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

Vol. 23 1978 No. 3

IUGS UNESCO IGCP

The Northwest European Tertiary Basin

Project 124

EWA ODRZYWOLSKA-BIEŃKOWA, KRYSTYNA POŻARYSKA AND ERLEND MARTINI

MIDDLE OLIGOCENE MICROFOSSILS FROM THE POLISH LOWLANDS: THEIR STRATIGRAPHICAL AND PALEOGEOGRAPHICAL SIGNIFICANCE

Abstract. — Middle Oligocene foraminifer assemblage was found in core material from several drillings made in the north-western Poland. This assemblage, consisting of 74 species of both benthic and planktonic foraminifers, resembles that from the stratotype of septarian clays from FRG and GDR. Its Middle Oligocene age is confirmed by calcareous nannoplankton dating (NP 24). The foraminifer assemblage was related to that of the Middle Oligocene sea of the North-European furrow which transgressed Poland as far as the Mid-Polish Anticlinorium which became its eastern margin. Deposits of this age are represented by septarian clays in the Szczecin area and quartz-glauconitic sands in the south-western (Fore-Sudetic Monocline) and central Poland (Kujawy). The temperature of water this basin was relatively low.

INTRODUCTION

This is the first report on foraminifers and calcareous nannoplankton from the Middle Oligocene of Poland. E. Odrzywolska-Bieńkowa and K. Pożaryska are responsible for identifications of foraminifers and E. Martini (Frankfurt on Main, FRG) — for identification of nannoplankton. The material studied comprises foraminifers from typical Rupelian deposits represented by septarian clays penetrated by the Szczecin IG 1 boreholes. The paper also presents the discussion of the distribution of the foraminifer species in Middle Oligocene deposits developed in the sandy-glauconite facies in the following areas (fig. 1): Puck Embayment and Łeba Elevation (boreholes Opalino IG 1, Żelistrzewo IG 1, Kłanino IG 1, Starzyno IG 1, Zdrada IG 1, 2, Sulicice IG 1, Mieroszyno IG 1, 2, 3, Chłapowo 1, 2, 3, Czarny Młyn IG 2, Jastrzębia Góra IG 1, Werblinia IG 1, Białogarda IG 1, Koszalin IG 1), Słupsk (Machowinko borehole, see: Odrzywolska-Bieńkowa 1977), Możdżanowo (Odrzywolska-Bieńkowa and Błaszak, in press), Fore-Sudetic Monocline (Głobice, Miechów, Gorzów Wielkopolski, Wschowa Geo 1, Choszczno boreholes) and Kujawy (Augustynowo).

The studied core material was derived from boreholes made by the Geological Institute from Warsaw. The geological profile of the deep borehole Szczecin IG 1 (Tanowo) is discussed in a collective work edited by M. Jaskowiak-Schoeneichowa (1973) in the series "Profiles of deep bore-

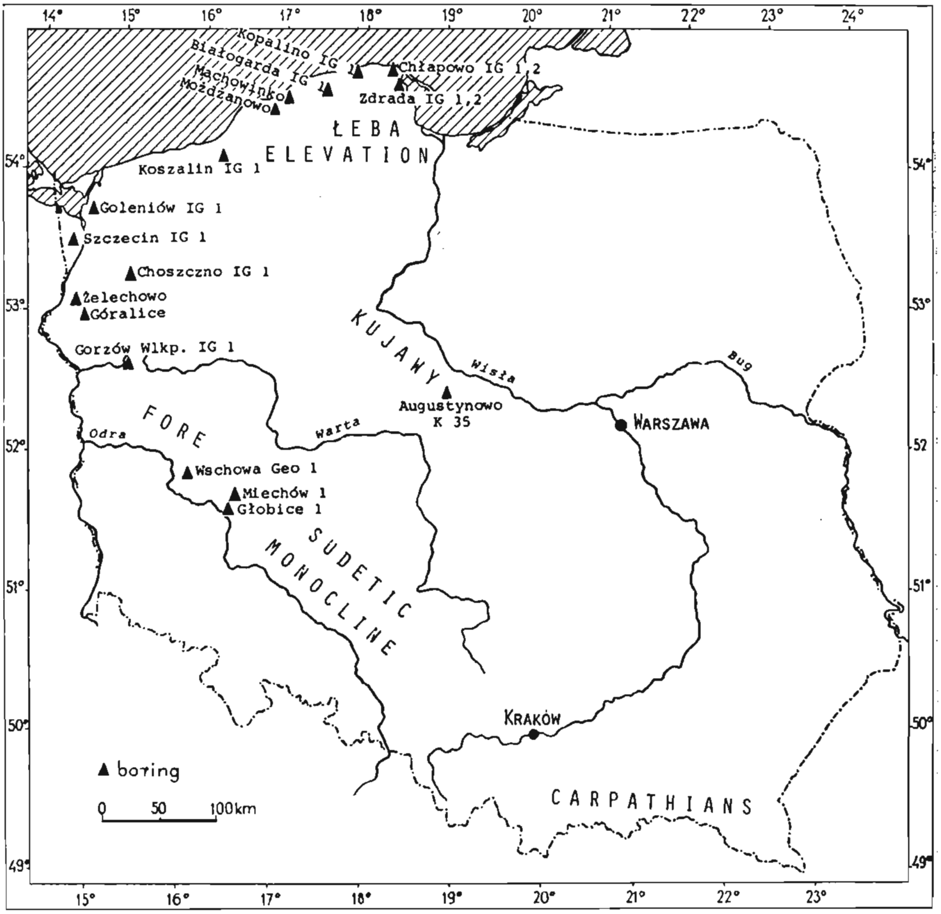


Fig. 1. Distribution of some borings performing Middle Oligocene deposits on the Polish Lowlands.

holes of the Geological Institute". Tertiary deposits were penetrated at the depth from 93 to 281 m in this borehole. They are represented by the Miocene (occurring at depths from 93 to 126 m), Oligocene (126—190 m) and Eocene (190—281 m). The Oligocene deposits, containing the fossil material described here, are represented by grey-brown, usually calcium-less clays with occasional concentrations of pyrite, and commonly relatively rich in carbonized plant debris. Preliminary identifications of microfossils from single samples were previously published by Odrzywolska-Bieńkowa (1967, 1973). The list of the identified species is here extended

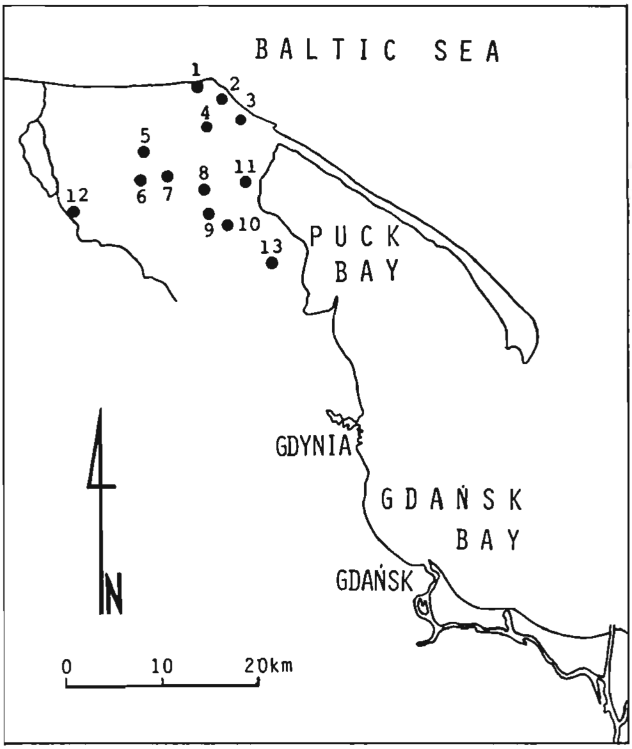


Fig. 2. Sites with the Middle Oligocene foraminifers in the Puck Embayment area: *1* Jastrzębia Góra IG 1, *2* Czarny Młyn IG 1, *3* Chłapowo IG 1, 2, *4* Mieroszyno IG 1, 2, *5* Sulicice IG 1, *6* Płanino IG 2, *7* Starzyno IG 1, *8* Głuszewo IG 1, *9* Zdrada IG 2, *10* Zdrada IG 1, *11* Werblinia IG 1, *12* Opalino IG 1, *13* Żelistrzewo IG 1.

thanks to supplementary material from the Szczecin IG 1 borehole, made available through the courtesy of Dr. H. Wolańska. A part of the material was given to Professor E. Martini of Frankfurt on Main (FRG), who found there nannofossils typical of the *Sphenolithus distentus* Zone (NP 24) of the Middle Oligocene. This nannoplankton assemblage (p. 281 and Table 2) appears closely related to those known from the Middle Oligocene septarian clays of GDR and FRG.

Table 1 presents the list of Oligocene foraminifer species discussed here as well as other species from the Middle Oligocene deposits from the Szczecin IG 1 borehole. These species give further support to connections between Middle Oligocene deposits of Poland, GDR, FRG, Belgium and, to a some degree, European parts of the USSR. The analysis presented here was made taking into account preliminary results of studies on Paleogene microfauna from the Puck Embayment and Słupsk area (Odrzywolska-Bieńkowa 1977), preliminary data on the development of Paleogene sedimentary basin in the northern Poland (Pożaryska 1976, 1977) and biostratigraphic correlation of the Polish Tertiary, made within the framework of the IGCP Project no. 124 (Pożaryska and Odrzywolska-

Bieńkowa 1977). It should be emphasized that Odrzywolska-Bieńkowa (1967, 1973) correlated Middle Oligocene deposits from the Szczecin IG 1 borehole with coeval deposits from the Gorzów Wielkopolski and Wschowa Geo 1 boreholes and Zgoda claypit from the vicinities of Szczecin (Wolańska 1962), Mainz area in FRG (Thursch 1956) and the Kapellen and Rosenray boreholes (Ellermann 1958, and Indans 1958, respectively). She also made correlation of Middle Oligocene of Poland and Brandenburg and Mecklenburg areas in the GDR (Spiegler 1960; Kiesel 1962). Microfaunal assemblages evidencing the presence of Rupelian deposits in the Puck Embayment area, identified by Odrzywolska-Bieńkowa, were listed by Marzec and Woźny (1972) in discussing litho- and biostratigraphy of that region.

In analysis of foraminifers discussed in this paper, the authors used comparative materials kindly supplied by Professor H. Bartenstein of Celle (FRG) and Dr. S. Ritzkowski of Göttingen (FRG). The number of species identified by the authors is four times larger than reported by Reuss (1865) from the Leopold Fort in the vicinities of Szczecin.

