investigated. Neither in the Intra-Sudetic synclinorium, nor in the Central Sudetes as a whole, is there any exposure showing the whole section of the Cretaceous sedimentary sequence. The continuous core drilling in the borehole Pisary IG made possible a recognition of both lithologic and biostratigraphic sequence in the southern Nysa Trough. Totally, 348 micropaleontologic samples were taken from the Upper Cretaceous sedimentary sequence.

The systematic study of the facies development and lithology of the Cretaceous deposits of the Central Sudetes was initiated and developed by Radwański (1966, 1970, 1975, and other papers). Macrofaunal biostratigraphy of those deposits has been established by Radwańska (1960, 1962, 1965, 1971, and other papers). Micropaleontologic stratigraphy of the Cretaceous of the Nysa Trough has been established by Teisseyre (1975) after exposures. The latter author published a list of the recorded foraminiferal taxa, and paleontologic descriptions of 29 stratigraphically important species.

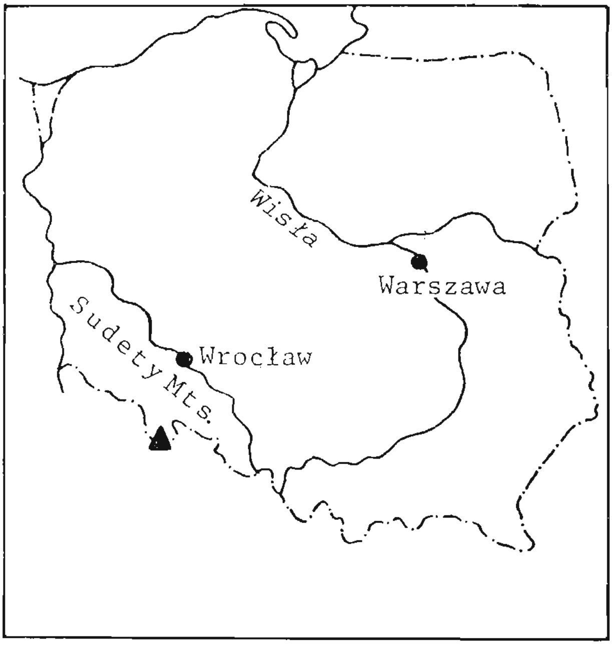


Fig. 1. Location of the Pisary borehole.

In the present paper, the lithologic section given by Radwański (1970, 1975) is accepted, and the macrofaunal biostratigraphic framework established by Radwańska (1971) is followed.

Acknowledgements. — The author wishes to extend her most sincere thanks to Dr. Stanisław Radwański, Geological Institute, Warsaw, for making available the micropaleontologic samples, giving much time to discussion, and reading and criticizing the general part of the text. The author is also grateful to all those who contributed to the present final form of the paper: Dr. Krzysztof Radlicz of the Geological Institute in Warsaw studied wall microstructure in the genus *Gavelinella*; Mrs. Jadwiga Oleksiak (Geological Institute, Warsaw) took the photos of foraminifera and their sections under a light microscope; SEM micrographs were taken at the Nencki Institute of Experimental Biology, Polish

Academy of Sciences, Warsaw; Mrs. Halina Jagodzińska and Mrs. Jolanta Dziubińska (Geological Institute, Warsaw) offered technical assistance.

The investigated micropaleontologic collection is housed at the Geological Institute, Warsaw (abbreviated as IG).

CRETACEOUS MACROFAUNAL BIOSTRATIGRAPHY IN THE BOREHOLE PISARY IG

In the southern Nysa Trough, Cretaceous deposits have been recorded in the borehole Pisary IG at the depth interval of 698.8 to 1.7 m; they overlay Śnieżnik-type gneisses. Their lithological section is given by Radwański (1970, 1975). Their chronostratigraphic pattern has been established by Radwańska on the basis of macrofaunal biostratigraphy, and presented in an unpublished report (Radwańska 1971). Characteristics of the macrofaunal assemblages and their stratigraphic ranges are given below accordingly to the latter report:

Turonian. — The lowermost strata of the Cretaceous sedimentary sequence recorded in the borehole Pisary IG were attributed by Radwański (1970) to the lower Lower Turonian because of their lithologic characteristics, while neither macrofauna, nor microfossils were found. Shells assigned to *Inoceramus labiatus* (Schlotheim) indicative of the Lower Turonian were found by Radwańska in clayey marls at the depth interval of 677.0 to 666.0 m. The associated fauna includes scanty rhynchonellids and fragmented oysters.

Strata with *Inoceramus lamarcki* Parkinson (depth interval of 664.0 to 584.5 m) were assigned by Radwańska to the Middle Turonian. The associated macrofauna is very poor and includes fragmented brachiopods, bivalves, and echinoids.

The Upper Turonian occurs at the depth interval of 564.5 to 400.0 m (Radwański 1970). The macrofaunal assemblage permitted recognition of the lower and upper parts of the substage. The bivalve *Inoceramus striatoconcentricus* Gümbel and the cephalopods *Prionocyclus neptuni* (Geinitz) and *Placenticeras orbignyanum* (Geinitz) are among the species indicative of the lower Upper Turonian. The associated macrofauna is abundant and dominated by bivalves, gastropods, and scaphopods; less common are cephalopods and echinoids (1 species); there are also fish remains. The most abundant macrofauna occurs in clayey marls. The macrofaunal assemblage of clayey marls attributed to the upper Upper Turonian resembles generally that of the lower part of the substage, except for a greater proportion of gastropods and occurrence of a few corals *Parasmilia centralis* (Mantel). The bivalves *Inoceramus schloenbachi* Böhm and *I. inconstans* Woods and the cephalopod *Peroniceras tricarinatum* (d'Orbigny) are indicative of the upper Upper Turonian.

Coniacian. — The Turonian/Coniacian boundary was traced by Radwańska at the depth of 400.0 m basing upon the appearance of *Inoceramus kleini* Müller. The inoceramids made possible a division of the stage into the Lower and Upper Coniacian.

The Lower Coniacian (depth interval of 400.0 to 98.0 m) contains *Inoceramus kleini* Müller, *I. involutus* Sowerby, and *I. mantelli* Mercey. The macrofaunal assemblage is more species-rich than that one recorded in the Upper Turonian. It includes more bivalves, cephalopods, corals, echinoids, and gastropods.

The uppermost part of the flysch sequence recorded in the borehole Pisary IG at the top of the Cretaceous (depth interval of 98.0 to 1.7 m) were attributed by Radwańska to the Upper Coniacian. Those strata contain abundant shells of *Inoceramus subquadratus* Schlüter. The macrofaunal assemblage resembles the Lower Coniacian one but it is less abundant numerically.

FORAMINIFERAL ASSEMBLAGES

Foraminifera and macrofauna are associated with the same lithofacies in the borehole Pisary IG. Foraminifera appear for the first time in the Cretaceous sedimentary sequence in the upper portion of the upper Lower Turonian clayey marls. These are scanty speciment of *Lenticulina rotulata* and *Ataxophragmium depressum.* Both the species are cosmopolitan and of long stratigraphic range.

A more abundant foraminiferal assemblage occurs in the Middle Turonian clayey marls. The most important species of this assemblage are *Gaudryina laevigata*, *G. rugosa*, and *Quadrimorphina allomorphinoides*, considered generally as being of younger than Cenomanian age (Tollmann 1960; Gorbenko 1974). The Middle Turonian marly sandstones are nonfossiliferous. Higher in the section, foraminifera were recorded in the upper portion of clayey marls at the top of the Middle Turonian. The assemblage is species-poor. Planktic foraminifera (*Heterohelix striata* and *Dicarinella sudetica* sp. n.) appear there for the first time in the Cretaceous sequence of the Nysa Trough; the assemblage includes also *Cassidella tegulata* unknown previously from the Sudetes. The lower Upper Turonian clayey marls yielded an assemblage much more abundant in both specimens and species, including some stratigraphically important forms. The assemblage contains planktic foraminifera *Marginotruncana coronata*, *M. linneiana*, and *M. marginata* that appear in the Polish Lowlands in the upper part of the *Inoceramus lamarcki* Zone or even higher (Gawor-Biedowa and Witwicka 1960). Among the benthic forms, there are the species *Gavelinella moniliformis* and *G. ammonoides* that may also be indicative of the Upper Turonian (Gawor-Biedowa and Witwicka in press). In the upper portion of the lower Upper Turonian the species

Plectina lenis was recorded, unknown previously from the Sudetes. The species was thus far reported from the Cenomanian to Eocene flysch of the Polish (Huss 1966) and Romanian Carpathians (Neagu 1972).

The richest forminiferal assemblage occurs in the upper Upper Turonian clayey marls. It includes benthic forms with aragonitic shells representative of the genus *Epistomina* (table 1), of which *E. stelligera* and *E. spinulifera polypioides* were thus far unknown from the investigated area. *Dicarinella concavata* recorded previously in the Turonian of Pieniny Klippen Belt (Książkiewicz 1958) and in the Middle Turonian to Lower Coniacian strata exposed in the Nysa Trough (Teisseyre 1975) is among the stratigraphically important members of the assemblage. The species occurs most commonly in the Mediterranean. *E. stelligera* was reported mainly from the Coniacian to Maastrichtian of the Tethyan Realm (Tollmann 1960). It seems to be associated mostly with marly-clayey facies (Ohm 1967: 152), which is indeed confirmed by its distributional pattern in the Nysa Trough. The present record of *E. spinulifera polypioides* is remarkable because this species was thus far reported from the Upper Aptian to Upper Albian strata of both epicontinental and geosynclinal areas (Salaj and Samuel 1966); while in the Polish Lowlands it makes part of the foraminiferal assemblage of the Maszkowo Beds (Gawor-Biedowa 1972). In the Nysa Trough, *E. spinulifera polypioides* has been for the first time recorded in the Upper Turonian to Coniacian. The associated foraminiferal assemblage (table 1) sharply differs from that one co-occurring with *E. spinulifera polypioides* in the Polish Lowlands.

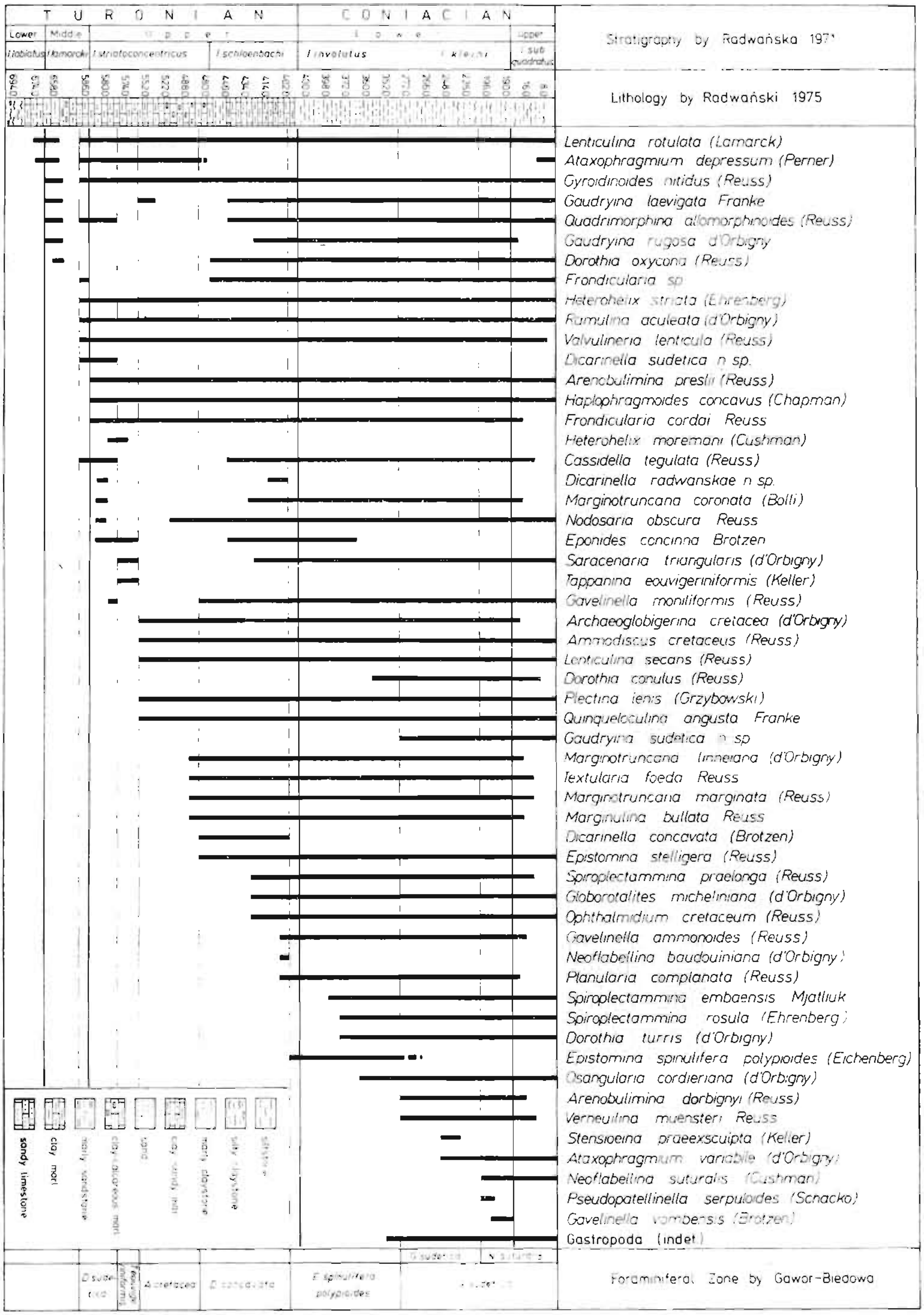
All but a few foraminiferal species recorded in the Upper Turonian clayey marls occur also in the flysch sequence making in the borehole Pisary IG the appearance of clayey flysch. Some additional, most commonly benthic agglutinated forms appear also in the flysch sequence. *Spiroplectammina rosula*, *Osangularis cordieriana*, and *Neoflabellina suturalis* are among the most important stratigraphically species of the assemblage because their stratigraphic ranges start with the Coniacian (Cushman 1935; Hofker 1957; Tollmann 1960; Grobenko 1974). These species along with the associated foraminifera *Gavelinella moniliformis*, *G. ammonoides*, and *Spiroplectammina praelonga* permit attribution of the investigated flysch sequence to the Coniacian. In the uppermost part of that sequence the species *Pseudopatellinella serpuloides* was recorded, unknown previously from Poland.

FORAMINIFERAL ZONES

Six local foraminiferal zones are recognized in the Upper Cretaceous section of the borehole Pisary IG: four of them in the Upper Turonian, the remaining two in the Coniacian.

Table 1

Distribution of the foraminifera in the Turonian and Coniacian of the Nysa Trough



The Upper Turonian zones are as follows:

I. *Dicarinella sudetica* Zone (range zone). — The most important stratigraphically species is *Dicarinella sudetica*. The foraminiferal assemblage is rather poor in both species and specimens. The zone includes the uppermost Middle Turonian to lowermost Upper Turonian strata.

II. *Tappanina eouvigeriniformis* Zone (assemblage zone). — The zone is defined by co-occurrence of *Tappanina eouvigeriniformis* and *Saracenaria triangularis*. The foraminiferal assemblage is rather poor both in species and specimens (table 1). The zone includes the lower Upper Turonian strata.

III. *Archaeoglobigerina cretacea* Zone (concurrent-range zone). — The zone is defined by co-occurrence of *Archaeoglobigerina cretacea*, *Plectina lenis*, *Quinqueloculina angusta*, and *Ataxophragmium depressum*. It includes the middle Upper Turonian strata.

IV. *Dicarinella concavata* Zone (range zone). — The most important stratigraphically species is *Dicarinella concavata*. The zone includes the upper Upper Turonian strata exclusive of the uppermost ones. The foraminiferal assemblage is much richer in species in the upper part of the zone than in the lower part (table 1).

The Coniacian zones are as follows:

I. *Epistomina spinulifera polypioides* Zone (assemblage zone). — In addition to *Epistomina spinulifera polypioides*, the characteristic species of the zone include also *Eponides concinna*, *Spiroplectammina embaensis*, and *S. rosula*. The foraminiferal assemblage is very rich in both specimens and species (table 1). The zone includes the uppermost Upper Turonian and lower Lower Coniacian strata.

II. *Gaudryina sudetica* Zone (range zone). — The most important stratigraphically species is *Gaudryina sudetica*. The associated foraminiferal assemblage is very abundant and species-rich. The zone includes the upper Lower Coniacian to Upper Coniacian strata. It is subdivided into two subzones: the *Gaudryina sudetica* Subzone at the base and *Neoflabellina suturalis* Subzone at the top. The *Neoflabellina suturalis* Subzone includes the uppermost Lower Coniacian to Upper Coniacian strata. In addition to *Neoflabellina suturalis*, the characteristic species of the latter subzone include also *Pseudopatellinella serpuloides* and *Gavelinella vombensis*.

PALEOGEOGRAPHIC AND ECOLOGIC REMARKS

As indicated by the facies development (Radwański 1975), macrofaunal biostratigraphy (Radwańska 1971), and the present micropaleontologic work, Cenomanian deposits were originally lacking at the eastern margin of the Nysa Trough. One may thus conclude that the Cretaceous transgression reached the southeastern part of the trough at the Early

Turonian. The transgression is evidenced in the borehole Pisary IG by conglomerates recorded at the base of siltstones (Radwański 1975). At the beginning of the Early Turonian the sea filling up the Nysa Trough was rather shallow and the Pisary region was close to the seashore (Radwański 1975: 14). One may suppose that the marginal part of the basin was brackish rather than normal marine owing to a freshwater influx from the land, which resulted in the absence of foraminifera from the Lower Turonian siltstones.

Later on, the Early Turonian sea became wider and deeper. The normal marine nature of the basin in the Pisary region is evidenced by foraminifera, inoceramids and other macrofossils present in the Lower Turonian clayey marls. The absence of planktic foraminifera from the assemblage may be indicative of some impediments in water exchange between the basin and open sea. Radwański (1966: 101) claims that several islands persisted during the Early and Middle Turonian in the Central Sudetes, which hindered water exchange between the basins located in the synclinoria and minor depressions. As judged from the deposition of non-fossiliferous marly sandstones, the basin started shallowing at the middle Middle Turonian. This shallowing of the sea was a reflection of the coeval uplift of the East-Sudetic land which could also affect the marginal area of the Nysa Trough (Radwański 1966: 101). The detritic influx to the basin was mainly from the East-Sudetic land and subordinately from the Orlicka island. The sea deepened again towards the end of the Middle Turonian. At that time it achieved also some wider connections with the pelagic realm, as it is evidenced by the appearance of planktic foraminifera. In fact, planktic foraminifera make already part of an assemblage fairly rich in both species and specimens, dominated by benthic forms, recorded in clayey-sandy marls of the lowermost Middle Turonian (table 1). The sea was continuously deepening during the Late Turonian when the marly facies became wider distributed, and the foraminiferal assemblage increased in numerical abundance and species diversity (planktic forms including). The paleogeographic analysis presented by Radwański (1975) gives an explanation to the appearance of the Carpathian species *Plectina lenis* in the Upper Turonian (exclusive of the lowermost strata) in the Central Sudetes. At the beginning of the Late Turonian the Intra-Sudetic Cretaceous basin was widely interconnected with both the North-Sudetic basin and the Bohemian sea (Radwański 1975: 25). One of the latter two epicontinental basins must have been interconnected with the Late Turonian geosynclinal area. By this way, *Plectina lenis* was able to immigrate to the Nysa Trough early in the Late Turonian. During the late Late Turonian two benthic species appear in the Nysa Trough related in general very closely to the Tethyan Realm. These are *Dicarinella concavata* and *Epistomina stelligera* (cf. Tollmann 1960; Barr 1972). Their occurrence makes evidence of a Tethyan influence upon the basin. In general, the foraminiferal assemblages are indicative of periods with relatively deep sea widely interconnected with the pelagic realm. This is confirmed by the occurrence of a hippurite in the Upper Turonian of the Nysa Trough (Radwański 1966: 103). One may thus conclude that the evidence from the foraminifera agrees well with those from the macrofauna (Radwańska 1965, 1971) and lithofacies distribution (Radwański 1966, 1975).

The Coniacian deposits of the Nysa Trough (Radwański 1975: 31) resemble the upper Upper Turonian ones (Radwański 1966: 113) in their spatial distribution, as they occur exclusively in the deepest part of the trough, that is that part used by the Nysa river. The most complete known section of the Coniacian is in the borehole Pisary IG. The lack of any basic change in composition of planktic and calcareous benthic foraminifera at the Turonian/Coniacian boundary is remarkable because this stratigraphic boundary coincides with a change from the marly to flysch facies. One has however, to keep in mind that one deals with clayey flysch in the borehole Pisary IG. Eight benthic agglutinated species appear in the Coniacian which was probably related to an increase in terrigenous influx to the basin. However, the increase in terrigenous influx did not hamper the flourishment of planktic and benthic foraminifera, those with aragonitic shells including (genus *Epistomina*), at least during the Early Coniacian. Later on, during the Late Coniacian, further increase in detritic influx resulted in a decrease in foraminiferal species diversity, especially among planktic forms. The sandy influx caused also a considerable decrease in macrofaunal abundance (Radwański 1971).

Plant remains seem to be among the best climatic indicators. There are abundant remains of trees in the Coniacian deposits of the Nysa Trough (Radwański 1966). They derived mostly from the East-Sudetic land covered at that time with forests. The best known Coniacian flora from the investigated area is derived from the Idzików delta, that is so-called Idzików flora (Fric 1897. *vide* Cieśliński and Witwicka 1962: 356): It contains dicotyledon imprints indicative of warm-temperate to subtropical climatic conditions.

