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PRIABONIAN FORAMINIFERS OF THE POLISH LOWLANDS

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Warm-water foraminifer assemblages indicate that the area of the Polish Lowlands have been situated within the extend of influences of the Mediterranean province in the Priabonian. The paper presents a first attempt to summarize the available data on influences of that province in the extra-Carpathian Poland. The stratigraphic setting of the described species and ecological and bathymetric conditions in the basin are reconstructed on the basis of comparisons with coeval assemblages of the same type from other countries and correlation with nannoplankton datings. The migration of warm water species from areas adjoining the Carpathian geosyncline far to the north are explained as due to tectonic pulses of the Pyrenean phase of the Alpine orogeny. The foraminifer microfauna appears clearly different in character from the coeval one from Northern Poland (Łeba Elevation and Puck Embayment).

Key words: Foraminifers, micropaleontology, ecology, paleogeography, Priabonian, Polish Lowlands.

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INTRODUCTION

The litho- and biostratigraphy of Paleogene strata from the Fore-Sudetic Monocline and Kujawy area have been studied by several authors including Dyjor (1970, 1974, 1978), Pożaryski (1954), Matl and Śmigielska (1977), Odrzywolska-Bieńkowa (1966, 1973, 1975), Cimaszewski (1964) and Ciuk (1967). However, microfauna remained unknown from these regions. The present paper is aimed at filling up that gap as well as to emphasize the recorded influences of the Mediterranean paleobiogeographic province.

The studied material comes from the Geological Institute boreholes Sieroszowice, Miechów, Głobice, Izbica Kujawska, Łanięta and Augustynowo. Moreover, S. Dyjor (Lower Silesian Branch of the Geological Institute, Wrocław) kindly supplied material from the boreholes Kurów Mały and Jerzmanowa. In that material, there were found 87 foraminifers spec-

manowa Eocene Beds — for mudstone-carbonate rocks from the Głogów-Jerzmanowa area. Rocks from the top of the sequence, yielding Oligocene elements, he assigned to the Lubuska Series, characterized by predominance of sandy facies on the carbonate, Odrzywolska-Bieńkowa (1972).

CHARACTERISTICS OF FORAMINIFER ASSEMBLAGES

Shallow- and warm-water assemblages of foraminifer microfauna, found in the Fore-Sudetic Monocline, Kujawy and Mazowsze regions, are surprisingly close to those described from the Upper Schönewalde Beds of the so-called Calau type in the GDR, described by Kiesel (1970). Both in the Polish Lowlands and GDR, strata yielding shallow-and warm-water microfauna occur in patches, due to pre-Oligocene emersion and erosion which has taken place between the Oligocene and Pleistocene (Lotsch 1967).

The omnipresent components of the assemblages from the Polish Lowlands and GDR include the genera *Articulina*, *Vertebralina*, *Reussella*, *Discorbis*, *Biapertorbis* (*sensu* Pokorny), *Planorbulina*, *Spiroloculina*, *Rhapydionina* which are unknown in basins of the boreal type. In turn typical boreal species *Astacolus decorata* Reuss, *Bulimina aksuatica* Morozova, *Brizalina antegressa* Subbotina and *Eoeponidella lucida* (Minakova) are missing. Kiesel and Lotsch (1963) were first to state that Upper Eocene warm-water assemblages sometimes comprise few species but very numerous individuals, calling them "Fast-Monofaunen". In Poland, this phenomenon is especially well expressed in the assemblages from the borehole columns Augustynowo and Izbica Kujawska, mainly composed of representatives of the genera *Asterigerina*, *Pararotalia*, *Vertebralina* and *Reussella*. Kiesel and Lotsch (1963) explain that phenomenon in terms of specific ecological conditions in littoral and sublittoral zones, favourable for symbiosis of foraminifers and algae requiring shallow and well illuminated water.

The tests of nummulitids and some small-sized foraminifers occurring in Priabonian rocks from the top of salt domes at Łanięta and Augustynowo are often damaged. That may be due to tectonic deformations related to halokinetic processes.

In the USSR, assemblages similar to those described here have been found in both European and Asiatic parts. Large monographic studies of that microfauna were published by Tutkovskij (1925), Kaptarenko-Tschernousova (1951, 1956), Morozova (1949), Samojlova (1947), Chalilov (1948), Kraeva and Zerneckij (1969) and others.

According to Bettenstaedt (1949), migration of warm-water Upper Eocene (Priabonian) forms to areas situated at fairly large distances north of those directly adjoining the Alpine region were made possible due to

	Roumania	Yugoslavia	Hungary	C S R	Poland	N R D	F R G	Holland	Belgium	France	Italy	England	U S S R European part	U S S R Asiatic Part	U S A	Mexico	Africa
Spiroplectammina carinata					+	+	+		+		+	+	+				
Spiroplectammina carinata deperdita					+	+	+	+	+		+						
Caudryina siphonella siphonella					+	+	+	+	+		+	+					
Clavulina anglica					+	+	+			+		+					
Spiroloculina alabastra					+						+				+		+
Spiroloculina communis					+												
Spiroloculina communis polita					+												
Spiroloculina grateloupi					+				+	+		+					
Vertebralina contracta					+					+			+				
Vertebralina eocaena					+												
Vertebralina terquemi					+			+	+			+			+		
Quinqueloculina costata	+				+			+	+			+					
Quinqueloculina imperialis					+	+									+		
Quinqueloculina impressa					+	+	+		+			+					
Quinqueloculina juleana					+	+			+			+					
Quinqueloculina ludwigi	+				+	+	+	+	+	+		+					
Quinqueloculina seminula					+	+	+	+	+	+	+	+	+				+
Quinqueloculina serovae					+								+				
Pyrgo appendiculata					+								+				
Pyrgo bulloides	+			+	+				+	+			+				
Triloculina angularis					+				+	+							
Triloculina gibba					+			+	+	+	+						
Miliola saxorum					+					+							
Articulina pseudosulcata					+	+			+				+				
Rhapydionina liburnica		+			+	+					+						
Nodosaria stipitata			+		+	+	+										
Dentalina hillaeformis					+												
Dentalina semilaevis			+		+											+	
Lagena hexagona				+	+	+	+	+		+			+				
Fissurina marginata			+		+	+	+			+	+	+	+		+		
Lenticulina herrmanni					+	+	+		+				+				
Vaginulina alazanensis					+											+	
Raphanulina tuberculata	+			+	+	+	+			+					+		
Guttulina caudata					+					+							
Guttulina problema			+	+	+	+						+			+		
Pseudopolymorphina dumblei					+	+	+								+		
Pyrulina fusiformis			+		+	+	+		+	+							
Sigmomorphina amygdaloides					+	+	+			+							
Buliminella cf. turbinata					+					+							
Polivina microlancetiformis					+	+							+				
Bolivina cookei				+	+	+	+	+	+	+	+	+			+		
Bolivina nobilis			+	+	+				+	+	+		+				+
Bolivina striatellata					+										+		
Reussella byramensis					+						+				+		
Reussella sculptilis					+										+		
Reussella terquemi					+	+	+		+	+			+				
Reussella sp.					+	+											
Uvigerina cocoaensis					+										+		
Uvigerina gallowayi basicordata					+											+	
Uvigerina spinicostata					+	+	+		+							+	
Sagrina pulchra					+					+							
Trifarina germanica				+	+	+			+	+							
Discorbis brandenburgensis					+	+											
Discorbis discoides				+	+					+							
Discorbis propinqua					+					+		+					
Neoconorbina obvoluta					+					+							
Rosalina douvillei				+	+				+	+							
Buggina subconica				+	+			+	+	+		+					
Glabratella ubiqua				+	+					+							
Asterigerina bartoniana					+			+	+	+		+	+	+			
Asterigerina aff. guerichi					+	+		+									
Pararotalia audouini	+				+	+		+	+	+		+					
Pararotalia lithothamnica	+		+		+	+	+				+		+	+		+	
Pararotalia spinigera					+	+	+	+	+	+		+					
Cribronion latidorsatum					+	+	+	+	+	+		+					
Nummulites germanicus					+	+											
Nummulites aff. stellatus					+						+						
Bifarina selseyensis					+			+	+			+					
Globigerina cf. angiporoides				+	+												
Neoeponides schreibersi			+	+	+	+	+	+	+	+	+						
Cibicides carinatus	+			+	+			+	+	+		+	+				
Cibicides lobatulus				+	+	+	+	+	+	+	+	+	+		+		
Cibicides amphalius					+												
Cibicides reussi					+	+	+	+									
Cibicides sulzensis					+	+		+	+	+		+	+		+		
Cibicides tenellus					+	+	+		+	+	+						
Cibicides ungerianus		+	+	+	+	+	+	+	+				+	+	+		+
Cibicides upresiensis					+				+	+							
Planorbulina sp.					+												
Nonion graniferum					+	+	+		+	+		+					
Florilus winnianus		+	+	+	+	+	+	+	+						+		
Pullenia bulloides		+	+	+	+				+	+			+	+			+
Anomalinoides granosus		+	+		+	+	+	+	+	+			+	+		+	
Heterolepa perlucida					+					+				+			+
Karreria fallax			+		+	+	+				+		+				
Melonis affine				+	+	+	+	+	+	+	+	+	+	+	+		
Robertina germanica					+	+	+		+			+					

OCCURRENCE

PALEOCENE | EOCENE | OLIGOCENE | NEOGENE | RECENT

Fig. 2. Distribution of Priabonian foraminifers in the Polish Lowlands and in some European countries.

the action of currents related to tectonic pulses of the Pyrenean phase (turn of the Eocene and Oligocene). In our opinion this explains well the case of the assemblages here studied.

DEPENDENCE OF THE FORAMINIFER ASSEMBLAGES ON LITHOLOGY

In the borehole column Kurów Mały, the reference section for this work, there is found a relation of the frequency of foraminifers and lithology. This relation is expressed by disappearance of foraminifers in top part of the Upper Eocene, not developed in carbonate-sandy facies with glauconite but rather mudstone-clay one. Other organic remains occurring there — sponge spicules and echinoid spines are rare and poorly preserved. This may be due to an ecological catastrophe which has taken place at the turn of the Eocene and Oligocene (Cavelier 1979).

Attention should be paid to the recently published paper by Setiawan (1983) on microfauna and microfacies in the Priabonian stratotype, especially to his remarks on negligible share of plankton in the foraminifer assemblages. Fifteen species (besides miliolids which were only listed by that author) are common with the Polish assemblages. Differences between the Priabonian assemblages of Poland and Italy were undoubtedly due to geographic separateness and warmer character of the basin in Italian sector of the Alps. The latter is characterized by the presence of *Discocyclina*, *Operculina* and *Asterocyclina*, i.e. the genera which include the decidedly warm-water forms.

The foraminifer assemblages from the Priabonian stratotype also comprises some redeposited Upper Cretaceous and Lower Tertiary species such as *Marssonella oxycona* (Reuss), *Eponides toulmini* Brotzen, as well as Miocene species *Bulimina kasselensis* Batjes and *Reussella spinulosa* (Reuss), presumably coming from erosion of other series of the Alpine Upper Cretaceous and Tertiary. According to us, the presence of redeposited specimens in the Priabonian microfaunal assemblage casts some doubts on the value of that locality as stratotype.

The features undoubtedly in common from the Priabonian of Italy and Poland include:

1) the presence of warm-water species of *Pararotalia* and *Asterigerina* and of numerous miliolids;

2) the identical lithology of basal parts of the section, developed in the limestone-marly facies (equivalent of the Sieroszowice Beds *sensu* Dyjor 1978);

3) the appearance of species known to bloom in the Oligocene, in higher parts of the Priabonian section;

4) the same age; nannoplankton datings (Martini 1981) showed that the Polish Priabonian represents the zones NP 19 (*Isthmolithus recurvus*),

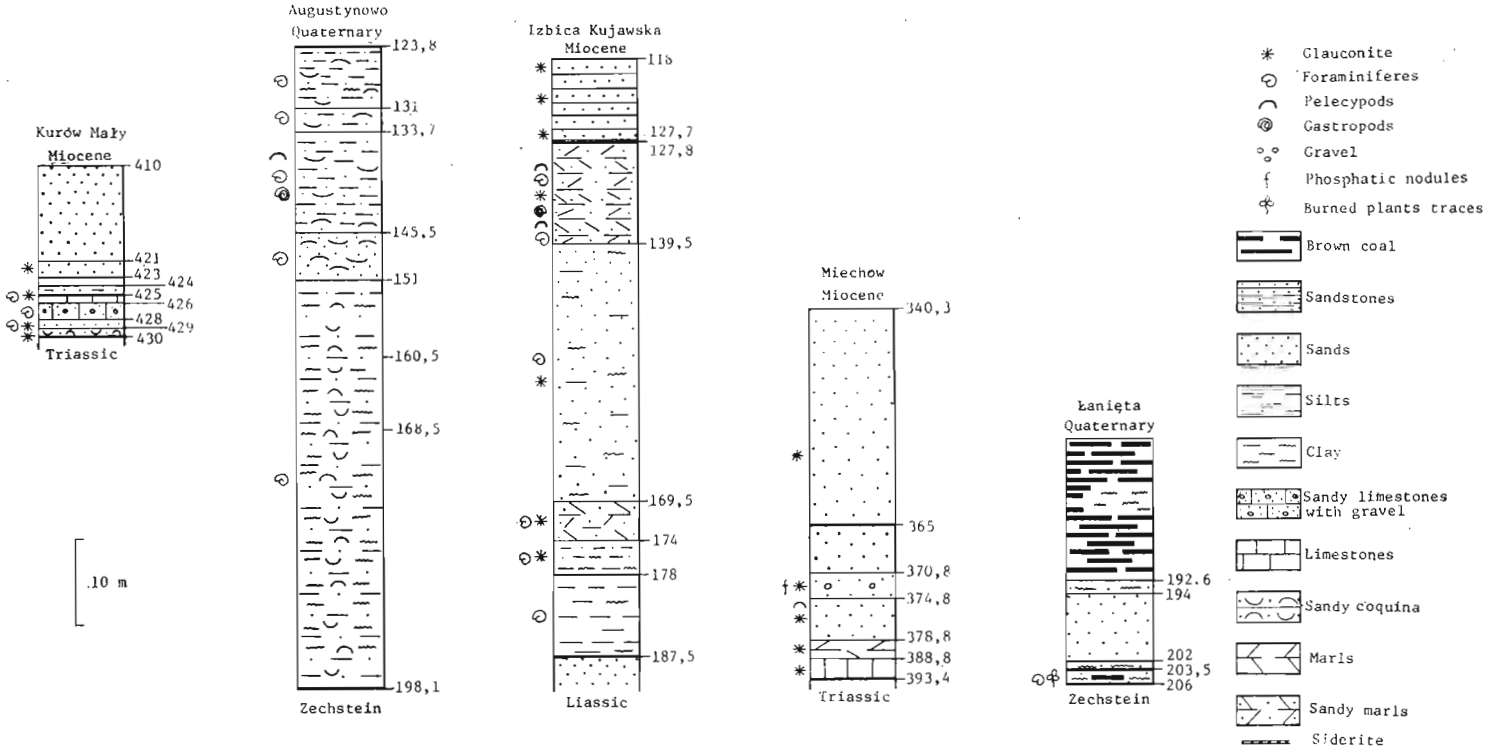


Fig. 3. Correlation of the most representative Priabonian profiles from borings.

NP 20 (*Sphenolithus pseudoradians*), NP 21 (*Ericksonia subdisticha*) and presumably NP 22 (*Helicosphaera reticulata*), indicative of the turn of the Eocene and Oligocene. In this way, the datings based on the recorded foraminifer species agree with those on nannoplankton.

PHYSICO-CHEMICAL AND FAUNISTIC INDICES OF THE ENVIRONMENT

The studied microfaunal assemblages appears indicative of relatively warm and shallow marine basin.

I. Non-faunistic indices of sedimentary environment

Temperature. — An increase in temperature in Europe in the Late Eocene, recorded by Buchardt (1970), followed a Middle Eocene period of highly varying climatic conditions, connected with alternating dry and prolonged humid intervals (Voigt 1934). The climatic oscillations were favourable for formation of both brown coal deposits and gypsum series (Paris Basin). It should be also remembered that the regression of Paleocene sea resulted in origin of landlocked marine basins differing in temperature conditions, as well as some land areas in the present-day lowlands of central and western Europe. The latter were subjected to intense erosion, becoming the site of formation of kaolin and red-coloured laterite soils. The sedimentation has been also markedly influenced by strong epeirogenic movements of the Baltic Shield.

Wirtz (1939) noted the presence of reworked laterite of Scandinavian origin in mottled Eocene clays in the area of Schleswig-Holstein (FRG). Red and mottled clay sediments could only originate in those parts of the Eocene basin where reducing did not predominate, Otherwise we are dealing with dark-coloured clays with pyrite. According to Schuh (1950), the basin was supplied by rivers transporting large quantities of colloidal silica. Bettenstaed (1949) and Schuh (1950) hold that the colloidal silica was transported to the basin from Scandinavian areas and humus acids and colloidal iron compounds from the south. This is shown by silica-rich intercalations in brown coal layers in the central European lowlands.

Laterite deposits, the origin of which is dated mainly at the Middle Eocene, were subsequently eroded in the course of Late Eocene transgression, resulting in red colouring of Upper Eocene rocks (some sequences in Yugoslavia, central European lowlands, Fore-Sudetic Monocline and Carpathian geosyncline).

Bathymetry. — According to Bettenstaedt (1949), there is growing evidence for small depth of the Late Eocene sea in zone affected by influences of the Mediterranean province. The abundance of glauconite in marly sediments is widely known. This phenomenon is recorded in both

shallow parts of the Eocene sea and the Paleocene sequences and regressive one of the Maastrichtian and other stages of the Cretaceous. Sediments of the Priabonian (Late Eocene) sea are characterized by high content of carbonates. However, attention should be also paid to other characteristic feature, pointed out by Bettensteadt (1949). According to him carbonate shoals in the Late Eocene sea were as a rule rimmed by a zone displaying impoverishment or even complete lack of carbonates. This is due to destructive effect of humus acids coming from areas of formation of brown coal series and alkaline solutions from erosion of kaolinized Middle Eocene strata.

Salinity. — The lack or scarcity of planktonic foraminifers in the warm-water assemblages of the Priabonian basin may be according to Le Calvez (1970), due to reduced salinity in areas of shoals in Boreal regions of the Eocene sea. Le Calvez emphasized that sediments originating in such environments are characterized by species of *Pararotalia*, preferring environments with reduced salinity. This is especially the case of *Pararotalia audouini*, the species highly common in sediments examined.

II. Faunistic indices of bathymetry and temperature

The presence of nummulitids, miliolids, *Pararotalia* and *Asterigerina* indicates that we are dealing with climatic optimum (Bettenstaedt 1949, Murray 1973).

Le Calvez (1970) stated that common representatives of *Cibicides* accompanied by *Planorbulina* are indicative of shallow and well illuminated environment, i.e. environment favourable for development of plants with which these foraminifers lived in symbiosis. Paleogeography of the Late Eocene sea was presumably complex due to a tectonic unrest. The unrest was related to movements of Paleogene tectonic phases, especially the Pyrenean phase, leading to origin of local, shallow embayments favourable for development of specialized microfauna of this type (Pożaryska and Odrzywolska-Bieńkowa 1982).

Nummulitids in Priabonian strata are also indicative of a water sedimentary environment. According to Cushman (1939), the Late Eocene sea was characterized by vast shallow and well oxidated shoals, the depth of which was merely up to 50 m. The data gathered by us show that the foraminifer microfauna is more common in marly sands than in clayey marls. This may be explained in terms of ecological requirements. Nummulitids are often found attached to quartz grain and in some way they overgrow it so the grain becomes permanently fixed to an individual test.

Although nummulitids are known from lower members of the Eocene in the Paris and London areas, Bettenstaedt (1949) holds that they could not appear in areas of the central European Lowlands (including Poland) until suitable shoals originated in the Late Eocene sea. In analysing tem-

perature conditions in the Polish part of the Priabonian basin it should be kept in mind that temperatures were there lower than in southern Europe, due to the influence of cool currents from the north. This is shown by impoverishment of the species spectrum as well as the presence of some foraminifers known to develop much better in cooler sectors of Late Eocene basins. Independently of bathymetric reconstructions made on the basis of the records of nummulitids by Cushman, it seems justified to accept that made with reference to analogy in petrography and fauna with the Szczecin Sands (Sindowski 1936) and sandy facies of the Vierland stage (Weyl 1936) by Bettenstaedt (1949). According to the latter author, the Priabonian basin was 20 to 60 m deep.

The littoral nature of sediments of the Priabonian age is shown by both foraminifers and other organisms. Similarly as in the littoral Paleocene (Hiltermann 1941) and regressive Maastrichtian facies (Haack 1939), the rocks contain small bryozoan colonies, typical of warm shoals.

Ecological requirements of some ornamented ostracodes indicate similar conditions. This is the case of *Leguminocythereis striatopunctata*, omnipresent component of the Priabonian assemblages in the Fore-Sudetic Monocline. Although that species is sometimes found in older members of the Eocene in Belgium, France and FRG, it is confined to Eocene-Oligocene junction beds in the GDR, FRG (Staesche and Hiltermann 1940) and Poland. In the latter areas, it is fairly important component of this shallow- and warm-water microfaunal assemblage, being unknown from cold-water ones. This is the only ostracod species found in Priabonian strata in both Fore-Sudetic Monocline and Kujawy region.