The foraminifer collection is housed in the Geological Institute, Warsaw, here abbreviated as IGeol Pal

FORAMINIFER SPECTRUM AND AGE OF DEPOSITS

The studied foraminifer assemblage was derived from the depth interval of 131.2—156.1 m in the Szczecin IG 1 borehole. Foraminifers were derived from grey-green marly or, locally, clay-sandy claystones with clay-pyritic lumps and pyritized plant remains, passing downward into dark-brown claystone, sandy-shaly clay rich in plant debris represented by stem sections and pyritized rootlets. Lithological profile of this borehole was given by Ciuk (1972, 1973) who assigned these strata to the Czempińskie Beds of the Middle Oligocene. The deposits, originally interpreted as calcium-less, actually yield some amounts of calcium. Low content of this element in the Middle Oligocene is reflected by poor development of foraminifer tests which are usually thin and small.

Rotaliatina bulimoides Reuss is the most important species of the foraminifer assemblage. The stratigraphic range of this species is considered to be limited to the Middle Oligocene (Staesche and Hiltermann 1940) which was not questioned in the last 37 years. This species may be, therefore, regarded as important for the septarian clay facies of the upper parts of the Rupelian. It is lacking in the Lower Rupelian of both the Mainz Basin and Poland. Its record from the Upper Rupelian of the latter area is also of biogeographic importance as up to now it was considered as limited to the north-western Germany exclusively (Bartenstein *et al.* 1962).

Table 1

Distribution of Middle Oligocene Foraminifera in Poland and in some European countries

Region / Species	Poland				G.D.R.	B.D.R.	France	Belgium	Soviet Union
	Szczecin IG 1	Leba Elevation	Fore Sudetic Monocline	Puck Bay	Kiesel (1962) Kiesel (1970)	Indans 1958 Ritzkowski 1965 Grossheide & Trunko 1965 Spiegler 1965 Gramann 1975	Butt 1966	Batjes 1958	Kraeva, Ziemieckij 1969
Haplophragmoides latidorsatus	●				●	●		●	
Spiroplectammina carinata intermedia	●				●				
Spiroplectammina carinata attenuata	●				●	●			
Gaudryina siphonella siphonella	●		●		●	●		●	
Gaudryina siphonella asiphonia	●				●			●	●
Gaudryina chilostoma	●					●			
Quinqueloculina ludwigi	●	●		●	●			●	
Quinqueloculina impressa	●		●		●	●		●	
Nodosaria multilineata	●								
Lenticulina depauperata	●	●		●	●				
Lenticulina inornata	●	●		●	●	●			
Lenticulina umbonata	●	●		●	●				
Lenticulina subangulata	●								
Dentalina grandis	●			●	●				●
Dentalina spinescens	●		●		●	●		●	●
Dentalina obliquestriata	●		●	●					
Dentalina soluta	●	●			●	●		●	
Dentalina inornata	●			●					
Raphanulina gibba globosa	●			●					●
Raphanulina minuta	●				●				
Guttulina problema	●	●			●			●	●
Fissurina lucida	●			●					
Bolivina beyrichii	●	●	●	●	●	●		●	
Stilostomella ewaldi	●	●	●		●	●		●	
Sphaeroidina variabilis	●	●		●	●	●		●	
Uvigerina batjesi	●				●				
Hopkinsina gracilis	●	●		●	●	●		●	
Trifarina germanica	●	●		●				●	
Valvulineria petrolei	●			●	●	●		●	
Cassigerinella cf. *chipolensis*	●								
Globigerina angustiumbilicata	●			●					
Globigerina aff. *ciperoensis*	●								
Globigerina corpulenta	●	●		●					
Globigerina inaequispira	●								
Globigerina officinalis	●	●							●
Globigerina pseudoeocaena	●								
Globigerina senilis	●								
Globigerina turkmenica	●			●					
Globigerina turritilina praeturritilina	●								
Cibicides reussi	●	●		●					
Cibicides ungerianus	●	●	●	●	●	●		●	●
Rotalitina bulimoides	●		●			●		●	
Globocassidulina oblonga	●	●		●					
Pullenia bulloides	●	●	●	●		●		●	
Pullenia quinqueloba	●	●		●	●	●		●	●
Alabamina tangentialis	●		●	●	●	●	●	●	
Gyroidina soldani	●	●		●					
Gyroidina girardana	●	●		●		●		●	
Melonis affine	●	●	●	●	●	●		●	
Svratkina perlata	●			●	●	●	●		●
Oridorsalis umbonatus	●	●	●	●	●	●		●	
Epistomina elegans	●	●	●	●	●	●		●	●

Foraminifer spectrum from Middle Oligocene deposits of north-western Poland comprises 74 species (12 planktonic and 62 benthic). From the species recorded here, 41 are also known from coeval deposits of GDR, 30 from FRG, 21 from Belgium and only 9 also from the USSR (mainly Ukraine).

No species typical of the Mediterranean province were found here which gives further support to low temperature of water in the North-European basin. Agglutinate foraminifers are markedly less numerous than the calcareous. Miliolids typical of warm-water basins and sheltered lagoons are scarce. The share of the representatives of the genera *Hopkinsina* and *Trifarina*, also indicative of low-temperature waters of shelf slope, is fairly large in the foraminifer spectrum.

Planktonic foraminifer species recorded in the Middle Oligocene of Poland include *Globigerina officinalis* and *G.turritilina*. These species are stratigraphically important, making possible to correlate the foraminifer assemblage with that typical of the Lower Rupelian whereas the presence of *Globigerina angustiumbilicata* — with the Upper Rupelian in the subdivision proposed by Menner and Krasheninnikov (1960).

Benthic foraminifers predominate in the Rupelian. A half of them belong to the species described by Reuss (1851) from coeval deposits in Germany. The assemblage also comprises representatives of several other species described by German authors (Andreae 1884; Bornemann 1885; Spandel 1901).

E. Martini (this paper) compares calcareous nannoplankton assemblage derived from the same samples as the above mentioned foraminifers, with the assemblages from so-called Rupelian C_2 and C_3 (Indans 1958). The Rupelian C_2 and C_3 studied by Indans (1958) is characterized by the foraminifer assemblages comprising the following species also known from the Middle Oligocene of Poland: *Cibicides ungerianus, Dentalina obliquestriata, Gyroidina girardana, Pullenia quinqueloba, Sphaeroidina variabilis, Melonis affine* and various miliolids. The IV horizon of the Rupelian, differentiated in the GDR and correlated with the C_2 and C_3

Table 2

Distribution of Middle Oligocene calcareous nannoplankton in the Szczecin IG 1 borehole and position in the standard nannoplankton zonation

× = present / Samples	*Braarudosphaera bigelowi*	*Coccolithus abisectus*	*Coccolithus eopelagicus*	*Coccolithus pelagicus*	*Cyclococcolithus floridanus*	*Cyclococcolithus hoerstgensis*	*Dictyococcites dictyodus*	*Discolithina desueta*	*Discolithina multipora*	*Discolithina pygmaea*	*Helicosphaera bramlettei*	*Helicosphaera recta*	*Reticulofenestra clatrata*	*Reticulofenestra lockeri*	*Reticulofenestra retisimilis*	*Sphenolithus* sp.	*Zygrhablithus bijugatus*	Nannoplankton Zone
131.2—137.2 m		×		×	×		×	×					×	×		×		
137.2—143.2 m	×	×		×	×	×	×		×	×			×	×	×	×	×	
143.2—149.7 m	×	×	×	×	×		×	×			×	×	×	×	×	×	×	NP 24
149.7—156.1 m	×	×		×	×	×	×						×	×	×	×	×	

horizons of Indans (1958) by Kiesel (1962) contains the following species known from the Rupelian of Poland: *Haplophragmoides latidorsatus*, *Quinqueloculina impressa*, *Svratkina perlata*, *Cibicides ungerianus*, and *Alabamina tangentialis*.

Taking into account the similarity of the nannoplankton assemblages from the Rupelian of FRG, GDR and Poland, the deposits penetrated by the Szczecin IG 1 borehole and other boreholes listed in this paper may be interpreted as coeval.

WATER TEMPERATURE

According to Thursch (1956), temperature of water in the Rupelian sea of the North-European furrow was below 20°C. The studies on temperature of Tertiary seas transgressing the area of Denmark recently carried out within the framework of the IGCP Project 124 (Buchardt 1977), gave the value as low as 5°C for Early Oligocene sea and only somewhat higher, 10°C, for the Middle Oligocene (Rupelian) one. This temperature crisis from the turn of the Eocene and Oligocene may be compared with the Messinian (Miocene-Pliocene) and coincides with the cool wave reflected by cold Oligocene flora recorded by Krutsch and Lotsch (1962—1969). The analysis presented here showed the presence of cold-water foraminifer assemblage without any warm-water elements as nummulitids, asterigerins, pararotalids or tropical varieties of miliolids typical of warmer-water basins. Planktonic foraminifers found here display trend to marked reduction in size which, to a certain degree, is also the case of the benthonic ones.

The foraminifer genera represented in the assemblage include *Gaudryina*, *Bolivina*, *Lenticulina*, *Uvigerina*, *Cibicides*, *Cassidulina*, *Pullenia*, and others which indicate normal salinity and low temperature of sea water according to Murray (1973). The majority of foraminifer tests are at present impregnated with pyrite. The genus *Dentalina* is represented by a fairly high number of species which was usually recorded in upper parts of the Rupelian. The microfaunal assemblage mainly lived in the outer shelf zone.

PALEOGEOGRAPHIC CONCLUSIONS

The Rupelian transgression was considered as the maximum Paleogene transgression in northern Europe. The further studies showed that several localities regarded as Oligocene are, actually, of the Late Eocene age and the Late Eocene transgression is nowadays considered as the greatest (see Pożaryska and Odrzywolska-Bieńkowa 1977; Pożaryska 1977).

The marine Lower Oligocene is still insufficiently known. It was formerly termed as Lattorfian but this concept is highly disputable and the Lattorfian is considered as facies of the Upper Eocene by some authors (Cavelier and Pomerol 1976, Pożaryska and Odrzywolska-Bieńkowa 1977). Moreover, it was stated as early as 1962 by Korobkov (Colloque 1962) that the bulk of the species of the "Lattorfian" microfauna are of the Eocene age. Only 70 out of 300 species are not know from the Eocene. The remaining species are in some sense endemic as they seemed limited to northern GDR and FRG. It follows that the German "Lattorfian" contains mostly species known from the Eocene but not the Rupelien or Chattian (Korobkov 1962: 750—752) so the "Lattorfian" cannot be understood as Lower Oligocene (Korobkov, *l.c.*).