DESCRIPTIONS

Order **Foraminiferida** Eichwald, 1830
Suborder **Textulariina** Delage et Hérouard, 1896
Superfamily **Ammodiscacea** Reuss, 1862
Family **Ammodiscidae** Reuss, 1862
Subfamily **Ammodiscinae** Reuss, 1862
Genus *Ammodiscus* Reuss, 1862

Ammodiscus cretaceus (Reuss, 1845)
(pl. 1: 1)

1845. *Operculina cretacea* Reuss: 35, pl. 13: 64, 65.
1946. *Ammodiscus cretaceus* (Reuss); Cushman: 17—18, pl. 1: 35 (with synonymy).
1975. *Ammodiscus cretaceus* (Reuss); Magniez-Jannin: 25—26, pl. 1: 1.

Material. — More than eighty well preserved to partly damaged specimens. Dimensions (in mm):

IG Nos.:	45361/79/F	45362/79/F	43363/79/F
diameter	1.012	0.816	0.600
thickness	0.120	0.096	0.096

Variability. — Intraspecific variability consists in test dimensions, whorl number, and last whorl height. The whorls increase gradually in height but in some specimens, the last whorl is disproportionately higher than the earlier ones.

Remarks. — The investigated specimens of *A. cretaceus* (Reuss, 1845) from the Nysa Trough are entirely consistent with the description given by Huss (1966). They differ from most thus far described specimens in the lack of glossy growth lines at their test. This may be due to the preservation state, as the Sudetic specimens are dark-colored.

Distribution. — Poland: Carpathians — Santonian to Maastrichtian; Sudetes (Nysa Trough) — Upper Turonian to Lower Coniacian. Europe: Middle to Upper Cretaceous. North and South America: Upper Cretaceous.

Superfamily **Lituolacea** de Blainville, 1825
Family **Lituolidae** de Blainville, 1825
Subfamily **Haplophragmoidinae** Maync, 1952
Genus *Haplophragmoides* Cushman, 1910
Haplophragmoides concavus (Chapman, 1892)
(pl. 1: 4)

1892. *Trochammina concava* Chapman: 327, pl. 6: 14a—b.
1957. *Haplophragmoides concavus* (Chapman); Sztejn: 28, pl. 2: 6 (with synonymy).
1975. *Haplophragmoides concavus* (Chapman, 1892); Magniez-Jannin: 38—40, pl. 2: 5—8.

Material. — More than a hundred well preserved specimens. Dimensions (in mm):

IG Nos.:	45364/79/F	45365/79/F	45366/79/F
diameter	0.408	0.360	0.240
thickness	0.120	0.120	0.076

Variability. — Intraspecific variability consists in test dimensions, chamber number at the last whorl (5 to 6 but most commonly 5), chamber convexity (chambers are usually flat to slightly convex), and suture depression (sutures are a little depressed, close to radial).

Remarks. — The specimens from the Nysa Trough assigned to *H. concavus* (Chapman, 1892) correspond entirely to the original description of the type specimen given by Chapman (1892). Their tests are finely granular, dark-grey in color. In the Sudetes, there are no specimens with a test built up by fairly large-sized quartz grains like those reported by Sztejn (1957) from the Polish Lowlands.

Distribution. — Poland: Polish Lowlands — Lower Cretaceous; Sudetes (Nysa Trough) — Upper Turonian to Lower Coniacian. England, France, FRG, Austria, and the Soviet Union (Podolia and Volhynia): Lower Cretaceous.

Family **Textulariidae** Ehrenberg, 1838
Subfamily **Spiroplectamminínae** Cushman, 1927
Genus *Spiroplectammina* Cushman, 1927
Spiroplectammina embaensis Mjatliuk, 1961
(pl. 1: 2, 3)

1961. *Spiroplectammina embaensis* Mjatliuk; Vassilenko: 14—15, pl. 1: 5a—b, 6a—b, 7a—b.
1974. *Spiroplectammina embaensis* Mjatliuk; Gorbenko: 28, pl. 1: 2a—b.

Material. — Thirty well preserved to partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45367/79/F	45368/79/F	45369/79/F
length	0.810	0.720	0.600
width	0.360	0.390	0.290
thickness	0.220	0.220	0.180

Variability. — There is a small intraspecific variability in test dimensions and elongation, chamber number in biserial part of a test (5 to 8 couples), and width of test periphery. The proximal chambers are low, two to three times lower than the distal ones. In some specimens, two or four last chambers are narrower than the earlier ones which causes a distal narrowing of the test.

Remarks. — The investigated specimens of *S. embaensis* Mjatliuk, 1961 are in conformity with the type specimen as described by Vassilenko (1961). The only difference is in that they are a little more flat than the previously described ones. Among the most diagnostic features of the species is the shape and position of the last chamber (pl. 1: 2).

Distribution. — Poland: Sudetes (Nysa Trough) — Coniacian. Soviet Union: Turonian to Santonian.

Spiroplectammina praelonga (Reuss, 1845)
(pl. 1: 5, 6)

1845. *Textularia praelonga* Reuss: 39, pl. 12: 14a—b.
1970. *Spiroplectammina praelonga* (Reuss); Neagu: 40, pl. 5: 4—6.
1972. *Spiroplectammina praelonga* (Reuss); Gawor-Biedowa: 18—19, pl. 1: 1 (with synonymy).
1975. *Spiroplectammina praelonga* (Reuss); Teisseyre: 104, pl. 3: 11a—b.

Material. — Twenty five partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45370/79/F	45371/79/F	45372/79/F
length	1.080	0.900	0.540
width	0.290	0.250	0.230
thickness	0.160	0.160	0.160

Variability. — The collection under study includes both *A*-and *B*-forms, which contrasts to the collections known thus far from the Polish Lowlands. The *B*-forms differ from the *A*-forms in their very small planispiral portion of the test with convex proloculus situated at its center (pl. 1: 5), more numerous and lower chambers in the biserial part (10 to 15 couples, while there are 7 to 10 couples in the *A*-forms), and distinctly raised, thickened sutures. The *A*-forms show slightly raised sutures in proximal part of the test, but in the distal part the sutures are considerably depressed.

Remarks. — The investigated specimens of *S. praelonga* (Reuss, 1845) are entirely consistent with the original description of the type specimen (Reuss 1845). From their conspecific relatives from the Carpathians and Polish Lowlands, the specimens under study differ in their siliceous test. The test composition of the holotype remains thus far unknown.

Distribution. — Poland: Polish Lowlands — Upper Albian to Turonian; Opole region — *Inoceramus schloenbachi* Zone; Carpathians — Turonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Czechoslovakia: Turonian. FRG and GDR: Cenomanian to Turonian. Soviet Union: Turonian to Coniacian. Austria: Coniacian. Romania: East Carpathians — Turonian.

Spiroplectammina rosula (Ehrenberg, 1854)
(pl. 1: 12)

1854. *Spiroplecta rosula* Ehrenberg: 24, pl. 32 (2): 26 (*fide* Ellis and Messina, Cat. of Foram.).
1963. *Spiroplectammina rosula* (Ehrenberg); Kaptarenko-Tschernousova *et al.*: 68—69, pl. 20: 1a—b.
1975. *Bolivinopsis rosula* (Ehrenberg); Vaptzarova: 58, pl. 1: 1—4.

Material. — Twenty partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45373/79/F	45374/79/F	45375/79/F
length	0.780	0.540	0.450
width	0.150	0.160	0.130
thickness	0.054	0.090	0.050

Variability. — There is a variation in chamber number and convexity in biserial part of a test, suture development (flat to thickened), and lobulation of test outline. The investigated collection includes only the *B*-forms.

Remarks. — The specimens from the Nysa Trough assigned to *S. rosula* (Ehrenberg, 1854) are entirely consistent with the description given by Gorbenko (1974).

The systematic position of *Spiroplecta rosula* Ehrenberg is in dispute since more than a century. A historical account is given by Loeblich and Tappan (1964: C251) on occasion of the genus *Bolivinopsis* Yakovlev, 1891, because those authors recognize *Spiroplecta rosula* Ehrenberg for the type species of the latter genus. Until the test wall of the type specimen is studied in order to recognize whether it is actually hyaline or agglutinated in structure, one can hardly determine whether both *Spiroplectammina* Cushman, 1927, and *Bolivinopsis* Yakovlev, 1891, are valid, or merely the former one. As judged from the material under study, the species *Spiroplecta rosula* Ehrenberg shows an agglutinated, finely granular test with both the grains and cement calcareous; therefore, it is here assigned to *Spiroplectammina* Cushman.

Distribution. — Poland: Sudetes (Nysa Trough) — Coniacian. Europe and North and South America: Upper Cretaceous.

Subfamily **Textulariinae** Ehrenberg, 1838
Genus *Textularia* Defrance *in* de Blainville, 1824
Textularia foeda Reuss, 1845
(pl. 2: 5)

1845. *Textularia foeda* Reuss: 109—110, pl. 43: 12a—b, 13.
1972. *Textularia foeda* Reuss; Gawor-Biedowa: 20—21, pl. 1: 3a—b (with synonymy).

Material. — Twenty variously preserved specimens.

Dimensions (in mm):

IG Nos.:	45376/79/F	45377/79/F	45378/79/F
length	0.768	0.648	0.528
width	0.288	0.288	0.240
thickness	0.216	0.168	0.168

Variability. — Intraspecific variability consists mostly in rate of expansion of a test with growth, roughness of test surface, and chamber convexity. The collection includes slender individuals, maintaining almost a constant width in ontogeny, along with fairly wide ones expanding gradually but considerably. The variation in roughness of test surface results from the finely to coarsely granular nature of the test.

Remarks. — The investigated specimens of *T. foeda* Reuss, 1845, differ from the type specimen in their smaller size and smaller number of chambers in each of the two rows. From the representatives of this species from the Polish Lowlands, they differ in their rough test composed in some specimens of rather coarse grains of quartz, whereas the test is finely granular and smooth in the specimens from the Lowlands. The test roughness results also in more convex chambers in the specimens from the Sudetes.

Specimens resembling very closely *T. foeda* from the Polish Lowlands were described from America under the specific name *T. rioensis* Carsey. Actually, the only difference is that the American specimens are twice smaller than those from the Polish Lowlands.

Distribution. — Poland: Polish Lowlands — Cenomanian to lowermost Turonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. FRG: Valanginian to Upper Santonian. Czechoslovakia: Middle to Upper Cretaceous.

Family **Ataxophragmiidae** Schwager, 1877

Subfamily **Verneuilininae** Cushman, 1911

Genus *Verneuilina* d'Orbigny *in* de la Sagra, 1839

Verneuilina muensteri Reuss, 1854

(pl. 2: 8, 9)

1854. *Verneuilina muensteri* Reuss: 71, pl. 26: 5 (*fide* Ellis and Messina, Cat. of Foram.).

1975. *Verneuilina muensteri* Reuss; Teisseyre: 104, pl. 3: 12a—b.

Material. — Thirty well preserved specimens.

Dimensions (in mm):

IG Nos.:	45379/79/F	45380/79/F	45381/79/F
length	0.700	0.630	0.450
width	0.450	0.430	0.320

Variability. — Intraspecific variability consists in rate of expansion of a test with growth, chamber concavity, and suture conspicuousness.

Remarks. — The investigated specimens of *V. muensteri* Reuss, 1854, are entirely consistent with the original description of the type specimen (Reuss 1854). The specimens of *V. muensteri* described by Martin (1964) from California differ from these European ones in the lack of sutural thickenings.

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Czechoslovakia: Turonian to Senionan. F.R.G: Turonian to Lower Senonian. Austria: Turonian to Santonian. Soviet Union: Turonian to Campanian. North America: California — Santonian.

Genus *Gaudryina* d'Orbigny *in* de la Sagra, 1839

Gaudryina laevigata Franke, 1914
(pl. 1: 11)

1845. *Gaudryina rugosa* d'Orbigny; Reuss: 38, pl. 12: 15, 24.
1914. *Gaudryina laevigata* Franke: 431, pl. 27: 1, 2 (*fide* Ellis and Messina Cat. of Foram.).
1974. *Gaudryina laevigata* Franke; Gorbenko: 30—31, pl. 1: 10a—w.

Material. — Eighty well preserved specimens.

Dimensions (in mm):

IG Nos.:	45382/79/F	45383A/79/F	45383B/79/F
length	0.960	0.720	0.450
width	0.490	0.450	0.290
thickness	0.380	0.340	0.230

Variability. — Intraspecific variability consists in test size and shape, and chamber number in both tri- and biserial parts of a test. The collection includes two distinct morphotypes: (*i*) pyramidal tests with the maximum width attained at the level of two last chambers; and (*ii*) — oval-pyramidal tests almost constant in width all over the test length to somewhat narrowing at the level of the final chamber. The pyramidal morphotype shows very low, indistinct chambers in triserial part of a test; there are 3—4 chambers in each of the three rows. In contrast, the oval-pyramidal morphotype displays higher, quite distinct chambers in the triserial part, separated one from another by a depressed suture.

Remarks. — The specimens of *G. laevigata* Franke, 1914, from the Nysa Trough resemble very closely those described by Vassilenko (1961) from the Mangyshlak peninsula. The pyramidal morphotype resembles *Gaudryina pyramidata* Cushman but it differs from the latter in its finely granular, smooth test surface and much smaller size (0.450 to 0.960 mm versus 0.900 to 1.250 mm in *G. pyramidata*).

Distribution. — Poland: Carpathians — Turonian to Lower Senonian; Polish Lowlands — Turonian to Campanian; Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Turonian to Campanian. North America: Santonian to Maastrichtian.

Gaudryina rugosa d'Orbigny, 1840
(pl. 1: 7, 8)

1840. *Gaudryina rugosa* d'Orbigny: 44, pl. 4: 20, 21.
1961. *Gaudryina rugosa* d'Orbigny; Akimez: 94—95, pl. 6: 1a—b, 2.

Material. — More than three hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45384/79/F	45385/79/F	45386/79/F
length	1.080	0.900	0.720
width	0.576	0.540	0.558
thickness	0.504	0.450	0.414

Variability. — There is a considerable intraspecific variation in test dimensions, rate of expansion of a test with growth, edge roundness in triserial part of a test, and chamber convexity in the biserial part. The chambers are flat in triserial part of the investigated specimens. The collection includes specimens at various stages of ontogenetic development.

Remarks. — The specimens under study do not differ to any considerable extent from the type specimen as described by d'Orbigny (1840). They differ from those recorded in Cracow area (Liszka 1955) in their smaller size, less numerous chambers in the biserial part of a test, less convex chambers, and less rough test surface. The specimens from the Nysa Trough show also less convex chambers than those described by Akimez (1961).

Distribution. — Poland: Wolin Island — Cenomanian to Maastrichtian (Franke 1925, 1928); Carpathians — Lower Senonian; Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: both epicontinental and geosynclinal facies — Turonian to Maastrichtian.

Gaudryina sudetica sp. n.
(pl. 1: 9, 10; pl. 5: 5)

Holotype: IG No. 45387/79/F: pl. 1: 10.

Paratypes: IG Nos; 45388/79/F, 45388A/79/.; pl. 1: 9 and pl. 5: 5.

Type horizon: Coniacian.

Type locality: Nysa Trough, borehole Pisary IG, depth of 164.0 m.

Derivation of the name: after the Sudetes where the species has been found.

Diagnosis. — Test large-sized, massive, weakly expanding with growth; chambers indistinct in triserial part, while tetragonal, considerably convex, protruding in form of a cornice (especially at the narrower sides) in biserial part; sutures considerably depressed, gutter-like.

Material. — Thirty very well preserved specimens.

Dimensions (in mm):

	holotype	paratype
IG Nos.:	45387/79/F	45388/79/F
length	1.080	0.920
width	0.540	0.610
thickness	0.400	0.360

Description. — Test large-sized, massive, roughened, composed of medium-sized quartz grains, expanding gradually but insignificantly with growth. Triserial part short, one fourth to third of test length, with 3 indistinct chambers in each of the three rows. Triserial part triangular in cross section, with concave sides and rounded angles. Biserial part including 3—4 chamber couples. Chambers considerably swollen, protruding in form of a cornice (especially at the narrower sides of test), three times wider than high. Sutures oblique, considerably depressed, gutter-like. Biserial part tetragonal, in cross section. Aperture semilunar, at the base of slightly convex apertural surface of the final chamber.

Variability. — There is some intraspecific variation in test dimensions, size of the triserial part of a test, chamber convexity and suture depression in triserial part, and grain arrangement in test wall. The largest grains may occur mainly at the maximum convexity of chambers.

Remarks. — The newly erected species resembles most closely *Gaudryina ingens* Voloshina but it differs from the later form in its nearly constant test width, less numerous chambers in both the triserial and biserial parts of a test, and considerably convex chambers protruding in form of a cornice. When compared to large-sized specimens of *Gaudryina rugosa* d'Orbigny, the species under discussion shows a different test outline, smaller triserial part, tetragonal in cross section biserial part, and considerably convex, cornice-like protruding chambers.

Distribution. — Poland: Sudetes (Nysa Trough) — Coniacian.

Subfamily **Globotextulariinae** Cushman, 1927

Genus *Arenobulimina* Cushman, 1927

Arenobulimina dorbignyi (Reuss, 1845)

(pl. 2: 6, 7)

1845. *Bulimina d'Orbignyi* Reuss: 38, pl. 13: 74a—b.
1937*b*. *Arenobulimina d'orbignyi* (Reuss); Cushman: 39—40, pl. 4: 9—12 (with synonymy).
1960. *Arenobulimina d'Orbigny* (Reuss); Rompf: 20, pl. 2: 3a—c.

Material. — More than a hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45392/79/F	45392A/79/F	45393/79/F
length	0.782	0.738	0.702
width	0.468	0.468	0.414

Variability. — There is a variation in chamber convexity, last whorl height, number of chambers (3 to 4) in the last whorl, and quartz grain size in test wall and by implication the roughness of test surface. In spite of this variation, the largest grains occur always at the proximal ad-sutural part of a chamber, and the smallest ones at the distal adsutural part.

Remarks. — The investigated specimens of *A. dorbignyi* (Reuss, 1845) are entirely consistent with the description given by Cushman (1937*b*), except for their smaller size. They resemble also *Arenobulimina chapmani* Cushman, the difference consisting in their more gradual expansion of a test with growth, less numerous chambers in the last whorl (3 to 4 versus 4 to 5 in *A. chapmani*), and smaller-sized final chamber. The specimens assigned by Voloshina (1972: 65—66, pl. 3: 1, 2) to *Arenobulimina (Pasternakia) dorbignyi* (Reuss) differ from those from the Nysa Trough in their short and rapidly expanding test, flat chambers, and less roughened test surface.

Distribution. — Poland: Polish Lowlands and Wolin Island — Cenomanian to Maastrichtian; Sudetes (Nysa Trough) — Upper Coniacian. Europe: Upper Cretaceous.

Arenobulimina preslii (Reuss, 1845)

(pl. 2: 1, 2)

1845. *Bulimina preslii* Reuss: 38, pl. 13: 72.
1937*b*. *Arenobulimina preslii* (Reuss); Cushman: 39, pl. 4: 5—8 (with synonymy).
1974. *Arenobulimina preslii* (Reuss); Hercogová: pl. 3: 2.

Material. — Some eighty well preserved specimens.

Dimensions (in mm):

IG Nos.:	45392/79/F	45392A/79/F	45393/79/F
length	0.648	0.558	0.450
width	0.450	0.378	0.378

Variability. — Intraspecific variability consists in elongation or roundness of the initial part of a test, chamber convexity, and suture depression. The collection includes several juvenile specimens.

Remarks. — The investigated specimens of *A. preslii* (Reuss, 1845) from the Nysa Trough show most affinity to those described by Voloshina (1972). There are both left- and right-hand coiled specimens in the collection under study, whereas exclusively left-hand coiled ones were recorded in the Lower Senonian of Cracow area (Liszka 1955). The specimens from the Nysa Trough show a little more convex chambers than most previously described ones, which makes them similar to *Arenobulimina conoidea* (Perner). As clearly seen in SEM micrographs, the specimens of *A. preslii* (Reuss) display a tooth within the aperture. This is a new, thus far unknown feature of the genus *Arenobulimina* Cushman, 1927, the type species of which is *Bulimina preslii* Reuss.

Distribution. — Poland: Carpathians and Polish Lowlands — Upper Cretaceous; Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Upper Cretaceous.

Genus *Dorothia* Plummer, 1931

Dorothia conulus (Reuss, 1845)

(pl. 2: 4)

1845. *Textularia conulus* Reuss: 38—39, pl. 8: 59, pl. 13: 75.
1960 . *Dorothia conulus* (Reuss); Tollmann: 162, pl. 10: 7—8 (with synonymy).
1972. *Dorothia conulus* (Reuss); Neagu: 15, pl. 3: 18—19 and 23—24.

Material. — Over two hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45394/79/F	45395/79/F	45396/79/F
length	0.630	0.558	0.504
width	0.324	0.360	0.360

Variability. — There is a slight intraspecific variability in test flatness, chamber convexity, and suture depression and curvature.

Remarks. — The specimens of *D. conulus* (Reuss, 1845) from the Nysa Trough are entirely consistent with the original description of the type specimen (Reuss 1845; Cushman 1937b, pl. 8: 11—14). The collection under study includes specimens at various stages of ontogenetic development. The investigated species differs from *Dorothia turris* (d'Orbigny) in its more stocky test, less numerous and more convex chambers, and depressed sutures. In turn, it differs from *Dorothia pupoides* (d'Orbigny) and *D. pupa* (Reuss) in its more stocky test, much lower and less convex chambers, and wide elliptic in cross section biserial part.