Glauconite-rich sediments formed in shoals in the Tertiary and Cretaceous seas characterized by presence of thin, white spicules of siliceous sponges. All the three elements: quartz, glauconite and sponge spicules from the bulk of residuum after washing samples of shallow-water rocks. With these facies, there is also connected the presence of pectens which are regarded by Sindowski (1936) as forms living on shallow and well illuminated, clear waters. In turn, the presence of echinoids plates and spines, which are so typical of the Priabonian, indicates that the waters were well oxidated. According to Schmidt (1935), the oxygen requirements of these organisms were higher than those of foraminifers.

CONCLUDING REMARKS

1) The studies showed that foraminifers are useful for dating Upper Paleogene strata. Specific composition of foraminifer microfauna makes it possible to trace influences of the Mediterranean biogeographic province in the Polish Lowlands as well as reconstruction of ecological conditions in the basin at the turn of the Eocene and Oligocene.

2) Lithological changes in the Upper Paleogene sections, i.e., appearance of mudstone-clay sediments in place of calcareous-sandy and glauconitic sandy ones in top parts of the sections, are accompanied by changes in microfaunal assemblages. Towards the end of the Eocene, foraminifer microfauna disappeared and the strata yielded scarce and poorly preserved organic remains only.

3) The presence of nummulitids in shallow-water Upper Eocene strata in the Fore-Sudetic Monocline, Kujawy and Mazowsze regions suggests their migration with warm currents coming northwards from the south.

4) Shallow- and warm-water foraminifer assemblages of the Priabonian type essentially differ from cold-water assemblages from deep zones of the basin, typical of northern Poland. The latter presumably correspond to the "Lattorfian", here considered as a facies of the Upper Eocene.

5) The ostracod *Leguminocythereis striato-punctata* (Roemer), also known as omnipresent component of microfauna from the Eocene-Oligocene passage beds, should be treated as an additional index of the age of the relevant strata.

6) The foraminifer assemblage is of the back-barrier type, rich in imperforate forms, nummulitids, *Pararotalia* and *Cibicides*; planktic species are lacking.

Order **Foraminiferida** Eichwald, 1830
Family **Textulariidae** Ehrenberg, 1838
Genus *Spiroplectammina* Cushman, 1927
Spiroplectammina carinata carinata (d'Orbigny, 1826)
(pl. 1: 1)

1826. *Textularia carinata* d'Orbigny: 263, fig. 2.
1926. *Spiroplecta carinata* (d'Orbigny); Chapmann: 32, pl. 5: 19*a*—*c*, 21*a*—*c*, 22*a*—*c* (*fide* Ellis and Messina 1942).
1970. *Spiroplectammina carinata* (d'Orbigny); Didkovskij, Satanovskaja: 10, pl. 3: 3*a*—*w*, 4*a*—*w*.

Material. — About a dozen well-preserved specimens.
Remarks. — Our specimens display typical development.
Occurrence. — Poland: Upper Eocene of the Puck Embayment, Oligocene of Fore-Sudetic Monocline (Miechów), Upper Silesia, margin of the Holy Cross Mts. and Lublin Upland. USSR: Upper Eocene of Caucasus and Ukraine, Miocene of Ukraine. Hungary: Paleogene. England: Eocene. GDR, FRG: Oligocene. Central Paratethys: Miocene. Italy: Pliocene and at present.

Spiroplectammina carinata deperdita (d'Orbigny, 1846)
(pl. 1: 12)

1846. *Textularia deperdita* d'Orbigny: 224, pl. 14: 23—25.
1940. *Spiroplecta deperdita* d'Orbigny; Staesche and Hiltermann: pl. 47: 1.
1970. *Spiroplectammina carinata deperdita* (d'Orbigny); Kiesel: 193, pl. 3: 23.

Material. — Some rather poorly preserved specimens.

Remarks. — Our specimens display somewhat narrower (lower) chambers than in figure of the holotype.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (Miechów). GDR, FRG, Belgium and Netherlands: Upper Eocene. Italy: Priabonian. In the remaining parts of Europe, this species is known from the Eocene to Miocene.

Family **Ataxophragmiidae** Schwager, 1877
Genus *Gaudryina* d'Orbigny *in* de la Sagra, 1839
Gaudryina siphonella siphonella Reuss, 1851
(pl. 1: 2)

1851. *Gaudryina siphonella* Reuss: 78, 42 (*non* 40, 41).
1962. *Karreriella siphonella* (Reuss); Kiesel: 15, pl. 1: 8—11.
1978. *Gaudryina siphonella siphonella* Reuss; Odrzywolska-Bieńkowa, Pożaryska and Martini; 260, pl. 7: 8*a*—*b*.

Material. — A few well-preserved specimens.

Occurrence, — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Miechów, Kurów Mały and Gorzów Wielkopolski) and NW Poland (borehole Szczecin IG-1). GDR, RFG, Belgium and Netherlands: Rupelian. Italy: Priabonian.

Genus *Clavulina* d'Orbigny, 1826
Clavulina anglica (Cushman, 1936)
(pl. 1: 3)

1936. *Pseudoclavulina anglica* Cushman: 18, pl. 3: 5.
1970. *Pseudoclavulina anglica* (Cushman): Kiesel, 199, pl. 4: 11, 12.

Material. — Several tens of well-preserved specimens.

Remarks. — The Polish specimens are highly varying, mainly in proportions of uni- to triserial parts.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Głobice and Kurów Mały). Sweden, Denmark: Lower Paleocene. England, RFG, GDR and Netherlands: Upper Paleocene. France, Netherlands: Lower Eocene.

Family **Nubeculariidae** Jones, 1875
Genus *Spiroloculina* d'Orbigny, 1826
Spiroloculina alabastra Cushman et Ellisor, 1944
(pl. 1: 4)

1944. *Spiroloculina alabastra* Cushman and Ellisor: 50, pl. 8: 11—13.

Material. — Single, slightly damaged specimen.

Remarks. — This species is most close to *Spiroloculina excavata* d'Orbigny,

differing in higher peripheral margin and higher rising ledges between individual chambers.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (borehole Kurów Mały). Italy: Priabonian. Egypt: Lower Eocene. USA: Oligocene of Texas. In Poland, this species is limited to areas affected by influences of the Mediterranean province. It is completely unknown from cold-water assemblages.

Spiroloculina communis communis Cushman et Todd, 1944
(pl. 1: 7, 15, 22)

1884. *Spiroloculina excavata* d'Orbigny; Brady: 151, pl. 9: 5, 6.
1942. *Spiroloculina communis* Cushman and Todd: 63, pl. 9: 4, 5, 7, 8.

Material. — About a dozen well-preserved specimens.

Remarks. — The subspecies is very similar to *Spiroloculina canaliculata* d'Orbigny, which differs from it in the presence of markedly projected apertural neck. The type of chambers is the same in both species.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). The species has been described from shallow-water zones in the Pacific Ocean. It is limited to zones affected by influences of the Mediterranean province, being unknown from cold-water assemblages.

Spiroloculina communis polita Cushman et Todd, 1944
(pl. 1: 10 *a*, *b*)

1942. *Spiroloculina communis polita* Cushman and Todd: 65, pl. 9: 14.

Material. — Single well-preserved specimens.

Remarks. — Our specimens are characterized by sigmoidal coiling of the test.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Głobice). The subspecies has been described from shallow-water zones in the Pacific Ocean. It is limited to zones affected by influences of the Metiterranean province, being unknown from cold-water assemblages.

Spiroloculina grateloupi d'Orbigny, 1826
(pl. 1: 14)

1826. *Spiroloculina grateloupi* d'Orbigny: 298, pl. 1: 9—11.
1943. *Spiroloculina obscura* Cushman and Todd: 20, pl. 1: 3; pl. 3: 25.
1961. *Spiroloculina canaliculata* Kaasschieter (non d'Orbigny): 154, pl. 3: 23.
1970. *Spiroloculina grateloupi* d'Orbigny; Le Calvez: 60 (with synonymy).

Material. — A few well-preserved specimens.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France: Eocene, Oligocene. Belgium: Focene. England: Eocene (Bartonian). In Poland, the species is limited to zones affected by influences of the Mediterranean province.

Genus *Vertebralina* d'Orbigny, 1826
Vertebralina contracta Terquem, 1882
(pl. 1: 8)

1882. *Vertebralina contracta* Terquem: 45, pl. 2: 19, 20, 22 (*non* 21).
non 1961. *Articulina contracta* (Terquem); Kaasschieter: 158, pl. 4: 14.
1969. *Vertebralina contracta* (Terquem); Kraeva, Zernetskij: 40, pl. 14: 2*a*—*b*.

Material. — About a dozen very well-preserved specimens.

Remarks. — Our specimens do not correspond to figures given by Kaasschieter (1961) which show a form ornamented with narrow, oblique riblets. The specimen shown by Terquem (1882) in his plate 2, fig. 21, actually represents *Vertebralina terquemi* (Cushman, 1933).

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). USSR: Upper Eocene of Ukraine. France: Eocene of Paris Basin. The species is limited to zones affected by influences of the Mediterranean province in Poland, being unknown from cold-water assemblages.

Vertebralina eocaena sp.n.
(pl. 5: 1*a*—*c*, 2*a*—*c*, 5*a*—*c*)

Holotype: Specimen Muz. IG F/76, figured in pl. 5: 1*a*, *b*, *c*.
Type horizon: Upper Eocene.
Type locality: Augustynowo boring, depth of 127 m.
Derivation of the name: After the Eocene age.

Diagnosis. — Test nut-like in outline, thick, porous; sutures obscured by ornamentation; aperture wide, peripheral, in the form of loop with lip.

Material. — Some tens of generally well-preserved specimens, except for slightly corroded surface.

Dimensions (in mm):
Maximum diameter 0.8
Minimum diameter 0.6
Aperture 0.8—0.12 mm long and 0.08 to 0.12 mm wide.

Description. — Biconvex test with miliolid-like arrangement of chambers, broadly ovate in outline, truncated near aperture and widely rounded or only slightly sharpened at the base. Wall porcelain, covered throughout the surface with marked, large depressions, sometimes merging with one another in the form of furrows. The proper ornamentation sometimes obscured by irregular encrustations, locally formed on the test. Encrustations varying from smooth with loosely spaced depressions to ornamented with elongate and diverging furrows. Aperture at test top, of the miliolid type, in the form of wide to narrow apertural opening with lip but without tooth.

Remarks. — The species is characterized by high variability in size of test, width of aperture and the style of ornamentation. The available specimens are very fragile which precluded making thin-sections. As it was suggested by Bettenstaedt (1941), the majority of Upper Eocene foraminifers in northern Europe were subjected to intense corrosion under the influence of humus acids coming from areas of formation of brown coals, and the described specimens are not an exception here.

Our specimens appear somewhat similar to the representatives of *Vertebralina foveolata* Francenau (1881) from the Paleogene-Neogene junction beds in Hungary.

The latter differ from the former in better visible arrangement of chambers at both sides.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Augustynowo).

Vertebralina terquemi (Cushman, 1933)
(pl. 1: 13)

1933. *Articulina terquemi* Cushman: 3, pl. 1: 7.
1961. *Articulina contracta* (Terquem); Kaasschieter: 158, pl. 4: 14.

Material. — A few well-preserved specimens.

Remarks. — Some of the specimens are characterized by more elongate tests and more heavy ribbing. *Vertebralina terquemi* (Cushman) is close to *V. contracta* Terquem, differing in narrower test and more heavy and sometimes diverging riblets. According to Kaasschieter (1961), the former also resembles *V. leavigata* Terquem, differing from it in more flattened test. Although similar species have been placed in the genus *Articulina* by Le Calvez (1970), we follow the systematics of Loeblich and Tappan (1964), assigning forms with ovate aperture with narrow lip to the genus *Vertebralina*.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). Belgium, Netherlands, England: Upper Eocene (Priabonian). USA: Eocene. In Poland, the species is known from the zone affected by influences of the Mediterranean province.

Family **Miliolidae** Ehrenberg, 1839
Genus *Quinqueloculina* d'Orbigny, 1826
Quinqueloculina costata Karrer, 1867
(pl. 1: 11)

1867. *Quinqueloculina costata* Karrer: 362, pl. 3: 4.
1970. *Quinqueloculina striata* d'Orbigny; Le Calvez: 11, pl. 3: 5.
non 1970. *Quinqeloculina costata* Karrer; Le Calvez: 34, pl. 3: 7—8.

Material. — A few specimens with corroded surface.

Remarks. — Ornamentation in our specimens (striation) is somewhat finer than in the holotype. Foraminifers described as *Quinqueloculina striata* by Le Calvez (1970) agree with those of *Q. costata* Karrer in character of ornamentation (see Kaasschieter, 1961).

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). Belgium, Netherlands and England: Upper Eocene (Bartonian). Romania: Miocene. In Poland, the species is known from the zone affected by influences of the Mediterranean province.

Quinqueloculina imperialis Hanna et Hanna, 1924
(pl. 1: 6, 9; pl. 4: 2*a*, *b*)

1924. *Quinqueloculina imperialis* Hanna and Hanna: 58, pl. 13: 7, 8, 10.
1970. *Quinqueloculina imperialis* Hanna and Hanna; Kiesel: 210, pl. 6: 12.

Material. — About a dozen very well preserved specimens.

Remarks. — Our specimens display aperture identical in character as in the holotype: with narrow and slightly splitted tooth and correspondingly wide chambers with similarly rounded peripheral margins.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Miechów) and Kujawy region (borehole Augustynowo). GDR: Upper Eocene (Schönewalde Schichten). USA: Eocene. In Poland, this species is known from the zone of influences of the Mediterranean province only.

Quinqueloculina impressa Reuss, 1851

(pl. 2: 5, 6; pl. 4: 4*a*, *b*)

1851. *Quinqueloculina impressa* Reuss: 87, pl. 7: 59.
non 1958. *Quinqueloculina impressa* Reuss; Batjes: 103, pl. 1: 13.
1978. *Quinqueloculina impressa* Reuss; Odrzywolska-Bieńkowa, Pożaryska and Martini: 262, pl. 8: 3*a*—*c*.

Material. — Numerous fairly well preserved specimens.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa) and Kujawy region (boreholes Gorzów Wielkopolski, Choszczno and Wschowa geo-6). GDR and FRG: Lower Oligocene (Rupelian). Belgium: Upper Eocene-Lower Oligocene. England: Bartonian. North Sea-region: Lower and Upper Oligocene.

Quinqueloculina juleana d'Orbigny, 1846

(pl. 1: 18, 19, 22)

1846. *Quinqueloculina juleana* d'Orbigny: 298, pl. 20: 1—3.
1970. *Quinqueloculina juleana* d'Orbigny; Kiesel: 211, pl. 6: 3 (with synonymy).

Material. — About a dozen well-preserved specimens.

Remarks. — Our specimens are close to the holotype, differing in more gentle edges. The species *Quinqueloculina badenesis* d'Orbigny, known from the Miocene in the Vienna Basin, is very close to that species, which may represent its ancestor one.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Głobice). GDR and Belgium: Upper Eocene. England: Bartonian.

Quinqueloculina ludwigi Reuss, 1865

(pl. 1: 16, 17; pl. 4: 5*a*, *b*, *c*)

1865. *Quinqueloculina ludwigi* Reuss: 126, pl. 1: 12.
1978. *Quinqueloculina ludwigi* Reuss; Odrzywolska-Bieńkowa, Pożaryska and E. Martini: 261, pl. 8: 1, 2.

Material. — About a dozen well-preserved specimens.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały, Głobice, Miechów and Jerzmanowa) and Gorzów Wielkopolski area, Oligocene of Łeba Elevation, Puck Embayment and vicinities of Słupsk and Szczecin. GDR, FRG, Netherlands and Belgium (Boom Clays): Rupelian. France: Middle Eocene-Oligocene. England: Bartonian.

Quinqueloculina serovae (Bogdanowich, 1952)
(pl. 4, figs. 11*a*, *b*)

1952. *Miliolina serovae* Bogdanowich: 108, pl. 9: 2*a*—*w* (*fide* Ellis and Messina 1957).
1955. *Miliolina badenensis* (d'Orbigny) var. *carinata* Serova: 304, pl. 2: 4—6 (*fide* Ellis and Messina 1957).
1961. *Quinqueloculina serovae* (Bogdanowich); Didkovskij: 26, pl. 1: 7 (*fide* Ellis and Messina 1960).

Material. — A few well-preserved specimens.
Occurrence:. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów). USSR: Miocene of Ukraine.

Quinqueloculina seminula (Linné 1758)
(pl. 1: 20, 23, 24; pl. 4: 7*a*—*c*, 8*a*, *b*, 10)

1758. *Serpula seminulum* Linné: 786.
1952. *Miliolina seminulum* (Linné); Bogdanowich: 134, pl. 16: 2*a*—*w*, 3*a*—*w* (*fide* Ellis and Messina 1957).
1985. *Quinqueloculina seminula* (Linné); Batjes: 102, pl. 1: 15.
1970. *Quinqueloculina seminulum seminulum* (Linné); Didkovskij, Satanovskaja: 33, pl. 19: 1*a*—*w*.

Material. — A few well-preserved specimens.
Remarks. — Our specimens very well match diagnosis of this species.
Occurrence. — Poland: Upper Eocene of Mazowsze (borehole Łanięta) and Kujawy regions (borehole Augustynowo); single specimens have also been found in the Paleogene but the species appears widely distributed in the Neogene of southern Poland. Europe and N America (Alaska): Eocene up to the present. Nigeria: Eocene. England: Bartonian.

Genus *Pyrgo* Defrance, 1824

Pyrgo appendiculata (Eichwald, 1853)
(pl. 2: 1)

1853. *Biloculina appendiculata* Eichwald: 11, pl. 1: 12*a*—*d*.
Material. — A few well-preserved specimens.
Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). USSR: Miocene of Ukraine. In Poland, the species occurs in zone of influences of the Mediterranean province.

Pyrgo bulloides (d'Orbigny, 1826)
(pl. 2: 2, 3, 7)

1826. *Biloculina bulloides* d'Orbigny: 13, pl. 1: 1.
1961. *Pyrgo bulloides* (d'Orbigny); Kasschieter: 167, pl. 5: 18.
1975. *Pyrgo bulloides* (d'Orbigny); Samuel: 118, pl. 65: 2*a*, *b*.

Material. — About a dozen well-preserved specimens.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). Belgium: Lower Oligocene (Rupelian). CSRS: Upper Eocene (Priabonian). France: Middle and Upper Eocene. According to d'Orbigny (1826), this species occurs in the Tertiary in the vicinities of Bordeaux and at present in the Atlantic. A close species, described under the name *Pyrgo* aff. *bulloides* (Jarceva, 1951), is known from the Upper Eocene of Ukraine (USSR).

Genus *Triloculina* d'Orbigny, 1826
Triloculina angularis d'Orbigny, 1850
(pl. 2: 8)

1850. *Triloculina angularis* d'Orbigny: 409.
1970. *Triloculina angularis* d'Orbigny; Le Calvez: 49, pl. 13: 9 (with synonymy).

Material. — A few specimens with fairly strongly corroded surface.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France and Belgium: Middle and Upper Eocene. In Poland, this species occurs in the zone of influences of the Mediterranean province.

Triloculina gibba d'Orbigny, 1846
(pl. 4: 6*a*, *b*, 9*a*, *b*)

1846. *Triloculina gibba* d'Orbigny: 274, pl. 16: 22—24.
non 1969. *Triloculina tricarinata* d'Orbigny; Kraeva, Zerneckij: 39, pl. 13: 10.
1974. *Triloculina gibba* d'Orbigny; Łuczkowska: 134, pl. 23: 2*a*, *c*, text-fig. 46/2.

Material. — About a dozen specimens with slightly corroded surface.

Remarks. — The species is the closest to *T. tricarinata*, which differs from it in markedly sharper edges. Therefore, it seems that treatment of these species as synonyms (Kraeva and Zernietskij 1969) is not justified.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów). France. Belgium and Netherlands: Upper Eocene. Poland: Miocene of Carpathian Foredeep and margins of the Holy Cross Mts. Italy: Pliocene and Recent.

Genus *Miliola* Lamarck, 1804
Miliola saxorum (Lamarck, 1804)
(pl. 2: 4)

1804. *Miliolites saxorum* Lamarck: 352, pl. 17: 2*a*, *b*.
1970. *Miliola saxorum* (Lamarck); Le Calvez: 43, pl. 6: 3.

Material. — A few slightly corroded specimens.

Remarks. — Our specimens are slightly more bulgy and with sharper peripheral margin as in the drawing of the holotype, whereas striation appears the same.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France: Lower and Upper Eocene of Paris Basin. The species seems limited to the Mediterranean province only.

Family **Soritidae** Ehrenberg, 1839
Genus *Rhapydionina* Stache, 1913
Rhapydionina liburnica (Stache, 1889)
(pl. 1: 5)

1889. *Peneroplis liburnica* Stache: 89, pl. 5a; 20.
1912. *Rhapydionina liburnica* (Stache); Stache: 661.
1963. *Tubulogenerina multicostata* Kiesel: 9, pl. 3: 3.

Material. — A few somewhat damaged specimens.