Lower Oligocene deposits were nowhere found in borehole columns

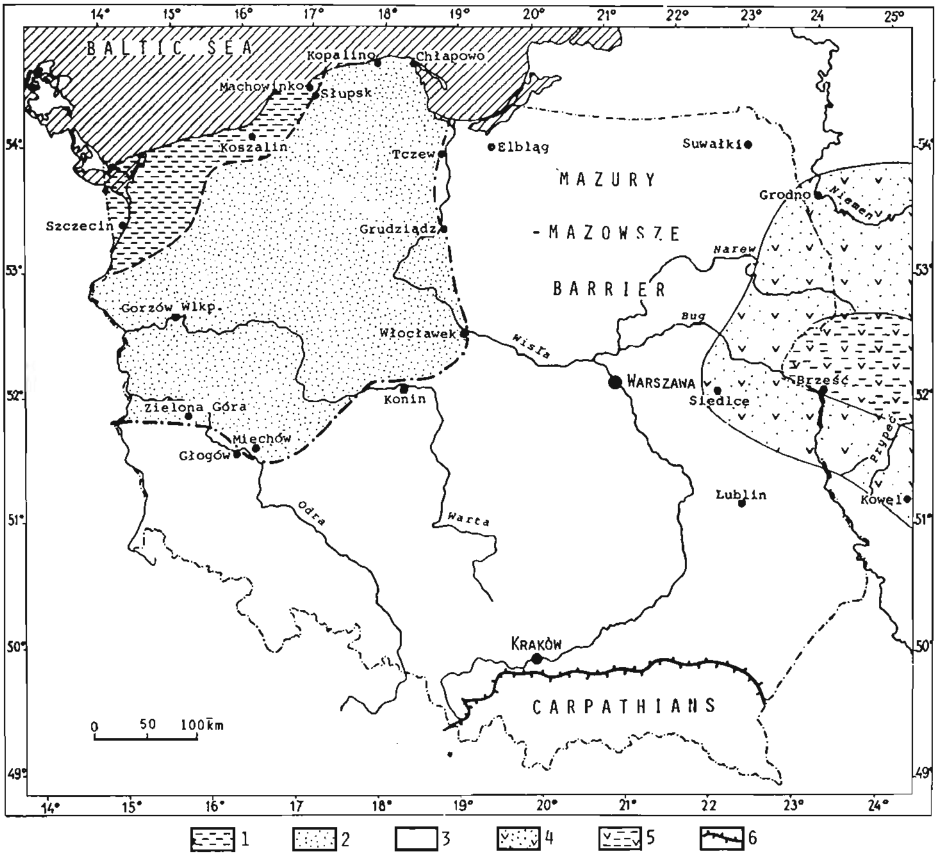


Fig. 3. Distribution of Middle Oligocene deposits in the Polish Lowlands (data concerning eastern Poland are taken from the Paleogeographic Atlas of the USRR); *1* Oligocene septarian clays, *2* Oligocene glauconitic sands, *3* land-swampy areas, forming so-called Mazury—Mazowsze barrier, *4* sandy deposits with plant debris but without coals, *5* clay sands with plant remains and coal intercalations, *6* margin of the Carpathians.

from NW Poland studied by the authors. In several columns are present calcium-less and faunistically barren deposits. The deposits with microfossils always appeared to be the Middle Oligocene resting directly on the Upper Eocene.

The authors found that the extent of the Middle Oligocene deposits comprises north-western Poland. The Middle Oligocene is developed in two facies here: (1) calcareous quartz-glauconite sands and (2) Rupelian clays with septarian nodules. The latter facies is limited to the areas of Szczecin, Koszalin, Darłowo and Słupsk, extending to Machowinko. The extent of the former facies is much greater, comprising the Wielkopolska basin as far as Głogów and Zielona Góra on the south and Włocławek, Grudziądz and Tczew on the east. The deposits from the Gołdap IG 1 borehole in the Mazury region, formerly assumed to be of the Oligocene age (Bojarski and Marek 1974), actually belong to the *Globanomalina micra* Zone of the Upper Eocene (Odrzywolska-Bieńkowa 1976).

Besides the Gołdap locality, Upper Eocene foraminifers were found in deposits penetrated by the Mikaszówka borehole in the Suwałki area (Odrzywolska-Bieńkowa 1974), at Hipolitów (Nowak and T. Uberna 1976), Miały near Grodno and Siemień near Parczew (Pożaryska 1977), Branica Suchowolska, Antonin and Michów near Radzyń Podlaski (J. Uberna and Odrzywolska-Bieńkowa 1977). All these finds speak against the occurrence of Oligocene deposits on eastern side of the Mid-Polish Anticlinorium.

In drawing stratigraphic-facies map of the Polish Paleogene, Areń (1957) assumed that the transgression of Oligocene sea comprised the whole northern Poland. According to that author, the Oligocene sea entered the area of Poland from the south-east and transgressed Roztocze, the whole Lublin region and later Mazowsze basin, Pomerania and northern Wielkopolska. The mixing with waters of a transgression coming from the German Lowlands and submerging the north-western Poland took place in the area situated behind the Odra river line. As it was shown above, we know nowadays that the bulk of deposits assigned to the Oligocene on Areń's (1957) map actually represent the Upper Eocene (see also Pożaryska 1977). It should be noted here that this map comprises the whole Oligocene, i.e. also the Lattorfian which is recently interpreted as Lattorfian facies of the Upper Eocene (Cavelier and Pomerol 1976). The Late Eocene age of Lattorfian deposits in Poland was suggested by Odrzywolska-Bieńkowa as early as 1964 on the basis of guide foraminifer species found in core material from north-western Poland (see Pożaryska and Odrzywolska-Bieńkowa 1977).

In the Oligocene, the Mid-Polish Anticlinorium no longer represented so distinct eastern boundary of the North-European furrow as in the Late Eocene. The eastern Poland still acted as a boundary area between this North-European and Kiev basins. The basins were characterized by different microfaunal assemblages, as well as palynological ones (Grabowska

1974) evidencing the lack of connections between them. Only a few species are know from both basin but they are common and without any greater stratigraphic value. Oligocene successor of the Eocene Kiev basin, called as Maikop basin, also comprised the areas of the Dnepr—Donetz aulacogen and its neighbourhood. Older Oligocene is here represented by brackish sandy facies or the facies of marine sands with fine gravel of milk quartz or, sometimes, lidite. Such deposits are fairly common in Poland, suggesting more or less continuous connections between this basin and north-western Polish Oligocene basin. The deposits were found in both boreholes and outcrops such as those from Góra Puławska on Middle Vistula river. The deposits are faunistically barren may represent equivalent of the Charkov Beds of the Lower Oligocene in the Soviet Union. The deepest parts of the basin include Black Sea and Caspian Sea and neighbouring areas, already be longing to the Tethys proper and existing through the whole Oligocene.

Contacts between Middle Oligocene North-European furrow and Ukrainian Sea where so-called Maikop series of the Oligocene-Miocene age were originating, were weak. According to Drooger (1962), this cannot be explained just by the lack of seaways but rather by complete isolation and some differences in ecological conditions in the two marine basins. The Ukrainian Maikop basin was characterized by somewhat lower water salinity, evidenced by predominance of anomalinids in foraminifer spectrum. Similar concept was put forwards by Drooger (1962) in order to solve difficulties encountered in correlating Tertiary deposits from Belgium and the Netherlands. The Belgium basin from the Oligocene times is interpreted as more saline (Batjes 1958) and the Dutch one as somewhat brackish, which is evidenced by predominance of agglutinated foraminifers and anomalinids (Drooger, *l.c.*). According to Drooger (*l.c.*), it is very difficult to draw reliable chronostratigraphic conclusions on the basis of foraminifer assemblage mainly consisting of the representatives of the genera *Cibicides* and *Anomalina.*

The existence of barrier responsible for separation of the North-European and South-Ukrainian marine basins in the Oligocene times seems undoubtful. In that situation, the presence of complete profiles of marine Paleogene in the Olsztyn area in the northern Poland, assumed by some authors (Ciuk 1974), seems unsubstantiated. The micropaleontological studies on material from the vicinities of Mińsk Mazowiecki (Odrzywolska-Bieńkowa, unpublished report from 1972) failed to show any microfauna in deposits assigned to the Oligocene. This gives further support to the existence of land area separating above mentioned marine basins (fig. 3). No marine deposits with Oligocene foraminifers but only some fish teeth and coprolites were found in this land area of the Mazury—Mazowsze barrier. The lack of microfauna (Dągi & Sztotowo IG borings) makes it difficult to precise the age of these fresh- or brackish-water deposits. It is assumed that palynological studies may be of some help here. Palynological studies (Grabowska 1972) showed the presence of Middle Oligocene microfloral assemblages indicative of the brackish environment. Further evidence for the presence of brackish deposits of the Middle Oligocene age at Rypin, i.e. in the area of the Mazury—Mazowsze barrier was given by Stuchlik (1964). Ziembińska-Tworzydło (1974) presented palynological data for the presence of the Oligocene brackish series in the Rawicz Trough (western Polish Lowlands), which is situated southward of the extent of Middle Oligocene marine sandy-glauconitic deposits. The presence of marine Oligocene in this area, inferred on the basis of lithological premises (Ciuk 1974), is not confirmed by biostratigraphic data as no marine fauna of this age was found despite of analyses of several hundred core samples.

DESCRIPTIONS

Order **Foraminiferida** Eichwald, 1830
Suborder **Textulariinae** Delage et Hérouard, 1869
Superfamily **Lituolacea** de Blainville, 1825
Subfamily **Haplophragmoidininae** Maync, 1952
Genus *Haplophragmoides* Cushman, 1910
Haplophragmoides latidorsatus (Bornemann, 1855)
(pl. 7: 1*a*, *b*)

1855. *Nonionina latidorsata* Bornemann: 339, pl. 16: 4.
1958. *Haplophragmoides latidorsatus* (Bornemann); Batjes: 98, pl. 1:1.

Material. — One well-preserved specimen, pyritized.
Dimensions (in mm): diameter IGeol Pal 1 0.275.
Remarks. — The specimen is very close to the drawing of the holotype (*fide* Ellis and Messina 1940), differing in less globular test with a trend to sharpening of peripheral margin. Bornemann, Kiesel and Batjes recorded incrustation of tests of this species with pyrite. The species is very rare.
Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR and FRG: Middle Oligocene septarian clays. Belgium: Middle Oligocene clays from Boom.

Subfamily **Spiroplectammininae** Cushman, 1927
Genus *Spiroplectammina* Cushman, 1927
Spiroplectammina carinata intermedia Spandel, 1901
(pl. 7: 2, 3)

1901. *Spiroplecta carinata* (d'Orbigny) Spandel: 112, pl. 2: 4.
1970. *Spiroplectammina carinata intermedia* (Spandel); Kiesel: 193, pl. 3: 20.
1966. *Spiroplectammina carinata oligocenica* Nikitina: 333, pl. 1: 23—25; pl. 2: 10a, b.