Distribution. — Poland: Wolin Island — Turonian; Sudetes (Nysa Trough) — Coniacian. FRG and GDR: Senonian. Czechoslovakia: Turonian. Austria: Upper Coniacian to Maastrichtian. Romania: southern East Carpathians — Cenomanian. North America: Upper Cretaceous.

Dorothia oxycona (Reuss, 1860)

(pl. 2: 3)

1860. *Gaudryina oxycona* Reuss: 229, pl. 12: 3.
1972. *Dorothia oxycona* (Reuss); Hanzliková: 57, pl. 11: 8, 10 (with synonymy).

Material. — Over three hundred well preserved to partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45397/79/F	45398/79/F	45399/79/F
length	0.540	0.450	0.396
width	0.450	0.388	0.372

Variability. — Intraspecific variability consists in test size, suture development, and flatness of the biserial part of a test (most commonly, biserial part is wide elliptic to subcircular in cross section). In most specimens, sutures are a little raised and thickened; they are a little depressed in a minority of specimens.

Remarks. — The specimens from the Nysa Trough attributed to *D. oxycona* (Reuss, 1860) correspond to the description given by Loeblich and Tappan (1964). They are, however, almost twice smaller than the holotype. Their test is narrow in its initial part and expands gradually with growth. The species under discussion resembles *D. turris* (d'Orbigny) but it shows less gradually expanding test (especially in its distal part) and raised, fairly wide sutures (especially in the distal part of a test).

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — the stratigraphic range unknown; Wolin Island — Turonian; Carpathians — Senonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe: Cretaceous. North and South America and Australia: Upper Cretaceous.

Subfamily **Valvulininae** Berthelin, 1880

Genus *Plectina* Marsson, 1878

Plectina lenis (Grzybowski, 1896)

(pl. 1: 13, 14)

1896. *Spiroplecta lenis* Grzybowski: 288, pl. 9: 24—25.
1966. *Plectina lenis* (Grzybowski); Huss: 50, pl. 8: 1—5 (with synonymy).
1972. *Plectina lenis* (Grzybowski); Neagu: 16, pl. 3: 15—16.

Material. — More than three hundred specimens in various preservation state. Dimensions (in mm):

IG Nos.:	45400/79/F	45401/79/F	45402/79/F
length	0.744	0.686	0.540
width	0.252	0.234	0.216

Variability. — Intraspecific variability consists mostly in test dimensions and multiserial to biserial part relation in length (the multiserial part may attain one third to half a test in length). There is also some variation in chamber convexity and test roughness.

Remarks. — The investigated specimens of *P. lenis* (Grzybowski, 1896) are entirely consistent with the description given by Huss (1966).

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Polish and Romanian Carpathians: Cenomanian to Eocene.

Subfamily **Ataxophragmiinae** Schwager, 1877

Genus *Ataxophragmium* Reuss, 1860

Ataxophragmium depressum (Perner, 1892)

(pl. 2: 14, 15)

1892. *Bulimina depressa* Perner: 27, 55, pl. 3: 3a—b.
1972. *Ataxophragmium* aff. *depressum* (Perner); Voloshina: 104—105, pl. 11: 6.
1972. *Ataxophragmium depressum* (Perner); Hanzliková: 61: pl. 13: 13 (with synonymy).
1974. *Ataxophragmium depressum* (Perner); Hercogová: 79, pl. 5: 1a—c.

Material. — More than a hundred well preserved specimens. Dimensions (in mm):

IG Nos.:	45403/79/F	45404/79/F	45405/79/F
length	0.882	0.756	0.630
diameter	0.810	0.630	0.540

Variability. — There is a slight intraspecific variability in chamber convexity, suture depression, and concavity of the apertural surface of a test. The collection includes specimens at various stages of ontogenetic development.

Remarks. — The investigated specimens of *A. depressum* (Perner, 1892) correspond entirely to the original description of the holotype (Perner 1892). The species *Bulimina depressa* Perner was recognized by Cushman (1933) for the type species of the genus *Pernerina* Cushman, 1933. However, that genus has been considered by Loeblich and Tappan (1964) as a junior synonym of *Ataxophragmium* Reuss, 1860, including accordingly to the latter authors all species with an agglutinated, trochospiral test, low and wide chambers subdivided inside, and interiomarginal, crevice-like to loop-shaped aperture.

The species *Bulimina jaekeli* Franke, 1925, displays all the characteristics of *A. depressum* (Perner) and hence, it is to be considered as a junior synonym of the latter. Only a single morphotype has been recorded in the Sudetes, namely with a test rounded in its initial part and elongate upwards in the distal part. In the Cretaceous of the Moravian Carpathians, Hanzliková (1972) noted a morphotype with a wide and flat test rounded in its initial part, along with another, less common morphotype with a high-spired, coarsely granular test. Hanzliková supposed that this variation may reflect a dimorphism.

Distribution. — Poland: Wolin Island — Turonian; Sudetes Nysa Trough) — Turonian to Coniacian. Czechoslovakia: Cenomanian to Santonian. FRG and GDR: Lower Senonian. Soviet Union: Turonian to Lower Coniacian.

Ataxophragmium variabile (d'Orbigny, 1840)
(pl. 2: 16, 17)

1840. *Bulimina variabile* d'Orbigny: 40—41, pl. 4: 9—11.
1955. *Ataxophragmium variabile* (d'Orbigny); Liszka: 175, pl. 13: 11.
1972. *Ataxophragmium variabile* (d'Orbigny); Voloshina: 106—107, pl. 13: 3.

Material. — More than three hundred well preserved to partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45406/79/F	45407/79/F	45408/78/F
length	0.810	0.630	0.540
width	0.612	0.540	0.432

Variability. — There is a variability in test shape, whorl height (the last whorl may be considerably elongate), chamber convexity, shape of the apertural surface of final chamber, and arrangement of the chambers of the last whorl. The collection includes several juveniles.

Remarks. — The investigated specimens attributed to *A. variabile* (d'Orbigny, 1840) are consistent with the description of the species as given by Cushman (1937b). However, they differ from those presented thus far in the literature in their more finely granular test wall and the lack of coarser quartz grains or sponge spicules in ad-sutural part of the chambers. The species under discussion differs from *A. depressum* (Perner) in its loosely coiled test, elongate test shape, and highly variable shape of the final chamber.

Distribution. — Poland: Carpathians — Upper Senonian; Sudetes (Nysa Trough) — Coniacian. France: Paris Basin — Senonian. England: Cenomanian to Maastrichtian. FRG and GDR: Senonian. Soviet Union: Volhynia and Podolia — Upper Santonian to Lower Campanian.

Suborder **Miliolina** Delage et Hérouard, 1896
Superfamily **Miliolacea** Ehrenberg, 1839
Family **Nubeculariidae** Jones, 1875
Subfamily **Ophthalmidiinae** Wiesner, 1920
Genus *Ophthalmidium* Kübler et Zwingli, 1870
Ophthalmidium cretaceum (Reuss, 1854)
(pl. 2: 10, 11)

1854. *Spiroloculina cretacea* Reuss: 72, pl. 26: 9 (*fide* Ellis and Messina, Cat. of Foram.).
1971. *Spiroloculina cretacea* Reuss; Fuchs: 15, pl. 3: 11.

Material. — More than a hundred partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45409/79/F	45410/79/F	45411/79/F
length	0.760	0.720	0.470
width	0.430	0.360	0.330
thickness	0.110	0.110	0.110

Variability. — Intraspecific variability consists in whorl number (4 to 6 whorls including 2 chambers each), test outline (narrow to wide elliptic), outline of test edge (flat to slightly concave), height of the slats at test edge, and length of apertural neck.

Remarks. — The investigated specimens of *O. cretaceum* (Reuss, 1854) resemble most closely those described by Franke (1925). The species "*Spiroloculina cretacea*" Reuss cannot be actually assigned to the genus *Spiroloculina* d'Orbigny, 1826, because it does not show any tooth within its aperture. In turn, it displays all the characteristics of the genus *Ophthalmidium* Kübler and Zwingli, 1870, among the junior synonyms of which is *Spirophthalmidium* Cushman, 1927 (Loeblich and Tappan 1964: C448). In the collection from the Nysa Trough, there are no specimens with two last chamber disproportionately wide as in those presented by Cushman (1946: pl. 14: 22a, 23).

Distribution. — Poland: Wolin Island — Turonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe: Barremian to Upper Cretaceous. North America: Upper Cretaceous.

Family **Miliolidae** Ehrenberg, 1839
Subfamily **Quinqueloculininae** Cushman, 1917
Genus *Quinqueloculina* d'Orbigny, 1826
Quinqueloculina angusta Franke, 1928
(pl. 3: 1, 2)

1928. *Miliolina* (*Quinqueloculina*) *antiqua* Franke var. *angusta* Franke: 127, pl. 11: 25.
1946. *Quinqueloculina antiqua* Franke var. *angusta* Franke; Cushman: 48, pl. 14: 8—11 (with synonymy).
1962. *Quinqueloculina angusta* (Franke); Bignot: 2: 2, 3.

Material. — More than three hundred well preserved specimens.
Dimensions (in mm):

IG Nos.:	45412/79/F	45413/79/F	45414/79/F
length	0.410	0.360	0.290
width	0.160	0.180	0.140
thickness	0.160	0.140	0.100

Variability. — Intraspecific variability consists in test size, suture depression, test outline (narrow elliptic to wide elliptic), and neck height.

Remarks. — The investigated specimens of *Q. angusta* Franke, 1928, from the Nysa Trough are entirely consistent with the description given by Cushman (1946). Franke (1928) recognized the variety "*angusta*" within the species *Miliolina (Quinqueloculina) antiqua*. This was followed by Cushman (1946) who also distinguished the variety "*angusta*" within the species *Q. antiqua* Franke, and illustrated a specimen derived from the type material (Cushman 1946: pl. 14: 8). The specimens collected in the Nysa Trough resemble very closely the latter illustration. The laconic description given by Franke (1928) tempted many authors to consider the variety "*angusta*" as a synonym of the species *Q. antiqua* Franke. The present author is of the opinion that *Quinqueloculina angusta* Franke is actually a distinct species. It differs from *Q. antiqua* Franke in its narrow elliptic outline of the test, uniformly convex chambers, and the lack of apertural tooth. From *Q. kozlowskii* Gawor-Biedowa, 1972, the considered species differs in its rounded test edges, tube-shaped and swollen chambers, larger-sized and thicker test. As judged from the investigated material. *Q. angusta* Franke was not associated with *Q. antiqua* Franke in the Nysa Trough.

Distribution. — Poland: Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: FRG (Westphalia) — Cenomanian to Upper Senonian; France — Albian. North America: United States and Mexico — Upper Cretaceous.

Suborder **Rotaliina** Delage et Hérouard, 1896
Superfamily **Nodosariacea** Ehrenberg, 1838
Family **Nodosariidae** Ehrenberg, 1838
Subfamily **Nodosariinae** Ehrenberg, 1838
Genus *Nodosaria* Lamarck, 1812
Nodosaria obscura Reuss, 1845
(pl. 2: 18)

1845. *Nodosaria obscura* Reuss: 26, pl. 13: 7—9.
1975. *Nodosaria obscura* Reuss; Magniez-Jannin: 192—194, pl. 12: 22—34, Text-fig. 105 (with synonymy).
1975. *Nodosaria obscura* Reuss; Neagu: 90, pl. 70: 31—34, pl. 71: 4—10 (with synonymy).

Material. — More than eighty well preserved specimens.

Dimensions (in mm):

IG Nos.:	45415/79/F	45416/79/F	45417/79/F
length	1.260	0.828	0.720
width	0.288	0.252	0.216

Variability. — Intraspecific variability is unusually large. Is consists in virtually all morphological test characteristics: test size, test shape (spindle-shaped to cylindrical, sometimes stocky), chamber convexity, suture depression (considerable to indiscernible), test ornamentation (7 to 12 costae, variable in height and thickness, additional costae may appear in ontogeny). Independent variation in these features results in innumerable morphotypes of the species.

Remarks. — The investigated specimens of *N. obscura* Reuss, 1845, do not differ to any considerable degree from those described by Pożarska (1957). The species under discussion resembles closely *N. affinis* Reuss but it differs from the latter in its smaller test size, less convex chambers, weakly depressed sutures, and more variable test shape.

Distribution. — Poland: Polish Lowlands — Turonian to Maastrichtian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe and North America: Lower to Upper Cretaceous.

Genus *Frondicularia* Defrance *in* d'Orbigny, 1826
Frondicularia cordai Reuss, 1845
(pl. 3: 3, 4)

1845. *Frondicularia cordai* Reuss: 31, pl. 8: 26—28, pl. 13: 41; 108, pl. 24: 38.
1936. *Frondicularia cordai* Reuss; Brotzen 95—96, pl. 6: 14.

Material. — Twenty five variously preserved specimens.
Dimensions (in mm):

IG Nos.:	45417/79/F	45419/79/F
length	1.674	1.440
width	1.260	0.720
thickness	0.108	0.090

Variability. — Intraspecific variability consists in test shape and ornamentation type and intensity of chambers and sutures. Chambers vary among individuals or even in a single specimen from smooth to finely costate. Slats covering the sutures may be homogeneous or split down into numerous, very fine ribs.

Remarks. — The investigated specimens of *F. cordai* Reuss, 1845 are entirely consistent with the original description by Reuss (1845). Similarly to the type material, the collection under study includes two distinct morphotypes of *F. cordai*: one with a wide deltoid, inversely cordate test; the other with a narrower, rhomboidal test. In both the morphotypes, chamber are narrow, slats at the sutures high, proloculus ovate and costate, test bears a weak median depression. This differentiation may reflect the occurrence of two generations of the species but the problem cannot be solved herein because of the insufficient sample size. The wide deltoid morphotype of *F. cordai* resembles most closely *Palmula cordata* (Reuss); aside of the generic characteristics, it differs from the latter species also in ornamentation of its chambers and sutures. In turn, the rhomboidal morphotype resembles *F. inversa* Reuss but it differs from the later in its test proportions, chamber and suture ornamentation, and the ornamented proloculus.

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe: Lower to Upper Cretaceous (very rarely in the chalk facies).

Frondicularia sp.
(pl. 3: 5)

Material. — Fifty partly damaged specimens.

Remarks. — The collection under study comprises fairly abundant fragments of tests assigned to the genus *Frondicularia* Defrance in d'Orbigny, 1826, but unidentifiable to the species level.

Distribution. — Turonian to Coniacian.

Genus *Lenticulina* Lamarck, 1804
Lenticulina rotulata (Lamarck, 1804)
(pl. 3: 13, 14)

1804. *Lenticulites rotulata* Lamarck: 188 (*fide* Ellis and Messina, Cat. of Foram.).
1959. *Lenticulina comptoni* (Sowerby); Alexandrowicz: pl. 13: 2a—b.

1975. *Lenticulina rotulata* (Lamarck); Jendryka-Fuglewicz: 173—175, pl. 15, 20: 3—6 (with synonymy).
1975. *Lenticulina (Lenticulina) rotulata* Lamarck; Magniez-Jannin: 100—101, pl. 9: 3a—b (with synonymy).

Material. — Over three hundred well preserved to partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45420/79/F	45421/79/F	45422/79/F
greater diameter	1.750	1.440	1.040
smaller diameter	1.480	1.260	0.850
thickness	0.990	0.810	0.550

Variability. — There is a considerable intraspecific variability in chamber number in the last whorl (8 to 11 or even up to 13), test thickness (due to a variation in chamber swelling), boss diameter and convexity, and suture convexity.

Remarks. — The specimens of *L. rotulata* (Lamarck, 1804) studied by the present author resemble very closely those described by d'Orbigny (1840), Jendryka-Fuglewicz (1975), and Magniez-Jannin (1975). The specimen illustrated by Lamarck (1804) lacks any boss. In turn, the specimen ascribed by Sowerby (1818) to *Nautilus comptoni* displays a boss. Nonetheless, as supposed by d'Orbigny (1840) and confirmed by the detailed investigations by Jendryka-Fuglewicz (1975), these are indeed conspecific forms. The considerable variation in boss development caused several taxonomic misunderstandings over the last two centuries, ended finally with the work by Jendryka-Fuglewicz (1975). Juvenile specimens of *L. rotulata* were commonly assigned to *Cristellaria* or *Lenticulina ovalis* (Reuss).

Distribution. — Poland: Polish Lowlands — Cenomanian to Maastrichtian; Sudetes — Upper Cretaceous (Nysa Trough — Turonian to Coniacian). Europe: Middle to Upper Cretaceous. North America and Australia: Upper Cretaceous.

Lenticulina secans (Reuss, 1860)

(pl. 3: 10)

1860. *Cristellaria secans* Reuss: 214—215, pl. 9: 7.
1957. *Lenticulina secans* (Reuss); Pożaryska: 127—128, pl. 15: 6.
1975. *Lenticulina (Lenticulina) secans* (Reuss); Magniez-Jannin: pl. 9: 17.

Material. — Two hundred well preserved specimens.
Dimensions (in mm):

IG Nos.:	45423/79/F	45424/79/F	45425/79/F
greater diameter	1.440	1.400	1.050
smaller diameter	1.080	1.080	0.760
thickness	0.690	0.560	0.500

Variability. — There is some variability in test dimensions, umbilicus convexity, height of the slats at sutures, and width of the keel edging a test. Some of the specimens studied have underwent diagenetic deformations.

Remarks. — The specimens of *L. secans* (Reuss, 1860) from the Nysa Trough are entirely consistent with the type specimen, and differ but insignificantly from those described by Pożaryska (1957). In spite of its considerable morphological variability, the species under discussion is easily recognizable. Nonetheless, its individuals are often attributed to *Robulus pseudosecans* Cushman.

Distribution. — Poland: Polish Lowlands — Cenomanian to Maastrichtian; Sudetes — Cenomanian to Santonian (Nysa Trough — Upper Turonian to Coniacian). Europe: Lower to Upper Cretaceous. North America: Upper Cretaceous.

Genus *Marginulina* d'Orbigny, 1826
Marginulina bullata Reuss, 1845
(pl. 3: 6, 7)

1845. *Marginulina bullata* Reuss: 29, pl. 13: 34—38.
1957. *Marginulina bullata* Reuss; Pożaryska: 106—107, pl. 12: 6 (with synonymy).
1972. *Marginulina bullata* Reuss; Hanzliková: 69, pl. 16: 5.

Material. — Eighty well preserved specimens.
Dimensions (in mm):

IG Nos.:	45426/79/F	45427/79/F	45428/79/F
length	0.782	0.612	0.450
width	0.378	0.360	0.342

Variability. — There is an intraspecific variability in involuteness of the initial part of a test, chamber convexity and number (4 to 6 in a test), and neck length.

Remarks. — The investigated specimens of *M. bullata* Reuss, 1845, resemble very closely the type specimen (Reuss 1845). The species is characterized by its considerably convex chambers and distinct, elongate, turned outwards neck.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — Coniacian to Maastrichtian; Carpathians — Lower Senonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe, North America, and Australia: Turonian to Maastrichtian.

Genus *Neoflabellina* Bartenstein, 1948
Neoflabellina suturalis (Cushman, 1935)
(pl. 3: 8)

1935. *Flabellina suturalis* Cushman: 86—87, pl. 13: 9—18.
1960. *Neoflabellina suturalis* (Cushman); Tollmann: 176—177, pl. 16: 3, 4.

Material. — Five partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45429/79/F	45430/79/F	45431/79/F
length	1.720	1.736	1.382
width	0.600	0.600	0.432
thickness	0.120	0.144	0.120

Variability. — Intraspecific variability can hardly be recognized because of too small sample size and poor preservation state of the specimens investigated.

Remarks. — The investigated specimens of *N. suturalis* (Cushman, 1935) correspond entirely to the holotype, except for their smaller size (Cushman 1935). Koch (1977) described some specimens with tuberculate chambers and attributed them to *N. suturalis suturalis* (Cushman, 1935). However, both the type specimen and the material from the Nysa Trough show smooth chambers and hence, the specimens studied by Koch (1977) are to be regarded as representative of another species, maybe of *N. "deltoidea"* (Wedekind). Teisseyre (1975: 105) pointed to a variation in test shape and ornamentation in *Neoflabellina rugosa* (d'Orbigny). One may, however, suppose that she included some individuals of *N. suturalis* to *N. rugosa*, as the specimen presented in her pl. 1: 12 resembles closely *N. suturalis* (Cushman).

Distribution. — Poland: Sudetes (Nysa Trough) — Coniacian. North and South America: Coniacian to Lower Campanian. In Europe, *N. suturalis* and *N. rugosa* are commonly misinterpreted and hence, one can hardly determine the proper stratigraphic and geographic range of either of the two species.

Genus *Planularia* Defrance *in* de Blainville, 1826

Planularia complanata (Reuss, 1845)

(pl. 3: 11)

1845. *Cristellaria complanata* Reuss: 33, pl. 13: 54.
1972. *Planularia complanata* (Reuss); Gawor-Biedowa: 42—43, pl. 3: 10 (with synonymy).
1975. *Lenticulina (Planularia) complanata complanata* (Reuss); Magniez-Jannin: 154—155, pl. 9: 31—36. Text-fig. 83c—d.

Material. — Seven well preserved specimens.