Remarks. — Our specimens agree with the figure of the holotype, except for being somewhat shorter. The species *Tubulogenerina multicostata* Kiesel (Kiesel 1963) appears very close to *Rhapydionina liburnica* in both the style of ornamentation and character of aperture.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów). Yugoslavia: Upper Eocene. GDR: Upper Eocene (Schönewalde Schichten). The species is limited to the zone of influences of the Mediterranean province only.

Family **Nodosariidae** Ehrenberg, 1838
Genus *Nodosaria* Lamarck, 1812
Nodosaria stipitata Reuss, 1850
(pl. 4: 3)

1850. *Nodosaria stipitata* Reuss: 366, pl. 46: 4.
1886. *Nodosaria stipitata* Reuss; Rzehak: 82.

Material. — One well-preserved specimen.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów). GDR, FRG and Hungary: Upper Eocene-Oligocene.

Genus *Dentalina* Risso, 1826
Dentalina hillaeformis Galloway et Heminway, 1941
(pl. 2: 9)

1941. *Dentalina hillaeformis* Galloway and Heminway: 341, pl. 9: 12.

Material. — A few well-preserved specimens.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały) and Kujawy region (borehole Izbica). Antilles (Puerto Rico): Upper Oligocene and Lower Miocene.

Dentalina semilaevis Hantken, 1875
(pl. 2: 10)

1875. *Dentalina semilaevis* Hantken: 39, pl. 4: 6, pl. 12: 13.

Material. — One well-preserved specimen.

Remarks. — Our specimen, displaying outline and ornamentation identical as fully grown representatives of this species, presumably represents its juvenile stage.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). Hungary: Lower Oligocene (*recte* Upper Eocene) of the *Clavulina szaboi* Beds. USSR: Middle Oligocene of Crimea.

Genus *Lagena* Walker et Jacob (*in* Kanmacher, 1798)
Lagena hexagona (Williamson, 1848)
(pl. 2: 14)

1948. *Entosolenia squamosa* (Montagu) var. Y *hexagona* Williamson: 20, pl. 2: 23.
1970. *Oolina hexagona* (Williamson); Y. Kiesel: 101, pl. 16: 2, 3.

Material. — Some tens of well-preserved specimens.

Remarks. — The species is highly common and widely distributed.

Occurrence. — Poland: Upper Eocene of Siemień (eastern Poland), Oligocene of Fore-Sudetic Monocline (boreholes Kurów Mały, Jerzmanowa and Miechów), Miocene of Carpathian Foredeep, margin of the Holy Cross Mts. and Lublin Upland. Cosmopolitic, known from the Cretaceous up to the present.

Genus *Fissurina* Reuss, 1850
Fissurina marginata (Walker et Boys, 1784)
(pl. 2. 13)

1784. *Serpula* (*Lagena*) *marginata* Walker and Boys: 2, pl. 1: 7.
1913. *Lagena marginata* (Walker and Boys); Cushman: 8, pl. 22: 1, 2.
1957. *Fissurina marginata* (Walker and Boys); Pożaryska: 61, pl. 5: 5, pl. 6: 4.
1969. *Entosolenia marginata* (Walker and Boys); Kraeva, Zerneckij: 133, pl. 78: 5*a*, *b*.

Material. — About a dozen well-preserved specimens.

Occurrence. — Poland: Upper Cretaceous of the Polish Lowlands, Paleogene of Fore-Sudetic Monocline (borehole Kurów Mały), Miocene of Carpathian Foredeep, margin of the Holy Cross Mts. and Lublin Upland (Central Paratethys). GDR: Cretaceous of Rügen Id. France: Eocene of Paris Basin. FRG: Rupelian. Hungary: Upper Eocene. Italy and Spain: Neogene. USSR: Paleogene and Neogene of Ukraine and Crimea. USA: Neogene and Pleistocene. England: Pleistocene. Also known to occur at present in seas and oceans.

Genus *Lenticulina* Lamarck, 1804
Lenticulina herrmani (Andreae, 1898)
(pl. 14: 2)

1898. *Cristellaria herrmani* Andreae: 298, fig. *A*, *B*.
1958. *Lenticulina* (*Robulus*) sp.; Batjes: 38, pl. 2: 15.
1970. *Lenticulina* (*Planulina*) *herrmanni* (Andreae); Kiesel: 235, pl. 9: 16.

Material. — Single well-preserved specimens.

Remarks. — Our specimens are very close to the holotype, except for being somewhat less elongate and with less regularly developed spines. The width of keel and the degree of flattening of test are also varying.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (borehole Miechów). USSR (Crimea, Aral part of the Caucasus, Kuban'), GDR, FRG and Belgium: Lower Oligocene.

Genus *Vaginulina* d'Orbigny, 1826
Vaginulina alazanensis Nuttall, 1932
(pl. 2: 13)

1932. *Vaginulina alazanensis* Nuttall: 17, pl. 1: 11, 15.

Material. — About a dozen of usually broken specimens.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów). Mexico: Lower Oligocene (*recte* Upper Eocene).

Family **Polymorphinidae** d'Orbigny, 1839
Genus *Raphanulina* Zborzewski, 1834
Raphanulina tuberculata (d'Orbigny, 1846)
(pl. 3: 4)

1846. *Globulina tuberculata* d'Orbigny: 230, pl. 13: 21, 22.
1961. *Globulina gibba* (d'Orbigny) var. *punctata* d'Orbigny; Kaasschieter: 183, pl. 8: 8, 9.
non 1970. *Globulina gibba* var. *punctata* d'Orbigny; Le Calvez: 86, pl. 18: 1—4.
1975. *Globulina gibba punctata* d'Orbigny; Samuel: 127, pl. 71: 1.

Material. — A few specimens with broken off spines.

Remarks. — Surface of test is covered with numerous projections in the form of blunt, presumably broken-off, and sharp spines. Distribution of both types of spines on test surface appears uniform. The same is found in the case of specimens from Slovakia (Samuel 1975).

Le Calvez (1970) treats *Globulina (recte Raphanulina) gibba punctata* d'Orbigny as synonym of *Globulina (recte Raphanulina) gibba tuberculata* d'Orbigny (1846). However, according to the original diagnosis, *Globulina (recte Raphanulina) gibba punctata* d'Orbigny is not characterized by surface ornamented with spines but with depressions which makes invalid the treatment of the above forms as conspecific.

Occurrence. — Poland: Upper Eocene of Siemień (eastern Poland) and Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). CSRS: Priabonian. France, GDR, FRG, Austria and USA: Eocene.

Genus *Guttulina* d'Orbigny *in* de la Sagra, 1839
Guttulina caudata d'Orbigny, 1826
(pl. 3: 6)

1826. *Guttulina caudata* d'Orbigny: 266, No. 16.
1970. *Guttulina caudata* d'Orbigny; Le Calvez: 91, pl. 17: 7.

Material. — Single specimens with corroded surface.

Remarks. — Our specimens well agree with those of the Eocene of the Paris Basin (France). Both small mucron from terminal part of test and slight convexity of chambers in lower part of test are developed in the same way in representatives of this species coming from different regions.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France: Eocene of Paris Basin.

Guttulina problema d'Orbigny, 1826
(pl. 3: 3; pl. 2: 15)

1826. *Guttulina problema* d'Orbigny: 266, pl. 26, fig. 14.
pars 1962. *Guttulina problema* d'Orbigny; Kiesel: 45, pl. 7: 4.
1978. *Guttulina problema* d'Orbigny; Odrzywolska-Bieńkowa, Pożaryska and Martini: 267, pl. 10: 4*a*, *b*.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens differ from the holotype in less overhanging but rather rounded chambers, especially lower ones (see Odrzywolska-Bieńkowa, Pożaryska and Martini, 1978, for details).

Occurrence. — Poland: Paleocene-Miocene in the Polish Lowlands, Fore-Sudetic Monocline, Kujawy region and in sequences of the Central Paratethys. CSRS, GDR and USA: Priabonian-Miocene. England: Bartonian.

Genus *Pseudopolymorphina* Cushman et Ozawa, 1928

Pseudopolymorphina dumblei Cushman et Applin, 1926
(pl. 4: 1)

1926. *Polymorphina compressa* d'Orbigny var. *dumblei* Cushman et Applin: 173, pl. 9: 4, 5.
1935. *Pseudopolymorphina dumblei* (Cushman et Applin); Cushman: 29, pl. 10: 14, 15.

Material. — A few well-preserved specimens.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów) and Kujawy region (borehole Augustynowo). GDR and FRG: Upper Eocene. USA: Upper Eocene-Miocene. In Poland, this species is limited to the zone of influences of the Mediterranean province, being unknown from cold-water assemblages.

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

Pyrulina fusiformis (Roemer, 1838)
(pl. 2: 3)

1838. *Polymorphina fusiformis* Roemer: 386, pl. 3: 37.
1855. *Guttulina cylindrica* Bornemann: 347, pl. 18: 4—6.
1855. *Guttulina ovalis* Bornemann: 345, pl. 17: 7.
1930. *Pyrulina fusiformis* (Roemer); Cushman and Ozawa: 55, pl. 13: 3—8.

Material. — Several specimens.

Remarks. — Comparison of our specimens with the holotype figure given by Roemer (1838) is pointless as the latter is highly schematic. However, it may be stated that our specimens well agree with German ones assigned to this species (see synonymy).

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). GDR, FRG and Belgium: Oligocene. France: the species has been reported (but not figured) from Oligocene of Paris Basin. Belgium, Austria and Hungary: Middle Miocene.

Genus *Sigmomorphina* Cushman et Ozawa, 1928
Sigmomorphina amygdaloides (Reuss, 1856)
(pl. 3: 1)

1856. *Polymorphina amygdaloides* Reuss: 25, pl. 8: 84.
1970. *Sigmomorphina amygdaloides* Reuss; Le Calvez: 24, pl. 1: 1, 3.

Material. — A few well-preserved specimens.

Remarks. — For discussion on forms described by Terquem and Reuss see Le Calvez (1970). Our specimens correspond to those described and figured by both Terquem and Reuss.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline borehole Kurów Mały). GDR and FRG: Oligocene. France: Lower and Upper Eocene.

Family **Turrilinidae** Cushman, 1927
Genus *Buliminella* Cushman 1911
Buliminella cf. *turbinata* (Terquem, 1882)
(pl. 3: 11, 15)

1882. *Bulimina turbinata* Terquem: 113, pl. 12: 6 (*non* 7).

Material. — A few specimens with damaged aperture.

Remarks. — The available specimens have damaged apertures so they are assigned to *Buliminella turbinata* (Terquem, 1822) with reservation. SEM micrographs well show irregular thick ribs continuing almost throughout the test surface.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France: Middle and Upper Eocene. Close forms were described from Upper Eocene of New Zealand under the name *Uvigerina bortotara* (Finlay) var. *costata* Dorreen, 1948.

Family **Bolivinitidae** Cushman, 1927
Genus *Bolivina* d'Orbigny 1837
Bolivina cookei Cushman, 1922
(pl. 3: 9, 10)

1922. *Bolivina cookei* Cushman: 126, pl. 29: 1.
1977. *Bolivina cookei* Cushman; Pożaryska: 27, pl. 9: 3.

Material. — A few well preserved specimens.

Remarks. — Our specimens fall within the limits of variability as defined by Kaasschieter (1961). The species is very close to *Bolivina striatellata* Bandy, mainly differing in the lack of rised inter-chamber sutures, well marked in the latter.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica) and Middle Eocene of Siemień (eastern Poland). The species is common in Eocene and Oligocene of Europe and USA.

Bolivina microlancetiformis Subbotina, 1953
(pl. 12: 5)

1953. *Bolivina microlancetiformis* Subbotina: 222, pl. 10: 5—7.
1977. *Bolivina microlancetiformis* Subbotina; Pożaryska: 28, pl. 10: 1, 9.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens very well agree with the holotype and those figured by Subbotina (1953) and Furssenko and Furssenko (1961). SEM micrographs gave support to the statement of Pożaryska (1977) that the features arranged in vertical lines are not pores but rather fine riblets.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów), Eastern Poland (boreholes Mikaszówka and Siemień), Łeba Elevation and Puck Embayment. GDR: Upper Eocene. USSR: Upper Eocene of Ukraine and Byelorussia.

Bolivina nobilis Hantken, 1875
(pl. 3: 7)

1875. *Bolivina nobilis* Hantken: 65, pl. 15: 4*a*, *b*.
1975. *Bolivina nobilis* Hantken; Samuel: 134, pl. 74: 4, 5, 6.

Material. — About a dozen well-preserved specimens.

Remarks. — All the specimens are narrow and with riblets in lower part of test. SEM micrographs show encrustations on sutures and numerous pores arranged in vertical rows.

Forms described by Le Calvez (1966) are excluded from the synonymy as they are characterized by different length-to-width ratio and, therefore, wider and with smaller number of chambers than the holotype.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa), Łeba Elevation, Puck Embayment and eastern Poland (borehole Mikaszówka). CSRS: Priabonian of Slovakia. USSR: Upper Eocene of Crimea and Ukraine. Hungary, Italy, France (Biarritz region) and Nigeria: Eocene.

Bolivina striatellata Bandy, 1949
(pl. 3: 8; pl. 11: 1)

1949. *Bolivina striatellata* Bandy: 129, pl. 24: 8.
1977. *Bolivina striatellata* Bandy; Pożaryska: 28, pl. 3: C 1—8; pl. 9: 1, 2, 5, 6, 7.

Material. — A few well-preserved specimens.

Remarks. — Our specimens fall within the limits of variability of this species as delineated by Pożaryska (1977). The species is the closest to *Bolivina cookei* Cushman (see discussion in Pożaryska, 1977).

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica), Middle Eocene of Siemień area (eastern Poland). USA: Eocene.

Family **Buliminidae** Jones, 1875
Genus *Reussella* Galloway, 1933
Reussella byramensis Cushman et Todd 1946
(pl. 3: 13, 14)

1946. *Reussella byramensis* Cushman and Todd: 94, pl. 16: 4, 5.

Material. — Large number of well-preserved specimens.

Remarks. — Our specimens are very close to the figure of the holotype in outline and the mode of development of sutures.

Occurrence. — Poland: Eocene-Oligocene junction beds of Kujawy (boreholes Izbica and Augustynowo) and Mazowsze regions (borehole Łanięta). Italy: Priabonian. USA: Oligocene. Distribution of this species is limited to the zone of influences of the Mediterranean province.

Reussella sculptilis (Cushman, 1926)
(pl. 12: 7*a*, *b*)

1926. *Verneuilina sculptilis* Cushman: 34, pl. 5: 3.

Material. — About a dozen usually damaged specimens.

Remarks. — Our specimens correspond to the topotypes and figured holotype of the Cushman species in general outline. In Cushman drawings, sutures seem to be broken but it follows from the accompanying descriptions that they are rised and continuous as in our specimens.

Occurrence. — Poland: Upper Eocene of Mazowsze (borehole Łanięta) and Kujawy regions (borehole Augustynowo), and Menillite Shales in Polish Carpathians. USA: Upper Eocene. In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Reussella terquemi Cushman, 1945
(pl. 12: 3; pl. 3: 12)

pars 1882. *Verneuilina spinulosa* Reuss; Terquem: 107, pl. 11: 16.
1935. *Reussella terquemi* Cushman: 28, pl. 5: 15, 16.

Material. — About a dozen well-preserved specimens.

Remarks. — Our specimens agree with those figured by Cushman (1945). Cushman separated this species from the Miocene *Verneulina spinulosa* Reuss, as interpreted by Terquem, taking into account differences in size and width of test and somewhat shorter or almost completely missing peripheral spines.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Miechów and Kurów Mały). France: Lower and Upper Eocene of Paris Basin. Belgium, GDR, FRG and USSR (Ukraine): Upper Eocene. In Poland, this species is known from the zone of influences of the Mediterranean province.

? *Reussella* sp.
(pl. 3: 5)

Material. — Single specimens, including one complete.

Remarks. — Our specimens are most similar to that figured under the name *Reussella eocaena* (Cushman) by Kiesel (1963) in strongly protruding and rounded test wings, differing in clearly marked incisions in lower part of test.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). GDR: Upper Eocene. In Poland, the species is limited to the zone of influences of the Mediterranean province.

Family **Uvigerinidae** Haeckel, 1894
Genus *Uvigerina* d'Orbigny, 1826
Uvigerina cocoaensis Cushman, 1925
(pl. 3: 21)

1925. *Uvigerina cocoaensis* Cushman: 68, pl. 10: 12.

Material. — Several well-preserved specimens.

Remarks. — Our specimens are characterized by widely spaced, straight ribs, running vertical to disappear at the last chamber.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). USA: Upper Eocene of Alabama.

Uvigerina gallowayi basicordata Cushman et Renz, 1941
(pl. 3: 16)

1942. *Uvigerina gallowayi* Cushman var. *basicordata* Cushman and Renz: 21, pl. 3: 18*a*.

Material. — A few well-preserved specimens.

Remarks. — Our specimens resemble the drawn holotype, differing in well-developed coarse vertical ribs, broken at sutures, and concave transversal riblets in inter-rib spaces.

There were reported several forms close to *Uvigerina gallowayi basicordata*, i.e., those described as *Uvigerina eocena* Gümbel, 1868 from the Eocene of Austria and *Uvigerina camagüeyeana* Bermudez (1937) from coeval strata of Cuba.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Jerzmanowa). Venezuela: Oligocene.

Uvigerina spinicostata Cushman et Jarvis, 1929
(pl. 3: 18, 19)

1929. *Uvigerina spinicostata* Cushman and Jarvis: 12, pl. 3: 9, 10.
1970. *Uvigerina spinicostata* Cushman and Jarvis; Kiesel: 265, pl. 13: 3.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens correspond to drawings of the holotype and figures of specimens from Belgium and GDR (Kaasschieter 1961; Kiesel 1970).

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). Łeba Elevation, Puck Embayment, Słupsk region and eastern Poland (borehole Mikaszówka). GDR, FRG, Belgium, Trinidad: Upper Eocene.

Genus *Sagrina* d'Orbigny *in* de la Sagra, 1839
Sagrina pulchra (Le Calvez, 1959)
(pl. 6: 1)

1959. *Tritubulogenerina pulchra* Le Calvez: 91, pl. 1: 8—11 (*fide* Ellis and Messina 1960).
1970. *Sagrina pulchra* (Le Calvez); Le Calvez: 127, pl. 24: 4.

Material. — A few well-preserved specimens.

Remarks. — Our specimens fairly well correspond to the figures of the holotype and topotypes (Le Calvez 1959, 1970), differing in narrower aperture and less overhanging chambers.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica). France: Lower Eocene of Paris Basin.

Genus *Trifarina* Cushman, 1923

Trifarina germanica (Cushman et Edwards, 1938)

(pl. 3: 20; pl. 11: 5)

1938. *Angulogerina germanica* Cushman and Edwards: 85, pl. 15: 14—16.
1958. *Angulogerina gracilis* (Reuss) var. *germanica* Cushman and Edwards; Batjes: 136, pl. 6: 4.
1975. *Angulogerina gracilis germanica* Cushman and Edwards; Samuel: 138, pl. 77: 4*a*, *b*.
1978. *Trifarina germanica* (Cushman and Edwards); Odrzywolska-Bieńkowa, Pożaryska and Martini: 270, pl. 11: 4.

Material. — Some tens of well-preserved specimens.

Occurrence. — Poland: Lower Oligocene (Rupelian) of NW Poland (borehole Szczecin), Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa), Słupsk area (boreholes Możdżanowo and Machowinko). CSRS and GDR: Priabonian. Belgium: Oligocene (Boom Clays). France: Rupelian of Paris Basin.

Family **Discorbidae** Ehrenberg, 1838

Genus *Discorbis* Lamarck, 1804

Discorbis brandenburgensis (Kiesel, 1963)

(pl. 6: 2, 5, 6, 11, 12, 13, 14)

1963. *Biapertorbis brandenburgensis* Kiesel: 11, pl. 4: 1.

Material. — Rich material coming from mass occurrences of this species.

Remarks. — Our specimens fully correspond to those described from the Upper Eocene of the GDR by Kiesel (1963). In the latter area, this species is known from the fauna of the Calauer type. Polish specimens are also close to those figured under the name *Rotorbinella fungiformis* from the Upper Eocene of Asiatic part of the USSR by Subbotina (1958). A some kind of central tubercle at ventral side, noted in this species, originated in result of merging of encrustations from sutures. The species is most similar to *Discorbis discoides* (d'Orbigny, 1826), described from France.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały, Jerzmanowa, Miechów and Głobice) and Mazowsze (borehole Łanięta) and Kujawy regions (boreholes Izbica and Augustynowo). GDR: Upper Eocene. This species is presumably present in Eocene of the USSR. Its distribution is limited to the zone of influences of the Mediterranean province.

Discorbis discoides (d'Orbigny, 1826)

(pl. 13: 4*a*—*c*)

1826. *Rotalia discoides* d'Orbigny: 272, fig. 5.
1970. *Discorbis discoides* (d'Orbigny); Le Calvez: 133, pl. 28: 2, 5.

Material. — A few well-preserved specimens.

Remarks. — Polish specimens well correspond to the figures of the holotype, i.e., both sketch drawing of d'Orbigny (1826) and SEM micrographs given by Le Calvez (1970). The species is (see above) most close to *Discorbis brandenburgensis* (Kiesel, 1963) from the Upper Eocene of the GDR and Poland, differing from the latter in the presence of clearly marked, dissected umbilical tubercle as well as the lack of striation at test margin.