Material. — Several well-preserved specimens.
Dimensions (in mm):
IGeol Pal 2
length 0.500
maximum width 0.325

Remarks. — The specimens are similar in morphology to those figured from the Middle Oligocene of northern Germany by Staesche and Hiltermann (1940). In Poland are present both triangular tests and more elongated ones with variable outline of spiny margin.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Choszczno and Gorzów Wielkopolski boreholes). In Europe it is known from the Eocene to Middle Oligocene.

Spiroplectammina carinata attenuata (Reuss, 1851)
(pl. 7: 4*a*, *b*; 5*a*, *b*; 6, 7)

1851. *Textularia attenuata* Reuss: 84, pl. 6: 54.
1970. *Spiroplectammina carinata attenuata* (Reuss); Kiesel: 192, pl. 3: 18, 19.

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

IGeol Pal 3
length 0.650
maximum width 0.275

Remarks. — The specimens are very similar to the holotype figured by Reuss. The variability concerns height of chambers and mode of development of peripheral margin which is either denticulate (spiny) or strongly sharpened. The last two pairs of chambers are usually swollen.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Choszczno and Gorzów Wielkopolski boreholes). GDR: Middle Oligocene.

Family **Ataxophragmiidae** Schwager, 1877
Subfamily **Verneuillininae** Cushman, 1927
Genus *Gaudryina* d'Orbigny, 1839
Gaudryina siphonella siphonella Reuss, 1851
(pl. 7: 8*a*, *b*)

1851. *Gaudryina siphonella* Reuss: 78, pl. 5: 42 (*non* 40, 41).
1962. *Karreriella siphonella* (Reuss); Kiesel: 15, pl. 1: 8—11.

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

IGeol Pal 4
length 0.375
maximum width 0.275

Remarks. — The specimens are most close to those shown on Reuss' (1851) figures 42a, b, markedly differing from those figured elsewhere (Reuss 1851, figs 40a, b; 41). Our specimens are characterized by well-marked triserial structure. The specimen shown on fig. 8a in pl. 7 displays circular aperture with lip, similarly as the Reuss' ones.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene.

Gaudryina siphonella asiphonia Andreae, 1884
(pl. 7: 9)

1884. *Gaudryina siphonella* Reuss var. *asiphonia* Andreae: 200, pl. 7: 7a, b.
1962. *Karreriella siphonella* (Reuss); Kiesel: 15, pl. 1: 8, 11.
1969. *Gaudryina asiphonia* (Andreae, 1884); Kraeva and Zerneckij: 30, pl. 10: 1a, b.

Material. — Several well-preserved specimens.

Dimensions (in mm):

IGeol Pal 5
length 0.850
maximum width 0.237

Remarks. — The specimens are very close to those figured by Andreae (1884) and Kiesel (1962). The biserial part of test is well developed in our specimens so we assigned them to the subspecies *Gaudryina siphonella asiphonia*. But for Kiesel (1962) the species under discussion is conspecific with *Karreriella siphonella* Reuss. Our specimens are more slender than the Ukrainian ones figured by Kapterenko-Tschernousova (1957, pl. 1: 14a, b).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG and Belgium: Middle Oligocene. Holland: Middle and Upper Oligocene. USSR: Upper Eocene, Kiev stage. Mexico: Oligocene.

Gaudryina chilostoma (Reuss, 1852)
(pl. 7: 10)

1852. *Textularia chilostoma* Reuss: 18, a, b.
1866. *Gaudryina chilostoma* (Reuss): Reuss, 120, pl. 1: 5.
1937. *Karreriella chilostoma* (Reuss); Cushman: 126, pl. 15: 1—8.
1958. *Karreriella siphonella* (Reuss); Batjes: 100, pl. 1: 8a, b; *non* 6, 7.
1962. *Karreriella chilostoma* (Reuss); Kiesel: 14, pl. 1: 10.

Material. — Several well-preserved specimens.

Dimensions (in mm):

IGeol Pal 6
length 0.587
maximum width 0.350

Remarks. — Our specimens resemble the representatives of the *G.chilostoma* figured by Reuss (1852), differing in smaller number of chambers. They differ from those figured by Batjes (1958, figs 8a, b) in more depressed sutures, and those figured by Kiesel (1962, pl. 1, fig. 10) in somewhat higher chambers only. The comparisons suggest that the species is sufficiently figured and its interpretation coherent.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Choszczno and Gorzów Wielkopolski boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene. This species was reported from the Oligocene of Trinidad by Cushman (1937).

Suborder **Miliolina** Delage and Hérouard, 1896
Superfamily **Miliolacea** Ehrenberg, 1839
Family **Miliolidae** Ehrenberg, 1839
Subfamily **Quinqueloculinae** Cushman, 1911
Genus *Quinqueloculina* d'Orbigny, 1826
Quinqueloculina ludwigi Reuss, 1865
(pl. 8: 1*a-c*; 2*a*, *b*)

1865. *Quinqueloculina ludwigi* Reuss: 126, pl. 1: 12.
1970. *Quinqueloculina ludwigi* Reuss; Kiesel: 212, pl. 6: 5, 6.

Material. — Over a dozen usually well-preserved specimens.

Dimensions (in mm):

IGeol Pal 7
length 0.450
maximum width 0.225

Remarks. — Our specimens are very close to that figured by Reuss (1865) (*fide* Ellis and Messina 1940), differing in somewhat less flattened terminal part of the last chamber, and less distinct medial chamber from triserial test side. As it was shown by Reuss, this species is characterized by a high individual variability. Batjes (1958) reported differences in depression of sutures. The specimens from Szczecin resemble the Belgian representativs of this species illustrated by Batjes (1958).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG: Middle Oligocene. Belgium: Middle Oligocene (clays from Boom).

Quinqueloculina impressa Reuss, 1851
(pl. 8: 3*a-c*)

1851. *Quinqueloculina impressa* Reuss: 87, pl. 7: 59.
1970. *Quinqueloculina impressa* Reuss; Kiesel: 210, pl. 6: 9.

Material. — Over a dozen well-preserved specimens.

Dimensions (in mm):

IGeol Pal 8
length 0.375
maximum width 0.275

Remarks. — Our specimens are very similar to those figured by Reuss (1851) and Kiesel (1970), but no Batjes (1958). The Batjes' specimens are clearly angular, which is not consistent with the description of the holotype.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski, Choszczno and Wschowa Geo 6 boreholes). GDR, FRG: Middle Oligocene. Belgium: Middle Oligocene (clays from Boom).

Suborder **Rotaliina** Delage and Hérouard, 1896
Superfamily **Nodosariacea** Ehrenberg, 1838
Family **Nodosariidae** Ehrenberg, 1838
Subfamily **Nodosariinae** Ehrenberg, 1838
Genus *Nodosaria* Lamarck, 1812
Nodosaria multilineata Reuss, 1875
(pl. 8: 5)

1875. *Nodosaria* (*Dentalina*) *multilineata* Reuss: 83, pl. II/20: 13.

Material. — One fragmentary specimen (without aperture).

Dimensions (in mm): length of IGeol Pal 10 test fragment 0.680

Remarks. — Our specimen is almost identical as that figured by Reuss (1875) in shape of chambers and ornamentation. The specimen assigned to *N.multilineata* Reuss by Batjes (1958) differs from the formed in ribs markedly thicker and obscuring sutures. A specimen figured as *Dentalina multilineata* Bornemann (*non* Reuss, 1875) by Kraeva and Zerneckij (1969) resembles that figured by Batjes (1958), entirely differing from ours in appearance.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR: Paleogene.

Genus *Lenticulina* Lamarck, 1804

Lenticulina depauperata Reuss, 1851
(pl. 8: 6*a*, *b*, 7*a*, *b*, 8*a*, *b*, 9*a*, *b*)

1851. *Robulina depauperata* Reuss: 70, pl. 4: 29.
1962. *Lenticulina* (*Robulus*) *depauperata* (Reuss); Kiesel: 31, pl. 5: 1.

Material. — Some scores of well-preserved specimens.
Dimensions (in mm):

IGeol Pal 14
maximum diameter 0.525
minimum diameter 0.312

Remarks. — Our specimens easily fall within the limits of intraspecific variability concerning differences in sharpening of peripheral margin.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG: Middle Oligocene.

Lenticulina inornata (d'Orbigny, 1846)
(pl. 9: 1*a*, *b*)

1846. *Robulina inornata* d'Orbigny: 102, pl. 4: 25/26.
1846. *Robulina intermedia* d'Orbigny: 104, pl. 5: 3, 4.
non 1956. *Robulus inornatus* (d'Orbigny); Kaptarenko-Tschernousova: 133, pl. 9: 1.
1969. *Robulus inornatus* (d'Orbigny); Kraeva and Zerneckij: 59, pl. 21: 1.
1970. *Lenticulina* (Robulus) *inornata* (d'Orbigny); Kiesel: 230, pl. 9: 3—5.

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

IGeol Pal 18
maximum diameter 0.312
minimum diameter 0.275

Remarks. — Our specimens fall within the limits of variability of this species. The Ukrainian specimen figured by Kaptarenko-Tschernousova (1956) was exluded from this species because of a more protruding umbilical node and markedly higher number of chambers but this species is undoubtedly present in this area (Kraeva and Zerneckij, 1969). Undoubtful representatives of this species were also recently described by Kiesel (1970, fig. 5).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG: Paleogene. Austria (Vienna Basin): Neogene. USSR (Ukraine): Oligocene.

Lenticulina umbonata (Reuss, 1851)
(pl. 9: 2)

1851. *Robulina umbonata* Reuss: 68, pl. 4: 24.
1970. *Lenticulina* (Robulus) *umbonata* (Reuss); Kiesel: 230, pl. 8: 19.

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

IGeol Pal 19
maximum diameter 0.395
minimum diameter 0.312

Remarks. — Our specimens correspond to the holotype illustrated by Reuss (1851); they display well-developed central node and a narrow and somewhat serrate keel not shown on the Reuss' drawing.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG: Middle Oligocene.

Lenticulina subangulata (Reuss, 1863)
(pl. 9: 3*a*, *b*; 4)

1863. *Cristellaria subangulata* Reuss: 53, pl. 6: 64.
1940. *Cristellaria* aff. *subangulata* Reuss; Staesche and Hiltermann: 201, pl. 42: 5.
1962. *Lenticulina* (Robulus) *subangulata* (Reuss); Kiesel: 32, pl. 4: 5.

Material. — Several well-preserved specimens.

Dimensions (in mm):

IGeol Pal 25
maximum diameter 0.450
minimum diameter 0.375

Remarks. — Our specimens are more rounded than the holotype figured by Reuss (1863) which makes them more similar to the specimen figured by Kiesel (1962). They also resemble that figured by Staesche and Hiltermann (1940).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG: Lower and Middle Oligocene.