Dimensions (in mm):

IG Nos.:	45432/79/F	45433/79/F	45434/79/F
length	0.612	0.576	0.468
width	0.270	0.252	0.198

Variability. — There is a variation in height and dorsal expansion of sutural slats, boss shape and convexity, and development of the slat edging the lower part of a test.

Remarks. — The investigated specimens of *P. complanata* (Reuss, 1845) resemble very closely the type specimen (Reuss 1845). The specimens under study derived from higher stratigraphic units than those described by Magniez-Jannin (1975). They show indeed well developed features that appeared in rudimentary form at middle Late Albian time, and quite distinctly at late Albian time. These features are: more oval test outline, rise and expansion of sutural slats up to formation of oval swellings at the dorsal margin, extension of the latest chambers up to the coiled part of a test, and formation of a convex boss.

Distribution. — Poland: Polish Lowlands — Albian to Lower Senonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Czechoslovakia: Cenomanian to Upper Turonian. FRG and GDR: Albian to Coniacian. England: Albian. France: Upper Albian to Coniacian.

Genus *Saracenaria* Defrance *in* de Blainville, 1824

Saracenaria triangularis (d'Orbigny, 1840)

(pl. 3: 9)

1840. *Cristellaria triangularis* d'Orbigny: 27, pl. 2: 21—22.
1957. *Saracenaria triangularis* (d'Orbigny); Pożaryska: 119—120, pl. 10: 8 (with synonymy).
1972. *Saracenaria triangularis* (d'Orbigny); Hanzliková: 72, pl. 16: 10.

Material. — Forty five well preserved specimens.

Dimensions (in mm):

IG Nos.:	45435/79/F	45436/79/F	45437/79/F
length	0.558	0.504	0.378
width	0.360	0.288	0.288
thickness	0.450	0.306	0.252

Variability. — There is some variation in test size, width of the slat edging the dorsal side of a test, ventral-side convexity, and involuteness of the initial part of a test.

Remarks. — The specimens from the Nysa Trough assigned here to *S. triangularis* (d'Orbigny, 1840) resemble very closely the type specimen (d'Orbigny 1840). From those described from the Polish Lowlands (Pożaryska 1957), they differ in their wider and thicker test. Some specimens attributed by Brotzen (1936) to *Astacolus jarvisi* (56, pl. 3: 5a—b) are actually representative of the species under discussion.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — Cenomanian to Maastrichtian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe: France (Paris Basin) — Campanian; Austria — Coniacian; Czechoslovakia (Moravia) — Senonian. North America: Gulf Coast — Coniacian to Maastrichtian.

Family **Polymorphinidae** d'Orbigny, 1839
Subfamily **Ramulininae** Brady, 1884
Genus *Ramulina* Jones *in* Wright, 1875
Ramulina aculeata (d'Orbigny, 1840)
(pl. 2. 12, 13)

1840. *Dentalina aculeata* d'Orbigny: 13, pl. 1: 2, 3.
1971. *Ramulina aculeata* (d'Orbigny); Fuchs: 31, pl. 9: 9 (with synonymy).
1975. *Ramulina aculeata* (d'Orbigny); Magniez-Jannin: 232—234, Text-fig. 124 (with synonymy).

Material. — A hundred well preserved to partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45438/79/F	45439/79/F	45440/79/F
length of a single chamber (without neck)	0.576	0.450	0.342
width of a single chamber	0.360	0.252	0.216

Variability. — The investigated collection includes merely isolated chambers. Their variation in shape and size depends probably upon the original position of a chamber in test. The chambers are more or less elongate to subspherical. Their surface is glossy, more or less eroded, with traces after numerous spines. All the chambers show rapid constrictions at the poles, resulting in formation of elongate necks linking the chambers into a row. No septa have been recorded.

Remarks. — The specimens of *R. aculeata* (d'Orbingy, 1840) from the Nysa Trough are entirely consistent with the description given by Fuchs (1971). There is a comprehensive list of junior synonyms of the species, due to variable interpretations of its generic attribution. The problem has been finally solved by Loeblich and Tappan (1964: C537) who demonstrated that the type material is representative of the genus *Ramulina* Jones *in* Wright, 1875.

Distribution. — Cosmopolitan, Lower to Upper Cretaceous species. Poland: Sudetes (Nysa Trough) — Turonian to Coniacian.

Superfamily **Robertinacea** Reuss, 1850
Family **Epistominidae** Wedekind, 1937
Genus *Epistomina* Terquem, 1883
Epistomina spinulifera polypioides (Eichenberg, 1933)
(pl. 4: 1, 2)

1933. *Rotalia* (?) *Epistomina polypioides* Eichenberg: 21, pl. 3: 1a—c.
1972. *Epistomina spinulifera polypioides* (Eichenberg); Gawor-Biedowa: 138—140, pl. 18: 4a—c, 5, 6a—b, 7a—c (with synonymy).

Material. — Ten specimens with partly dissovled tests.
Dimensions (in mm):

IG Nos.:	45441/79/F	45442/79/F	45443/79/F
diameter	0.630	0.486	0.360
thickness	0.306	0.324	0.216

Variability. — Intraspecific variability could not be investigated because of the poor preservation state of the specimens.

Remarks. — The specimens of *E. spinulifera polypioides* (Eichenberg, 1933) under study are entirely consistent with the present author's previous description (Gawor-Biedowa 1972). In spite of the poor preservation state of the material, the specific identification was possible by a comparison to the specimens from the Polish Lowlands. Despite the partly dissolution of the tests, remnants of the ornamentation indicative of *E. spinulifera polypioides* are preserved.

Distribution. — Poland: Polish Lowlands — Lower Turonian; Sudetes (Nysa Trough) — uppermost Turonian to Coniacian. FRG: Upper Aptian to lower Upper Albian. Tethyan Realm: Baleares, North Africa, Turkmanistan, West Carpathians, and Yugoslavia — Upper Aptian to Upper Albian (? Cenomanian).

Epistomina stelligera (Reuss, 1854)

(pl. 4: 3, 4)

1854. *Rotalina stelligera* Reuss: 69, pl. 25: 15 (*fide* Ellis and Messina, Cat. of Foram.).
1967. *Epistomina stelligera stelligera* (Reuss); Ohm: 151—152, pl. 20: 3, Text-fig. 46a—f.
1976. *Epistomina stelligera stelligera* (Reuss); Ascoli: pl. 5: 4a—c.

Material. — More than three hundred poorly preserved specimens.
Dimensions (in mm):

IG Nos.:	45444/79/F	45445/79/F	45446/79/F
diameter	0.558	0.468	0.342
thickness	0.342	0.270	0.234

Variability. — Intraspecific variability consists in test convexity. Ventral side of a test ranges from equally to a little more convex than the dorsal one.

Remarks. — *E. stelligera* (Reuss, 1854) resembles most closely *E. caracolla* (Roemer) but it differs from the latter species in less numerous chambers in the last whorl (5 to 7 versus 8 to 11 in *E. caracolla*), less massive test, and radial convex sutures at the ventral side.

Distribution. — Poland: Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Tethyan province — Coniacian to Maastrichtian. Canada: Coniacian.

Superfamily **Buliminacea** Jones, 1875
Family **Bolivinitidae** Cushman, 1927
Genus *Tappanina* Montanaro-Gallitelli, 1955
Tappanina eouvigeriniformis (Keller, 1935)

(pl. 3: 12)

1935. *Bolivinita eouvigeriniformis* Keller: 548—549, pl. 3: 20, 21.
1963. *Tappanina eouvigeriniformis* (Keller); Štemproková-Jirová: 141—143, pl. 1. 1a—c.
1975. *Bolivinita eouvigeriniformis* Keller; Magniez-Jannin: 238, pl. 15: 35, 36.

Material. — Seven well preserved specimens.
Dimensions (in mm):

IG Nos.:	45447/79/F	45448/79/F	45449/79/F
height	0.468	0.340	0.250
width	0.126	0.126	0.070
thickness	0.090	0.090	0.070

Variability. — There is some variability in height and width of the slats at sutures.

Remarks. — The specimens of *T. eouvigeriniformis* (Keller, 1935) from the Nysa Trough are entirely consistent with the present author's former description (Gawor-Biedowa 1972).

Distribution. — Poland: Polish Lowlands — Cenomanian to Lower Turonian; Sudetes (Nysa Trough) — Upper Turonian. Northwest FRG: Upper Albian to Lower Coniacian. France: Upper Albian to lowermost Cenomanian. Czechoslovakia: Turonian to lowermost Coniacian. Soviet Union: Cenomanian to Turonian. West Indies: Trinidad — Turonian to Coniacian.

Superfamily **Discorbacea** Ehrenberg, 1838
Family **Discorbidae** Ehrenberg, 1838
Subfamily **Discorbinae** Ehrenberg, 1838
Genus *Pseudopatellinella* Takayanagi, 1960
Pseudopatellinella serpuloides (Schacko, 1892)
(pl. 4: 5, 6)

1892. *Trochammina serpuloides* Schacko: 159: 5 (*fide* Ellis and Messina, Cat. of Foram.).
1975. *Pseudopatellinella cretacea* Takayanagi; Magniez-Jannin: 238—239, 15: 10, 11.

Material. — Seven well preserved to partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45450/79/F	45451/79/F	45452/79/F
length	0.390	0.342	0.288
width	0.234	0.216	0.162
thickness	0.162	0.090	0.090

Variability. — There is some variation in gradual to rapid increase in height of the chambers in both "lobes" linked together by the proloculus. The 8 shaped test ranges from elongate to bulgy in outline. Chamber surfaces at the dorsal side of a test show, even when slightly eroded, pores arranged usually in rows dispersed all over the chambers in width.

Remarks. — The specimens assigned here to *P. serpuloides* (Schacko, 1892) are consistent with the description given by Magniez-Jannin (1975). The original description and illustrations were sketchy, as is also the illustration given by Egger (1899). The present author is of the opinion that the specimens collected in the Nysa Trough as well as those from the Paris Basin assigned by Magniez-Jannin (1975) to *Pseudopatellinella cretacea* Takayanagi should be attributed to the species *Trochammina serpuloides* Schacko. They resemble the type material of the latter species in their elongate, distinctly 8-shaped test and the arrangement of the two latest chambers at the ventral side, which features make the difference between *T. serpuloides* and *P. cretacea*. Magniez-Jannin (1975: 239) was unable to study the aperture of the specimens she investigated and hence, assigned them only tentatively to *Pseudopatellinella* and its species *P. cretacea*. The specimens from the Sudetes resemble very closely the French ones and their aperture cannot be observed either. Nevertheless, they clearly display the other diagnostic features of the genus *Pseudopatellinella*. In *P. cretacea* Takayanagi, the aperture is easily discernible, fissure-like, narrow, running from test center outwards, at the surface of the final chamber. Sliter (1968) described *P. cretacea* Takayanagi from the Campanian to Maastrichtian Rosario Formation, California; his specimens differ from *P. serpuloides* in their oval instead of the 8-shaped test. A closely related species, *P. howchini* Ludbrook, 1966, was found in the Albian of South Australia. Neagu (1975) described recently a new species *P. rumana* from the Lower Cretaceous of Rumania, which resembles *P. cretacea* Takayanagi rather than *P. serpuloides* (Schacko), in its wide oval test outline and wide chambers at the ventral side.

Distribution. — Poland: Sudetes (Nysa Trough) — Coniacian. GDR: Cenomanian to Turonian. FRG: Bavarian Alps — Cretaceous. France: Paris Basin — Upper Albian to Lower Cenomanian.

Subfamily **Bagginina**e Cushman, 1927
Genus *Valvulineria* Cushman, 1926
Valvulineria lenticula (Reuss, 1845)
(pl. 5: 1, 2)

1845. *Rotalina lenticula* Reuss: 35, pl. 12: 17a—c.
1964. *Valvulineria lenticula* (Reuss); Martin: 103—104, pl. 15: 5a—c.
1978. *Valvulineria lenticula* (Reuss); Vaptzarova: 59—60, pl. 2: 1—3 (with synonymy).

Material. — Eighty well preserved specimens.

Dimensions (in mm):

IG Nos.:	45453/79/F	45454/79/F	45455/79/F
greater diameter	0.288	0.270	0.254
smaller diameter	0.252	0.216	0.198
thickness	0.144	0.144	0.108

Variability. — Intraspecific variability consists mostly in convexity of the ventral side of test, chamber convexity, suture depression, size of the final chamber, chamber number in the last whorl (7 to 8), and size of the tongue-shaped processus covering umbilical depression.

Remarks. — The investigated specimens of *V. lenticula* (Reuss, 1845) resemble very closely those described by Akimez (1961). The species under discussion shows much affinity to *V. berthelini* Jannin but it differs from the latter species in its more oval test outline, narrower test edge, less convex chambers, smaller and more elongate tongue-shaped processus covering umbilical depression, and more extended final chamber. Harris and McNulty (1956) studied in detail foraminifers found in the United States and assigned previously to *Rotalina depressa* Alth and *R. cretacea* Carsey. They concluded that the specimens at their disposal should be attributed to *Valvulineria lenticula*. Those American specimens are indeed representative of the genus *Valvulineria* Cushman, 1926, but are to be considered as a distinct species *V. depressa* (Alth). *V. depressa* differs from *V. lenticula* in more convex whorls at the dorsal side of its test, more numerous chambers in the last whorl (10 to 12 instead of 7 to 8 in *V. lenticula*), narrower chambers, and considerably depressed sutures.

Distribution. — Poland: Polish Lowlands — Upper Albian to Santonian (the stratigraphic range has not been investigated higher in the section); Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Europe and North America: Upper Cretaceous.

Family **Eponididae** Hofker, 1951
Genus *Eponides* de Montfort, 1808
Eponides concinna Brotzen, 1936
(pl. 5: 6—8)

1936. *Eponides concinna* Brotzen: 167, pl. 12: 4a—c.
1978. *Eponides concinnus* Brotzen; Vaptzarova: 62, pl. 2: 7—9.

Material. — Forty five variously preserved specimens.
Dimensions (in mm):

IG Nos.:	45456/79/F	45457/79/F	45458/79/F
diameter	0.234	0.180	0.144
thickness	0.090	0.090	0.072

Variability. — There is merely a slight intraspecific variability in convexity of the dorsal side of test.

Remarks. — The specimens of *E. concinna* Brotzen, 1936, from the Nysa Trough are consistent with the original description of the holotype (Brotzen 1936), except for the number of chambers in the last whorl (5 to 6 versus 7 chambers in the holotype). The species under discussion resembles *E. monterelensis* Marie in test symmetry and chamber number in the last whorl but it differs from the latter in its invisible early whorls, wider whorls and poorly developed sutures at the dorsal side. Vassilenko (1961: 79) attributed to the considered species specimens with 7 to 10 chambers in the last whorl and observed that chamber number in the last whorl and convexity of the ventral side increase in filogeny.

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian to Lower Coniacian. Sweden: Lower Senonian. Soviet Union: uppermost Turonian to Santonian. Bulgaria: Santonian.

Superfamily **Globigerinacea** Carpenter, Parker et Jones, 1862
Family **Heterohelicidae** Cushman, 1927
Subfamily **Heterohelicinae** Cushman, 1927
Genus *Heterohelix* Ehrenberg, 1927
Heterohelix moremani (Cushman, 1938)
(pl. 5: 3, 4)

1938. *Gümbelina moremani* Cushman: 10, pl. 2: 1, 2 (*non*: 3) (*fide* Ellis and Messina, Cat. of Foram.).
1975. *Heterohelix moremani* (Cushman); Darmoian: 191—192, pl. 1: 3 (with synonymy).
1977. *Heterohelix moremani* (Cushman); Petters: pl. 1: 10.

Material. — A hundred well preserved specimens.
Dimensions (in mm):

IG Nos.:	45459/79/F	45460/79/F	45461/79/F
length	0.270	0.234	0.198
width	0.162	0.144	0.126
thickness	0.096	0.096	0.072

Variability. — Intraspecific variability consists in test dimensions, chamber number in the biserial part of a test, and rate of test expansion with growth (nonetheless, the expansion is never very rapid). Aside of tests straight in outline, there are also some bended ones in the collection.

Remarks. — The specimens of *H. moremani* (Cushman, 1938) from the Nysa Trough largely correspond to the type material; the test striation is their additional character. The species under discussion differs from *H. washitensis* (Tappan), the stratigraphically oldest (Albian to Cenomanian) species of *Heterohelix*, in its larger-sized test, more spherical chambers, more oblique sutures, and costation of test surface. Bandy (1967: 22) claims that *H. washitensis* and *H. moremani* may actually represent distinct generations of a single species. However, neither in the Polish Lowlands, nor in the Sudetes do the two morphotypes co-occur, which indicates that these are indeed distinct species. In fact, Brown (1969; 24) ascertained that: "All heterohelicids have striae on their tests with the possible exception of the most primitive species, *Heterohelix washitensis* (Tappan), a late Albian-Cenomanian form (pl. 1: 7)."

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian. Europe, North and South America, and Africa: Upper Cenomanian to Lower Santonian, maybe up to Campanian.

Heterohelix striata (Ehrenberg, 1840)
(pl. 4: 7)

1840. *Textularia striata Ehrenberg*: 135, pl. 4: 1*a*, 2*a*, 3*a* (*non*: 9) (*fide* Ellis and Messina, Cat. of Foram.).
1972. *Heterohelix striata* (Ehrenberg); Hanzliková: 93, pl. 23: 14—18.
1977. *Heterohelix globulosa* (Ehrenberg); Petters: pl. 1: 11—12.

Material. — A hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45462/79/F	45463/79/F	45464/79/f
length	0.360	0.234	0.198
width	0.324	0.234	0.126
thickness	0.198	0.180	0.090

Variability. — Intraspecific variability consists in test size, chamber number in the biserial part of test, rate of test expansion with growth, size of the two last chambers (a quarter to half the length of a test), and intensity of the ornamentation of chamber surface. Very fine, uniformly spaced ribs at chamber surface are continuous or broken. Biserial individuals of macrospheric generation prevail, whereas individuals of microspheric generation (with very small planispiral, initial part of test) are very rare in the investigated collection.

Remarks. — The specimens of *H. striata* (Ehrenberg, 1840) from the Nysa Trough resemble closely those described by Darmoian (1975). As pointed out by Pessagno (1967: 264), the systematic position of *H. striata* (Ehrenberg) and *H. globulosa* (Ehrenberg) is doubtful. Pessagno (1967) recognized the specimen presented by Ehrenberg (1840: pl. 4: 2*a* for the lectotype of *H. striata*, and the Kjolby Gaard marls, Jutland, Denmark, for the type locality and horizon (see Berggren 1962: pl. 5: 1). The only thus far established morphological difference between *H. striata* and *H. globulosa* is in the lack of striae at chamber surface in the latter species. However, SEM studies demonstrate that the seemingly smooth chambers of *H. globulosa* are actually covered with fine striae. Therefore, the present author agrees with Darmoian (1975) that foraminifera assigned thus far to *H. striata* and *H. globulosa* are actually conspecific.

Distribution. — Poland: Sudetes (Nysa Through) — Turonian to Coniacian, Europe, and North and South America: Turonian do Maastrichtian. Africa: Cenomanian to Maastrichtian. Australia: Santonian to Maastrichtian.

Family **Marginotruncanidae** Pessagno, 1967

Genus *Marginotruncana* Hofker, 1956

Marginotruncana coronata (Bolli, 1944)

(pl. 4: 11—13)

1918. *Rosalina linnei* d'Orbigny type 4 de Lapparent: 4: 1g.
1944. *Globotruncana lapparenti coronata* Bolli: 233, pl. 9: 14, 15, Text-figs 21, 22.
1970. *Marginotruncana coronata* (Bolli); Donze *et al.*: 78—79, pl. 11: 1—3, pl. 13: 20 (with synonymy).
1977. *Marginotruncana coronata* (Bolli); Linares Rodriguez: 186—192, pl. 28: 1, 2.

Material. — Forty variously preserved specimens.

Dimensions (in mm):

IG Nos.:	45465/79/F	45466/79/F	45467/79/F
diameter	0.720	0.684	0.294
thickness	0.216	0.180	0.128

Variability. — There is some variation in chamber number in the last whorl (6 to 9), test and chambers convexity, degree of lobulation of test outline, and width of the belt between keels.

Remarks. — The investigated specimens of *M. coronata* (Bolli, 1944) are entirely consistent with the description given by Książkiewicz (1956). The species under discussion differs from *M. linneiana* (d'Orbigny) in its a little biconvex test, narrower belt between keels, and a trend towards fusion of the keels at the latest chambers. In turn, it differs from *M. angusticarinata* (Gandolfi) in its much less convex test and chambers, and the thicker, horizontal keels.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — upper Lower Turonian to Lower Santonian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. World-wide: Turonian (exclusive of the lowermost strata) to Santonian (except for the upermost strata).

Marginotruncana linneiana (d Orbigny, 1839)

(pl. 6: 1—3)

1839. *Rosalina linneaiana* d'Orbigny *in* Ramon de la Sagra: 110, pl. 5: 10—12 (*fide* Ellis and Messina, Cat. of Foram.).
1969. *Globotruncana linneiana* (d'Orbigny); Douglas: 181—182, pl. 3: 1 (with synonymy).
1972. *Globotruncana pseudolinneiana* (Pessagno); Hanzlikovà: 109, pl. 29: 8, 9.
1977. *Marginotruncana pseudolinneiana* Pessagno; Linares Rodriguez: 180—186, pl. 19: 1—2, pl. 28: 4—5.
1977. *Globotruncana linneiana* (d'Orbigny); Koch: 40, pl. 5: 7—8.