Occurrence. — Poland: Upper Eocene of Mazowsze region (borehole Łanięta). France: Oligocene of Paris Basin. Distribution of this species is in Poland limited to the zone of influences of the Mediterranean province.

Discorbis propinqua (Terquem, 1882)

(pl. 11: 9)

1882. *Rosalina propinqua* Terquem: 99, pl. 10: 14.
1882. *Rotalina carctata* Terquem: 76, pl. 7: 8.
1970. *Discorbis propinqua* (Terquem); Le Calvez: 133, pl. 28: 7.

Material. — Several well-preserved specimens.

Remarks. — Our specimens resemble the holotype in the same number of chambers, identical connections over umbilical depression, built of test matter, and identically developed wide margin. For revision of this species and discussion on its generic affiliation see Le Calvez (1970). Le Calvez assigned to this species 3 other species of Terquem (1882).

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica). France: the whole Eocene of Paris Basin. England: Bartonian.

Genus *Neoconorbina* Hofker, 1951
Neoconorbina obvoluta (Terquem, 1882)

(pl. 6: 10; pl. 11: 7*a*—*c*)

1882. *Rotalina obvoluta* Terquem: 81, pl. 8: 7.
1882. *Rotalina hemisphaerica* Terquem: 75, pl. 7: 7.
1949. *Discorbis obvoluta* (Terquem); Le Calvez: 20, pl. 2: 33—35 (*fide* Ellis and Messina 1960).
1970. *Rosalina obvoluta* (Terquem); Le Calvez: 142, figs. 52—54.
1977. *Neoconorbina obvoluta* (Terquem); Pożaryska and Odrzywolska-Bieńkowa: 62, pl. 6: 7*a*—*c*.

Material. — Several well-preserved specimens.

Remarks. — Our specimens fully agree with those of the Terquem (1882) collections which have been revised by Le Calvez (1949), who also discussed their similarity to the holotype.

Occurrence. — Poland: Upper Eocene (Priabonian) of Kujawy (borehole Izbica) and Mazowsze regions (borehole Łanięta). GDR: Upper Eocene. France: Lower and Upper Eocene of Paris Basin.

Genus *Rosalina* d'Orbigny, 1826
Rosalina douvillei (Cushman, 1928)

(pl. 6: 7)

1928. *Discorbis douvillei* Cushman: 54, pl. 3: 1.
1958. *Discorbis globularis* (d'Orbigny); Batjes: 145, pl. 7: 2.

1970. *Rosalina douvillei* (Cushman); Le Calvez: 140, pl. 29: 3—5.

Material. — About a dozen well-preserved specimens.

Remarks. — Our specimens agree with those figured from the Paris Basin by Le Calvez (1970), being also very close to the holotype described by Cushman (1928). In accordance with the suggestions of Le Calvez (1970), *Rosalina douvillei* appears a transitional form between Middle Eocene *Rosalina quadrata* Terquem and Miocene *R. globularis* d'Orbigny.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa). CSRS: Priabonian. France and Belgium: Oligocene. In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Rosalina globularis d'Orbigny, 1826
(pl. 6: 3)

1826. *Rosalina globularis* d'Orbigny: 271, pl. 13: 1—4.

1970. *Rosalina globularis* d'Orbigny; Kiesel: 285, pl. 15: 18.

Material. — Several well-preserved specimens.

Remarks. — Polish specimens agree with those figured by Kiesel (1970). They differ from those of d'Orbigny (1826) and Cushman (1931) in weaker granulation at ventral side and less clear outer margins of chambers.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica). GDR, FRG, Nigeria, USA: Eocene. The species is known from the Eocene up to the present.

Genus *Baggina* Cushman, 1927
Baggina subconica (Terquem, 1882) emend. Le Calvez, 1949
(pl. 6: 4, 8, 9)

non 1882. *Rotalina subconica* Terquem: 61, pl. 6: 5*a*—*c*.

1882. *Valvulina ovalis* Terquem: 103, pl. 11: 10.

1942. *Cancris turgidus* Cushman and Todd: 92, pl. 24: 3, 4.

1949. *Valvulineria subconica* Terquem; Le Calvez: 26, pl. 5: 87—89 (*fide* Ellis and Messina 1960).

1961. *Cancris subconicus* (Terquem); Kaasschieter: 213, pl. 12: 6—8.

1977. *Baggina subconica* (Terquem); Pożaryska: 33, pl. 11: 1.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens are very similar to those assigned to the species *Valvulineria subconica* Terquem by Le Calvez (1949) in her revision of the Terquem collection, completely differing from the figure of the holotype as given by Terquem (1882). This striking difference between the drawing given by Terquem and actual appearance of his specimens was also emphasized by Le Calvez (1949, 1970). She subsequently allocated the species in the genus *Cancris* (Le Calvez 1970). However, taking into account non-porous surface near aperture and broadly rounded peripheral margin of test, we place it in the genus *Baggina*.

Occurrence. — Poland: Upper Eocene and Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa) and Kujawy (borehole Izbica) and Mazowsze regions (borehole Łanięta). CSRS: Priabonian. France (Paris Basin), Belgium and Netherlands: Eocene. England: Bartonian.

Family **Glabratellidae** Loeblich and Tappan, 1964
Genus *Glabratella* Dorreen, 1948
Glabratella ubiqua (Le Calvez, 1949)
(pl. 9: 13*a*—*c*)

1949. *Discorbis ubiqua* Le Calvez: 23, pl. 2: 27—29 (*fide* Ellis and Messina 1960).
1970. *Glabratella ubiqua* (Le Calvez): Le Calvez: 149, pl. 35: 7.
non 1975. *Glabratella ubiqua* (Le Calvez): Samuel: 144, pl. 85: 2*a*—*d*.

Material. — A few well-preserved specimens.

Remarks. — Our specimens are very close to those figured by Le Calvez (1949), markedly differing from that figured by Samuel (1975). The latter is angular, subquadrate in outline and with a pair of distinct tubercles at dorsal side, whereas test of the type specimen appears completely smooth. Therefore, the specimens coming from Slovakia are excluded from this species. Our specimens well display radial ornamentation at ventral side of test (see pl. 9, fig. 13*c*).

Occurrence. — Poland: Upper Eocene of Mazowsze region (borehole Łanięta). France: Lower and Upper Eocene of Paris Basin. In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Family **Asterigerinidae** d'Orbigny, 1839
Genus *Asterigerina* d'Orbigny, *in* de la Sagra, 1839
Asterigerina bartoniana (ten Dam, 1947)
(pl. 6: 15—18; pl. 11: 10, 11)

1947. *Rotalia bartoniana* ten Dam: 186 (new name).
1948. *Asterigerina cyclops* Dorreen: 271, pl. 40: 5*a*—*c*.
1958. *Asterigerina stelligera* Kraeva: 73, figs. 2*a*, *b*, *w* (*fide* Ellis and Messina 1960).
non 1963. *Asterigerina bartoniana* (ten Dam); Kiesel: 20, pl. 10: 2.
1977. *Asterigerina bartoniana* (ten Dam); Pożaryska and Orzywolska-Bieńkowa: 62, pl. 6: 1.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens are very close to the holotype and topotypes of ten Dam (1947). We regard *Asterigerina cyclops* Dorren, 1948 from the Upper Eocene of New Zealand and *A. stelligera* Kraeva, 1958 from the Upper Eocene of Crimea as junior synonyms of this species. Gramann (1968) holds that *A. bartoniana* as interpreted by Kiesel (1963) does match the diagnosis of the species of Ten Dam but rather that of *A. brandhorstiana* Gramann (1964).

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa) and Kujawy (borehole Izbica) and Mazowsze regions (borehole Łanięta). Belgium and Netherlands: Middle and Upper Eocene. England: Bartonian. GDR, USSR and New Zealand: Upper Eocene. In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Asterigerina aff. *guerichi* (Franke, 1912)
(pl. 6: 19, 20)

1912. *Discorbina gürichi* Franke: 29, fig. 8.
1941. *Asterigerina frankei* Ten Dam et Reinhold: 220, pl. 2: 1—3.
1958. *Asterigerina gürichi* (Franke); Batjes: 159, pl. 10: 6, 7.

Material. — A few well-preserved specimens.

Remarks. — Our specimens are identically biconvex as those described by Franke (1912). Moreover, they also display band-like development of marginal parts of chambers at dorsal side. However, they differ from the latter in more star-like character of additional chambers, It is possible that this species represents a transition between Upper Eocene *Asterigerina bartoniana* (ten Dam) and typical *A. guerichi* (Franke), known from the Upper Oligocene.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (borehole Kurów Mały). GDR and Netherlands: Lower and Upper Oligocene.

Family **Rotaliidae** Ehrenberg, 1839

Genus *Pararotalia* Le Calvez, 1949

Pararotalia audouini (d'Orbigny, 1850)

(pl. 10: 1, 5)

1850. *Rotalia audouini* d'Orbigny: 307, pl. 2: 9, 10.
1970. *Pararotalia audouini* (d'Orbigny): Kiesel: 332, pl. 22: 18 (*non* 17, 19, 20).
1970. *Pararotalia audouini* (d'Orbigny); Le Calvez: 162, pl. 34: 8.
1970. *Pararotalia armata* (d'Orbigny); Le Calvez: 161, pl. 39: 1.
1970. *Pararotalia inermis* (Terquem); Le Calvez: 163, pl. 34: 6, 7.
1970. *Pararotalia subinermis* Bhatias; Le Calvez: 164, pl. 42: 2.

Material. — About a dozen well-preserved specimens.

Remarks. — For revision of the d'Orbigny collection and good figures of the type specimens see Le Calvez (1970). The species differs from *P. lithothamnica* in more depressed sutures at ventral side, the presence of clearly marked umbilical tubercle surrounded by a wide furrow and more strongly partitioned, and lobe-like peripheral margin of test. Moreover, the margin displays granulation which is missing on surface of chamber.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). GDR, Belgium and Netherlands: Upper Eocene. England: Bartonian. France: Middle and Upper Eocene of Paris Basin. Distribution of this species is limited to the zone of influences of the Mediterranean province.

Pararotalia spinigera (Terquem, 1882)

(pl. 9: 1—6, 10*a*—*c*)

1882. *Rosalina spinigera* Terquem: 97, pl. 10: 10*a*—*c*.
1970. *Pararotalia spinigera* (Le Calvez); Le Calvez: 164, pl. 39, fig. 6.
pars 1970. *Pararotalia audouini* (d'Orbigny); Kiesel: 332, pl. 22: 17, 19, 20.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens correspond to those of the Terquem (1882) collection, revised by Le Calvez (1949, 1970), as well as other French ones. The species is most similar to *Pararotalia lithothamnica* (Uhlig) and *P. audouini* (d'Orbigny), from which it differs in development of spines in central part of peripheral margin of the last whorl and the lack of any distinct plug at ventral side of the test. Umbilical depression may be infilled with irregular accumulation of test matter or well pronounced and empty. The specific variability may be also expressed in varying convexity of ventral side of the test.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały) and Kujawy region (borehole Izbica). France: Middle and Upper Eocene of Paris Basin. England: Bartonian. In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province only.

Pararotalia lithothamnica (Uhlig, 1886)

(pl. 10: 2, 3, 4, 6—16; pl. 9: 9; pl. 11: 14, 18, 19)

1886. *Rotalia lithothamnica* Uhlig: 195, pl. 5: 9; pl. 11: 14, 18, 19.
1928. *Rotalia mexicana* Nuttall: 374, pl. 50: 6—8.
1974. *Rotalia lithothamnica* Uhlig; Szczechura and Pożaryska: 64, pl. 13: 3, 5—8.

Material. — Some hundreds of specimens, including numerous well-preserved.

Remarks. — Our specimens well fall within the limits of variability of this species as outlined on the basis of the figures of the holotype and topotypes (Uhlig 1886). The species is characterized by very high variability of individuals, including size of central tubercle, depth and branching of sutures, shape of chambers varying from triangular to trapezoid and finally polygonal, and ratio of convexity of ventral side to the dorsal. Moreover, ornamentation is varying from negligible to comprising tubercles and deep furrows and margin of test may be sharp or slightly rounded. Taking into account so high variability, Kaptarenko-Tschernousova (1951) differentiated several varieties of this species. We do not agree with that approach and follow Uhlig (1886) in treating the above differences as manifestation of intraspecific variability. The species *Rotalia mexicana* Nuttall, 1928 from Mexico does not differ in any important features from *Pararotalia lithothamnica* (Uhlig, 1886).

Occurrence. — Poland: Upper Eocene of the Carpathians (limestone facies of Magura unit), Upper Paleocene of the Przemyśl Carpathians, where the species has been found in strata of subaqueous slide (Szczechura and Pożaryska, 1974), Upper Eocene of Fore-Sudetic Monocline (boreholes Miechów, Głobice, Sieroszowice), Kujawy (boreholes Izbica Kujawska and Augustynowo) and Mazowsze regions (borehole Łanięta). GDR: Upper Eocene (Schönewalde Beds). Italy: Priabonian. Romania, Hungary, Ukraine, Cuba and Mexico: Eocene.

Family **Nummulitidae** de Blainville, 1825

Genus *Nummulites* Lamarck, 1801

Nummulites germanicus Bornemann, 1860

(pl. 7)

1856. *Amphistegina nummularia* Reuss: 44, pl. 4: 46—50.
1860. *Nummulina germanica* Bornemann: 158, pl. 12: 2.
1973. *Nummulites concinnus* Jarzeva; Olempska: 213, pl. 14: 2, 3; pl. 15: 1—8.

Material. — Some tens of specimens, mostly broken.

Remarks. — Cross-sections of nummulitids from extra-Carpathian Poland are most similar to that figured by Bornemann (1860) and the last unnumbered figure. Plate 7 shows variability of representatives of this species and their deformations (especially in the case of material from the borehole Łanięta). The phenomenon of deformation of nummulitids and accompanying microfauna is known from several other localities in northern Europe, e.g. in the USSR (Kaptarenko-Tschernousova 1951, Bettenstaedt 1949, Schuh 1950).

Some authors regard this species as comprising various polyspecific forms. In turn, Bornemann interpreted it as highly varying in morphology. We accepted definition of that species after consultations with Dr. A. Blondeau (Paris), placing *Nummulites concinnus* Jarzeva in its synonymy.

Taking into account differences in morphology, Jarzeva, Lotsch and Nemkov (1968) splitted the species into a number of separate ones, assigning some species to *Nummulites orbignyi* (Galeotti), *N. concinnus* Jarzeva and *N. rectus* Curry. According to these authors, *N. prestwichianus* Jones is a synonym of *N. germanicus* Bornemann, and the latter is not a nordic nummulitid but rather Mediterranean species of the Priabonian age which evolved (similarly as *N. stellatus* Roveda) from *N. anomalus* de la Harpe. *Nummulites germanicus* Bornemann is rather flattened and *N. stellatus* Roveda — highly convex and with tuberculated surface. According to Blondeau (1969), *N. germanicus* Bornemann migrated from the Mediterranean areas via the Carpathian sea to the German basin where it occurs together with fauna of the Priabonian type. The two nummulitid species recorded in our country also occur together with assemblages of small foraminifers of the Priabonian type.

The species *N. germanicus* is still unknown from Upper Eocene-Oligocene strata in England, France and Belgium, i.e., in western part of the North European furrow so its records appear limited to eastern parts of the furrow. For example, it is known to occur in masses in some localities in SW Poland. According to Blondeau (1969), *N. germanicus* should not be present in strata of the nannoplankton *Discoaster tani nodifer* zone (NP16) which fully support our hypothesis of separate character of microfauna of eastern (where we have NP16 zone) and western Poland and, therefore, the two basins: Boreal and warm, with strong influences of the Mediterranean province. This also confirms the supposition that Late Eocene transgression of boreal sea reached eastern Poland from the east (see Pożaryska 1976).

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Jerzmanowa and Kurów Mały), Kujawy (borehole Damasławek) and Mazowsze regions (borehole Łanięta). GDR: Upper Eocene, so-called Lattorfian. The distribution of this species is limited to the zone of influences of the Mediterranean province only.

Nummulites aff. *stellatus* Roveda (1961)

(pl. 8)

Material. — Several specimens, including one well-preserved.

Remarks. — The species is characterized by different arrangement of chambers than in *Nummulites germanicus* (Bornemann). Its chambers are wider and interchamber septa more strongly bent. Preservation of the avialable specimens precludes their identification without making a reservation.

Occurrence. — *Nummulites* aff. *stellatus* has been found in Upper Eocene (Priabonian) strata in the borehole Łanięta in Poland. The species *N. stellatus* Roveda is known from the Middle and Upper Priabonian of Italy. S. Ungaro (1968) reported it from marly and limestone-marly series of the Priabonian. Distribution of this species in Europe is limited to the zone of influences of the Mediterranean province.

Family **Elphidiidae** Galloway, 1953

Genus *Cribrononion latidorsatum* (Reuss, 1864)

(pl. 11: 8)

1864. *Polystomella latidorsata* Reuss: 10, pl. 1: 6.
1939. *Elphidium latidorsatum* (Reuss); Cushman: 39, pl. 10: 16.

Material. — A few slightly damaged specimens.

Remarks. — The species is most similar to *Cribrononion hiltermanni* Hagn (1952), from which it differs in the lack of ornamentation on apertural surface of test.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica) and Middle Eocene of Siemień (eastern Poland). Belgium, Netherlands, GDR, RFN and England: Upper Eocene. France: Upper Eocene-Lower Oligocene of Paris Basin.

Family **Heterohelicidae** Cushman, 1927
Genus *Bifarina* Parker et Jones, 1872
Bifarina selseyensis (Heron-Allen and Earland, 1909)

(pl. 3: 17; pl. 11: 6)

1909. *Bigenerina selseyensis* Heron-Allen et Earland: 330, pl. 15: 15—17.
1918. *Siphogenerina hexagona* Halkyard: 41, pl. 6: 5.
1961. *Bifarina selseyensis* (Heron Allen and Earland); Kaasschieter: 200, pl. 10: 8—10.

Material. — A few specimens with the youngest part damaged.

Remarks. — Our specimens differs from the drawing of the holotype in markedly shortened biserial part. Similar specimens have been reported from Belgium by Kaasschieter (1961) who noted the lack of specimens with clearly differentiated uniserial part of test in his material.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica). Belgium, Netherlands and England: Bartonian.

Family **Globigerinidae** Carpenter, Parker et Jones, 1862
Genus *Globigerina* d'Orbigny, 1826
Globigerina cf. *angiporoides* Hornibrook, 1971

(pl. 12: 1*a*, *b*)

Material. — A few slightly damaged specimens.

Remarks. — Our specimens are more similar to those figured from the Priabonian of Slovakia by Samuel (1975) than to the holotype and other forms from New Zealand (Hornibrook 1971). The specimens from CSRS resemble those described and figured by Blow (1969). According to Samuel (1975), *G. angiporoides* Hornibrook is affined to *G. linaperta* Finlay.

Occurrence. — Poland: Eocene-Oligocene junction beds of Fore-Sudetic Monocline (borehole Kurów Mały). In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Family **Eponididae** Hofker, 1951
Genus *Neoeponides* Reiss, 1960
Neoeponides schreibersi (d'Orbigny, 1846)

(pl. 9; 7*a*, *b*; 8*a*, *b*; 11)

1846. *Rotalina schreibersi* d'Orbigny: 154, pl. 8: 4—6.
1851. *Rotalia karsteni* Reuss: 273, pl. 9: 6.
1883. *Pulvinulina candidula* Schwager: 33, pl. 28: 10.
1961. *Eponides schreibersi* (d'Orbigny); Kaasschieter: 210, pl. 11: 14, 15.
1970. *Neoeponides schreibersi* (d'Orbigny); Le Calvez: 177, pl. 42: 3.
1977. *Neoeponides schreibersi* (d'Orbigny); Pożaryska: 37, pl. 5: 2*a*—*c*.

Material. — Numerous well-preserved specimens.

Remarks. — The species is highly variable in development of central parts of chambers at ventral side, so-called tena, which may be large or small and turned upwards in a varying degree. SEM micrographs showed that dorsal side is highly porous (Pożaryska 1977: pl. 9: 7*b*).

Occurrence. — Poland: Upper Eocene-Lower Badenian. The species is omnipresent in the Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa), Kujawy (boreholes Izbica and Augustynowo) and Mazowsze regions (borehole Łanięta), in the Middle Eocene at Siemień (eastern Poland) as well as in the Paratethys region. Italy, France, GDR, FRG, Belgium and Netherlands: Upper Eocene.

Family **Cibicidinae** Cushman, 1927
Genus *Cibicides* de Montfort, 1808
Cibicides carinatus (Terquem, 1882)
(pl. 12: 2, 6)

1882. *Truncatulina carinata* Terquem: 94, pl. 10: 1, 2.
1949. *Cibicides carinatus* (Terquem); Le Calvez: 45, pl. 4: 72—74 (fide Ellis and Messina 1960).
1974. *Cibicides carinatus* (Terquem); Szczechura and Pożaryska: 86, pl. 18: 6, 7.

Material. — About a dozen well-preserved specimens.

Remarks. — *Cibicides carinatus* is highly variable in general outline and convexity of both sides (from biconvex to flat-convex and finally concave-convex). Keel is varying from underdeveloped to very wide and serrate.