Genus *Dentalina* Risso, 1826
Dentalina grandis (Reuss, 1865)
(pl. 9: 5)

1865. *Nodosaria grandis* Reuss: 131, pl. 1: 26, 28.
1956. *Nodosaria grandis* Reuss; Kaptarenko-Tschernousova: 112, pl. 7: 2.
1962. *Dentalina grandis* Reuss; Kiesel: 25, pl. 3: 15.
1969. *Nodosaria grandis* Reuss; Kraeva and Zerneckij: 44, pl. 15: 8.

Material. — Several well-preserved specimens and numerous fragments.

Dimensions (in mm):

IGeol Pal 20
length 0.70
maximum width 0.30

Remarks. — Our specimens are very close to that figured by Reuss (1865). The species is well defined.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG: Middle Oligocene. USSR (Ukraine): Upper Cretaceous — Oligocene.

Dentalina spinescens Reuss, 1851
(pl. 9: 6)

1851. *Dentalina spinescens* Reuss: 62, pl. 3: 10.
1958. *Nodosaria spinescens* (Reuss); Batjes: 116, pl. 3: 13.
1969. *Nodosaria spinescens* (Reuss): Kraeva and Zerneckij: 46, pl. 15: 15.

Material. — One damaged specimen.

Dimensions (in mm):

IGeol Pal 26
length of test fragment 0.650
width 0.180

Remarks. — Our specimen fully corresponds to those figured by Reuss (1851) and Kraeva and Zerneckij (1969) in shape of chambers and their ornamentation. The specimen figured by Batjes (1958) is characterized by more cylindrical chambers and thicker and more blunt spines.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG and Belgium: Oligocene, USSR (Ukraine, Emba region and Mangyshlak): Upper Eocene — Oligocene.

Dentalina obliquestriata Reuss, 1851
(pl. 9: 7)

1851. *Dentalina obliquestriata* Reuss: 63, pl. 3: 11, 12.
1962. *Dentalina obliquestriata* Reuss; Kiesel: 26, pl. 4: 2.
non 1969. *Nodosaria obliquestriata* (Reuss); Kraeva and Zerneckij: 45, pl. 15: 14.

Material. — Several fragmentary specimens.

Dimensions (in mm):

IGeol Pal 27
length of test fragments 0.650
maximum width 0.190

Remarks. — Our specimens are identical as those figured by Reuss (1851) and Kiesel (1962). This species was invalidly put into the synonymy of the species *Nodosaria emaciata* (Reuss), common till the present, by Batjes (1958). The specimen figured as *D.obliquestriata* Reuss by Kraeva and Zerneckij (1969) actually belongs to *Bifarina liebusi* Schubert. We consider *Dentalina obliquestriata* Reuss as guide species for the middle parts of the Rupelian (*Rotaliatina bulimoides* Zone)

Occurrence. — Poland: Middle Oligocene (*Rotaliatina bulimoides* Zone) (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG: Middle Oligocene. Belgium: Middle Oligocene (clays from Boom). Holland: Middle and Upper Oligocene.

Dentalina soluta Reuss, 1851
(pl. 9: 8, 10)

1851. *Dentalina soluta* Reuss: 60, pl. 3: 4.
1962. *Dentalina soluta* Reuss; Kiesel: 27, pl. 3: 14; pl. 4: 1.

Material. — About a dozen of more of less incomplete specimens.

Dimensions (in mm):

IGeol Pal 28
length 0.500—0.260
width 0.312—0.320

Remarks. — Our specimens somewhat differ from that figured by Reuss (1851) in the lack of distinct constriction at the boundary between the last two chambers, but the shape of chambers in the same. The Polish specimens are similar to those figured by Batjes (1958), and Kiesel (1962).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG and Belgium: Middle Oligocene. Holland: Middle Oligocene — Lower Miocene.

Dentalina inornata d'Orbigny, 1846
(pl. 9: 9)

1846. *Dentalina inornata* d'Orbigny: 44, pl. 1: 50, 51 (*fide* Catalogue of Foram., Ellis and Messina).
1970. *Dentalina inornata* d'Orbigny; Kiesel: 225, pl. 8: 1.

Material. — One specimen.
Dimensions (in mm):

IGeol Pal 29
length 0.870
maximum width 0.184

Remarks. — Our specimen somewhat differs from that figured by d'Orbigny (1846) in less convex lower part of chambers, being identical as that figured by Kiesel (1970).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR: Paleocene, Eocene. Austria (Vienna Basin): Miocene.

Family **Polymorphinidae** d'Orbigny, 1839
Subfamily **Polymorphininae** d'Orbigny, 1839
Genus *Raphanulina* Zborzewski, 1834
Raphanulina gibba globosa (Münster, 1838)
(pl. 10: 6*a*, *b*)

1838. *Polymorphina globosa* Münster; Roemer: 386, pl. 3: 33.
1930. *Globulina gibba* var. *globosa* (Münster); Cushman and Ozawa: 64, pl. 17: 8, 9.
1962. *Globulina gibba* d'Orbigny var. *globosa* (Roemer); Kiesel: 49, pl. 7: 11.

Material. — Some scores of well-preserved specimens.
Dimensions (in mm):

IGeol Pal 30
length 0.600
maximum width 0.525

Remarks. — Our specimens are incomparable with hardly legible drawing of Münster (1838), being identical as those figured by Cushman and Ozawa (1930) and very similar to that figured by Kiesel (1962).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR: Middle Oligocene. FRG: Middle-Upper Oligocene. Austria (Vienna Basin): Miocene.

Raphanulina minuta (Roemer, 1838)
(pl. 10: 3*a*, *b*)

1838. *Polymorphina minuta* Roemer: 386, pl. 3: 35.
1962. *Globulina minuta* (Roemer); Kiesel: 49, pl. 7: 17.

Material. — About a dozen well-preserved specimens.
Dimensions (in mm):

IGeol Pal 31
length 0.520
maximum width 0.325

Remarks. — Our specimens are very close to those figured from GDR by Kiesel (1962). In Poland this species seems confined to the *Rotaliatina bulimoides* Zone.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR: Middle Oligocene, FRG: Middle — Upper Oligocene.

Genus *Guttulina* d'Orbigny, 1839
Guttulina problema d'Orbigny, 1826
(pl. 10: 4*a*-*b*)

1826. *Guttulina problema* d'Orbigny: 266: 14.
1962. *Guttulina problema* d'Orbigny; Kiesel: 45, pl. 7: 4.
1970. *Guttulina problema* d'Orbigny; Didkovski and Satanovskaja: 76, pl. 49: 9a, b.

Material. — About a dozen well-preserved specimens.
Dimensions (in mm):

IGeol Pal 42
length 0.375
maximum width 0.325

Remarks. — This species is highly variable. Early Tertiary (Danian and Montian) forms are characterized by more strongly depressed sutures and individualized overhanging chambers (Pożaryska 1965) and the younger, Late Paleogene and Neogene forms — by more coherent tests (Didkovskij and Satanowskaja 1970).

Occurrence. — This species is pandemic in the whole Tertiary and Quaternary.

Family **Glandulinidae** Reuss, 1860
Subfamily **Oolininae** Leoblich and Tappan, 1961
Genus *Fissurina* Reuss, 1850
Fissurina lucida (Williamson, 1848)
(pl. 10: 5)

1848. *Entosolenia marginata* var. *lucida* Williamson: 17, pl. 2: 17.
1962. *Fissurina lucida* (Williamson); Kiesel: 155, pl. 8: 5.

Material. — About a dozen well-preserved specimens.
Dimensions (in mm):

IGeol Pal 44
length 0.350
maximum width 0.284

Remarks. — Our specimens are characterized by central parts of tests somewhat wider than that figured by Williamson (1848) but falling within the limits of intraspecific variability. The species is very close to *Fissurina marginata* and was initially treated even as subspecies of the latter.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG: Middle Oligocene. Austria (Vienna Basin): Miocene.

Family **Bolivinitidae** Cushman, 1927
Genus *Bolivina* d'Orbigny, 1939
Bolivina beyrichi Reuss, 1851
(pl. 10: 8, 9, 10)

1851. *Bolivina beyrichi* Reuss: 83, pl. 6: 51.
1962. *Bolivina beyrichi* Reuss; Kiesel: 60, pl. 9: 6.

Material. — About a dozen mostly fragmentary specimens.
Dimensions (in mm):

IGeol Pal 48
length 0.587
maximum width 0.157

Remarks. — Our specimens are almost identical as that figured by Reuss (1851). The species is characterized by a high intraspecific variability, concerning curvature of sutures and development of spines on peripheral margin.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Choszczno, Drawno, Gorzów Wielkopolski boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene.

Family **Eouvigerinidae** Cushman, 1927
Genus *Stilostomella* Guppy, 1894
Stilostomella ewaldi (Reuss, 1851)
(pl. 8: 4)

1851. *Nodosaria ewaldi* Reuss: 58, pl. 3: 2.
1956. *Nodosaria ewaldi* Reuss; Kaptarenko-Tschernousova: 105, pl. 6: 8—10.
1962. *Nodosaria ewaldi* Reuss; Kiesel: 23, pl. 4: 7.
1969. *Nodosaria ewaldi* Reuss; Kraeva and Zerneckij: 43, pl. 15: 5.

Material. — About a dozen broken specimens usually without aperture.
Dimensions (in mm):

IGeol Pal 50
length 0.775
width 0.108

Remarks. — As it was reported by other authors (Kiesel 1962; Batjes 1958; Kaptarenko-Tschernousova 1956 and others), the preservation of the representatives of this species is usually fragmentary and only a single specimen with aperture is known (Wolańska, MS). The aperture is formed by a thin, fine and very long tube ending with a slightly widened circular opening with lip.

This species evolved from Early Paleocene *Dentalina vistulae* Pożaryska (1957), somewhat smaller but also with very strongly elongate chambers, weakly incised sutures, smooth surface of the test and extended aperture. Oligocene *Stilostomella ewaldi* Reuss represents evolutionary link leading to Miocene species *Nodosaria longiscata* d'Orbigny. The names *Nodosaria ewaldi* and *N.longiscata* were sometimes invalidly used for Early Paleocene forms such as those from Midway Fm. in Texas (Plummer 1926). A species surprisingly close to the above described was reported under the name *Nodosaria farcimen* from the Pliocene of Italy (Catania) by Silvestri (1872).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene. USSR (Ukraine): Paleogene.

Superfamily **Buliminacea** Jones, 1875
Family **Sphaeroidinae** Cushman, 1927
Genus *Sphaeroidina* d'Orbigny, 1826
Sphaeroidina variabilis Reuss, 1851
(pl. 10: 1*a*, *b*; 2 *a*, *b*)

1851. *Sphaeroidina variabilis* Reuss: 88, pl. 7: 61, 64.
1969. *Sphaeroidina variabilis* Reuss; Kraeva and Zerneckij: 168, pl. 76: 9a, b; 10a, b.