Material. — Over a hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45468/79/F	45469/79/F	45470/79/F
diameter	0.620	0.540	0.450
thickness	0.234	0.162	0.162

Variability. — Intraspecific variability consists in test dimensions, chamber shape at the dorsal side of a test (triangular-lobate to more elongate-semilunar in outline), width of the keels, sutural slats, and belt inbetween keels.

Remarks. — Douglas (1969) discussed critically various opinions on the taxonomic and stratigraphic position of *M. linneiana* (d'Orbigny, 1839). That author considers the species *Globotruncana canaliculata* (Reuss) as distinct from *M. linneiana*, the difference between the two species consisting mostly in convex chambers and depressed radial sutures at the ventral side of test in *G. canaliculata*. The present author agrees however with those students who regard *G. canaliculata* as a junior synonym of *M. linneiana*. In fact, the original description and illustrations given by Reuss (1854) point clearly out the thickened sutures and flat to concave chambers at the ventral side of the type specimen of *G. canaliculata*.

The present author follows Trujillo (1960) and other authors in considering *Globotruncana lapparenti* Brotzen as a junior synonym of *M. linneiana*. Actually, one can hardly say how do the individuals of *G. lapparenti* look. Pessagno (1967) attempted to solve the problem by designating a specimen from de Lapparent's (1918) collection from Hendaye for the lectotype of *G. lapparenti*; in fact, this collection was recalled by Brotzen (1936). He pointed to the group of *Rosalina linneiana* d'Orbigny, split by de Lapparent (1918) down into 6 morphotypes, as typical of his new species. The lectotype (de Lapparent 1918: 5,2(n) designated by Pessagno (1967) does not determine unequivocally the morphological characteristics of *G. lapparenti* because similar cross sections can well be displayed by specimens representative of various species. This is indeed confirmed by the work by Douglas (1969) on the section of Hendaye, France, investigated previously by de Lapparent. In addition to *M. linneiana*, Douglas recorded also in that section *Globotruncana arca* (Cushman), *G. fornicata* Plummer, *G. calciformis* (Lapparent) and *G. ventricosa* White. The morphotypes 1 to 6 recognized by de Lapparent (1918) may thus include all those species and some others as well. Accordingly to Douglas (1969) some individuals of *G. lapparenti* Brotzen are to be assigned to *M. linneiana*.

Globotruncanids with both sides of the test flat are assigned by Pessagno (1967), Douglas (1969), and several other authors partly to *Marginotruncana pseudolinneiana* Pessagno, and partly to *Globotruncana linneiana* (d'Orbigny); the stratigraphic range of the two species appear then different. The material collected by the present author in the Polish Lowlands and Sudetes shows that there are no sufficient morphological criteria to distinguish between the two species. All the variation in test dimensions, keel width, and chamber shape falls within the range of intraspecific variability. One may obviously claim, as several authors do, that the Turonian to Santonian bilaterally flat globotruncanids belong to the species *G. pseudolinneiana*, and the Campanian to Maastrichtian ones belong to *G. linneiana*; no doubt however that this would be an arbitrary taxonomic classification. Furthermore, there is no change in aperture position in the specimens from the Turonian to Santonian to those of Campanian to Maastrichtian age and hence, there is no reason to assign the latter to another genus than the former.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — Upper Turonian to Campanian; Sudetes (Nysa Trough) — Upper Turonian to Coniacian. World-wide: Turonian to Maastrichtian.

Marginotruncana marginata (Reuss, 1845)

(pl. 4: 8—10)

1845. *Rosalina marginata* Reuss: 36, pl. 8: 54, 74, pl. 13: 68.
1970. *Marginotruncana marginata* (Reuss); Donze *et al.*: 74—75, pl. 10: 18—20, pl. 13: 21, 23.

1977. *Marginotruncana marginata* (Reuss); Linares Rodriguez: 192—198, pl. 34: 1—3 (with synonymy).
1977. *Globotruncana marginata* (Reuss); Koch: 29, pl. 4: 5—7.

Material. — More than three hundred variously preserved specimens.
Dimensions (in mm):

IG Nos.:	45471/79/F	45472/79/F	45473/79/F
diameter	0.630	0.540	0.468
thickness	0.324	0.270	0.180

Variability. — There is a very large intraspecific variability in chamber number in the last whorl (6 to 8), chamber convexity, shape and ornamentation of the sutures at the ventral side of a test. The sutures are most commonly radial, considerably depressed, without slats; there are however a few specimens with sigmoidal, a little thickened sutures at the beginning of the whorl, and radial sutures towards the whorl end.

Remarks. — The investigated specimens of *M. marginata* (Reuss, 1845) are entirely consistent with the description of the neotype designated by Jirová (1956). The original illustrations given by Reuss (1845) do not allow to recognize precisely the morphological characteristics of the species. Cushman (1946: 150, pl. 62: 1a—c) studied therefore the Reuss' collections in Dresden, Vienna, and Cambridge and illustrated one of the specimens. That specimen is now considered by many micropaleontologists as the neotype of *Globotruncana marginata* (Reuss). In turn, Jirová (1956) designated for the neotype a well illustrated and precisely described specimen collected at Lužice, the type locality pointed by Reuss (1845). Bolli, Loeblich, and Tappan (1957: 46) proposed to recognize the original illustration given by Reuss (1845: pl. 13: 68) for the lectotype of the species under discussion. The figure appears however too sketchy to permit definition of the specific features; moreover, it is uncertain whether the specimen has persisted in the collection or not.

Hofker (1956) designated *Rosalina marginata* Reuss for the type species of his newly erected genus *Marginotruncana*. The criteria applied by Hofker to the creation of that genus were strongly criticized by Bolli *et al.* (1957: 45) and by Pessagno (1967: 300). The latter author had also redefined the genus *Marginotruncana* Hofker, and his definition was subsequently emended by Donze *et al.* (1970). The emended definition of the genus includes all the morphological characteristics observed in *G. marginata* by Jirová (1956) and Štemproková-Jirová (1970) who investigated the intraspecific variability in populations collected at the type locality. It is however to be noted that neither the specimens from the type locality, nor those from Poland show slats at the umbilical part of chambers at the ventral side of a test.

Distribution. — Cosmopolitan species with Turonian to Coniacian acme. Poland: Carpathians and Polish Lowlands — upper Lower Turonian to Maastrichtian; Sudetes (Nysa Trough) — Turonian to Santonian.

Genus *Dicarinella* Porthault, 1970

Dicarinella concavata (Brotzen, 1934)

(pl. 6: 4—7)

1934. *Rotalia concavata* Brotzen: 66, pl. 3: b (*fide* Ellis and Messina, Cat. of Foram.)
1977. *Dicarinella concavata* (Brotzen); Linares Rodriguez: 110—116, pl. 8: 2—4, pl. 9: 1—2 (with synonymy).

Material. — Thirty variously preserved specimens.
Dimensions (in mm):

IG Nos.:	45474/79/F	45475/79/F	45476/79/F
diameter	0.620	0.540	0.468
thickness	0.180	0.180	0.180

Variability. — Intraspecific variability consists in test shape, lobulation of test outline, width of the belt inbetween keels, chamber convexity and suture thickening at the dorsal side of a test, and concavity of the dorsal side.

Remarks. — The specimens of *D. concavata* (Brotzen, 1934) from the Nysa Trough are consistent with the description of the species given by Bolli (1957). The species under study resembles *Globotruncana ventricosa* White to which its individuals are often mistakenly attributed. The differences consist in 6 to 7 chambers in the last whorl, lobate chambers, and flat to convex dorsal side of a test in *G. ventricosa*; while *D. concavata* shows 5 to 6 chambers in the last whorl, angular chambers, and concave dorsal side.

Distribution. — Most common in the Mediterranean. Often considered as a guide fossil but its stratigraphic range is variously interpreted. Poland: Carpathians — Turonian; Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Upper Turonian to Santonian. North and South America: Santonian. Asia and Africa: Coniacian.

Dicarinella radwanskae sp. n.

(pl. 6: 8—10)

Holotype: specimen IG No. 45477/79/F, presented in pl. 6: 8a, b.

Paratypes: IG Nos. 45478/79/F, 45479/79/F; pl. 6: 9, 10.

Type horizon: Turonian.

Type locality: Nysa Trough, borehole Pisary IG, depth of 580 m.

Derivation of the name: in honor of Mrs. Zofia Radwańska, student of the Upper Cretaceous macrofauna of the Nysa Trough.

Diagnosis. — Test low trochospiral, biconvex (more convex at the dorsal side than at the ventral one), circular to suboval lobulate in outline, consisting of 2.5 whorls, with 5 chambers in the last whorl; two weakly developed keels located very close to each other; umbilicus attaining at most one third of test diameter.

Material. — Twenty well preserved specimens.

Dimensions (in mm):

	Holotype	Paratypes	
IG Nos.:	45477/79/F	45478/79/F	45479/79/F
diameter	0.644	0.528	0.480
thickness	0.288	0.240	0.240

Description. — Test low trochospiral, biconvex (a little more convex at the dorsal side than at the ventral one), sometimes a little twisted, consisting of 2.5 whorls. Early whorls make up one third of a test in diameter. Increase in chamber size slow and uniform throughout the ontogeny. In early whorls, chambers are spherical; in the last whorl chambers become lobate, a little more convex at the dorsal side. Septal sutures a little oblique, depressed, sometimes covered with indistinct roll-like swellings at the dorsal side; radial and considerably depressed at the ventral side. Test surface covered with uniformly spaced tubercles. Test circular to suboval, lobulate in outline. Periphery with two weakly developed keels situated very close to each other or even fused at some chambers. Keel may also appear at the periphery of the penultimate whorl (pl. 6: 8a; holotype). Umbilicus attains at most one third of test diameter.

Variability. — Intraspecific variability consists in keel distinctness, occurrence of but a single keel at some chambers, presence or absence of keel at the penultimate whorl and sutural slats at the dorsal side of a test, test twisting, and size relationship between the final chamber and the penultimate one.

Remarks. — The species under discussion resembles *Dicarinella sudetica* sp. n. in keel development and test ornamentation but it differs from the latter species in its test outline, uniform increase in chamber size, presence of a slat at some sutures at the dorsal side of a test, and occurrence of a rudimentary keel at the penultimate whorl.

Distribution. — Poland: Sudetes (Nysa Trough) — Turonian.

Dicarinella sudetica sp. n.

(pl. 7: 1—3)

Holotype: specimen IG No. 45480/79/F, presented in pl. 7: 1a, b, c.

Paratypes: specimens IG Nos. 45481A/79/F, 45481A, pl. 7: 2, 3.

Type horizon: Turonian.

Type locality: Nysa Trough, borehole Pisary IG, depth of 580 m.

Derivation of the name: after the Sudetes where the species has been found.

Diagnosis. — Test low trochospiral, biconvex (a little more convex at the ventral side than at the dorsal one), consisting of 2.5 to 3 whorls, with 5 chambers visible in the last whorl at the dorsal side, and most commonly 4 chambers visible at the ventral side; test outline subtetragonal, considerably lobulate; test surface covered with tubercles; periphery with two narrow keels situated very close to each other, fusing or disappearing at the final chamber; belt inbetween keels very narrow, imperforate; umbilicus narrow; umbilical parts of chambers displaying fragments of portici.

Material. — Thirty well preserved specimens.

Dimensions (in mm):

	Holotype	Paratype
IG Nos.:	45480/79/F	45481/79/F
diameter	0.480	0.552
thickness	0.240	0.216

Description. — Test biconvex with the dorsal side equally to a little more convex than the ventral one, composed of 2.5 to 3 whorls. Early whorls much narrower than the last one, composed of small-sized, spherical chambers. The last whorl includes 4 chambers trapezoidal in outline, considerably convex, especially at the dorsal side, rapidly increasing in size with growth. At both the sides of a test, chambers covered with uniformly spaced tubercles. Spiral suture and septal sutures considerably depressed. At both sides of a test, septal sutures radial, non-ornamented. Test subtetragonal in outline. Periphery with two narrow keels situated very close to each other, fusing or disappearing at the final chamber. Umbilicus narrow, up to one third of test diameter, surrounded with portici preserved in fragments at the umbilical parts of chambers. Umbilical part of the final chamber shows something like a rudimentary umbilical, slat-like swelling.

Variability. — There is some variability in lobulation of test outline, development of keels and their presence or absence at the final chamber, chamber convexity at the dorsal side of test (nonetheless, the chambers are always considerably convex).

Remarks. — The species under discussion resembles in its test form, whorl proportions, and rapid increase in chamber size in the last whorl the species *Globotruncana inornata* Bolli. It differs from the latter in the presence of weakly developed but distinct keels at all the chambers of the last whorl with possible exception of the final chamber.

Distribution. — Sudetes (Nysa Trough) — Turonian.

Family **Globotruncanidae** Brotzen, 1942
Genus *Archaeoglobigerina* Pessagno, 1967
Archaeoglobigerina cretacea (d'Orbigny, 1840)
(pl. 7: 4—6)

1840. *Globigerina cretacea* d'Orbigny: 34, pl. 3: 12, 13, 14.
1967. *Archaeoglobigerina cretacea* (d'Orbigny); Pessagno: 317—318, pl. 70: 3—8, pl. 94: 4—5.
1972. *Globotruncana cretacea* (d'Orbigny); Hanzliková: 105, pl. 28: 3—5 (with synonymy).
1977. *Archaeoglobigerina cretacea* (d'Orbigny); Linares Rodriguez: 72—77, pl. 4: 1—2

Material. — More than fifty variously preserved specimens.
Dimensions (in mm):

IG Nos.:	45482/79/F	45483/79/F	45484/79/F
diameter	0.450	0.393	0.360
thickness	0.234	0.180	0.180

Variability. — There is a large intraspecific variability in test size, keel development, presence versus absence of keels at the final chamber, and chamber swelling.

Remarks. — Banner and Blow (1960: pl. 7: 1) designated the lectotype of *Globigerina cretacea* d'Orbigny from among the original d'Orbigny's collection housed at the Musée d'Histoire Naturelle, Paris. Their diagnosis of the species is consistent with the original one, except for two characters of the lectotype (two faint keels and a wide, imperforate belt inbetween) probably missed by d'Orbigny. Other specimens making part of that collection and recognized for conspecific with the lectotype show well developed tegillae. With all these characteristics taken into account, Banner and Blow (1960) assigned the considered species to the genus *Globotruncana* Cushman. Its homonym *Globotruncana cretacea* Cushman, 1938 (*non* d'Orbigny, 1840) has been called as *Globotruncana mariei* Banner et Blow, 1960. Later on Pessagno (1967) erected a new genus *Archaeoglobigerina* and designated the species *Globigerina cretacea* d'Orbigny for its type species. The latter genus differs from *Globotruncana* in the weak development to absence of keels at the latest chambers (and by implication, absence of imperforate belt from non-keeled chambers), lack of sutural slats, and radial, depressed sutures at the ventral side of test.

Distribution. — Cosmopolitan species. Poland: Carpathians and Polish Lowlands — Upper Turonian to Maastrichtian; Sudetes (Nysa Trough) — Turonian to Santonian. Europe, North and South America, and Australia: Upper Turonian to Maastrichtian.

Superfamily **Cassidulinacea** d'Orbigny, 1839
Family **Caucasinidae** Bykova, 1959
Subfamily **Fursenkoininae** Loeblich and Tappan, 1961
Genus *Cassidella* Hofker, 1951
Cassidella tegulata (Reuss, 1845)
(pl. 8: 1—3)

1845. *Virgulina tegulata* Reuss: 40, pl. 13: 81.
1951. *Cassidella tegulata* (Reuss); Hofker: 265; text-fig. 175.
1974. *Cassidella tegulata* (Reuss); Hercogová: 93, pl. 8: 5 (with synonymy).

Material. — Forty well preserved to partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45485/79/F	45486/79/F	45487/79/F
length	0.558	0.486	0.378
width	0.126	0.162	0.126
thickness	0.090	0.108	0.090

Variability. — Intraspecific variability consists in length and visibility of the triserial part of test, chamber number in the biserial part (5 to 7 couples), rate of test expansion with growth, rate of test torsion relative to its vertical axis, depression of septal and spiral sutures, size of two last chambers (making jointly up a quarter to one third of test length). Well preserved specimens show numerous, minute pores scattered uniformly at chamber surfaces.

Remarks. — The investigated specimens of *C. tegulata* (Reuss, 1845) are entirely consistent with the description given by Loeblich and Tappan (1964). Except for the generic characters, the species under discussion resembles *Bolivina textilarioides* Reuss. However *C. tegulata* shows the test less oval in outline, more flattened at both sides, higher chambers, much larger final and penultimate chambers, and considerably depressed sutures. Nevertheless, the two species are commonly misidentified and hence, their stratigraphic ranges are uncertain. The history of the generic position of *Virgulina tegulata* Reuss has been presented by Loeblich and Tappan (1964) and Hercogová (1974). At the beginning of the original description of his new genus *Cassidella*, Hofker (1951: 264) pointed to *Virgulina* (*Bolivina*) *tegulata* (Reuss) as its type species; however, at the end of the same description (*op. cit*: 265) he designated *Cassidella oligocenica* Hofker for the type species. Loeblich and Tappan (1964) accepted *Virgulina* (*Bolivina*) *tegulata* (Reuss), the first mentioned species in the original description of the genus, as the type species of *Cassidella* Hofker, 1951.

Distribution. — Poland: Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Lower to Upper Cretaceous. North America: Cenomanian to Maastrichtian.

Superfamily **Nonionacea** Schultze, 1854
Family **Nonionidae** Schultze, 1854
Subfamily **Chilostomellinae** Brady, 1881
Genus *Quadrimorphina* Finlay, 1939
Quadrimorphina allomorphinoides (Reuss, 1860)
(pl. 5: 9—11)

1860. *Valvulina allomorphinoides* Reuss: 223, pl. 11: 6.
1960. *Quadrimorphina allomorphinoides* (Reuss); Belford: 87—88, pl. 24: 9—12.
1972. *Quadrimorphina allomorphinoides* (Reuss); Hanzlikovà: 123, pl. 35: 16.

Material. — Eighty well preserved specimens.
Dimensions (in mm):

IG Nos.:	45488/79/F	45489/79/F	45490/79/F
greater diameter	0.270	0.234	0.216
smaller diameter	0.216	0.198	0.216
thickness	0.162	0.126	0.144

Variability. — Intraspecific variability consists in visibility of the early two whorls in dorsal view, width of the last whorl (a half to two thirs of dorsal test surface), chamber number in the last whorl (4 to rarely 5), chamber convexity especially at the last whorl, size and shape of the final chamber (covering up to a half of test ventral surface), and size of the tongue-shaped flap projecting from the umbilical margin of the final chamber.

Remarks. — The specimens of *Q. allomorphinoides* (Reuss, 1860) from the Nysa Trough are entirely consistent with Franke's (1925, 1928) description; they are however smaller than the type specimen. The specimens assigned by Franke (1925, 1928) to *Discorbina allomorphinoides* (Reuss) were subsequently included by Brotzen (1936) to his new species *Valvulineria camerata.* Accordingly to Brotzen 1936: 156), the two morphotypes of *V. camerata* may represent distinct generations of that species. The present author is however of the opinion that these are more probably distinct generations of the species *Q. allomorphinoides.*

Distribution. — Cosmopolitan species. Poland: Sudetes (Nysa Trough) — Turonian to Coniacian. Europe: Turonian to Paleocene. Asia and North and South America: Upper Cretaceous. Australia: Santonian to Campanian.

Family **Osangulariidae** Loeblich and Tappan, 1964

Genus *Osangularia* Brotzen, 1940

Osangularia cordieriana (d'Orbigny, 1840)

(pl. 6: 11, 12)

1840. *Rotalina cordieriana* d'Orbigny: 33, pl. 3: 9, 10, 11.
1958. *Osangularia cordieriana* (d'Orbigny); Bieda: 54—55; text-fig. 21.
1975*b*. *Osangularia cordieriana* (d'Orbigny); Vaptzarová: 65, pl. 2: 16, 17, 18.

Material. — Over eighty well preserved to partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45491/79/F	45492/79/F	45493/79/F
diameter	0.378	0.342	0.270
thickness	0.162	0.162	0.144

Variability. — There is a variability in test convexity at both its sides, chamber convexity at the ventral side of test, and width and sharpness of the keel edging a test.

Remarks. — The investigated specimens of *O. cordieriana* (d'Orbigny, 1840) are entirely consistent with the description of the species given by Bieda (1958). The species under study resembles most closely *O. whitei* (Brotzen) but it differs from the latter species in its more convex ventral and less convex dorsal sides of test, less convex chambers at the ventral side, and more sharpened keel.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — Campanian to Maastrichtian; Sudetes (Nysa Trough) — Coniacian. Europe: Boreal province — Coniacian to Maastrichtian; Mediterranean province — Campanian to Maastrichtian. North and South America: Santonian to Maastrichtian.

Genus *Globorotalites* Brotzen, 1942

Globorotalites michelinianus (d'Orbigny, 1840)

(pl. 7: 7—9)

1840. *Rotalina micheliniana* d'Orbigny: 31—32, pl. 3: 1, 2, 3.
1958. *Globorotalites micheliniana* (d'Orbigny); Witwicka: 227, pl. 9: 37a—d.
1976. *Globorotalites michelinianus* (d'Orbigny); Ascoli: pl. 5: 8a—c.

Material. — More than sixty well preserved to partly damaged specimens.