Occurrence. — Poland: Upper Paleocene of the Carpathians (Babice) and Polish Lowlands, Upper Eocene of Fore-Sudetic Monocline (boreholes Jerzmanowa and Kurów Mały). France (Paris Basin), England, Belgium, Netherlands, USSR (Ukraine): Upper Eocene.

Cibicides lobatulus (Walker et Jacob, 1798)
(pl. 12: 8*a*, *b*; pl. 13: 2*a*, *b*)

1798. *Nautilus lobatulus* Walker and Jacob: 642, pl. 14: 36.
1970. *Cibicides* (*Dyocibicides*) *lobatulus* (Walker and Jacob); Kiesel: 308, pl. 20: 10*a*, *b*, 11.

Material. — Some tens of well-preserved specimens.

Remarks. — The specimens shown in pl. 12, fig. 8*a*, *b*, resemble representatives of the genus *Dyocibicides* in arrangement of chambers. They are generally similar to the holotype as shown in its rather sketchy drawing. High variability of this species has been reported from several areas of its occurrence. Forms assigned to it are varying from flat and uncoiling to thick and more tightly coiled. Kiesel (1970) emphasized that in the GDR this species appears limited to the so-called Calau facies, being completely unknown from the Boreal facies (so-called Eocene 5). Taking this into account, she followed Nyholm (1971) in interpreting the species as related to shallow-and fairly warm-water environment.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (all the studied borehole columns). GDR, FRG, Belgium, Netherlands, France, Italy, England, USSR and USA: Eocene-Miocene, Poland, Austria, Nigeria: Miocene. It is known to occur at present in the North Sea, Atlantic and other places. Cosmopolitan form.

Cibicides omphalius (Grzybowski, 1895)
(pl. 13: 8, 9, 10)

1895. *Truncatulina omphalia* Grzybowski: 201, pl. 3: 14*a*—*c*.
1977. *Cibicides omphalius* (Grzybowski); Pożaryska and Odrzywolska-Bieńkowa: 62, pl. 5: 1a—c.

Material. — Several well-preserved specimens.

Remarks. — Our specimens resemble the figured holotype in outline, highly porous test and irregular, sharp peripheral margin rimmed with serrate keel.

Occurrence. — Poland: Upper Eocene of the Carpathians (Dukla region) and Kujawy region (borehole Izbica). In Poland, distribution of this species is limited to the zone of influences of the Mediterranean province.

Cibicides reussi (ten Dam et Reinhold, 1942)
(pl. 13: 5)

1941. *Cibicides reussi* ten Dam and Reinhold; 100, pl. 8: 4*a*—*c*.
1978. *Cibicides reussi* ten Dam and Reinhold; Odrzywolska-Bieńkowa, Pożaryska and Martini: 275, pl. 12: 5*a*—*c*, 6*a*—*c*.

Material. — Several well-preserved specimens.

Remarks. — Our specimens closely resemble the holotype.

Occurrence. — Poland: Upper Eocene of Kujawy region (borehole Izbica) and Lower Oligocene (Rupelian) of NW Poland (borehole Szczecin). GDR, FRG, Netherlands: Rupelian.

Cibicides sulzensis (Hermann, 1917)
(pl. 13: 3*a*, *b*)

1917. *Discorbina sulzensis* Hermann: 290, pl. 3: 26.
1970. *Cibicides sulzensis* (Hermann); Kiesel: 312, pl. 19: 7—10.

Material. — About a dozen well-preserved specimens.

Remarks. — Our specimens well agree with the figure of holotype, except for more triangular outline of apertural chamber. Specimens from the Oligocene of the Kujawy region are characterized by convex dorsal side, whereas all the remaining ones are flat-convex.

Occurrence. — Poland: Upper Eocene of Mazowsze region (borehole Łanięta) and Kujawy (Izbica borehole). GDR, Netherlands and Belgium: Upper Eocene and Rupelian. France: Oligocene. England: Bartonian. USSR: Oligocene of Ukraine and Pericaspian Depression. USA: Eocene of Eastern Regions.

Cibicides tenellus (Reuss, 1864)
(pl. 14: 9; pl. 13: 1*a*—*c*, 12*a*—*c*, 13*a*—*c*, 14*a*, *b*)

1864. *Truncatulina tenella* Reuss: 477, pl. 5: 6.
1958. *Cibicides tenellus* (Reuss); Batjes: 151, pl. 9: 3, 4.
1965. *Cibicides tenellus tenellus* (Reuss); Grossheide and Trunko: 149, pl. 16: 9*a*, *b*, 10.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens well agree with the figure of holotype, especially in characteristic tubercle at ventral size and completely flat dorsal side.

Occurrence. — Poland: Lower and Upper Oligocene of Fore-Sudetic Monocline (boreholes Kurów Mały and Miechów), Mazowsze (borehole Łanięta) and Kujawy (borehole Izbica) and Polish Carpathians. GDR, FRG and Belgium: Lower and Upper Oligocene. Italy: Priabonian.

Cibicides ungerianus (d'Orbigny, 1846)
(pl. 12: 11)

1846. *Rotalina ungeriana* d'Orbigny: 157, pl. 8: 16—18.
1958. *Cibicides ungerianus* (d'Orbigny); Batjes: 152, pl. 9: 6.
1978. *Cibicides ungerianus* (d'Orbigny); Odrzywolska-Bieńkowa, Pożaryska and Martini: 275, pl. 12: 7*a*—*c*.

Material. — About 20 well-preserved specimens.

Remarks. — Our specimens fully agree with the d'Orbigny (1846) drawing. The species is characterized by high variability, especially in differences in granulation at dorsal side of test.

Cibicides verrucosus Finlay (1940), described from the Lower Oligocene of New Zealand, is presumably a junior synonym of *C. ungerianus* (d'Orbigny) as there seem to be no important differences between the two taxa.

Occurrence. — Poland: Lower Oligocene (Rupelian) of Fore-Sudetic Monocline (boreholes Kurów Mały and Jerzmanowa), Wielkopolska (borehole Gorzów Wielkopolski) and NW Poland (borehole Szczecin), Miocene of Central Paratethys (foreland of the Carpathians and margin of the Holy Cross Mts.). GDR, FRG, Belgium, Netherlands, Hungary, USSR (Ukraine) and USA: Oligocene-Miocene. Nigeria: Upper Eocene.

Cibicides ypresiensis ten Dam, 1947
(pl. 12: 12; pl. 13: 6, 7, 11)

1947. *Cibicides ypresiensis* ten Dam; ten Dam: 136, pl. 6: 2.

Material. — A few specimens, usually broken off near aperture.

Remarks. — Our specimens agree with the figure of holotype. They differ from the French ones figured by Le Calvez (1970) in being more elongate and deeper incised sutures between chambers and, therefore, more lobe-like peripheral margin, whereas the type of aperture is the same. The whole test (including apertural surface) in our specimens displays pores varying in size, whereas the French specimens do not show any pores.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały). France (Paris Basin): Lower and Upper Eocene. Netherlands: Eocene.

Family **Planorbulinidae** Schwager, 1877
Genus *Planorbulina* d'Orbigny, 1826
?*Planorbulina* sp.
(pl. 11: 15)

Material. — One well-preserved specimen.

Remarks. — Our specimen resembles that described by Roemer (1838) but the figure of the latter is too sketchy for any identification with certainity.

Occurrence. — Poland: Upper Eocene of Kujawy (borehole Izbica). Distribution of that species will probably appear limited to the zone of influences of the Mediterranean province.

Family **Nonionidae** Schultze, 1854
Genus *Nonion* de Montfort, 1808
Nonion graniferum (Terquem, 1882)
(pl. 9: 14, 15)

1882. *Nonionina granifera* Terquem: 42, figs. 8, 9.
1968. *Nonion graniferum* (Terquem); Pożaryska and Szczechura: 81, text-fig. 19, pl. 9: 10—12.

Material. — Numerous well-preserved specimens.

Remarks. — Our specimens differ from the holotype figured by Terquem (1882) in granulation, which enters so deep into the area of sutures that some kind of star originates around umbilical depression. High variability in this species, connected with differences in depth to which granulation enters intra-chamber sutures, was discussed and illustrated by Pożaryska and Szczechura (1968).

Occurrence. — Poland: Lower Paleocene-Upper Eocene of Polish Lowlands, Upper Eocene of Fore-Sudetic Monocline (borehole Kurów Mały) and Kujawy (borehole Augustynowo). Sweden and Denmark: Paleocene. GDR, FRG, Belgium, France and England: Upper Eocene. France: Oligocene of Paris Basin.

Genus *Florilus* de Montfort, 1808
Florilus winnianus (Howe, 1939)
(pl. 9: 12)

1939. *Nonionella winniana* Howe: 60, pl. 7: 26, 27.
1977. *Florilus winnianus* (Howe); Pożaryska: 42, pl. 8: 5, 6.

Material. — About a dozen well-preserved specimens.

Remarks. — The species is characterized by high variability, especially in small projections (papillae) well developed or missing in umbilical depression.

Occurrence. — Poland: Upper Eocene of Kujawy (borehole Izbica) and Siemień (eastern Poland). Species common in the Upper Eocene of Europe and N America.

Genus *Pullenia* Parker et Jones, 1862
Pullenia bulloides (d'Orbigny, 1826)
(pl. 14: 6)

1826. *Nonionella bulloides* d'Orbigny: 107, pl. 5: 9, 10.
1975. *Pullenia bulloides* (d'Orbigny); Samuel: 145, pl. 78: 5*a*, *b*.

Material. — About a dozen well-preserved specimens.

Remarks. — Our specimens are very similar to the holotype in general appearance, except for slightly more bent sutures.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów), Miocene of Central Paratethys. Belgium, France, USSR (Ukraine); Upper Eocene, Austria, Japan: Miocene.

Family **Anomalinidae** Cushman, 1927
Genus *Anomalinoides* Brotzen, 1942
Anomalinoides granosus (Hantken, 1875)
(pl. 14: 3)

1875. *Truncatulina granosa* Hantken: 224, pl. 10: 2*a*, *c*.
1930. *Anomalina dorri* Cole var. *aragonensis* Nuttall: 291, pl. 24: 18.
1941. *Cibicides granosus* (Hantken): van Bellen: 1002, fig. 29.
1977. *Anomalinoides granosus* (Hantken); Pożaryska: 43, pl. 7: 4*a*, *c*, pl. 11: 5 (here synonymy).

Material. — Several tens of well-preserved specimens.

Remarks. — Our specimens are very close to the holotype. For revision of this species and its comparison with similar ones, *Anomalinoides grosserugosa* (Gümbel), *A. danica* (Brotzen) and *A. rubiginosa* Cushman see Hagn and Ohmert (1971).

Occurrence. — Poland: Upper Eocene of the whole Polish Lowlands. Netherlands, Belgium, France, FRG, GDR, Hungary, Yygoslavia (Dalmatia), USSR (Ukraine, Byelorussia, Aral Sea area, Tadzhik SSR, N Caucasus) and Mexico: Upper Eocene.

Genus *Heterolepa* Franzenau, 1884
Heterolepa perlucida (Nuttall, 1932)
(pl. 14: 4)

1932. *Cibicides perlucida* Nuttall: 33, pl. 8: 10—12.
1977. *Heterolepa perlucida* (Nuttall); Pożaryska and Odrzywolska-Bieńkowa: 62, pl. 1: 9*a*, *b*.

Material. — Some tens of well-preserved specimens.

Remarks. — Our specimens fully agree with the figure of holotype, especially in development of encrustations on inter-chamber sutures on both dorsal and ventral sides and very well developed coarse pores.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (borehole Miechów) and northern Poland. USSR (Ukraine), France (Aquitanian Basin), Mexico: Lower Oligocene.

Genus *Karreria* Rzehak, 1881
Karreria fallax Rzehak, 1891
(pl. 14: 1*a*—*c*; pl. 11; 12; pl. 14: 11)

1891. *Karreria fallax* Rzehak: 4, pl. 7: 7, 8.
1970. *Karreria fallax* Rzehak; Kiesel: 315, pl. 19: 3 (here synonymy).

Material. — Single well-preserved specimens.

Remarks. — Our specimens agree with the figure of holotype. In the studied assemblage, this species is of relict character as up to the present it has been known from the uppermost Cretaceous and Paleogene, where it is very common and highly variable.

Occurrence. — Poland: Upper Maastrichtian and Lower Paleocene of Polish Lowlands, Upper Eocene of Mazowsze (borehole Łanięta) and Kujawy (borehole Izbica). Southern Scandinavia (Denmark and Sweden): Paleocene. Austria: Danian (*recte* Montian). N Europe and USSR: Upper Maastrichtian. Italy: Priabonian.

Genus *Melonis* de Montfort, 1808
Melonia affine (Reuss, 1851)
(pl. 14: 7, 8)

1851. *Nonionina affine* Reuss: 72, pl. 5: 22.
1939. *Nonion affine* (Reuss); Cushman: 9, pl. 2: 13.
1970. *Melonis affine* (Reuss); Kiesel: 283, pl. 15: 7.
1978. *Melonia affine* (Reuss); Odrzywolska-Bieńkowa: Pożaryska and Martini: 278, pl. 14: 1, 2.

Material. — Several hundreds of well-preserved specimens.

Remarks. — This species was recently discussed in detail by Odrzywolska-Bieńkowa, Pożaryska and Martini (1978).

Occurrence: — Poland: Upper Eocene of Fore-Sudetic Monocline and Lower Oligocene (Rupelian) of northern Poland. GDR, FRG, Belgium, Netherlands, France, England, USSR (Ukraine and Azerbaidzhan): Upper Eocene-Lower Oligocene. USA: Upper Eocene.

Family **Robertininidae** Reuss, 1850
Genus *Robertina* d'Orbigny, 1846
Robertina germanica Cushman et Parker, 1938
(pl. 12: 9)

1938. *Robertina germanica* Cushman et Parker: 73, pl. 13: 2.

Material. — Single well-preserved specimens.

Remarks. — Our specimens do not differ from the figure of holotype. The species is most close to *Robertina ovigera* Cushman and Parker (1936), differing in the type of aperture, more oblique sutures, more massive and shorter test, rather flat apertural surface and more numerous chambers in the last whorl.

Occurrence. — Poland: Upper Eocene of Fore-Sudetic Monocline (boreholes Miechów and Głobice). Belgium: Upper Eocene. England: Bartonian. GDR, FRG: Upper Eocene.

REFERENCES

ANDREAE, A. 1896. Die Foraminiferen des Mitteloligozäns der Umgegend von Lobsann und Pechelbronn im Unter-Elssas und das Resultat der neueren Bohrungen in dortiger Gegend. — *Mitt. geol. Landesanst. Els. Lothr.*, **4**, 287—303.

BANDY, O. L. 1949. Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke County. — *Bull. Amer. Paleont.*, **32**, 1—207.

BATJES, D. A. J. 1958. Foraminifera of the Oligocene of Belgium. — *Mém. I. R. Sci. Nat. Belgique*, **143**, 1—188.

BELLEN, R. C. van. 1946. Foraminifera from the Middle Eocene in the Southern Part of the Nederlands Province of Limburg. — *Med. Geol. Stcht.*, ser C-V, **4**, 1—144.

BERMUDEZ, P. J. 1937. Estudio micropaleontologico de dos formaciones Eocenicas de las cercanias de la Habana, Cuba. — *Mem. Soc. Cub. Hist. Nat.*, **11**, 153—180.

BETTENSTAEDT, F. 1949. Paleogeographie des Nordwestdeutschen Tertiär mit besonderer Berücksichtigung der Mikropaläontologie. Erdöl und Tektonik in Nordwestdeutschland, Amt Bodenforsch. 143—172, Hannover-Celle.

BLAICHER, J. 1961. Poziom wapiennej mikrofauny w górnym eocenie serii magurskiej. — *Biul. Inst. Geol.*, **166**, 5—57.

BLOW, W. H. 1969. Late middle Eocene to Recent planktonic foraminiferal biostratigraphy. Intern. Conf. Planktonic Microfossils, Geneva, Proc., **1**, 199—422.

BORNEMAN, J. G. 1855. Die mikroskopische Fauna des Septarienthones von Hermsdorf bei Berlin. — *Ztschr. Deutsch. Geol. Ges.*, **7**, 307—371.

— 1860. Bemerkungen über einige Foraminiferen aus den Tertiärbildungen der Umgegend von Magdeburg. — *Ibidem*, **12**, 156—160.

BRADY, H. B. 1884. Report on the Foraminifera dredged by H. M. S. Challenger during the years 1873-76. — *Rep. Chall. Exped. 1873-67*, **9**, 1—814.

BUCHARDT, B. 1970. Oxygen isotope palaeotemperatures from the Danish Tertiary, in IGCP project 124, Report No. 2, 1—9.

CAVELIER, C. 1979. La limite éocene-oligocene en Europe occidentale. — *Sci. Géol. Mém.*, **54**, 1—280.

[CHALILOV, D. M.] ХАЛИЛОВ, Д. М. 1948. Стратиграфия верхнемеловых и палеогеновых отложений Малого Балхана по фауне фораминифер. Азнефтьиздат, 181—218. Баку.

CHAPMAN, F. 1926. The Cretaceous and Tertiary Foraminifera of New Zealand, with an appendix of the Ostracoda. — *Bull. Geol. Surv. Dep. Mines.*, **11**, 1—119.

CIMASZEWSKI, L. 1964. Uwagi o utworach trzeciorzędu Polski Zachodniej. — *Geofiz. Geol. Naft.*, **6—7**, 171—175.

CIUK, E. 1967. New localities of the Upper Eocene and Lower Oligocene from the areas of Głobice, Szaszorowice and Miechów, SW part of Fore-Sudetic monocline. — *Przegl. Geol.*, **1**, 1—6.

CUSHMAN, J. A. 1913. A monograph of the foraminifera of the North Pacific Ocean; Part III-Lagenidae. — *Bull. US. Nat. Mus.*, **71**, 1—119.

— 1922. The foraminifera of the Mint Spring calcareous marl member of the Marianna limestone. — *US. Geol. Surv. Prof. Pap. D.C.* **129-F**, 123—152.

— 1925. An Eocene fauna from the Montezuma River, Mexico. — *Bull. Amer. Assoc. Petr. Geol.*, **9**, 298—303.

— 1926. Some new Foraminifera from the upper Eocene of the southeastern Coastal Plain of the United States. — *Contr. Cushm. Lab. Foram. Res.*, **2**, 29—36.

— 1928. Foraminifères du Stampien du Bassin de Paris. — *Bull. Soc. Sci. Seine-et-Oise*, ser. 2, **9**, 47—57.

— 1931. Three new Upper Eocene foraminifera. — *Contr. Cush. Lab. Foram.*, **7**, 58—59.

— 1933. New foraminifera from the Upper Jackson Eocene of the southeastern Coastal Plain region of the United States. — *Ibidem*, **9**, 1—21.

— 1935. Upper Eocene foraminifera of the southeastern United States. — *US. Geol. Surv. Prof. Pap. D.C.*, **181**, 1—88.

— 1936. New genera and species of the families Verneuilinidae and Valvulinidae and the subfamily Virgulininae. — *Contr. Cushm. Lab. Foram. Res.*, **6**, 1—78.

— 1939. Paleoecology as shown by the foraminifera. — *Ibidem*, **2**, 21—23.

— and APPLIN, E. R. 1926. Texas Jackson foraminifera. — *Bull. Amer. Assoc. Petr. Geol.*, **10**, 154—189.

— and EDWARDS, P. G. 1938. Notes on the Oligocene species of *Uvigerina* and *Angulogerina*. — *Contr. Cush. Lab. Foram. Res.*, **14**, 74—89.

— and ELLISSOR, A. C. 1944. Three new species of *Spiroloculina* from the Middle Oligocene of Texas. — *Ibidem*, **19**, 550—551.