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

IGeol Pal 56
diameter 0.250

Remarks. — Our specimens are identical as those figured by Reuss (1851) and Kiesel (1962). Vasiček (1954) initially regarded *Sphaeroidina variabilis* as synonym of *S.bulloides* which is known to occur from the Miocene till the present. In a subsequent paper, Vasiček (1956) interpreted *S.variabilis* as a subspecies of *S.bulloides* confined to the Lower Tertiary. According to the present authors, sutures deeper incised than in *S.bulloides* and a small, spherical chamber from the base of the aperture, not present in the latter species, make it possible to regard *S.variabilis* as a separate species of the genus *Sphaeroidina.*

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski, Choszczno and Wschowa Geo 6 boreholes) and Upper Oligocene (Fore-Sudetic Monocline, Matl and Śmigielska 1977). GDR, FRG, Belgium and Holland: Middle Oligocene. USSR (Ukraine, Caucasus Northern, Sakhalin): Oligocene — Miocene. USA: Oligocene.

Family **Uvigerinidae** Haeckel, 1894
Genus *Uvigerina* d'Orbigny, 1826
Uvigerina batjesi Kaasschieter, 1961
(pl. 10: 7)

1961. *Uvigerina batjesi* Kaasschieter: 197, pl. 8: 27, 28; pl. 9: 23.
1973. *Uvigerina batjesi* Kaasschieter; Gawor-Biedowa: 130, pl. 1: 4.

Material. — About a dozen well-preserved specimens.
Dimensions (in mm):

IGeol Pal 58
diameter 0.275
maximum width 0.190

Remarks. — Our specimens fully correspond to those figured by Kaasschieter (1961).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole) and Upper Eocene (Iława borehole). GDR, FRG, Belgium and Holland: Eocene and Middle Oligocene.

Genus *Hopkinsina* Howe and Wallace, 1932
Hopkinsina gracilis (Reuss, 1851)
(pl. 11: 1, 2, 3)

1851. *Uvigerina gracilis* Reuss: 77, pl. 5: 39.
1962. *Angulogerina gracilis* (Reuss); Kiesel: 56, pl. 8: 10, 11, 12 (with *synonymy*).

Material. — Several dozens of well-preserved specimens.
Dimensions (in mm):

IGeol Pal 62
length 0.587
maximum width 0 156

Remarks. — Our specimens are identical as those figured by Batjes (1958), being somewhat variable in elongation of test and interrelations between bi- and triserial parts (see pl. 11: 1, 2, 3).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Choszczno, Gorzów Wielkopolski and Wschowa Geo 6 boreholes, Łeba elevation and Puck Bay). GDR, FRG, Belgium: Middle Oligocene.

Genus *Trifarina* Cushman, 1923
Trifarina germanica (Cushman and Edwards, 1938)
(pl. 11: 4)

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.

Material. — About a dozen well-preserved specimens.

Dimensions (in mm):

IGeol Pal 83
length 0.375
maximum width 0.162

Remarks. — Our specimens are similar to that figured by Batjes (1958). The species seems limited to middle parts of the Rupelian, i.e. to the *Rotaliatina bulimoides* zone.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, Belgium: Middle Oligocene.

Superfamily **Discorbacea** Ehrenberg, 1938
Family **Discorbidae** Ehrenberg, 1938
Subfamily **Bagginiae** Cushman, 1927
Genus *Valvulineria* Cushman, 1927
Valvulineria petrolei (Andreae, 1884)
(pl. 11: 5*a*, *b*)

1884. *Pulvinulina petrolei* Andreae: 217, pl. 8: 15.
1962. *Valvulineria petrolei* (Andreae); Kiesel: 68, pl. 10: 3.

Material. — Three well-preserved specimens.

Dimensions (in mm):

IGeol Pal 64
maximum diameter 0.234
minimum diameter 0.221

Remarks. — Our specimens are identical as the holotype figured by Andreae (1884) and those figured by Batjes (1958). Photos of our specimens show that the pores are coarser than it would follow from figures given by the above mentioned authors. The species is confined to middle part of the Rupelian, the *Rotaliatina bulimoides* zone.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski and Choszczno boreholes). GDR, FRG and Belgium: Middle Oligocene.

Superfamily **Globigerinacea** Carpenter, Parker and Jones, 1862
Family **Hantkeninidae** Cushman, 1927
Subfamily **Cassigerinellinae** Bolli, Loeblich and Tappan, 1957
Genus *Cassigerinella* Pokorny, 1959
Cassigerinella cf. *chipolensis* (Cushman and Ponton), 1932
(pl. 11: 6*a*, *b*)

1964. *Cassigerinella chipolensis* (Cushman and Ponton); Postuma: p. 254, text — fig. p. 255.

Material. — Two well-preserved specimens.

Dimensions (in mm): maximum diameter 0.242

Remarks. — Our specimens are very small and with glittering test surface which agrees with description given by Postuma (1964). They differ from the illustrated holotype of *C.chipolensis* (see Cushman and Ponton 1932: 98, pl. 15: 2a, c) in less incised sutures whereas the shape of aperture and arrangement of chambers are typical of this species. It should be noted that according to Postuma (1964), this species does not belong to planktonic foraminifers as its walls are not porous.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). *Cassigerinella chipolensis* is known from the Oligocene of Belgium and Trinidad and Lower Miocene of Florida.

Family **Globigerinidae** Carpenter, Parker and Jones, 1862
Subfamily **Globigerininae** Carpenter, Parker and Jones, 1862
Genus *Globigerina* d'Orbigny, 1862
Globigerina angustiumbilicata Bolli, 1957
(pl. 12: 1*a*, *b*)

1957. *Globigerina angustiumbilicata* Bolli: 109, pl. 22: 12a, 13c; p. 164, pl. 36: 6a, b.
1962. *Globigerina angustiumbilicata* Bolli; Eames *et al.*: 85, pl. 9: 9, 16.
1975. *Globigerina angustiumbilicata* Bolli; Stainforth *et. al.*: 253: 105 (1—5c).
1975. *Globigerina angustiumbilicata* Bolli; Bertels: 44, pl. 3: 4, 5.

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 65
maximum diameter 0.312
minimum diameter 0.280

Remarks. — Our specimens do not differ from the holotype figured by Bolli (1957). The species differs from *Globigerina ouichitaensis ciperoensis* Blow in narrower umbilicus and smaller and arcuate aperture asymmetrically located and with lip. Eames and others (1962) considered that this species is related to *G.officinalis* Subbotina (1953) as they found several transitional forms in the material from the western Africa.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USA: uppermost Bartonian — top of Rupelian (Cipero Formation). Venezuela: Miocene (Pozon Formation). SW France: common in Oligocene — Miocene junction beds. Argentina: Oligocene, *Globigerina ciperoensis* zone. According to Stainforth (1975), this species occurs from the Upper Eocene to Pleistocene.

Globigerina aff. *ciperoensis* Bolli, 1954
(pl. 12: 3*a*, *b*)

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 66
maximum diameter 0.275
minimum diameter 0.254

Remarks. — Our specimens slightly differ from the holotype of *Globigerina ciperoensis* Bolli, mainly in poorly marked fifth chamber almost indiscernible in the last whorl. Dorsal side of our specimens is very similar to that of the specimen figured as *G.ciperoensis* by Cushman and Stainforth (1945).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). Trinidad, Tanzania, Argentina: Oligocene.

Globigerina corpulenta Subbotina, 1953
(pl. 11: 7*a*, *b*; 8*a*, *b*)

1953. *Globigerina corpulenta* Subbotina: 76, pl. 9: 5a, b, w — 7a, b, w; pl. 10: 1a, b, w — 3a, b, w; 4a, b.
1969. *Globigerina corpulenta* Subbotina; Kraeva and Zerneckij: 106, pl. 43: 5a, b, w.
1975. *Globigerina corpulenta* Subbotina; Caus: 303, pl. 1: 16a, b.

Material. — About a dozen well-preserved specimens.

Dimensions (in mm):

IGeol Pal 67
maximum diameter 0.325
minimum diameter 0.316

Remarks. — Our specimens do not differ from the holotype figured by Subbotina (1953). The species appears most similar to *Globigerina eocena* Gümbel (1868), differing in chambers less closely adjoining one another and more depressed sutures only.

Occurrence. — Poland: Middle Oligocene (basal Rupelian in the Szczecin IG 1 borehole). USSR (Mangyshlak, Central Asia and Ukraine): uppermost Upper Eocene. Spain: Paleogene.

Globigerina inaequispira Subbotina, 1953
(pl. 12: 2*a*, *b*)

1953. *Globigerina inaequispira* Subbotina: 69, pl. 6: 1—3.
1976. *Globigerina* (*Eoglobigerina*) *inaequispira* Subbotina; Hillebrandt: 331, pl. 1: 1, 6, 8, 11, 13; pl. 2: 7a, b.

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 68
maximum diameter 0.184
minimum diameter 0.182

Remarks. — Our specimens well correspond to the holotype figured by Subbotina (1953). Chambers of representatives of this species are very close to those of *Globigerina linaperta* Finlay (1939) in shape, essentially differing, however, in the shape of aperture.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USSR (Caucasus): Eocene and Oligocene. Spain: Eocene and Oligocene junction beds (*Globigerina caucasica* zone).

Globigerina officinalis Subbotina, 1953
(pl. 11: 10*a*, *b*)

1953. *Globigerina officinalis* Subbotina: 78, pl. 11: 1—7.
1975. *Globigerina officinalis* Subbotina; Stainforth *et al.*: 211, 71, 1—7.

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

IGeol Pal 69
maximum diameter 0.156
minimum diameter 0.152

Remarks. — Our specimen fully corresponds to the holotype figured by Subbotina (1953) in a very low aperture with lip and finaly-perforated test wall. This species resembles *Globigerina ouichitaensis* Howe and Wallace in shape, differing in the lack of wide umbilicus and more tightly packed chambers. It differs from *G.senilis* Bandy (1949) in markedly smaller size and narrower aperture.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USSR: Upper Eocene — Lower Oligocene (Caucasus), Lower Oligocene (Ukrainian Carpathians, Crimea and Aral Sea Depression and Georgian SSR), Oligocene (Ustjurt). Spain: Paleogene.

Globigerina pseudoeocaena Subbotina, 1953
(pl. 12: 4*a*, *b*)

1953. *Globigerina pseudoeocaena* Subbotina: 67, pl. 5: 1a, b, w; 2a, b, w.

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

IGeol Pal 70
maximum diameter 0.350
minimum diameter 0.324

Remarks. — Our specimens do not differ from the holotype figured by Subbotina (1953). This species is most close to *G.eocaena* Gümbel (1868), differing in less elongate test, differentiated size of chambers of the last whorl and more tight packing chambers.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USSR (Ukraine, Crimea, Caucasus and Mangyshlak): Upper Eocene.