Dimensions (in mm):

IG Nos.:	45494/79/F	45495/79/F	45496/79/F
diameter	0.432	0.360	0.306
height	0.234	0.234	0.234

Variability. — Intraspecific variability consists in outline of the dorsal side of test (a little convex to a little concave), sharpness of test edge, elongation of the latest chamber in ventral view, chamber number in the last whorl (6 to 8), and depression of sutures at the ventral side.

Remarks. — The investigated specimens of *G. michelinianus* (d'Orbigny, 1840) are consistent with the description given by Witwicka (1958). The species under study resembles most closely *G. multisepta* (Brotzen) but it differs from the latter species in the flattened dorsal side of its test, narrow conical outline of the ventral side, less numerous chambers in the last whorl (6 to 8 versus 8 to 9 in *G. multisepta*), less arcuate sutures, and flat chambers at the ventral side.

Distribution. — Cosmopolitan species, more common in the Boreal Realm than in the Tethyan. Poland: Polish Lowlands — Upper Turonian to Campanian; Sudetes — Turonian to Santonian (Nysa Trough — Upper Turonian to Coniacian). Europe: Turonian to Lower Maastrichtian. North and South America: Campanian to Maastrichtian.

Genus *Gyroidinoides* Brotzen, 1942

Gyroidinoides nitidus (Reuss, 1844)

(pl. 8: 12, 13)

1844. *Rotalina nitida* Reuss: 214 (*fide* Ellis and Messina, Cat. of Foram.).
1960. *Gyroidinoides nitida* (Reuss); Tollmann: 186—187, pl. 19: 2.
1972. *Gyroidinoides nitidus* (Reuss); Hanzliková: 129, pl. 37: 9 (with synonymy).
1972. *Valvulineria lenticula* (Reuss) var. *plummerae* Loetterle; Teisseyre: pl. 3: 9a—c.

Material. — More than two hundred well preserved specimens.

Dimensions (in mm):

IG Nos.:	45497/79/F	45498/79/F	45499/79/F
diameter	0.216	0.192	0.168
thickness	0.192	0.144	0.096

Variability. — There is a considerable variability in test size, outline of the dorsal side of test (a little convex to slightly concave), whorl visibility in dorsal view (the whorls are sometimes encrusted with test matter), and height of the latest chamber at the ventral side.

Remarks. — The specimens of *G. nitidus* (Reuss, 1844) are entirely consistent with the description of the type specimen given by Reuss (1845). The species resembles in its general form *G. infracretaceus* (Morozova) but it differs from the latter species in more flattened dorsal side of its test, less convex chambers and less depressed sutures at the ventral side, and flat apertural surface of the final chamber.

Distribution. — Cosmopolitan species. Poland: Polish Lowlands — Upper Cretaceous; Sudetes (Nysa Trough) — Turonian to Coniacian. Europe, North and South America, and Africa: Upper Cretaceous.

Family **Anomalinidiae** Cushman, 1927
Genus *Gavelinella* Brotzen, 1942

Remarks. — As revealed by the petrographic study on representatives of the species of *Gavelinella* described below, their test wall and the septa are trilamellar in structure. The mid-layer, marked in micrographs as a dark line, consists of semitransparent micrite. Both the surrounding thicker layers consist of transparent granular calcite. The trilamellar structure of test wall in *Gavelinella* and some other anomalinids was already noted by the present author in an earlier paper (Gawor-Biedowa 1972: 15). One may thus supplement the characteristics of the family Anomalinidae Cushman, 1927, with a note that the test wall is bi- or trilamellar in structure.

Gavelinella ammonoides (Reuss, 1845)
(pl. 8: 7, 8; pl. 9: 1—4, 10)

1845. *Rosalina ammonoides* Reuss: 36, pl. 13: 66.
1954. *Anomalina (Gavelinella) ammonoides* (Reuss); Vassilenko: 77, pl. 7: 3a—w.
1975. *Gavelinella ammonoides* (Reuss); Teisseyre: 117—118, pl. 1: 1a—c, 2.

Material. — Over a hundred well preserved specimens.
Dimensions (in mm):

IG Nos.:	45500/79/F	45501/79/F	45502/79/F
diameter	0.522	0.486	0.360
thickness	0.270	0.216	0.162

Description. — The investigated material from the Nysa Trough includes individuals of two distinct generations of the species. The generations do not differ at all in their external morphological characteristics. One can however see in thin sections that the *B*-forms comprise each 2.5 whorls including totally 16 chambers, with 8 (pl. 9: 1) to 9 (pl. 9: 3) chambers in the last whorl; their proloculus attains 19 μm in size. In turn, the *A*-forms comprise each 2 whorls including totally 12 (pl. 9: 4) to 13 (pl. 9: 2) chambers, with 8 chambers in the last whorl; their proloculus ranges between 26 and 29 μm in size.

Variability. — Intraspecific variability consists in convexity of the final chamber, umbilicus width and depth, length of the tongue-shaped flaps projecting from the umbilical margins of chambers, height of sutural slats, and width of test edge.

Remarks. — The investigated specimens of *G. ammonoides* (Reuss, 1845) resemble the type specimen from which they differ merely in their wide and high, slat-like sutures. The Turonian to Coniacian specimens of *G. ammonoides* from Czechoslovakia do not differ at all from those from the Sudetes. Michael (1966) gives another interpretation of the species under discussion and attributes to it rapidly increasing specimens with swollen chambers of the last whorl. The endmember variety of the range of intraspecific variation is then *Rotalina moniliformis* Reuss assigned indeed by Michael (1966: 434) to *G. ammonoides*.

Distribution. — Poland: Sudetes (Nysa Trough) — Upper Turonian to Coniacian. Soviet Union and Czechoslovakia: Turonian to Coniacian. Bulgaria: Coniacian.

Gavelinella moniliformis (Reuss, 1845)
(pl. 8: 4—6; pl. 9: 5—7, 11)

1845. *Rotalina moniliformis* Reuss: 36, pl. 12: 30, pl. 13: 67.
1954. *Gavelinella (Anomalina) moniliformis* (Reuss); Vassilenko: 81—82, pl. 8: 4a—w, 5a—w, 6a—w.
1975. *Gavelinella moniliformis moniliformis* (Reuss); Teisseyre: 117, pl. 1: 3a—c.

Material. — More than two hundred well preserved to partly damaged specimens. Dimensions (in mm):

IG Nos.:	45503/79/F	45504/79/F	45505/79/F
diameter	0.432	0.378	0.270
thickness	0.306	0.270	0.124

Description. — The investigated material from the Nysa Trough includes individuals of two distinct generations of the species. The generations do not differ at all in their external morphological characteristics. The *B*-forms comprise each 3 whorls including totally 17 to 18 chambers, with 7 chambers in the last whorl; their proloculus attains 12 μm in size. The *A-forms* comprise each 2 whorls including totally 12 to 14 chambers, with 6.5 to 7 chambers in the last whorl; proloculus size is 25 μm.

Variability. — There is a considerable variability in chamber convexity and number in the last whorl (6 to 7), depression of septal sutures, size and ventral inclination of the final chamber, and width of umbilical depression. The collection includes both left-and right-hand coiled specimens.

Remarks. — The investigated specimens of *G. moniliformis* (Reuss, 1845) resemble very closely the type specimen. The subspecies distinguished by Vassilenko (1954), *Anomalina (Gavelinella) moniliformis ukrainica* and *A.* (*G.*) *moniliformis lidiae*, fall within the range of intraspecific variability. In fact, some subspecific differences pointed out by Vassilenko (*op. cit.*), as e.g. chamber number in the last whorl, may reflect the occurrence of two distinct generations of the species.

Distribution. — Poland: Polish Lowlands — Upper Turonian to Coniacian; Sudetes (Nysa Trough) — Turonian to Coniacian. Czechoslovakia: Upper Turonian to Coniacian. Soviet Union: Turonian to Coniacian. Bulgaria: Coniacian.

Gavelinella vombensis (Brotzen, 1945)

(pl. 8: 9—11; pl. 9: 8, 9)

1945. *Pseudovalvulineria vombensis* Brotzen: 50—52, pl. 1: 13 (*non* 12), text-fig. 9.
1974. *Anomalina infrasantonica* Balakhmatova; Gorbenko: 43, pl. 5: 7a—w (with synonymy).

Material. — Seven partly damaged specimens.
Dimensions (in mm):

IG Nos.:	45506/79/F	45507/79/F	45508/79/F
diameter	0.576	0.552	0.452
thickness	0.288	0.264	0.240

Description. — Generations of the species could not be recognized because of the too small sample size. Three specimens studied in thin sections represent a single generation. They comprise each 3 whorls, with 13 chambers in the last whorl and proloculus of 22 μm in size; the chambers of the earlier whorls could not be counted.

Variability. — Intraspecific variability consists in presence or absence of a dorsal encrustation of the test matter covering the early whorls, chamber number in the last whorl (10 to 13), and height and width of septal sutures at the ventral side of a test. The sutures are narrow and a little raised at the periphery but they increase in both width and height towards the umbilicus. Their endings form a star-like ornament in umbilicus.

Remarks. — The specimens of *G. vombensis* (Brotzen, 1945) from the Nysa Trough are entirely consistent with the original description of the type specimen (Brotzen 1945). The Maastrichtian specimens illustrated in the original paper by Brotzen (1945: pl. 1: 12) are to be assigned to *Stensioeina beccariiformis* (White) instead of

G. vombensis. As judged from thus far published reports, there are no representatives of true *G. vombensis* in the Upper Campanian to Maastrichtian. Both the Soviet (Vassilenko 1954, Plotnikova 1967) and the Bulgarian paleontologists (Vaptzarova 1972) describe commonly individuals of *G. vombensis* under the name of *Anomalina infrasantonica*. No doubt that the specimens they deal with are conspecific with *G. vombensis*.

Distribution. — Poland: Polish Lowlands — Turonian (exclusive of the lowermost strata) to Santonian; Sudetes (Nysa Trough) — Coniacian. Sweden: Turonian to Lower Campanian. Soviet Union and Bulgaria: Coniacian to Santonian.

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EUGENIA GAWOR-BIEDOWA

OTWORNICE TURONU I KONIAKU Z ROWU NYSY, SUDETY, POLSKA

Streszczenie

W Sudetach osady okresu kredowego występują w niecce północno sudeckiej, w niecce śródsudeckiej i rowie Nysy Kłodzkiej. Niecka śródsudecka rozpada się ku południowemu wschodowi na szereg drugorzędnych obniżeń, z których największym jest rów Nysy Kłodzkiej. Otwór Pisary IG znajduje się w rejonie Międzylesia (fig. 1) w pobliżu brzegu rowu. Skały serii osadowej w omawianym rejonie należą do dwóch pięter górnej kredy — turonu i koniaku i leżą na gnejsach typu śnieżnickiego. Najbogatszy zespół otwornic występuje w osadach górnego turonu i koniaku, z wyjątkiem jego najwyższych warstw. W obu piętrach przeważają otwornice bentoniczne, w większości długowieczne, nie pozwalające na zbyt ścisłe określenie wieku osadów. Z tych to względów przyjęto biostratygrafię makrofaunistyczną opracowaną przez Radwańską (1971) i na tle podziału makrofaunistycznego wydzielono zaznaczające się poziomy otwornicowe (tabela 1). W turonie wyróżniono 4 poziomy otwornicowe: I. poziom z *Dicarinella sudetica*, II. poziom z *Tappanina eouvigeriniformis*, III. poziom *Archaeoglobigerina cretacea* i IV. poziom *Dicarinella concavata*.

I. Poziom z *Dicarinella sudetica* (poziom zasięgu taksonu). Obejmuje stropową część osadów środkowego turonu i dolne warstwy turonu górnego. W poziomie tym ilość gatunków i okazów otwornic jest niewielka. Gatunkiem najważniejszym stratygraficznie jest *Dicarinella sudetica*.

II. Poziom z *Tappanina eouvigeriniformis* (poziom zespołowy). Charakteryzuje się równoczesnym występowaniem *Tappanina eouvigeriniformis* i *Saracenaria triangularis*. Ilość gatunków i osobników otwornic w tym poziomie jest niewielka (tabela 1).

III. Poziom z *Archaeoglobigerina cretacea* (poziom niesamoistny). Charakteryzuje się równoczesnym występowaniem *Archaeoglobigerina cretacea*, *Plectina lenis*, *Quinqueloculina angusta i Ataxophragmium depressum*. Zespół otwornic w tym poziomie jest dość liczny (tabela 1). Poziom ten obejmuje środkowe warstwy turonu górnego.

IV. Poziom z *Dicarinella concavata* (poziom zasięgu taksonu). Gatunkiem stratygraficznie najważniejszym dla tego poziomu jest *Dicarinella concavata*. Obejmuje on górne warstwy górnego turonu z wyjątkiem warstw najwyższych. W dolnej jego części występuje znacznie mniej gatunków otwornic niż w wyższej (tabela 1).

W osadach koniaku zaznaczają się dwa poziomy otwornicowe: I. poziom z *Epistomina spinulifera polypioides* i II. poziom z *Gaudryina sudetica*.

I. Poziom z *Epistomina spinulifera polypioides* (poziom zespołowy). Gatunkami charakteryzującymi ten poziom są obok *Epistomina spinulifera polypioides*: *Eponides concinna*, *Spiroplectammina embaensis*, *S. rosula*. Mikrofauna w tym poziomie jest bardzo liczna tak pod względem ilości gatunków jak i osobników. Obejmuje on stropowe warstwy górnego turonu i niższe warstwy dolnego koniaku.

II. Poziom z *Gaudryina sudetica* (poziom zasięgu taksonu). Gatunkiem stratygraficznie najważniejszym jest *Gaudryina sudetica*. Charakteryzuje się podobnie jak poziom poprzedni bogatą mikrofauną. Obejmuje wyższe warstwy dolnego koniaku i warstwy koniaku górnego. W poziomie tym wyróżniono dwa podpoziomy. W dolnej jego części podpoziom z *Gaudryina sudetica* i w górnej podpoziom z *Neoflabellina suturalis*.

Zarówno badania litostratygraficzne jak i makro- a także mikrofaunistyczne wykazują brak osadów cenomanu we wschodnim brzegu rowu Nysy Kłodzkiej. Kredowa transgresja morska dotarła do południowo wschodniej części rowu Nysy Kłodzkiej dopiero w dolnym turonie. We wczesnym turonie dolnym morze na obszarze rowu Nysy Kłodzkiej było względnie płytkie, a okolice Pisar znajdowały się w pobliżu brzegu. W późniejszym turonie dolnym pogłębiło się ono i poszerzyło. W połowie turonu nastąpiło spłycenie zbornika, co spowodowało przerwę zarówno w rozwoju otwornic jak i makrofauny. Spłycenie to było odbiciem dźwigania się lądu wschodniosudeckiego. W najwyższym turonie środkowym morze ponownie pogłębiło się i miało lepsze niż dotychczas połączenie z otwartym morzem, na co wskazują pojawiające się otwornice planktoniczne. W górnym turonie morze pogłębiło się bardziej, co przejawia się zarówno w rozwoju facji marglistej jak i we wzroście ilości rodzajów i gatunków otwornic, w tym również otwornic planktonicznych. Rozszerzał się też jego zasięg. Już z początkiem górnego turonu istniało szerokie połączenie środkowo-sudeckiego basenu kredowego zarówno z basenem północnosudeckim, jak też z morzem z obszaru Czech. Musiało w tym czasie istnieć również połączenie środkowo-sudeckiego morza z morzem geosynklinalnym, o czym świadczy obecność *Plectina lenis* w osadach turonu górnego okolic Pisar.

W zespołach otwornic nie obserwuje się zasadniczych zmian przy zmianie sedymentacji marglistej na fliszową na granicy turonu i koniaku. W koniaku zwiększony dopływ do zbiornika materiału detrytycznego nie wpłynął na zahamowanie rozwoju otwornic planktonicznych i bentonicznych wapiennych. Zwiększyła się natomiast liczba gatunków zlepieńcowych otwornic bentonicznych. Rów Nysy Kłodzkiej jest miejscem, gdzie w osadach koniaku zachowały się szczątki roślin drzewiastych. Dzięki tym szczątkom, zwłaszcza roślin dwuliściennych, wiemy, że klimat w koniaku był umiarkowany lub subtropikalny.

EXPLANATIONS OF THE PLATES 1—10

Photographs of the pls. 1—8 (with the exception of pl. 5: 5a, b, c, pl. 6: 7a, b) taken with the scanning electron microscope

Plate 1

1. *Ammodiscus cretaceus* (Reuss): IG 45509/79/F, side view, ×55.
2, 3. *Spiroplectammina embaensis* Mjatliuk: IG 45511/79/F, ×100; IG 45512, ×150; side views.
4. *Haplophragmoides concavus* (Chapman): IG 45513/79/F, side view, ×135.
5, 6. *Spiroplectammina praelonga* (Reuss): IG 45515, microspheric form, ×55; IG 45516/79/F, macrospheric form, ×75; side views.
7, 8. *Gaudryina rugosa* d'Orbigny: IG 45527/79/F; side views; ×55.

9, 10. *Gaudryina sudetica* sp. n.: 9 IG 45388/79/F, paratype, edge view, ×55, 10 IG 45387/79/F, holotype, side view, ×38.
11. *Gaudryina laevigata* Franke: IG 45523, side view, ×55.
12. *Spiroplectammina rosula* (Ehrenberg): IG 45517/79/F, side view, ×110.
13, 14. *Plectina lenis* (Grzybowski): IG 45530/79/F, IG 45531/79/F; side views; ×90.

Pisary borehole, Coniacian, Upper Cretaceous

Plate 2

1, 2. *Arenobulimina preslii* (Reuss): IG 45532/79/F, ventral view, ×75; IG 45533/79/F, dorsal view, ×100.
3. *Dorothia oxycona* (Reuss): IG 45534/79/F, ×90.
4. *Dorothia conulus* (Reuss): IG 45529/79/F, side view, ×55.
5. *Textularia foeda* Reuss: IG 45518/79/F, side view, ×90.
6, 7. *Arenobulimina dorbignyi* (Reuss): IG 45526/79/F, ventral view; IG 45525/79/F, dorsal view; ×55.
8, 9. *Verneuilina münsteri* Reuss: IG 45519/79/F, side view; IG 45520/79/F, apertural view; ×55.
10. 11. *Ophthalmidium cretaceum* (Reuss): IG 45540/79/F, side view; IG 45541/79/F, edge view; ×110.
12, 13. *Ramulina aculeata* (d'Orbigny): IG 45555/79/F, IG 45556/79/F; side views; ×110.
14, 15. *Ataxophragmium depressum* (Perner): IG 45535/79/F, ventral view; IG 45536/79/F, dorsal view; ×55.
16, 17. *Ataxophragmium variabile* (d'Orbigny): IG 45539/79/F, ventral view; IG 45538/79/F, dorsal view; ×55.
18. *Nodosaria obscura* Reuss: IG 45549/79/F, side view, ×40.

Pisary borehole, Coniacian, Upper Cretaceous

Plate 3

1, 2. *Quinqueloculina angusta* Franke: IG 45542/79/F, ×200; IG 45543/79/F, ×140; oblique side views.
3, 4. *Frondicularia cordai* Reuss: IG 45554/79/F, IG 45545/79/F; side views; ×40.
5. *Frondicularia* sp.: IG 45546/79/F, side view, ×40.
6, 7. *Marginulina bullata* Reuss: IG 45547/79/F, ventral view; IG 45559/79/F, dorsal view; ×100.
8. *Neoflabellina suturalis* (Cushman): IG 45552/79/F, slightly oblique side view, ×90.
9. *Saracenaria triangularis* (d'Orbigny): IG 45557/79/F, side view, ×90.
10. *Lenticulina secans* (Reuss): IG 45553/79/F, side-edge view, ×40.
11. *Planularia complanata* (Reuss): IG 45558/79/F, side view, ×75.
12. *Tappanina eouvigeriniformis* (Keller): IG 45574/79/F, side view, ×75.
13, 14. *Lenticulina rotulata* (Lamarck): IG 45550/79/F, side view; IG 45551/79/F, edge view; ×36.

Pisary borehole, Coniacian, Upper Cretaceous

Plate 4

1, 2. *Epistomina spinulifera polypioides* (Eichenberg): IG 45560/79/F, dorsal view; IG 45561/79/F, ventral view; ×75.
3, 4. *Epistomina stelligera* (Reuss): IG 45562/79/F, strongly oblique dorsal view; IG 45563/79/F, strongly oblique ventral view; ×135.

5, 6. *Pseudopatellinella serpuloides* (Schacko): IG 45566/79/F, dorsal view; IG 45567/79/F, ventral view; ×200.
7. *Heterohelix striata* (Ehrenberg): IG 45572/79/F, side view, ×180.
8, 9, 10. *Marginotruncana marginata* (Reuss): IG 45582/79/F, dorsal view; IG 45583/79/F, ventral view; IG 45584/79/F, peripheral view; ×110.
11, 12, 13. *Marginotruncana coronata* (Bolli): IG 45578/79/F, strongly oblique dorsal view; IG 45581/79/F, strongly oblique ventral view; IG 45585/79/F, peripheral view; ×80.

Pisary borehole, Upper Cretaceous
1—6, 8—13 from the Coniacian; *7* from the Upper Turonian

Plate 5

1, 2. *Valvulineria lenticula* (Reuss): IG 45568/79/F, oblique dorsal view; IG 45569/79/F, oblique ventral view; ×180.
3, 4. *Heterohelix moremani* (Cushman): IG 45570/79/F, side view; IG 45571/79/F, edge view; ×200.
5. *Gaudryina sudetica* sp. n.: IG 45388A/79/F, paratype; *a, b* side views, *c* edge view; ×40.
6, 7, 8. *Eponides concinna* Brotzen: IG 45575/79/F, oblique dorsal view; IG 45576/79/F, oblique ventral view; IG 45577/79/F, peripheral view; ×270.
9, 10, 11. *Quadrimorphina allomorphinoides* (Reuss): IG 45591/79/F, dorsal view; IG 45593/79/F, ventral view; ×200, ×270; IG 45594/79/F, peripheral view, ×200.