— and JARVIS, P. W. 1929. New Foraminifera from Trinidad. — *Ibidem*, **4**, 85—103.
— and OZAWA, Y. 1930. A monograph of the foraminiferal family Polymorphinidae recent and fossil. — *US. Nat. Mus. Proc.*, **77**, 1—85.
— and PARKER, F. L. 1936. Some American Eocene Buliminidae. — *Contr. Cush. Lab. Foram. Res.*, **12**, 39—45.
— and RENZ, H. H. 1942. Eocene Midway Foraminifera from Soldado Rock, Trinidad. — *Ibidem*, **18**, 23—46.
— and TODD, R. 1942. The Foraminifera of the type locality of the Naheola Formation. — *Ibidem*, **18**, 23—46.
— and — 1943. The genus *Pullenia* and its species. — *Ibidem*, **19**, 1, 1—23.
— and — 1946. A foraminiferas fauna from the Paleocene of Arkansas. — *Ibidem*, **22**, 45—65.
DAM, A., ten. 1947. Structure of *Asterigerina* and a new species. — *J. Paleont.*, **21**, 584—586.
— and REINHOLD, TH. 1941. Nonionidae as Tertiary index-foraminifera. — *Verh. Geol. Mijnb. Genoot. Nederl. Kolon.*, **3**, 209—212.
[DIDKOVSKIJ, W. J., SATANOVSKAJA, Z. N.] ДИДКОВСКИЙ, В. Я., САТАНОВСКАЯ, З. Н. 1970. Палеонтологический справочник, 4. Фораминиферы миоцена Украины. Изд. Наукова Думка, 1—167. Киев.
DOREEN, J. M. 1948. A foraminiferas fauna from the Kaiatan stage (Upper Eocene) of New Zeland. — *J. Paleont.*, **22**, 25—320.
DYJOR, S. 1970. Oligocen okolic Jerzmanowej. — *Przegl. Geol.*, **12**, 557.
— 1974. Oligocen niżowej części Dolnego Śląska i Ziemi Lubuskiej. — *Biul. I. Geol.*, **281**, 119—137.
— 1978. Wykształcenie i stratygrafia utworów trzeciorzędowych na obszarze Legnicko-Głogowskiego Okręgu Miedziowego. Przew. 50 Zjazdu PTG (Zielona Góra). 210—214. Wydawnictwa Geologiczne, Warszawa.
EICHWALD, E. 1853. Lethaea Rossica ou Paléontologie de la Russe. **3**, 1—153.
ELLIS, B. F. and MESSINA, A. 1942, 1957, 1960, 1973. Catalogue of Foraminifera. — *Amer. Mus. Nat. Hist. spec. publ.* (cum suppl.).
FRANKE, A. 1912. Die Foraminiferen der Tiefbohrung Th. XVI auf Blatt Allermöhe bei Hamburg. — *Hamburg. Wiss. Anst. Jb.*, **29**, 29—31.
GALLOWAY, J. J. and HEMINWAY, C. E. 1941. The Tertiary Foraminifera of Porto Rico. — *N.Y. Acad. Sci. Scientific Survey of Porto Rico and Virgin Island*, **3**, 275—491.
GRAMANN, F. 1964. Die Arten der Foraminiferengattung *Asterigerina* d'Orbigny im Tertiär NW Deutschland. — *Paläont. Ztschr.*, **38**, 207—222.
GRZYBOWSKI, J. 1895. Die Mikrofauna der Karpathen bildungen. Die Foraminiferen der rothen Thone von Wadowice. — *Bull. Acad. Sci.*, **30**, ser. 2, 10, 281—308.
GÜMBEL, G. 1840. Beiträge zur Foraminiferenfauna der nordalpinen Eozängebilde. — *Abh. Bay. Akad. Wiss.*, Cl. II, **10**, 2, 581—730.
HAACK, W. 1939. Der Untergrund der Lüneburger Heide inter Berücksichtigung der neuesten Bohrungen. — *Abh. Nat. Ver. B.*, **31**, 377.
HAGN, H. and OHMERT, W. 1971. Révision de *"Truncatulina" grosserugosa* Gümbel (Foraminifères) de l'Eocène des Préalpes bavaroises. *Rev. Microp.*, **14**, 5, 131—144.
HALKYARD, E. 1918. The fossil foraminifera of the Blue Marl of the Cote des Basques, Biarritz. — *Manch. Lit. Phil. Soc. Mem. Proc.*, **62**, 1—145.
HANNA, G. D. and HANNA, M. A. 1924. Foraminifera from the Eocene of Cowlitz River, Levis County, Washington Univ. — *Publ. Geol.*, **1**, 55—64.

HANTKEN, M. 1875. — Die Fauna der *Clavulina*-Szaboi Schichten. I. Foraminiferen. — *Mitt. Ung. Geol. Anst.*, **4**, 1—94.

HERMANN, A. 1917. Vierter Beitrag zur Kenntniss des Vorkommens von Foraminiferen im Tertiär des Unter-Elsass. — *Mitt. Geol. Landesanst. Els. Loth.*, **10**, 257—299.

HERON-ALLEN, E. and EARLAND, A. 1909. On the Recent and fossil Foraminifera of the shore-sands of Selsey Bill, Sussex. — *Roy. Micr. Soc. London. J.*, 422—446.

HILTERMANN, H. 1941. Ein litorales Paläozän in Norddeutschland. — *Ztschr. Deutsch. Geol. Ges. B.* **93**, 259—266.

HOWE, H. V. 1939. Louisiana Cook Mountains Eocene Foraminifera. — *Bull. Louisiana Geol. Surv. Geol.*, **14**, 11—122.

JARZEVA, M. W., LOTSCH, D. and NEMKOV, G. I. 1968. Zur Nummulitenfauna des mitleren und höheren Eozäns der Deutschen Demokratischen Republik. — *Geologie*, **17**, 418—459.

KAASSCHIETER, J. P. H. 1961. Foraminifera of the Eocene of Belgium. — *Mém. Inst. Sci. Nat. Belgique*, **147**, 1—271.

[KAPTARENKO-TSCHERNOUSOVA, O. K.] КАПТАРЕНКО-ЧЕРНОУСОВА, О. К. 1951. Киевский ярус и элементы его палеогеографии, 7-178. Киев.

— 1956. Фораминиферы кыивского ярусу днипровско-донецкой западины на пивнично-захидных окраинах донецкого басейну. — *Тр. Инст. Геол. Наук, Сер. Страт. Палеонт.*, **8**, 9—164.

KARRER, F. 1867. Zur Foraminiferenfauna in Oesterreich. — *K. Akad. Wiss. Wien, Math. Naturw. Cl.Sitzebrg*, **55**, 331—368.

KIESEL, Y. 1962. Die oligozänen Foraminiferen der Tiefbohrung Dobbertin (Mecklemburg). Ein Beitrag zur Feinstratigraphie des mitteldeutscher. — *Rupels. Freiberg. Forsch. H.C.*, **122**, 1—123.

— 1970. Die Foraminiferenfauna des Paläozänen und Eozänen Schichtenfolge der Deutschen Demokratischen Republik. — *Pal. Abh., A*, **4**, 2, 163—394.

— and LOTSCH, D. 1963. Zur Mikrofauna des südbrandenburgischen Obereozäns. — *Beih. Geologie*, **38**, 1—71.

KOENEN, A., von. 1867. Über die Parallelisierung des norddeutschen englischen und französischen Oligozäns. — *Ztschr. Deutsch. Geol. Ges.*, **19**, 145—158.

[KRAEVA, E. JA, ZERNECKIJ, B. F.] КРАЕВА, Е. Я., ЗЕРНЕЦКИЙ, Б. Ф. 1969. Палеонтологический справочник, 3. Фораминиферы палеогена Украины. — Изд. Наукова Думка, 1—199. Киев.

LAMARCK, J. B. 1804. Suite des mémoires sur les fossiles des environs de Paris. — *Ann. Mus. Nat. Hist.*, **5**, 177—188.

LE CALVEZ, Y. 1970. Contribution à l'étude des Foraminifères du Bassin de Paris. — *Cahiers de Paléont. CNRS.* 1—326.

LOEBLICH, A. R. and TAPPAN, H. 1964. *In*: R. C. Moore (ed.), Treatise on Invertebrate Paleontology. C. Protista 2, 2, 1—900. Geological Society of America and Kansas University Press, Lawrence.

LOTSCH, D. 1967. Stratigraphisches Schema für das Tertiär der DDR. — *Abh. zentr. geol. Inst.*, **12**, 1—70.

ŁUCZKOWSKA, E. 1974. Miliolidae (Foraminiferida) from the Miocene of Poland, Part II. Biostratigraphy, palaeocology and systematics. — *Acta Palaeont. Polonica*, **19**, 1, 3—176.

MARTINI, E. 1981. Upper Eocene and Lower Oligocene Calcareous Nannoplankton from the Fore-Sudetic Monocline. — *Bull. Acad. Pol. Sci.*, **29**, 1, 45—50.

MATL, K. and ŚMIGIELSKA, T. 1977. Morskie osady paleogenu między Głogowem a Sieroszowicami. — *Roczn. Pol. Tow. Geol.*, **47**, 1, 11—22.

MURRAY, J. W. 1973. Distribution and ecology of living benthic foraminiferids. University of Bristol. 1—274. Bristol.

[MOROZOVA, W. G.] МОРОЗОВА, В. Г. 1949. Стратиграфическое распределение фораминифер в палеогене Туркмении. — *Бюл. Моск. общест. исп. прир., отд. геол.*, **24**, 83—100.

NUTTALL, W. L. F. 1928. Notes on the Tertiary foraminifera of southern Mexico. — *J. Paleont.*, **2**, 372—377.

— 1930. Eocene Foraminifera from Mexico. — *Ibidem*, **4**, 271—293.

— 1932. Lower Oligocene Foraminifera from Mexico. — *Ibidem*, **6**, 3—5.

— 1935. Upper Eocene Foraminifera from Venezuela. — *Ibidem*, **9**, 2, 121—131.

NYHOLM, K. G. 1961. Morphogenesis and biology of the foraminifer *Cibicides lobatulus*. — *Zool. Bidr. Uppsala*, **33**, 157—196.

ODRZYWOLSKA-BIEŃKOWA, E. 1966. O mikrofaunistycznej granicy eocenu i oligocenu na Kujawach — *Kwart. Geol.*, **10**, 1072—1078.

— 1972. Wstępne wyniki badań mikrofaunistycznych starszego trzeciorzędu rejonu Zatoki Puckiej. — *Przegl. Geol.*, **12**, 570—573.

— 1973. Mikrofauna starszego trzeciorzędu w rejonie Sieroszowic. — *Ibidem*, **7**, 377.

— 1975. Osady paleogenu w wierceniach Miechów (monoklina przedsudecka) w w świetle badań mikropaleontologicznych. — *Ibidem*, **8**, 407—408.

OLEMPSKA, E. 1973. Górnoeoceńskie numulity z wiercenia Damasławek w północno-zachodniej Polsce (Upper Eocene nummulites from the Damasławek borehole NW Poland—English summary). — *Acta Palaeont. Polonica*, **18**, 3, 211—218.

D'ORBIGNY, A. 1826. Tableau méthodique de la classe des Céphalopodes. — *Ann. Sci. Nat. Paris.*, **7**, 96—314.

— 1846. Foraminifères fossiles du bassin tertiaire de Vienne. Gide et Comp. 1—103.

— 1850. Prodrome de paléontologie universelle des animaux mollusques et rayonnés, V. Masson, 1, 1—392.

POŻARYSKA, K. 1957. Lagenidae du Crétacé Supèrieur de Pologne. — *Palaeont. Polonica*, **9**, 1—190.

— 1976. Struktura i ewolucja polskiej części północno-zachodniego trzeciorzędowego basenu europejskiego. — *Przegl. Geol.*, **7**, 400—403.

— 1977. Upper Eocene Foraminifera of East Poland and their paleogeographical meaning. — *Acta Palaeont. Polonica*, **22**, 1, 3—54.

— and ODRZYWOLSKA-BIEŃKOWA, E. 1977. O górnym eocenie w Polsce. — *Kwart. Geol.*, **21**, 57—72.

— and — 1978. Wstępne wyniki badań stratygraficznych osadów eoceńskich i oligoceńskich w rejonie Głogowa. Przew. 50 Zjazdu PTG. Zielona Góra, 214—219. Wydawnictwa Geologiczne, Warszawa.

— and — 1982. Wpływ tektoniki na sedymentację w trzeciorzędzie na Niżu Polski. — *Przegl. Geol.*, **11**, 589—591.

— and SZCZECHURA, J. 1968. Foraminifera from the Paleocene of Poland, their ecological and biostratigraphical meaning. — *Palaeont. Polonica*, **20**, 3—107.

POŻARYSKI, W. 1954. Marine sediments of younger Oligocene in Kujawy (Middle Poland). — *Biul. I.G.*, **87**, 59—72.

REUSS, A. E. 1850. Neues Foraminiferen aus den Schichtendes österreichischen Tertiärbeckens. — *Naturw. Abh. Wien*, **1**, 365—390.

— 1851. Die Fossilen Foraminiferen, Bryozoen und Anthozoen von Oberburg in Steiermark. Ein Beitrag zur Fauna der oberen Nummulitenschichten. — *Sitzb. Akad. Wiss.*, **48**, 49—92.

— 1856. Beiträge zur Charakteristik der Tertiärschichten des Nordlichen und mittleren Deutschlands. — *Sitzber. K. Akad. Wiss. Math. Naturw. Cl.*, **18**, 197—273.

— 1864. Die Fossilen Foraminiferen, Anthozoen und Bryozoen von Oberburg in Steiermark. — *Denkschr. K. Akad. Wiss. Wien. Math.-Naturw. Cl.*, **23**, 1—39.

— 1865. Zur Fauna des deutschen Oberoligozäns. — *Sitzber. K. Akad. Wiss. Math.-Naturw. Cl.* **50**, 435—482.

ROEMER, F. A. 1838. Die Cephalopoden des Nordwestdeutschen tertiären Meeressandes. — *N. Jb. Miner.*, 381—394.

RZEHAK, A. 1886. Die Foraminiferenfauna der Neogenformation der Umgebung von Mähr. — *Ostrau. Verh. Naturf. Ver. Brünn*, **24**, 77—126.

— 1891. Die Foraminiferenfauna der alttertiären Ablagerungen von Bruderndorf in Niederösterreich. — *Ann. Naturh. Hofmus.*, **10**, 1—12.

[SAMOJLOVA, R. B.] САМОЙЛОВА, Р. Б. 1947. Стратиграфическое распределение фораминифер в верхнепалеогеновых отложениях р. Альмы (Крым). — *Бюл. Моск. общест, испыт. прир.*, **21**, 2, 77—101.

SAMUEL, O. 1975. Foraminifera of Upper Priabonian from Lubietowa (Slovakia), Zapadne Karpaty. Seria paleontologia, **1**, 1—291, Bratislava.

SCHMIDT, H. 1935. Die bionomische Einteilung der fossilen Meeresböden. — *Fortschr. Geol. Paläont.*, **12**, 38, 1—46.

SCHUH, F. 1950. Beitrag zur Alttertiärstratigraphie Nordwestdeutschlands, ausgehend von der Untersuchung einer fast geschlossenen Bohrkernfolge von über 300m aus dem nordwestlichen Mecklemburg. — *Geol. Jb.*, **66**, 313—374.

SCHWAGER, G. 1883. Die Foraminiferen aus dem Eozänablagerungen der libyschen Wüste und Aegyptens. — *Palaeontographica*, **30**, 79—153.

SETIAWAN, R. J. 1983. Foraminifera and microfacies of the type-Priabonian. Thesis. — *Bull. Utrecht Micropaleont.*, **29**, 1—154.

SINDOWSKI, K. H. 1936. Faziesprobleme der Mitteleuropäischen Tertiärmeere. Sediment und Fauna von Septarienton und Stettiner Sand bei Stettin. — *Ztbl. Min., Abt. B*, 1—192.

STACHE, G. 1889. Die Liburnische Stufe und deren Grenz-Horizonte. — *Abh. Geol. Reichanst.*, **13**, 1—170.

— 1912. Über *Rhapydionina* St. und *Rhipydionina* St. — *Jb. Geol. Reichsanst.*, **62**, 659—680.

STAESCHE, K. and HILTERMANN, H. 1940. Mikrofaunen aus dem Tertiär Nordwestdeutschlands. — *Abh. Reichsanst. Bodenf.*, **201**, 1—26.

[SUBBOTINA, N. N.] СУББОТИНА, Н. Н. 1953. Верхнеэоценовые лагениды и булиминиды юга СССР. — *Тр. ВНИГРИ*, н. сер., **69**, 115—255.

SZCZECHURA, J. and POŻARYSKA, K. 1974. Foraminiferida from the Paleocene of Polish Carpathians (Babica Clays). — *Palaeont. Polonica*, **31**, 1—142.

TERQUEM, O. 1882. Les Foraminiferès de l'Eocène des environs de Paris. — *Mém. Soc. Geol. France*, **2**, 1—193.

[TUTKOVSKIJ, P. A.] ТУТКОВСКИЙ, П. А. 1925. Копальни микрофауны Украины их геологична ваха и методы их достижения. I. — *Тр. физ. мат. вид АН УССР*, **1**, **8**, 1—62.

UHLIG, W. 1886. Ueber eine Mikrofauna aus dem Alttertiär der Westgalizischen Karpathen. — *Jb. k. k. Geol. Reichanst. Wien*, **36**, 141—214.

VOIGT, E. 1934. Die Fische aus der mitteleozänen Braunkohle des Geiseltales mit besonderer Berücksichtigung der erhaltenen Weichteile. — *Nova Acta Leopoldina, N.F.*, **2**, 21, 11—17.

WALKER, G. and BOYS, W. 1784. Testacea minuta raroria, nuperrime detecta in arena littoris Sandvicensis a Gul Boys, arm S.A.S. multa addidit, et omnium figuras ope microscopii ampliatas accurate delineavit. Geo. Walker. 1—25.

— and JACOB, E. 1798. Foraminifera. Kanmachers Ed. of Adams E. Essays on the microscope, **2**, 1—712.

WEYL, H. 1936. Faziesprobleme der mitteleuropäischen Tertiär-Meere Nr. 2 Fazies und Fauna im Untermiozän Schleswig-Holstein. — *Ztbl. Min., Abt. B.*, 1—377.

WIRTZ, D. 1939. Das Alttertiär in Schleswig-Holstein. — *N. Jb. f. Min., Abt. B*, **81**, 1—215.

WÓJCIK, K. 1903. Dolno-oligoceńska fauna Kruhela Małego pod Przemyślem (warstwy z *Clavulina szaboi*). Cz. I. Otwornice i mięczaki. — *Rozpr. Akad. Umiej.*, ser. 3, **3**, *B*, 489—569.

EWA ODRZYWOLSKA-BIEŃKOWA I KRYSTYNA POŻARYSKA

PRIABOŃSKIE OTWORNICE Z NIŻU POLSKIEGO

Streszczenie

Praca zawiera identyfikacje i ilustracje 87 gatunków otwornic (w tym *Vertebralina eocaena* sp. n.) występujących w licznych wierceniach obejmujących osady eocenu w środkowej i południowo-zachodniej części Niżu Polskiego (fig. 1,3; plansze 1—14). Autorki stwierdziły, że mikrofauna z badanego obszaru charakterem różni się od równowiekowej mikrofauny północnej Polski.

Obecność ciepłolubnych otwornic wśród badanej mikrofauny, charakterystyczne dla biofacji priabonu, wskazuje na ich śródziemnomorskie pochodzenie. Migracje gatunków ciepłolubnych z obszarów przyległych do geosynkliny karpackiej daleko na północ mogły być spowodowane pulsacjami tektonicznymi, które były związane z pirenejską fazą orogenezy alpejskiej. Priaboński wiek otwornic potwierdza analiza osadów oparta o kokkolity, która wskazuje na zony NP od 19 do 22.

Autorki przeprowadziły analizę wskaźników paleoekologicznych środowiska w jakim żyły badane otwornice i doszły do wniosku, że zbiornik był płytki, dobrze przewietrzany i ciepły o nieco zredukowanym zasoleniu.

Powiązania badanej mikrofauny z mikrofauną innych obszarów przedstawiono na tabeli rozprzestrzeniania stratygraficznego i geograficznego gatunków (fig. 2).

EXPLANATION OF PLATES 1—14

Plate 1

1. *Spiroplectammina carinata* (d'Orbigny): Miechów. Muz. IG F/1.
2. *Gaudryina siphonella siphonella* Reuss: Miechów. Muz. IG F/2.
3. *Spiroloculina alabastra* Cushman et Ellisor: Kurów Mały. Muz. IG F/3.
4. *Rhapydionina liburnica* Stache: Miechów. Muz. IG F/4.
5, 8. *Quinqueloculina imperialis* Hanna et Hanna: Miechów. Muz. IG F/5, 6.
6. *Clavulina anglica* Cushman: Miechów. Muz. IG F/7.
7. *Spiroplectammina carinata deperdita* (d'Orbigny): Kurów Mały. Muz. IG F/8.
9. *Vertebralina terquemi* (Cushman): Kurów Mały. Muz. IG F/9.
10, 15, 22. *Spiroloculina communis* Cushman et Todd: Miechów. Muz. IG F/10—12.
11. *Spiroloculina grateloupi* d'Orbigny: Kurów Mały. Muz. IG F/13.
12. *Quinqueloculina costata* Karrer: Kurów Mały. Muz. IG F/14.
13. *Vertebralina eocaena* sp.n.: Augustynowo. Muz. IG F/15.
14. *Vertebralina contracta* Terquem: Kurów Mały. Muz. IG F/16.
16, 17. *Spiroloculina communis polita* Cushman et Todd: Miechów. Muz. IG F/17, 18.
18, 19. *Quinqueloculina ludwigi* Reuss: Kurów Mały. Muz. IG F/19, 20.
20, 24, 25. *Quinqueloculina juleana* d'Orbigny: Kurów Mały. Muz. IG F/21—23.
21, 23, 26. *Quinqueloculina seminula* (Linné): Kurów Mały. Muz. IG F/24—26.

All from the Fore-Sudetic Monocline with the exception of 13 from Kujawy region
approx. ×70

Plate 2

1. *Pyrgo appendiculata* (Eichwald): Kurów Mały. Muz. IG F/27.
2, 3, 7. *Pyrgo bulloides* (d'Orbigny): Kurów Mały. Muz. IG F/28—30.
4. *Miliola saxorum* (Lamarck): Kurów Mały. Muz. IG F/31.
5, 6. *Quinqueloculina impressa* Reuss: Kurów Mały. Muz. IG F/32, 33.
8. *Triloculina angularis* d'Orbigny: Kurów Mały. Muz. IG F/34.
9. *Dentalina hillaeformis* Galloway and Heminway: Kurów Mały. Muz. IG F/35.
10. *Dentalina semilaevis* Hantken: Kurów Mały. Muz. IG F/36.
11, 12, 16. *Lagena humifera* Bandy: Kurów Mały. Muz. IG F/37—39.
13. *Fissurina marginata* (Walker et Boys): Kurów Mały. Muz. IG F/40.
14. *Lagena hexagona* (Williamson): Miechów. Muz. IG F/41.
15. *Guttulina problema* d'Orbigny: Kurów Mały. Muz. IG F/42.
17. *Guttulina* sp.: Kurów Mały. Muz. IG F/43.