Globigerina senilis Bandy, 1949
(pl. 11: 9*a*, *b*)

1949. *Globigerina ouichitaensis* Howe and Wallace var. *senilis* Bandy: 121, pl. 22: 5a, c.
1975. *Globigerina senilis* Bandy; Bertels: 445, pl. 4: 1a, b.

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

IGeol Pal 71
maximum diameter 0.372
minimum diameter 0.350

Remarks. — Our specimens do not differ from the holotype figured by Bandy (1949). This species differs from *Globigerina ouichitaensis* Howe and Wallace in coarser perforated test wall, less depressed sutures between chambers and somewhat asymmetric location of apertural chamber.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USA (Alabama): Upper Eocene (Jackson Formation). East Africa: Eocene — top of Oligocene. Argentina: Oligocene.

Globigerina turkmenica Khalilov, 1956
(pl. 11: 11*a*, *b*)

1969. *Globigerina turkmenica* Khalilov; Kraeva and Zerneckij: 109, pl. 44: 7a, b, w.

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 72
maximum diameter 0.312
minimum diameter 0.275

Remarks. — Our specimens do not differ from the holotype in number of chambers nor the type of aperture. The species is close to stratigraphically younger species *Globigerina apertura* (Cushman, 1918), differing in markedly smaller and less obtuse aperture and somewhat higher apertural chamber.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). USSR (Ukraine, Northern Caucasus, Azerbaijan and Turkmenia): Upper Eocene.

Globigerina turritilina praeturritilina Blow and Banner, 1962
(pl. 11: 12*a*, *b*)

1962. *Globigerina turritilina praeturritilina* Blow and Banner: 99, pl. 13: A—C.

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 73
maximum diameter 0.275
minimum diameter 0.250

Remarks. — Our specimens do not differ from the holotype of this subspecies figured by Blow and Banner (1962). Our specimens differ from the representatives of *Globigerina turritilina turritilina* Blow and Banner (1962) in less swollen chambers, wider umbilicus, somewhat higher apertural chamber and finer perforated test wall.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). Africa (Tanzania): Upper Eocene, from the *Globigerapsis semiinvoluta* to *Globigerina turritilina turritilina* zone.

Globigerina sp.
(pl. 11: 13*a*, *b*; 14*a*, *b*)

Material. — A few well-preserved specimens.

Dimensions (in mm):

IGeol Pal 74
maximum diameter 0.282
minimum diameter 0.250

Remarks. — Our specimens are similar to both these of the species *Globigerina pseudodubia* Bandy (1949) and *Globigerina conglomerata* Schwager (1866) from the Neogene of India. The identification is, unfortunately, precluded as dorsal side of the Indian species was not figured.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole).

Superfamily **Orbitoidacea** Schwager, 1876
Family **Cibicididae** Cushman, 1927
Subfamily **Cibicidinae** Cushman, 1927
Genus *Cibicides* de Montfort, 1808
Cibicides reussi Ten Dam and Reinhold, 1942
(pl. 12: 5*a-c*; 6*a-c*)

1942. *Cibicides reussi* Ten Dam and Reinhold: 100, pl. 8: 4a, c.
1962. *Cibicides reussi* Ten Dam and Reinhold; Kiesel: 74, pl. 11: 4.

Material. — Several fairly well preserved specimens; the last chamber often damaged.

Dimensions (in mm):

IGeol Pal 76
maximum diameter 0.437
minimum diameter 0.286

Remarks. — Our specimens are identical as the holotype figured by Ten Dam and Reinhold (1942). This species was described from upper part of the Middle Oligocene of the Netherlands. The analysis of our material also suggests that it is limited to the *Rotaliatina bulimoides* zone of upper parts of the Rupelian in the Central Europe.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole). GDR, FRG, Holland: Middle Oligocene.

Cibicides ungerianus (d'Orbigny, 1846)
(pl. 12: 7*a-c*)

1846. *Rotalina ungeriana* d'Orbigny: 157, pl. 8: 16, 18.
1962. *Cibicides ungerianus* (d'Orbigny, 1848); Kiesel: 75, pl. 11: 7 (with synonymy).

Material. — Some dozens of well-preserved specimens.

Dimensions (in mm):

IGeol Pal 82
maximum diameter 0.450
minimum diameter 0.325

Remarks. — Our specimens are identical as those figured by d'Orbigny (1846). They are also similar to those from the Oligocene of GDR, figured by Kiesel (1962).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes), Miocene (margins of the Holy Cross Mts and Carpathian Foredeep). GDR, FRG, Belgium and Holland: Middle Oligocene. Hungary: Middle Oligocene (clays from Kiscel). USSR: Eocene — Oligocene (Turkmenia, Tadzhik Depression and Mangyshlak), America: Oligocene. Austria: Miocene (Vienna Basin). Czechoslovakia, Bulgaria: Miocene. At present, *Cibicides ungerianus* occurs in the Mediterranean Sea, Atlantic and Pacific.

Superfamily **Cassidulinacea** d'Orbigny, 1839
Family **Cassidulinidae** d'Orbigny, 1839
Genus *Globocassidulina* Voloshinova, 1960
Globocassidulina oblonga (Reuss, 1850)
(pl. 13: 1*a-c*)

1850. *Cassidulina oblonga* Reuss: 376, pl. 48: 5, 6.
1958. *Cassidulina subglobosa* var. Brady; Batjes: 127, pl. 6: 10.
1970. *Cassidulina oblonga* Reuss; Didkovskij and Satanowskaja: 141, pl. 81: 6*a*, *b*; 8.

Material. — About a dozen specimens with terminal chambers damaged. Dimensions (in mm):

IGeol Pal 89
length 0.340
maximum width 0.180

Remarks. — Our specimens somewhat differ from the holotype (Reuss, 1850) in more rounded peripheral margin. The specimen assigned to *Cassidulina subglobosa* Brady by Batjes (1958) resembles them in test outline and arrangement of chambers. The same is the case of specimens figured by Didkovskij and Satanowskaja (1970).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 borehole), Miocene (Carpathian Foredeep). FRG and Belgium: Middle and Upper Oligocene. USSR: Oligocene (Caucasus), Miocene (Ukraine). Bulgaria, Romania and Austria: Miocene.

Family **Nonionidae** Schultze, 1854
Subfamily **Nonioninae** Schultze, 1854
Genus *Pullenia* Parker and Jones, 1862
Pullenia bulloides (d'Orbigny, 1846)
(pl. 13: 2*a*, *b*; 3*a*, *b*)

1846. *Nonionina bulloides* d'Orbigny: 107, pl. 5: 9, 10.
1969. *Pullenia bulloides* (d'Orbigny); Kraeva and Zerneckij: 100, pl. 42: 2*a*, *b*.

Material. — About a dozen well-preserved specimens
Dimensions (in mm):

IGeol Pal 90
minimum diameter 0.214
maximum diameter 0.237

Remarks. — Our specimens are very close to the specimen figured by d'Orbigny, differing in somewhat less incurved sutures. A high variability in the degree of flattening of tests of this species was stressed by Batjes (1958).

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes), Miocene (Carpathian Foredeep). GDR, FRG and Belgium: Midddle Oligocene. USSR (Ukraine): Upper Oligocene (*Sphaeroidina variabilis* zone). Austria (Vienna Basin): Miocene. Japan (Okinawa): Miocene.

Pullenia quinqueloba (Reuss, 1851)
(pl. 13: 4*a*, *b*)

1851. *Nonionina quinqueloba* Reuss: 71, pl. 5: 31.
1969. *Pullenia quinqueloba* Reuss; Kraeva and Zerneckij: 101, pl. 42: 3.
1977. *Pullenia quinqueloba* (Reuss); Pożaryska: pl. 5: 7a, b.

Material. — Several well preserved specimens.

Remarks. — Our specimens are similar to the holotype (Reuss, 1851) in test outline and shape of sutures, differing in four (instead 5) chambers in the last whorl. Four-chambered specimens were also figured by Kraeva and Zerneckij (1969).

Occurrence. — Poland: Upper Eocene (Siemień), Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR: Middle Oligocene. FRG: Middle Oligocene — Miocene. Holland and Belgium: Oligocene — Miocene.

Family **Alabaminidae** Hofker, 1951
Genus *Rotaliatina* Cushman, 1925
Rotaliatina bulimoides (Reuss, 1851)
(pl. 12: 8, 9)

1851. *Rotaliatina bulimoides* Reuss: 77, pl. 5: 38.
1962. *Rotaliatina bulimoides* (Reuss); Kiesel: 70, pl. 10: 8 (with synonymy).

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

IGeol Pal 86
length 0.375
maximum width 0.225

Remarks. — Our specimens are identical as the holotype figured by Reuss (1851). The variability concerns elongation of spiral part of test only.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski and Wschowa Geo 6 boreholes). GDR, FRG: Middle Oligocene. Holland: Middle Oligocene. Belgium: Middle Oligocene (clays from Boom).

Genus *Alabamina* Toulmin, 1941
Alabamina tangentialis (Clodius, 1922)
(pl. 13: 5*a*, *b*)

1922. *Pulvinulina tangentialis* Clodius: 138, pl. 1: 14.
1970. *Alabamina tangentialis* (Clodius); Kiesel: 295, pl. 17: 8.

Material. — About a dozen well-preserved specimens.
Dimensions (in mm):

IGeol Pal 101
maximum diameter 0.312
minimum diameter 0.276

Remarks. — Our specimens are identical with the holotype.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR and FRG: Middle Oligocene. Belgium: Middle Oligocene (clays from Boom). Holland and SW France: Middle Oligocene. Middle Miocene of North Sea coasts.

Genus *Gyroidina* d'Orbigny, 1826
Gyroidina soldanii d'Orbigny, 1826
(pl. 13: 6*a*-*c*)

1826. *Gyroidina soldanii* d'Orbigny: 278, pl. 46: 10—12.
1977. *Gyroidina soldanii* d'Orbigny; Pożaryska: 43, pl. 4: 4*a*-*c*.

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

IGeol Pal 107
maximum diameter 0.320
minimum diameter 0.289

Remarks. — Our specimens differ from the holotype figured by d'Orbigny (1826) by widened sutures, being more close to those described from the Upper Eocene of eastern Poland and Oligocene of Belgium (Batjes, 1958).

Occurrence. — Poland: Upper Eocene (Siemień) and Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski and Choszczno boreholes). Europe and America: Middle Oligocene, Miocene.

Gyroidina girardana Reuss, 1851
(pl. 13: 7*a-c*)

1851. *Gyroidina girardana* Reuss: 73, pl. 5: 24.
1970. *Gyroidinoides girardanus* Reuss; Kiesel: 288, pl. 16: 2.
1974. *Gyroidina soldanii* forma *girardana* (Reuss); Ulleberg: 282, pl. 5: 1, 5; pl. 7: 8, 9.