Pisary borehole, Upper Cretaceous
1—4, 6—11 from the Turonian; *5* from the Coniacian

Plate 6

1, 2, 3. *Marginotruncana linneiana* (d'Orbigny): IG 45580/79/F, dorsal view; IG 45581/79/F, ventral view; IG 45586/79/F, peripheral view; ×75.
4, 5, 6, 7. *Dicarinella concavata* (Brotzen): IG 45588/79/F, oblique dorsal view; IG 45589/79/F, ventral view; IG 45590/79/F, peripheral view; ×100; IG 45587/79/F, *7a* dorsal view and *7b* ventral view, ×75.
8, 9, 10. *Dicarinella radwanskae* sp. n.: IG 45477/79/F, holotype; *8a* dorsal view and *8b* ventral view, ×70; IG 45478/79/F, paratype; IG 45479/79/F, paratype; oblique dorsal view, ×90.
11, 12. *Osangularia cordieriana* (d'Orbigny): IG 45598/79/F, oblique dorsal view; IG 45598/79/F, peripheral view; ×270.

Pisary borehole, Upper Cretaceous
4—10 from the Turonian; *1, 2, 3, 11, 12* from the Coniacian

Plate 7

1, 2, 3. *Dicarinella sudetica* sp. n.: IG 45480/79/F, holotype, *1a* dorsal view and *1b* ventral view, ×140, *1c* ornamentation details of the surface of the ventral side, ×600: IG 45481A/79/F, paratype *2a* dorsal view and *2b* ventral view, ×110; IG 45481/79/F, dorsal view, ×120.
4, 5, 6. *Archaeoglobigerina cretacea* (d'Orbigny): IG 45595/79/F, dorsal view, ×160; IG 45596/79/F, ventral view, ×220; IG 45597/79/F, peripheral view, ×150.
7, 8, 9. *Globorotalites michelinianus* (d'Orbigny): IG 45604/79/F, dorsal view, ×190; IG 45600/79/F, ventral view, ×100; IG 45600A/79/F, peripheral view, ×170.

Pisary borehole, Upper Cretaceous
1, 2, 3 from the Turonian; *4—9* from the Coniacian

Plate 8

1, 2, 3. *Cassidella tegulata* (Reuss): IG 45601/79/F, side view, ×150; IG 45602/79/F, side view; IG 45603/79/F, peripheral view showing aperture; ×160.
4, 5, 6. *Gavelinella moniliformis* (Reuss): IG 45610/79/F, oblique dorsal view, ×120; IG 45611/79/F, ventral view; IG 45612/79/F, peripheral view; ×130.
7, 8. *Gavelinella ammonoides* (Reuss): IG 45605/79/F, oblique ventral view; IG 45606/79/F, peripheral view; ×100.
9, 10, 11. *Gavelinella vombensis* (Brotzen): IG 45613/79/F, dorsal view; IG 45614//79/F, ventral view; ×120; IG 45607/79/F, peripheral view, ×100.
12, 13. *Gyroidinoides nitidus* (Reuss): IG 45608/79/F, ventral view, 75; IG 45609/79/F, peripheral view, ×120.

Pisary borehole, Coniacian, Upper Cretaceous

Plate 9

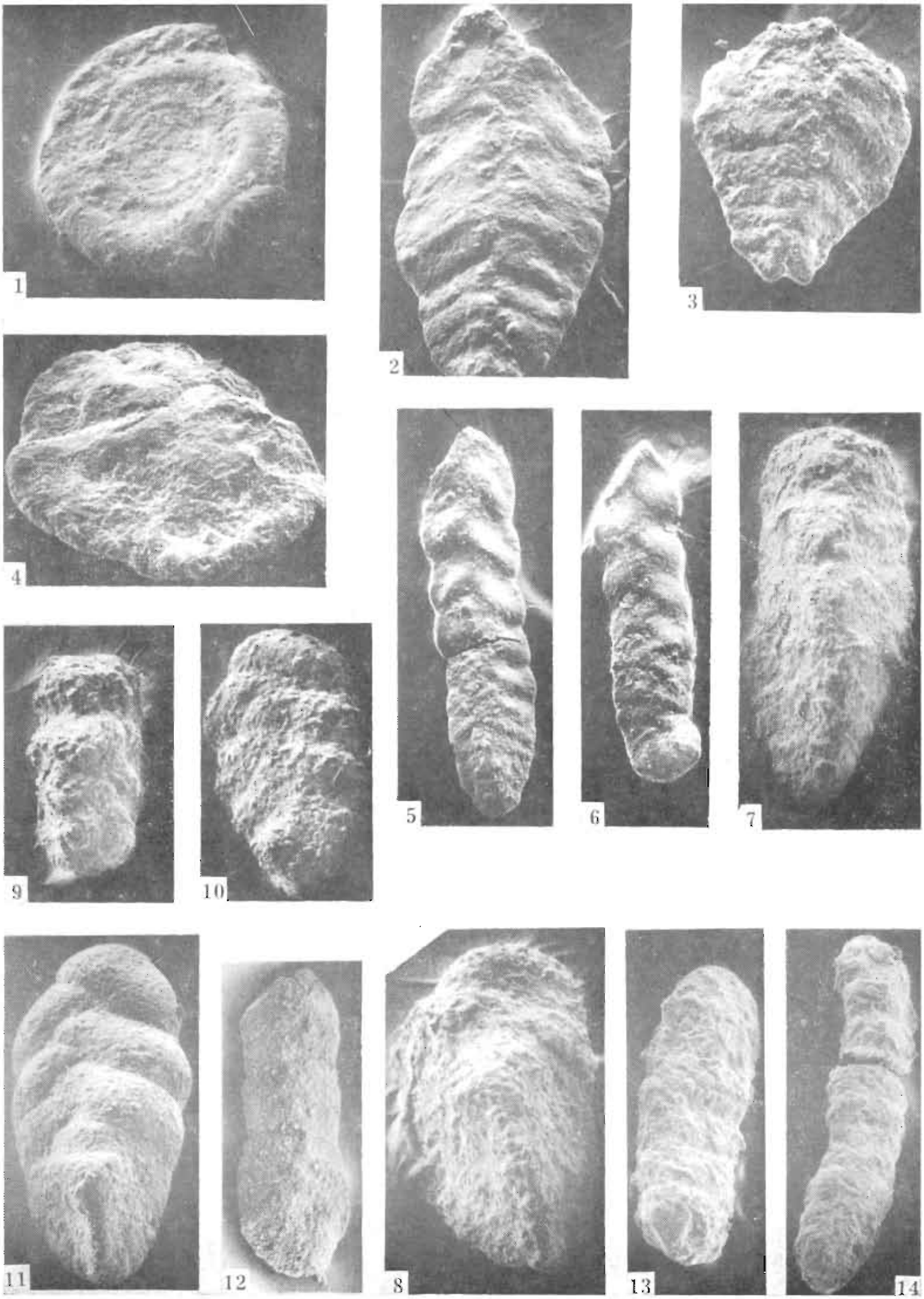
1, 3. *Gavelinella ammonoides* (Reuss): IG 45616/79/F, IG 45618/79/F; form B, horizontal section showing very fine embrional chamber and trilamellar structure of septa, ×110.
2, 4. Same species: IG 45617/79/F, IG 45619/79/F; form A, horizontal section showing big embrional chamber and trilamellar structure of septa, ×110.
10. Same species: IG 45625/79/F, horizontal section showing trilamellar structure of septa, ×110.
5, 6. *Gavelinella moniliformis* (Reuss): IG 45620/79/F, IG 45621/79/F; form B, horizontal sections showing very fine embrional chamber and (6) trilamellar structure of septa, ×110.
7, 11. Same species: IG 45622/79/F, IG 45626/79/F form A, horizontal sections showing big embrional chamber and (11) trilamellar structure of septa, ×110.
8. *Gavelinella vombensis* (Brotzen): IG 45623/79/F, form A, horizontal section showing a big embrional chamber and trilamellar structure of septa, ×190.
9. Same species: IG 45624/79/F, horizontal section showing recrystallized septa and wall, ×190.

Pisary borehole, Coniacian, Upper Cretaceous

Plate 10

The assemblage of foraminifers of the *Gaudryina sudetica* zone, ×75.
1, 2. *Gaudryina sudetica* n. sp.
3, 4. *Ophthalmidium cretaceum* (Reuss).
5. *Spiroplectammina embaensis* Mjatliuk.
6, 7. *Plectina lenis* (Grzybowski).
8. *Dorothia conulus* (Reuss).
9, 10. *Epistomina stelligera* (Reuss).
11. *Quinqueloculina angusta* Franke.
12. *Marginotruncana marginata* (Reuss).
13, 14. *Gaudryina rugosa* d'Orbigny.
15. *Dorothia oxycona* (Reuss).
16. *Nodosaria obscura* Reuss.

Pisary borehole, Coniacian, Upper Cretaceous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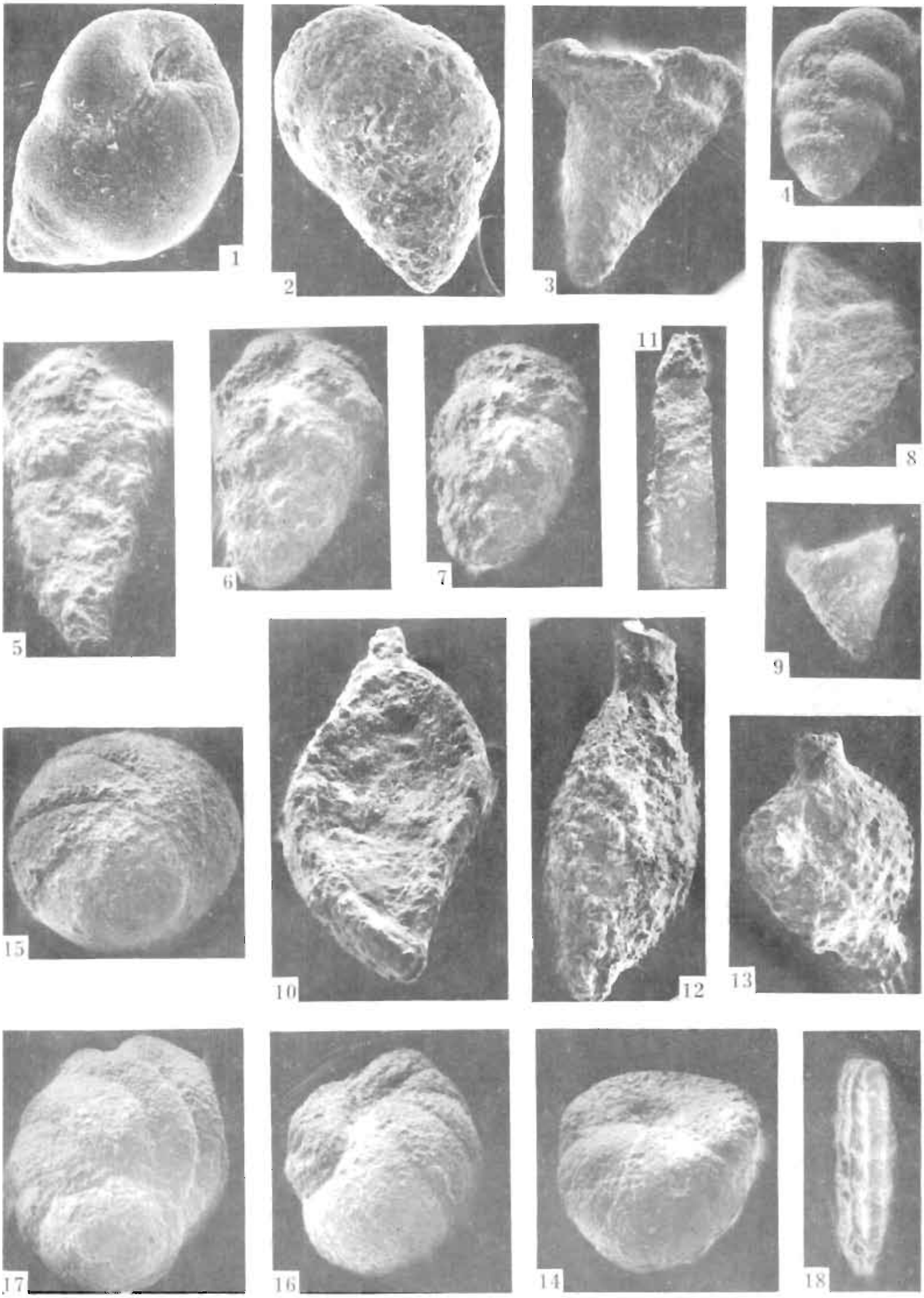
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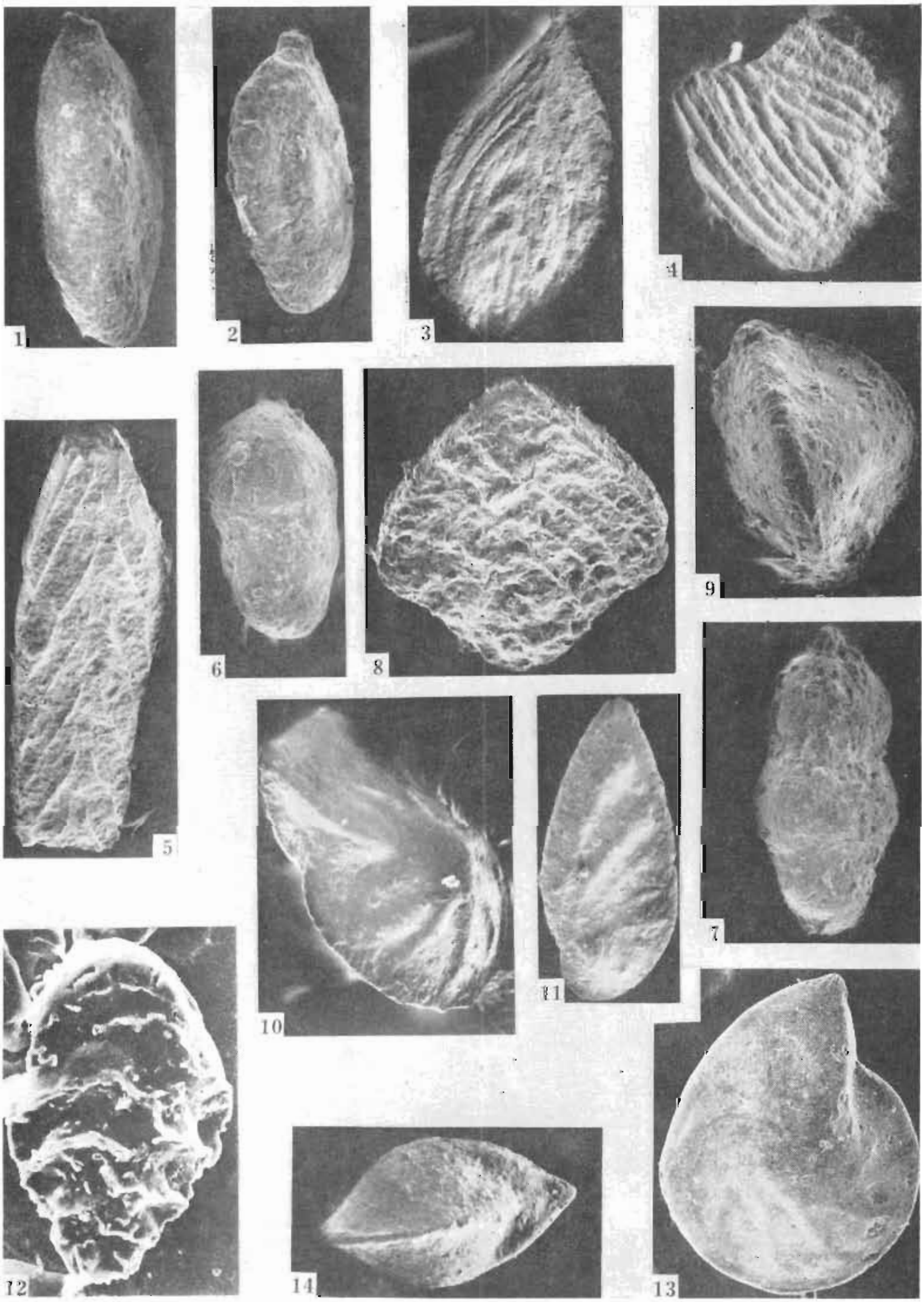
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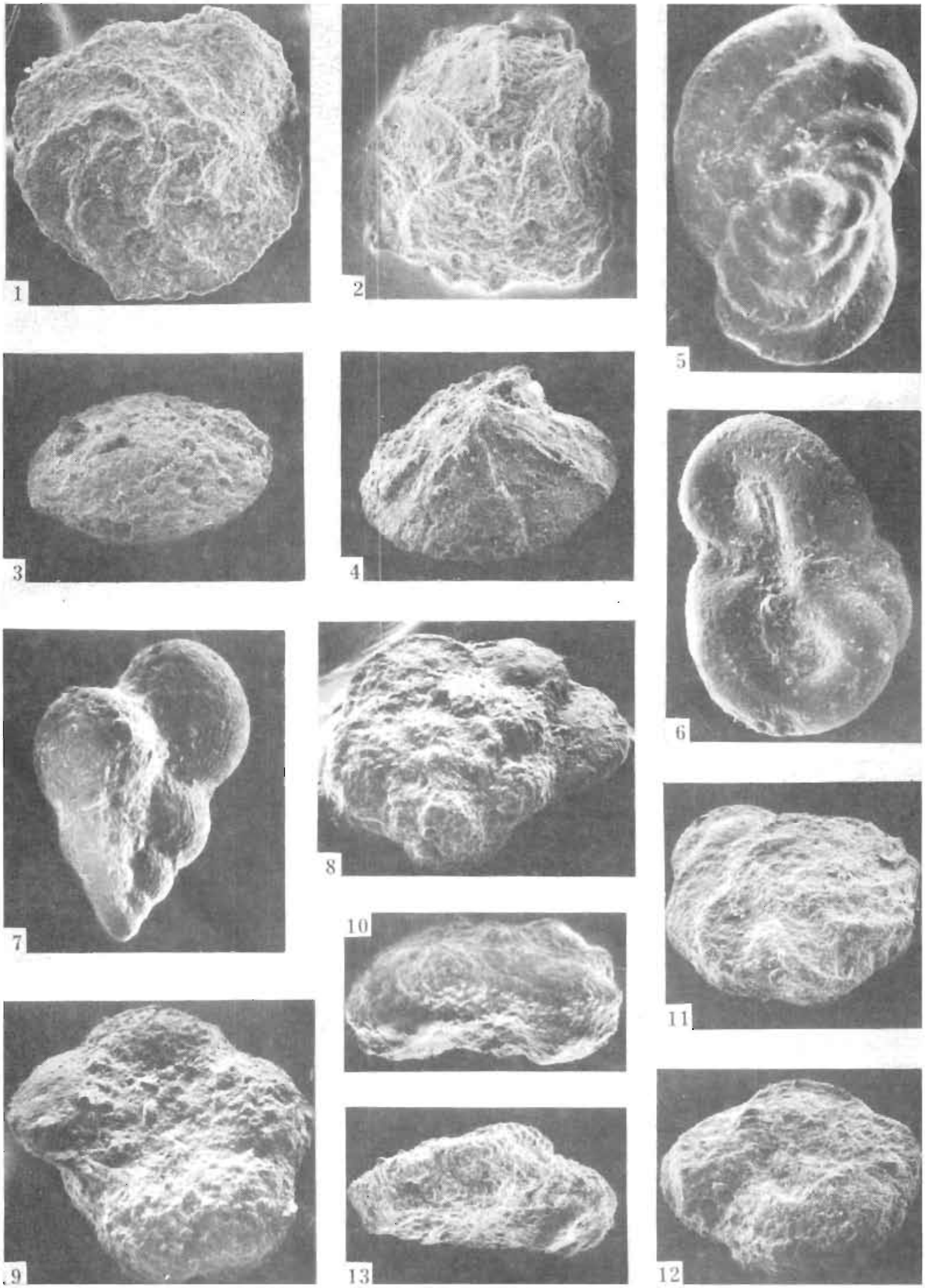