All from Fore-Sudetic Monocline
approx. ×70

Plate 3

1. *Sigmomorphina amygdaloides* (Reuss): Kurów Mały. Muz. IG F/44.
2. *Pyrulina fusiformis* (Roemer): Kurów Mały. Muz. IG F/45.
3. *Guttulina problema* d'Orbigny: Kurów Mały. Muz. IG F/46.
4. *Raphanulina tuberculata* (d'Orbigny): Kurów Mały. Muz. IG F/47.
5. *Reussella* sp.: Kurów Mały. Muz. IG F/48.
6. *Guttulina caudata* d'Orbigny: Kurów Mały. Muz. IG F/49.
7. *Bolivina nobilis* Hantken: Miechów. Muz. IG F/50.
8. *Bolivina striatellata* Bandy: Kurów Mały. Muz. IG F/51.

9, 10. *Bolivina cookei* Cushman: Kurów Mały. Muz. IG F/52, 53.
11, 15. *Buliminella* cf. *turbinata* (Terquem): Kurów Mały. Muz. IG F/54, 55.
12. *Reussella terquemi* (Cushman): Kurów Mały. Muz. IG F/56.
13, 14. *Reussella byramensis* Cushman: Kurów Mały. Muz. IG F/57, 58.
16. *Uvigerina gallowayi basicordata* Cushman et Renz: Kurów Mały. Muz. IG F/59.
17. *Bifarina selseyensis* (Heron-Allen et Earland): Izbica Kujawska. Muz. IG F/60.
18, 19. *Uvigerina spinicostata* Cushman and Jarvis: Izbica Kujawska. Muz. IG F/61, 62.
20. *Trifarina germanica* Cushman et Edwards: Kurów Mały. Muz. IG F/63.
21. *Uvigerina cocoaensis* Cushman: Kurów Mały. Muz. IG F/64.

Specimens from the Fore-Sudetic Monocline (Kurów Mały) and Kujawy region (Izbica Kujawska)

approx. ×70

Plate 4

1. *Pseudopolymorphina dumblei* (Cushman et Applin): Augustynowo. Muz. IG F/65.
2. *Quinqueloculina imperialis* Hanna et Hanna: *a* dorsal and *b* side views. Augustynowo. Muz. IG F/66.
3. *Nodosaria stipitata* Reuss: Miechów. Muz. IG F/67.
4. *Quinqueloculina impressa* Reuss: *a* dorsal and *b* side views. Łanięta. Muz. IG F/68.
5. *Quinqueloculina ludwigi* Reuss: *a* dorsal, *b* side and *c* ventral views. Łanięta. Muz. IG F/69.
6, 9. *Triloculina gibba* d'Orbigny: *6a* dorsal, and *6b* ventral views, *9a* dorsal and *9b* apertural views. Łanięta. Muz. IG F/70, 71.
7, 8, 10. *Quinqueloculina seminula* (Linné): *7abc*: dorsal, side and ventral views; *8ab*: dorsal and side views. Łanięta. Muz. IG F/72—74.
11. *Quinqueloculina serovae* (Bogdanowicz): Łanięta. Muz. IG F/75.

Specimens from the Fore-Sudetic Monocline (Miechów), Mazowsze (Łanięta) and Kujawy regions (Augustynowo)

approx. ×70

Plate 5

1—6. *Vertebralina eocaena* sp. n.: *1* holotype, Muz. IG F/76, *2—6* paratypes, Muz. IG F/77—81.
1—5: *a* and *b* views of opposite sides, *c* apertural views; *6a* side view, *6b* apertural view.

All from the Kujawy region (Augustynowo)

approx. ×70

Plate 6

1. *Sagrina pulchra* Le Calvez: Izbica Kujawska. Muz. IG F/82.
2, 5, 6, 10, 13, 14. *Discorbis brandenburgensis* (Kiesel): Kurów Mały. Muz. IG F/83—88.
3. *Rosalina globularis* d'Orbigny: Kurów Mały. Muz. IG F/89.
4, 8, 12. *Baggina subconica* (Terquem): Kurów Mały. Muz. IG F/90—92.

7. *Rosalina douvillei* (Cushman): Kurów Mały. Muz. IG F/93.
11. *Neoconorbina obvoluta* (Terquem): Kurów Mały. Muz. IG F/94.
15, 16, 17, 18. *Asterigerina bartoniana* (ten Dam): Kurów Mały. Muz. IG F/95—98.
19, 20. *Asterigerina guerichi* (Franke): Kurów Mały. Muz. IG F/99, 100.
All from the Fore-Sudetic Monocline with the exception of 1 from Kujawy region
approx. ×70

Plate 7

1—16. *Nummulites germanicus* (Bornemann): Jerzmanowa. Muz. IG F/101—116.
All from the Fore-Sudetic Monocline
approx. ×70

Plate 8

1—14. *Nummulites* aff. *stellatus* Roveda: Łanięta. Muz. IG F/117—130.
All from Mazowsze region
approx. ×70

Plate 9

1—6, 10. *Pararotalia spinigera* (Terquem): 10 *abc*: dorsal, ventral and side views. Kurów Mały. Muz. IG F/131—137.
7, 9, 12. *Neoeponides schreibersi* (d'Orbigny): *a* dorsal and *b* ventral views. Miechów. Muz. IG F/138—140.
8. *Pararotalia lithothamnica* (Uhlig): *a* dorsal, *b* ventral and *c* side views. Łanięta. Muz. IG F/141.
11. *Glabratella ubiqua* (Le Calvez): *a* dorsal, *b* ventral and *c* side views. Łanięta. Muz. IG F/142.
13. *Florilus winnianus* (Howe): Kurów Mały. Muz. IG F/143.
14, 15. *Nonion graniferum* (Terquem): Kurów Mały. Muz. IG F/144, 145.
Specimens from the Fore-Sudetic Monocline (Kurów Mały, Miechów) and Kujawy region (Łanięta)
approx. ×70

Plate 10

1, 5. *Pararotalia audouini* (d'Orbigny): Kurów Mały. Muz. IG F/146—147.
2—4, 6—16. *Pararotalia lithothamnica* (Uhlig): Augustynowo (Uhlig). Muz. IG F/151—164.
Specimens from the Kujawy region (Augustynowo) and Fore-Sudetic Monocline (Kurów Mały)
approx. ×70

Plate 11

1. *Bolivina striatellata* Bandy: Muz. IG F/165.
2, 3, 4. *Uvigerina spinicostata* Cushman et Jarvis: Muz. IG F/166—168.
5. *Trifarina germanica* (Cushman et Edwards): Muz. IG F/169.

6. *Bifarina selseyensis* (Heron Allen et Earland): Muz. IG F/170.
7. *Neoconorbina obvoluta* (Terquem): *a* ventral, *b* side and *c* dorsal views. Muz. IG F/171.
8. *Cribrononion latidorsatum* (Reuss): Muz. IG F/172.
9. *Discorbis propinqua* (Terquem): Muz. IG F/173.
10, 11. *Asterigerina bartoniana* (ten Dam): Muz. IG F/174, 175.
12. *Karreria fallax* Rzehak: Muz. IG F/176.
13. *Pararotalia marginata* (d'Orbigny): Muz. IG F/177.
14, 18, 19. *Pararotalia lithothamnica* (Uhlig): Muz. IG F/178—180.
15. *Planorbulina difformis* (Roemer): Muz. IG F/181.
16. *Pararotalia* aff. *pinarensis* (Cushman et Bermudez): Muz. IG F/182.
17. *Pararotalia arcuata* (d'Orbigny): Muz. IG F/183.

All from Izbica Kujawska, Kujawy region
approx. ×70

Plate 12

1. *Globigerina cf. angiporoides* Hornibrook: *a* side and *b* ventral views. Miechów. Muz. IG F/184.
2, 6. *Cibicides carinatus* (Terquem): Miechów. Muz. IG F/185, 186.
3. *Reussella terquemi* Cushman: Augustynowo. Muz. IG F/187.
4. *Cibicides tenellus* (Reuss): Kurów Mały. Muz. IG F/188.
5. *Bolivina microlancetiformis* Subbotina: Augustynowo. Muz. IG F/189.
7. *Reussella sculptilis* (Cushman): *a* and *b* side views. Augustynowo. Muz. IG F/190.
8. *Cibicides lobatulus* (Walker et Jacob): *a* and *b* side views. Miechów. Muz. IG F/191.
9. *Robertina germanica* Cushman et Parker: Miechów. Muz. IG F/192.
10. *Reussella byramensis* Cushman et Todd: Augustynowo. Muz. IG F/193.
11. *Cibicides ungerianus* (d'Orbigny): *a* dorsal and *b* ventral views. Miechów. Muz. IG F/194.
12. *Cibicides ypresiensis* ten Dam: Kurów Mały. Muz. IG F/195.
13. *Vaginulina alazanensis* Nuttall: Miechów. Muz. IG F/196.

Specimens from the Fore-Sudetic Monocline (Kurów Mały, Miechów) and Kujawy region (Augustynowo)
approx. ×70

Plate 13

1, 12—14. *Cibicides tenellus* (Reuss): 1 *a*, *b*: dorsal and side views; 12*a*, *b*, *c*: dorsal, side and ventral views; 13*a*, *b*, *c*: dorsal, side and ventral views; 14 dorsal, side and ventral views. Łanięta. Muz. IG F/197—200.
2. *Cibicides lobatulus* (Walker et Jacob): *a* dorsal and *b* ventral views. Miechów. Muz. IG F/201.
3. *Cibicides sulzensis* Hermann: *a* dorsal and *b* apertural views. Łanięta. Muz. IG F/202.
4. *Discorbis discoides* (d'Orbigny): *a*, *b*, *c* dorsal, ventral and apertural views. Łanięta. Muz. IG F/203.
5. *Cibicides reussi* ten Dam et Reinhold: Kurów Mały. Muz. IG F/204.
6, 7, 11. *Cibicides ypresiensis* ten Dam: Łanięta. Muz. IG F/207.
8—10. *Cibicides omphalius* (Grzybowski): Izbica Kujawska. Muz. IG F/208—210.

Specimens from the Fore-Sudetic Monocline (Kurów Mały, Miechów), Kujawy (Izbica Kujawska) and Mazowsze (Łanięta) regions
approx. ×70

Plate 14

1. *Leguminocythereis striatopunctata* (Roemer): Augustynowo. Muz. IG F/211.
2. *Lenticulina herrmanni* (Andreae): Miechów. Muz. IG F/212.
3. *Anomalinoides granosus* (Hantken), Miechów. Muz. IG F/213.
4. *Heterolepa perlucida* Nuttall: Miechów. Muz. IG F/214.

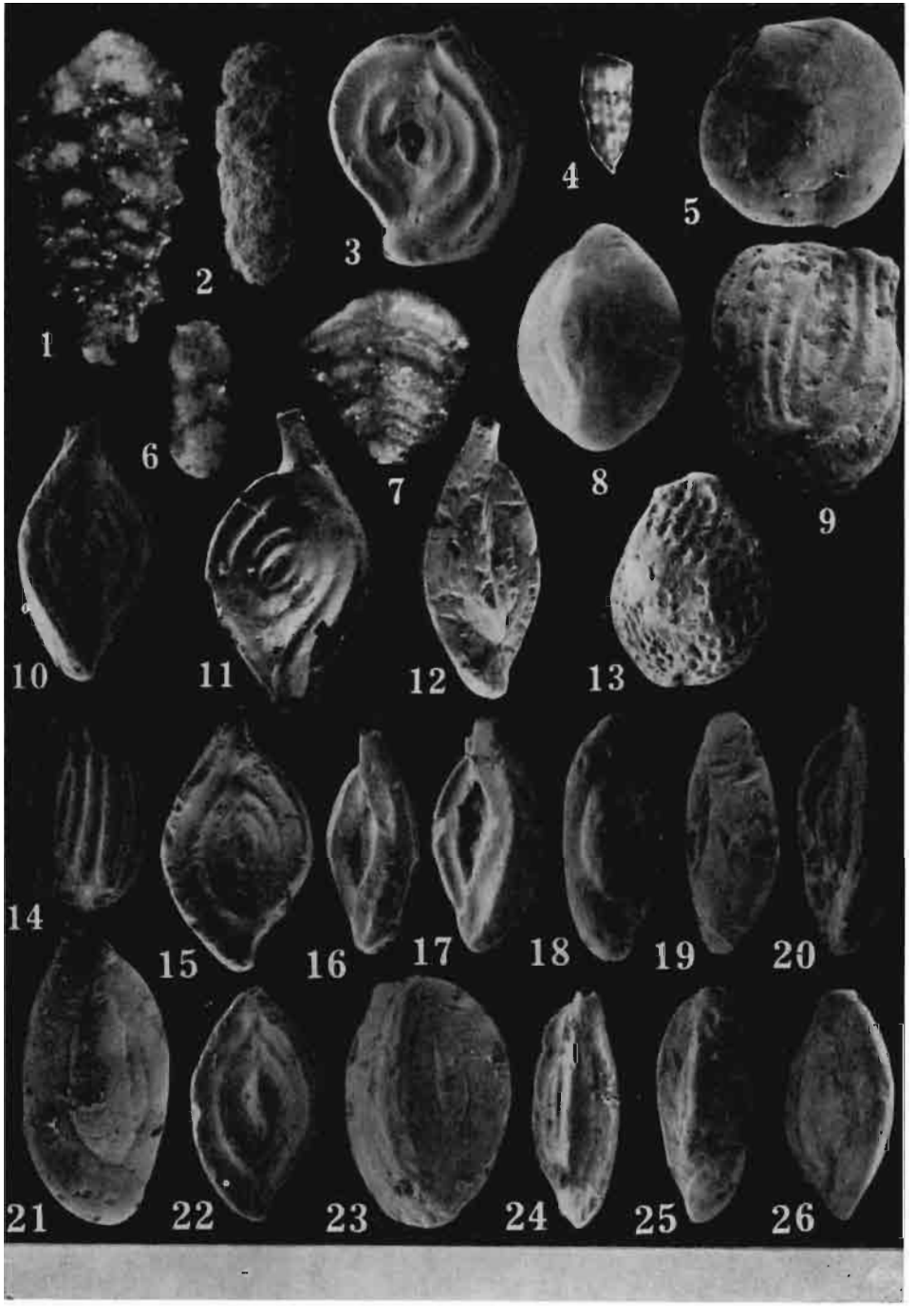
5, 10. *Asterigerina bartoniana* ten Dam: *a* dorsal and *b* ventral views. Augustynowo. Muz. IG F/215, 216.

6. *Pullenia bulloides* (d'Orbigny): Miechów. Muz. IG F/217.

7, 8. *Melonis affine* (Reuss): Kurów Mały. Muz. IG F/218, 219.

9. *Cibicides tenellus* (Reuss): Kurów Mały. Muz. IG F/220.
11. *Karreria fallax* (Rzehak): Izbica Kujawska. Muz. IG F/221.