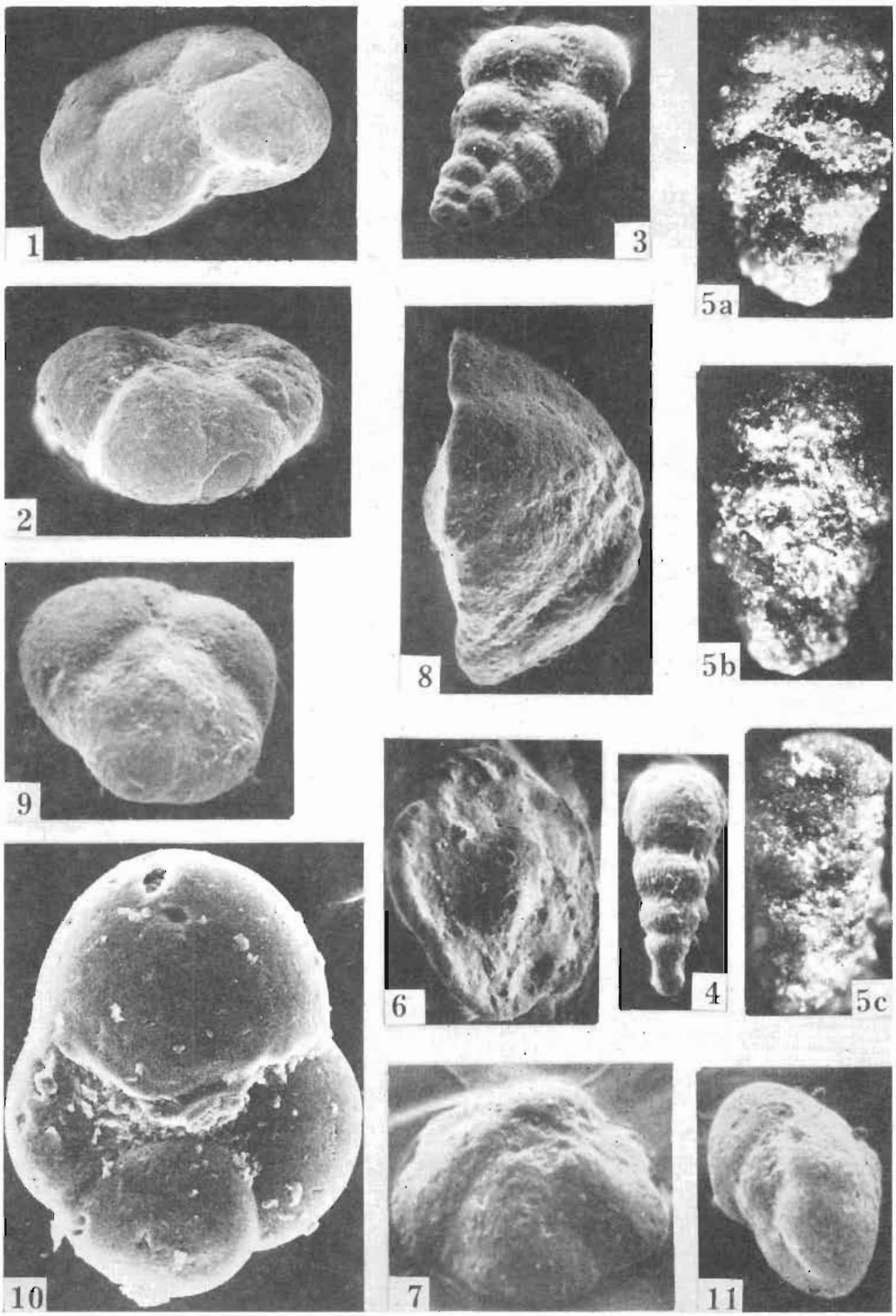
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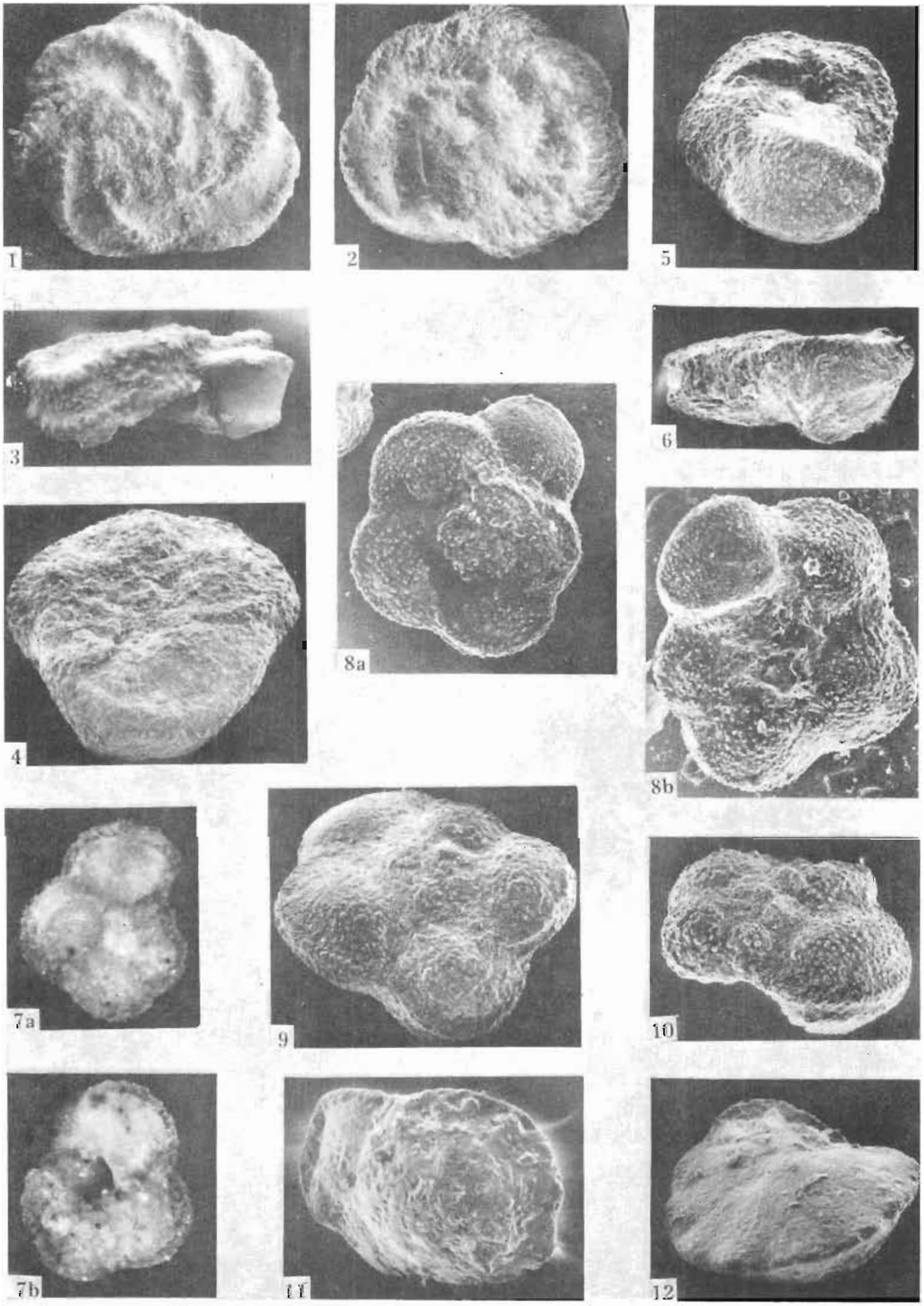
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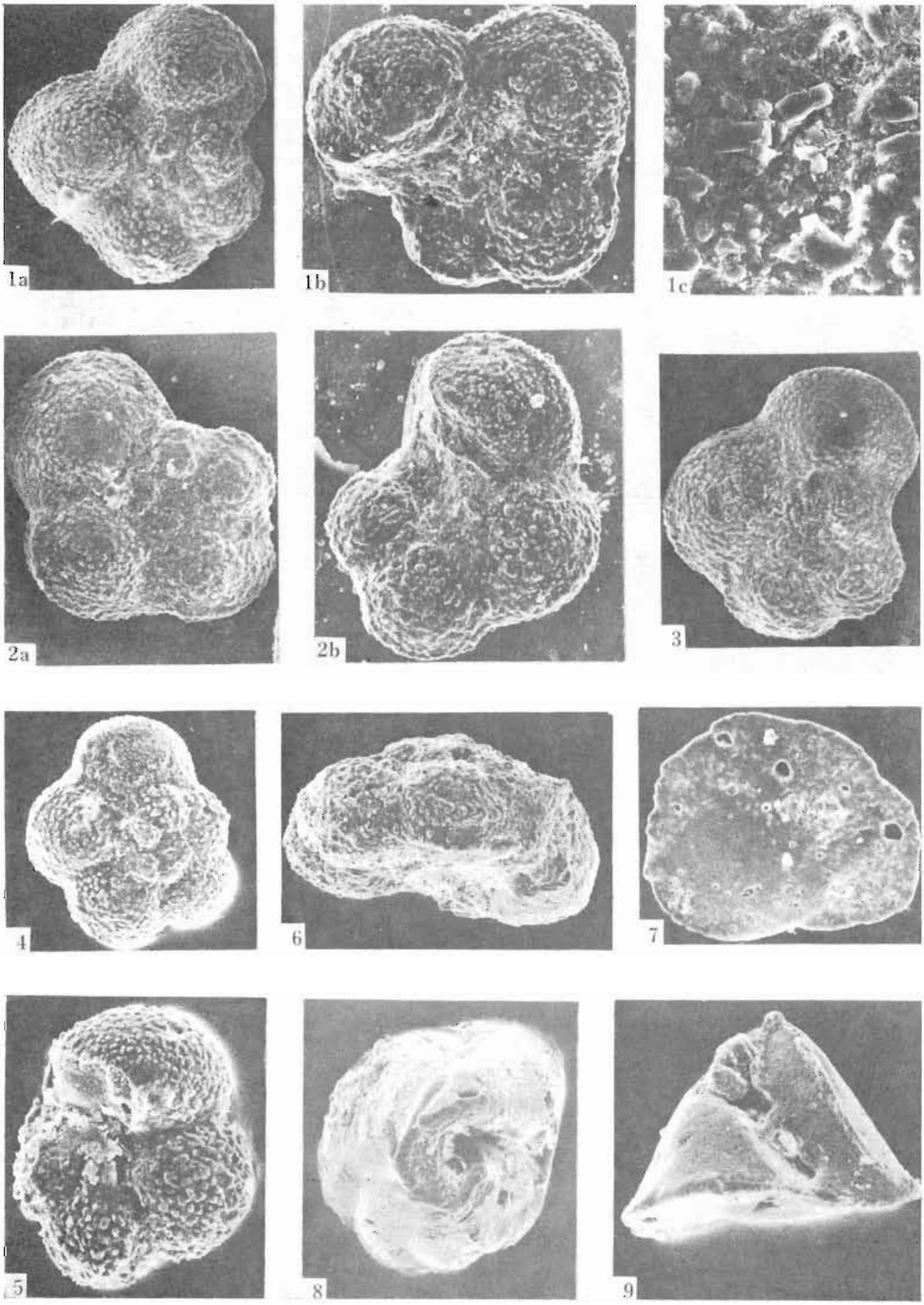
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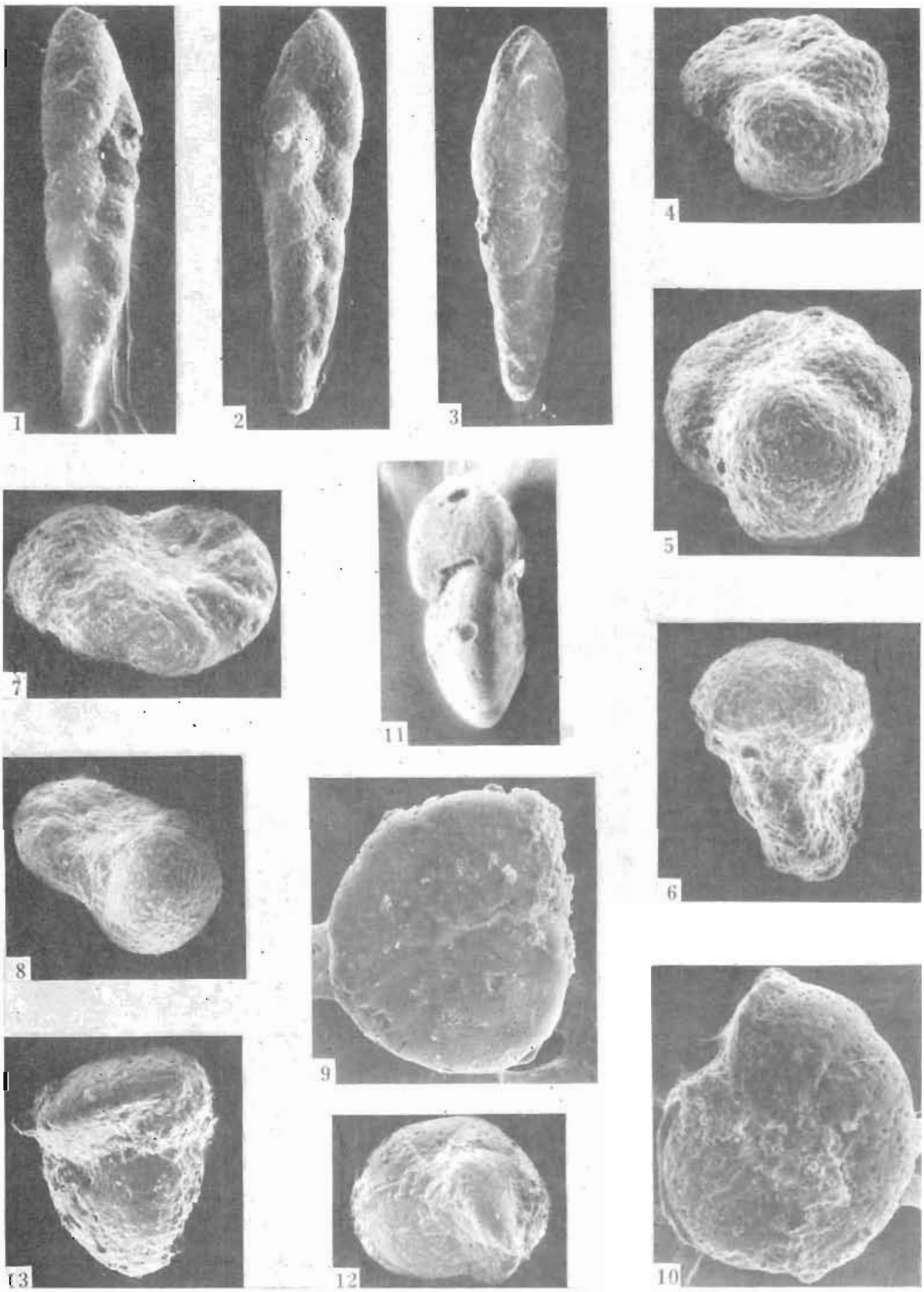
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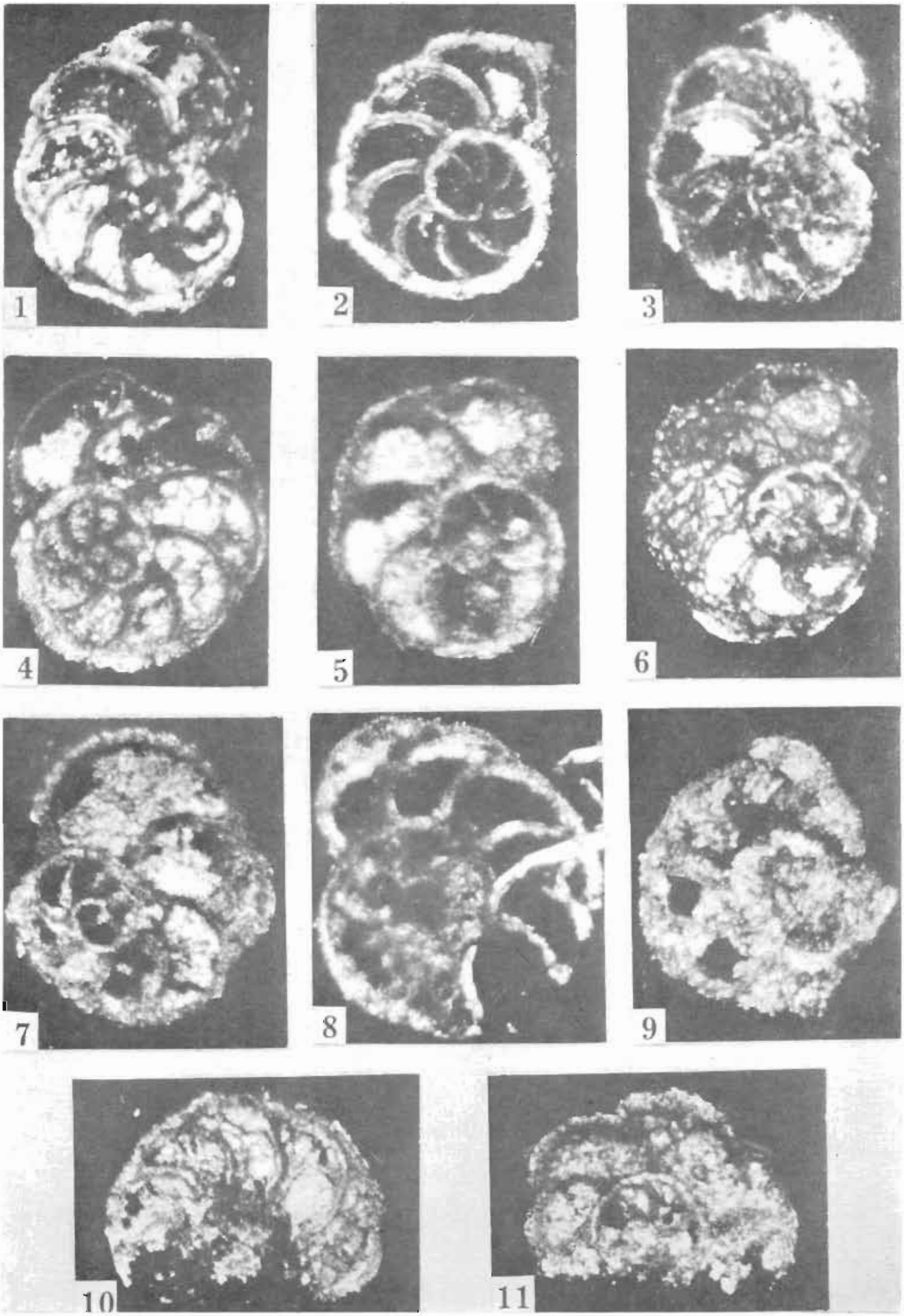
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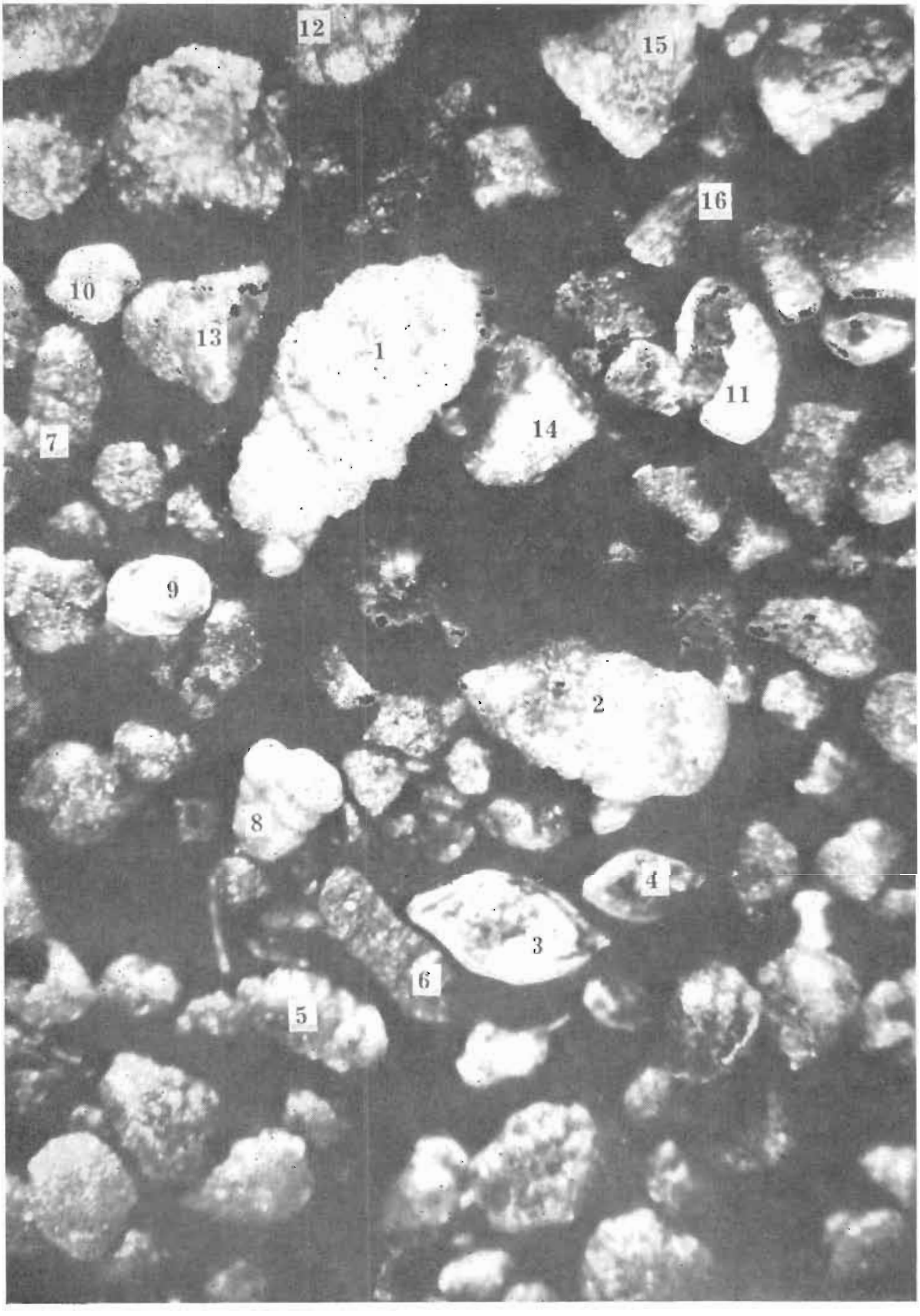
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