Specimens from the Fore-Sudetic Monocline (Miechów, Kurów Mały) and Kujawy region (Izbica Kujawska)
approx. ×70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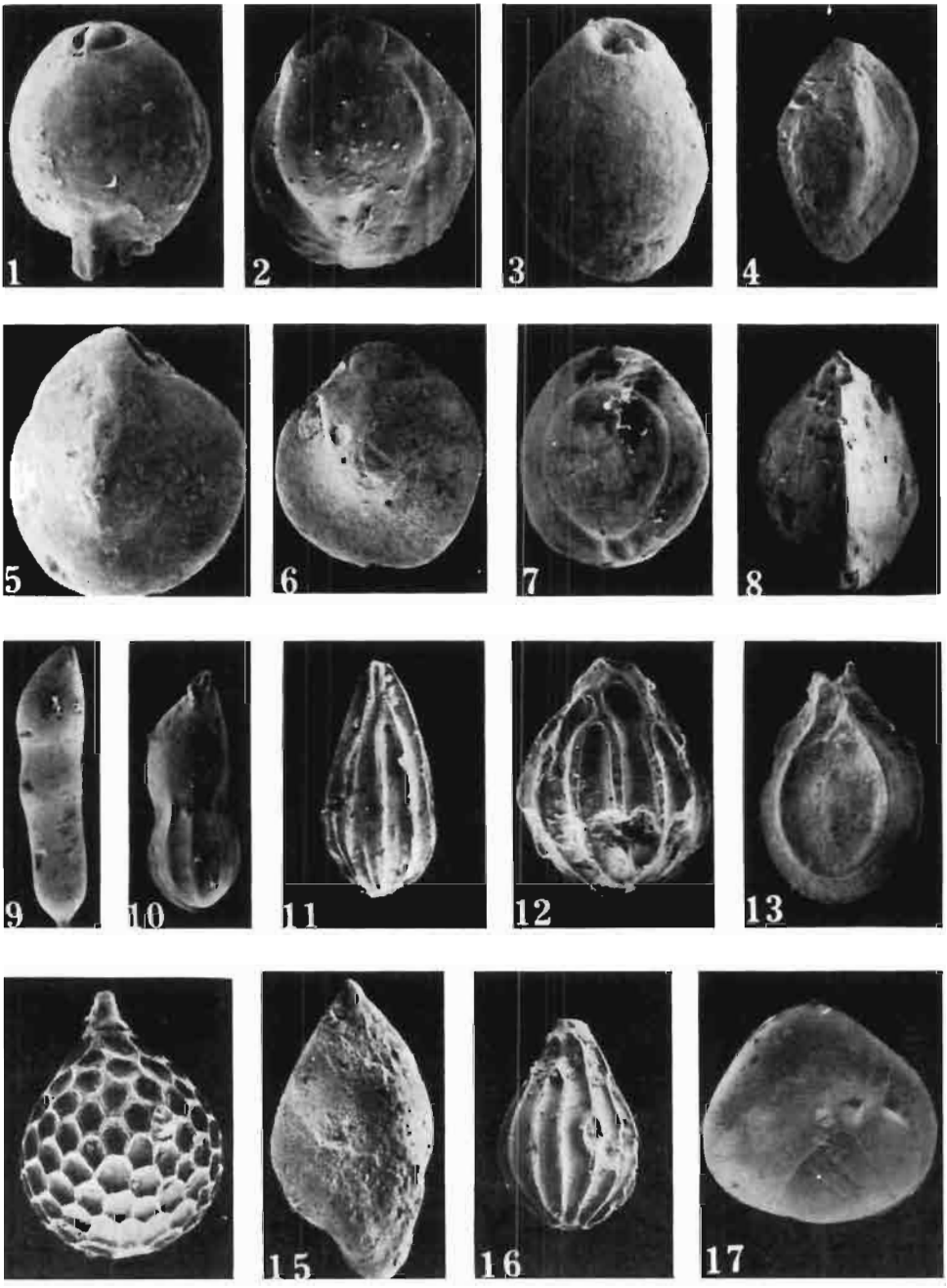
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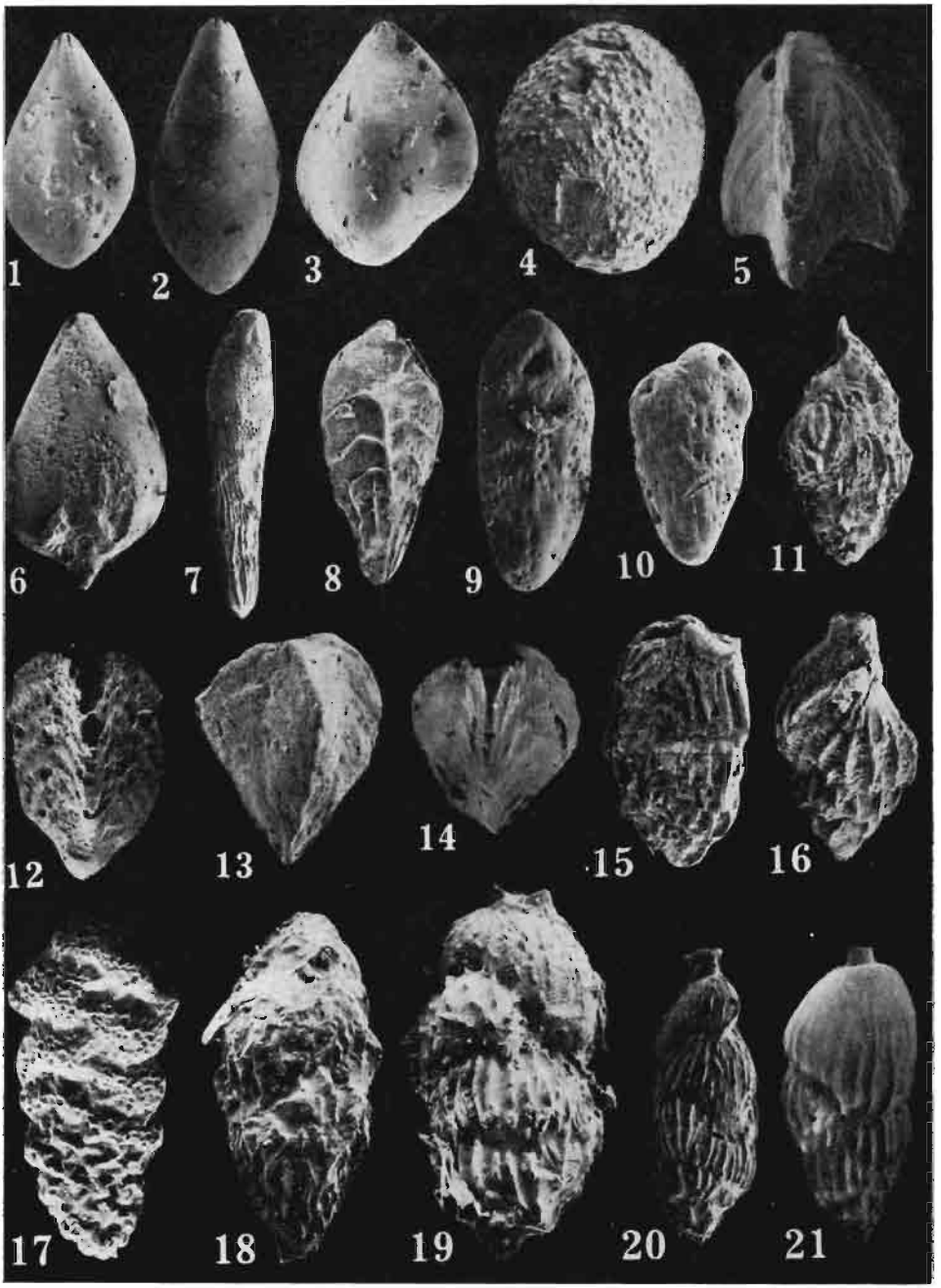
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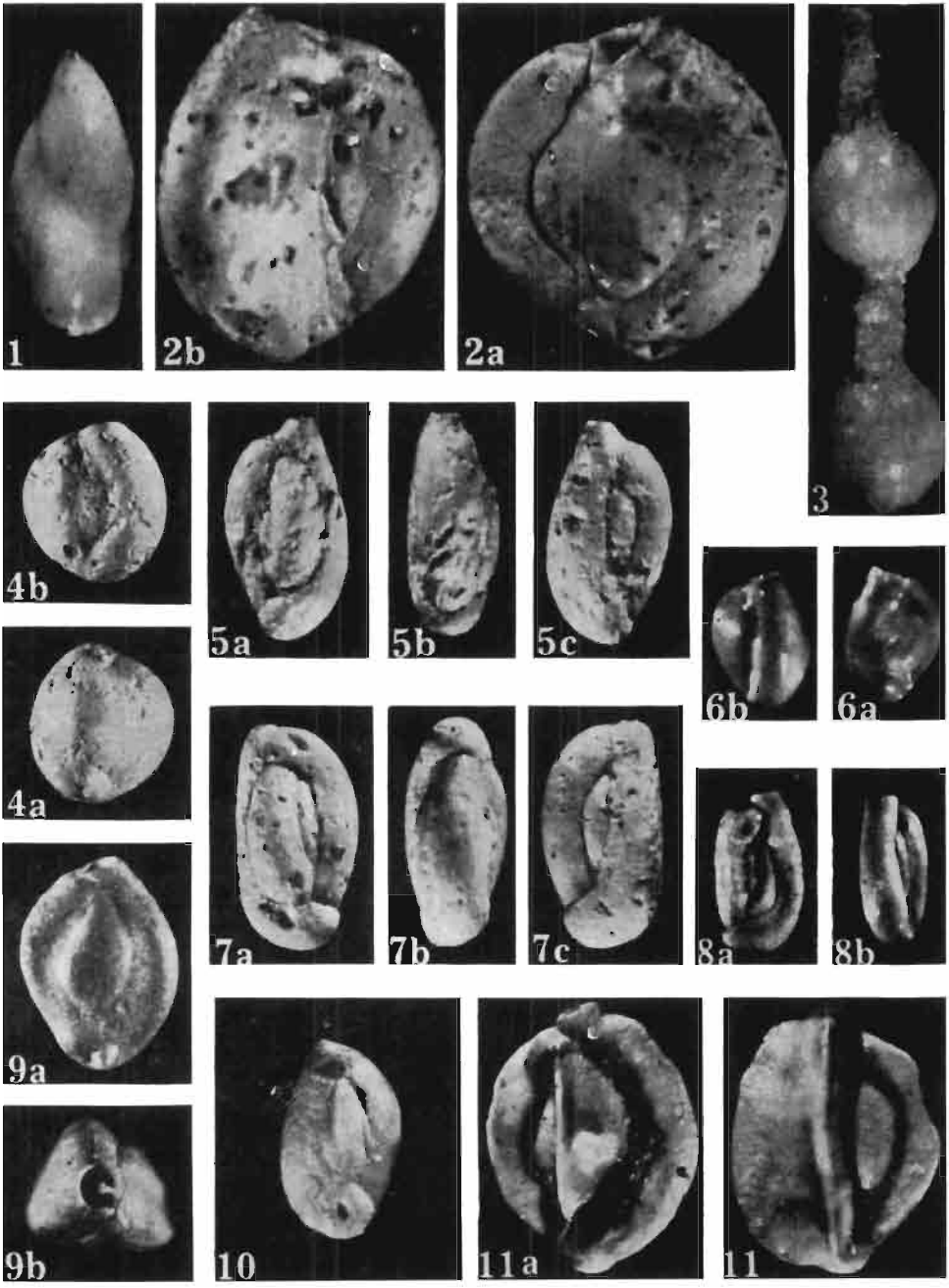
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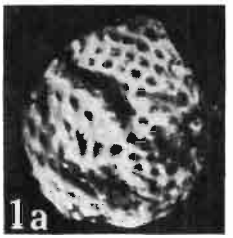
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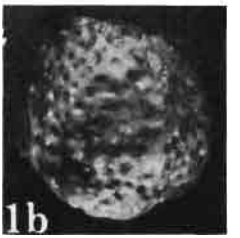
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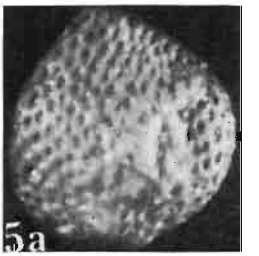
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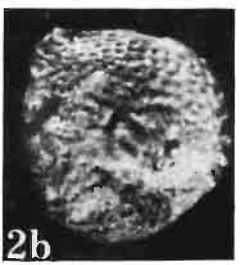
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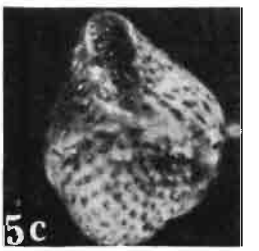
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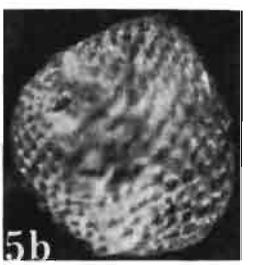
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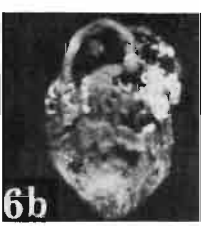
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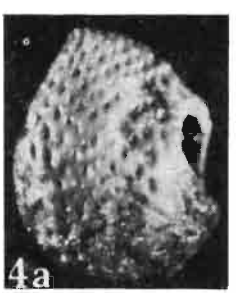
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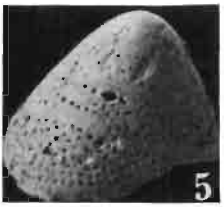
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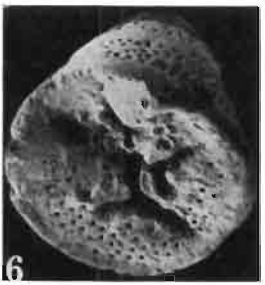
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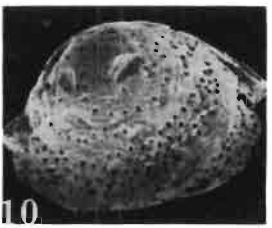
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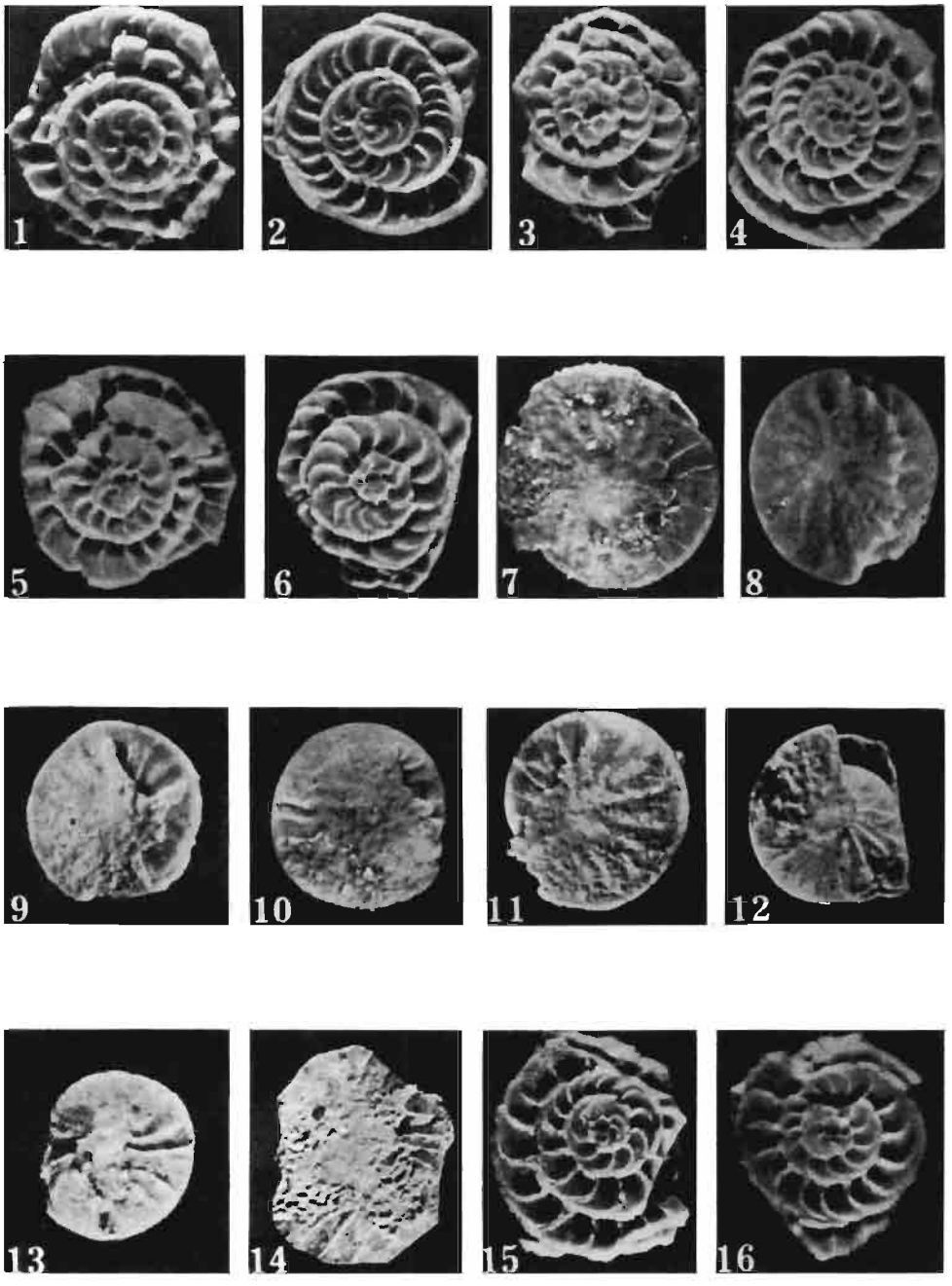
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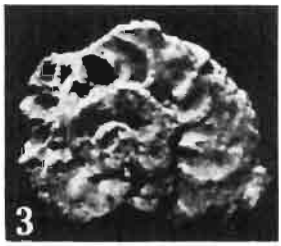
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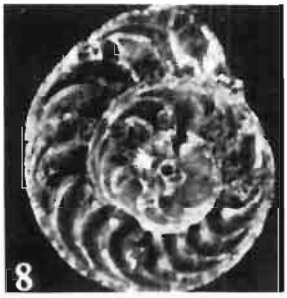
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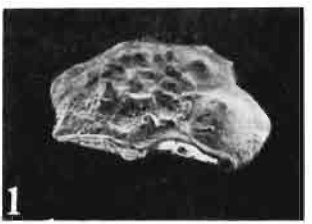
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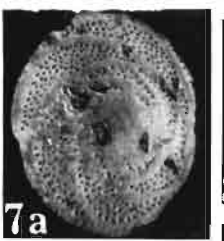
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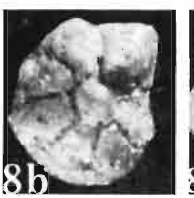
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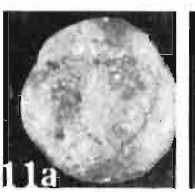
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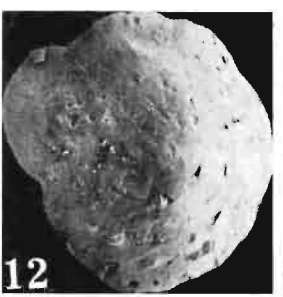
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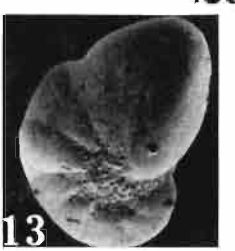
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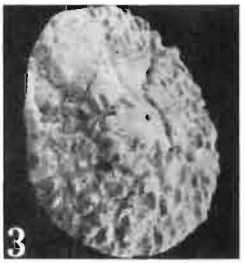
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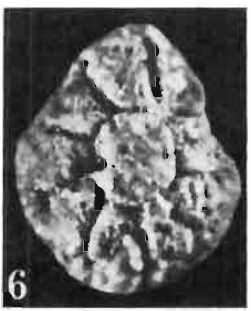
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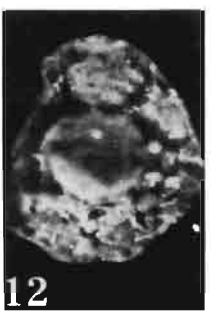
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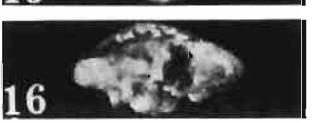
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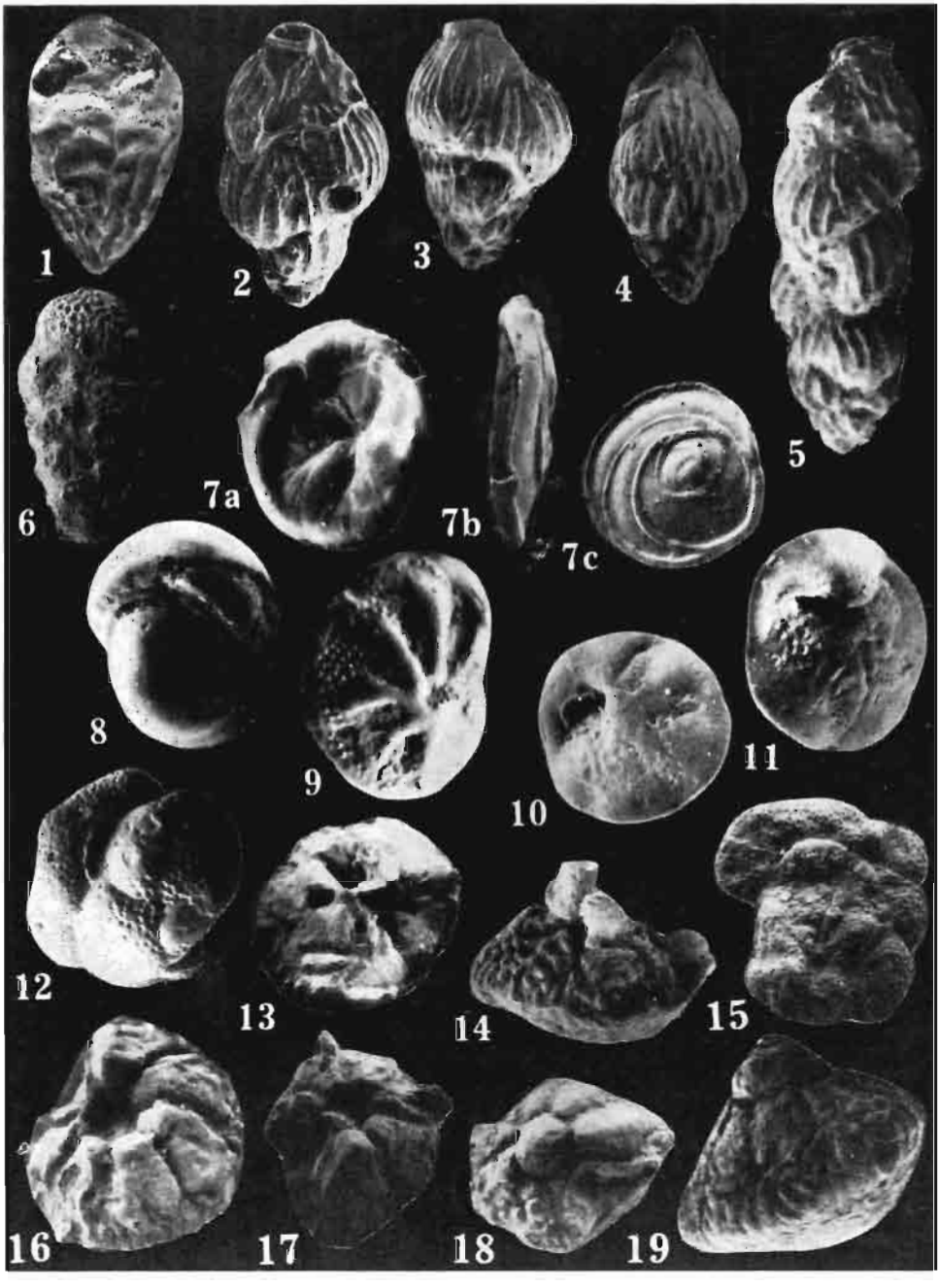
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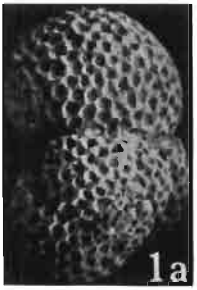
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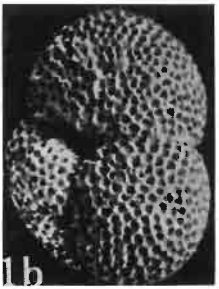
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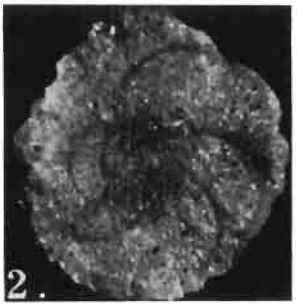
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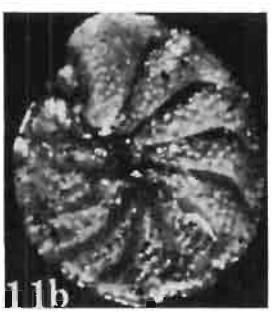
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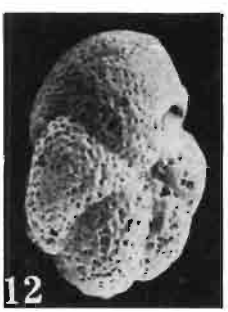
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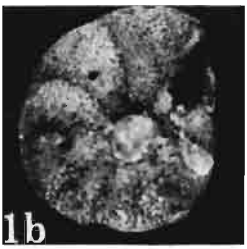
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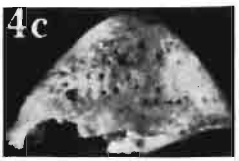
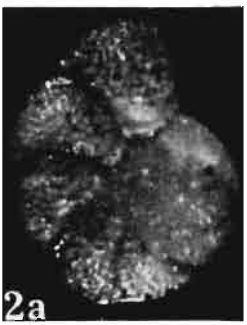
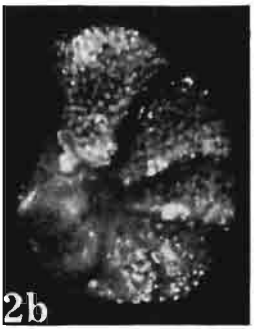
1c


1a

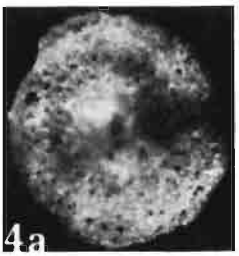

4c


2a


2b


3b


3a


4a


11


7


4b


5


6


12a


12c


12b


8


13b


13c


13a


9


10


14a


14b


1

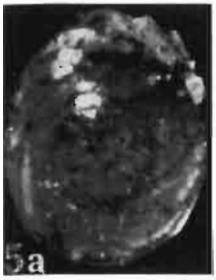

11


2


3


4


7


5a


5b


6


8


9


10a


10b