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

IGeol Pal 108
maximum diameter 0.524
minimum diameter 0.482

Remarks. — Our specimens are identical as the holotype figured by Reuss (1851). The variability concerns differences in degree of flattening of test and width of umbilicus.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG and Denmark: Middle Oligocene. America an Egypt: Paleogene.

Family **Anomalinidae** Cushman, 1927
Genus *Melonis* de Monfort, 1808
Melonis affine (Reuss, 1851)
(pl. 14: 1*a*, *b*; 2*a*, *b*)

1851. *Nonionina affinis* Reuss: 72, pl. 5: 22.
1977. *Melonis affine* (Reuss); Pożaryska and Odrzywolska-Bieńkowa: 62, pl. 4: 8*a*, *b* (with synonymy).

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

IGeol Pal 110
maximum diameter 0.320
minimum diameter 0.250

Remarks. — Our specimens are insignificantly more swollen than the holotype figured by Reuss (1851) but easily fall within the limits of intraspecific variability which is connected with the degree of flattening of test.

Occurrence. — Poland: Upper Eocene (northern Poland), Middle Oligocene (Szczecin IG 1, Gorzów Wielkopolski, Choszczno, Wschowa Geo 6 boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene.

Genus *Svratkina* Pokorny, 1956
Svratkina perlata (Andreae, 1884)
(pl. 14: 4*a*, *b*; 5*a-c*)

1884. *Pulvinulina perlata* Andreae: 216, pl. 8: 12.
1977. *Svratkina perlata* (Andreae); Pożaryska: 42, pl. 5: 1*a-c*.

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

IGeol Pal 43
maximum diameter 0.242
minimum diameter 0.220

Remarks. — Our specimens are identical as the holotype figured by Andreae (1884). Variability high (see Pożaryska 1977).

Occurrence. — Poland: Upper Eocene (Siemień), Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG: Middle Oligocene, Rupelian. Belgium: Middle Oligocene (clays from Boom).

Genus *Oridorsalis* Andersen, 1961
Oridorsalis umbonatus (Reuss, 1851)
(pl. 14: 3*a*-*c*)

1851. ***Rotalina umbonata*** Reuss: 75, pl. 5: 35.
1970. *Eponides umbonatus* (Reuss); Kiesel: 292, pl. 17: 2.
non 1969. *Eponides umbonatus* (Reuss); Kraeva and Zerneckij: 78, pl. 28: 2*a*, *b*, *w*.

Material. — Some dozens of well-preserved specimens.
Dimensions (in mm):

IGeol Pal 52
maximum diameter 0.375
minimum diameter 0.330

Remarks. — Our specimens are identical as the holotype figured by Reuss (1851). They are characterized by well-developed additional skeletal elements on ventral side, represented by six-arm star in central part of the test. This element is missing in the specimen figured by Kraeva and Zerneckij (1969) so it was excluded from this species.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes). GDR, FRG, Belgium and Holland: Middle Oligocene.

Superfamily **Robertinacea** Reuss, 1850
Family **Ceratobuliminidae** Cushman, 1927
Subfamily **Epistomininae** Wedekind, 1937
Genus *Epistomina* Terquem, 1883
Epistomina elegans (d'Orbigny, 1826)
(pl. 14: 6*a*-*c*; 7*a*-*c*)

1826. *Rotalia elegans* d'Orbigny: 276: 54.
1846. *Rotalina partschiana* d'Orbigny: 153, pl. 7: 28—30.
1970. *Epistomina partschiana* (d'Orbigny); Didkovskij and Satanovskaja: 88, pl. 56: 5*a*, *b*, *w*.

Material. — Some dozens of usually well-preserved specimens.
Dimensions (in mm):

IGeol Pal 56
maximum diameter 0.312
minimum diameter 0.293

Remarks. — Our specimens are very similar to those figured as *Rotalia elegans* d'Orbigny, 1826, and *Rotalina partschiana* d'Orbigny, 1846. We agree with Kiesel that

Rotalina partschiana is the junior synonym of *Rotalia elegans*. According to Pazdro (1969), there is no reason for separating a new genus *Höglundina* (Brotzen, 1948) for post-Mesozoic representatives of the genus *Epistomina*.

Occurrence. — Poland: Middle Oligocene (Szczecin IG 1 and Gorzów Wielkopolski boreholes), Miocene (Carpathian Foredeep, margins of the Holy Cross Mts). GDR, FRG: Rupelian. Belgium: Middle Oligocene (clays from Boom) — Miocene. Holland: Middle Oligocene — Miocene. Austria: Miocene (Vienna Basin). USSR (Ukraine): Miocene.

CALCAREOUS NANNOPLANKTON

During investigation of 113 samples between 50.0 and 239.3 meters of the Szczecin (= Stettin) IG 1 borehole, 2 horizons containing calcareous nannoplankton were found. The upper horizon, approximately between 131.2 and 156.1 meters, belongs to the Oligocene calcareous nannoplankton zone NP 24 (*Sphenolithus distentus* Zone) as discussed below. The lower horizon, approximately between 192.0 and 223.0 meters, can be placed in the Eocene calcareous nannoplankton zones NP 15 (*Chiphragmalithus alatus* Zone) and NP 16 (*Discoaster tani nodifer* Zone). The intervals between 50.0 and 131.2 meters, 156.1 and 192.0 meters as well as between 226.6 and 239.3 meters are barren in calcareous nannoplankton.

In the Oligocene succession the first occurrences of calcareous nannoplankton are within the interval between 149.7 and 156.1 meters, probably around 152 meters as three of 10 samples from this interval contain calcareous nannoplankton. The highest occurrences were noted approximately at 134 meters as four out of 8 samples from the interval between 131.2 and 137.2 meters were barren in calcareous nannoplankton. The assemblages found are poorly preserved and most specimens are effected by solution.

A total of 18 samples are grouped together in their respective interval because their unknown position within these intervals, and distribution of autochtonous calcareous nannoplankton species is listed in table 2. Reworked nannoplankton species from the Upper Cretaceous and Paleogene are present in most samples and include the following taxa:

Arkhangelskiella cymbiformis Vekshina, 1959
Cretarhabdus ? anthrophorus (Deflandre) Bramlette and Martini, 1964
Cretarhabdus crenulatus Bramlette and Martini, 1964
Cribrosphaerella ehrenbergi Archangelsky, 1912
Glaukolithus diplogrammus (Deflandre) Reinhardt, 1964
Lithastrinus floralis Stradner, 1962
Microrhabdulus stradneri Bramlette and Martini, 1964
Micula staurophora (Gardet) Stradner, 1963
Nephrolithus frequens Górka, 1957
Predicosphaera cretacea (Archangelsky) Gartner, 1968
Tetralithus aculeus (Stradner) Gartner, 1968
Tetralithus trifidus (Stradner) Bukry, 1973

Watznaueria barnesae (Black) Perch-Nielsen, 1968
Chiasmolithus solitus (Bramlette and Sullivan) Locker, 1968
Cyclococcolithus formosus Kamptner, 1963
Discoaster barbadiensis Tan Sin Hok, 1927
Discoaster cf. *tani* Bramlette and Riedel, 1954
Ericsonia subdisticha (Roth and Hay) Roth, 1969
Isthmolithus recurvus Deflandre, 1954
Reticulofenestra umbilica (Levin) Martini and Ritzkowski, 1968
Zygodiscus sigmoides Bramlette and Sullivan, 1961

The high percentage of reworked calcareous nannoplankton was also noted for equivalent beds in Northern Germany by Locker (1968) and Müller (1970).

The autochtonous calcareous nannoplankton assemblages include the following species:

Braarudosphaera bigelowi (Gran and Braarud) Deflandre, 1947
Coccolithus abisectus Müller, 1970
Coccolithus eopelagicus (Bramlette and Riedel) Bramlette and Sullivan, 1961
Coccolithus pelagicus (Wallich) Schiller, 1930
Cyclococcolithus floridanus (Roth and Hay) Müller, 1970
Cyclococcolithus hoerstgensis Müller, 1970
Dictyococcites dictyodus (Deflandre and Fert) Martini, 1969
Discolithina desueta Müller, 1970
Discolithina multipora (Kamptner) Martini, 1965
Discolithina pygmaea Locker, 1967
Helicosphaera bramlettei (Müller) Jafar and Martini, 1975
Helicosphaera recta (Haq) Jafar and Martini, 1975
Reticulofenestra clatrata Müller, 1970
Reticulofenestra lockeri Müller, 1970
Reticulofenestra retisimilis Müller, 1970
Sphenolithus sp.
Zygrhablithus bijugatus (Deflandre) Deflandre, 1959

The autochtonus calcareous nannoplankton is dominated by *Reticulofenestra lockeri* in almost all samples. Fairly common are *Coccolithus abisectus, Cyclococolithus floridanus, Dictyococcites dictyodus* and *Reticulofenestra clatrata*. Other species listed above in table 2 are rare and not present in all samples. Species like *Braarudosphaera bigelowi, Discolithina desueta, Discolithina multipora, Discolithina pygmaea* and *Zygrhablithus bijugatus*, which are known from "near shore" environments and shallow water (e.g. Müller 1971) are rare, indicating somewhat deeper water during part of the *Sphenolithus distentus* Zone (NP 24) in the area investigated.

Concerning the stratigraphic position of the interval between 134 and 152 meters containing calcareous nannoplankton the placement in zone NP 24 (*Sphenolithus distentus* Zone) of the standard calcareous nannoplankton zonation (Martini 1971) is based on substitute species as sphenoliths commonly used as index-species in the Middle Oligocene are missing in most of the North Sea basin (Müller 1970). *Coccolithus abisectus* and *Helicosphaera recta* have their first occurrence at or near the base of zone NP 24, which is originally defined by the first occurrence of *Spheno-*

lithus ciperoensis. The boundary between zone NP 24 (*Sphenolithus distentus* Zone) and NP 25 (*Sphenolithus ciperoensis* Zone), originally defined by the last occurrence of *Sphenolithus distentus*, in the North Sea basin is better defined by the first occurrence of *Discolithina enormis* and *Helicosphaera perch-nielseniae* (Benedek and Müller 1974; Martini and Müller 1975), which seem to occur first near the last occurrence of *Sphenolithus distentus* elsewhere. In samples investigated *Coccolithus abisectus* as well as *Helicosphaera recta* have been found, but *Discolithina enormis* and *Helicosphaera perch-nielseniae* were not encountered, consequently the interval between 134 and 152 meters can be placed in zone NP 24 (*Sphenolithus distentus* Zone) of the standard calcareous nannoplankton zonation.

The Oligocene calcareous nannoplankton assemblages from the Szczecin IG 1 borehole show close similarities to assemblages of other north-German "Septarien-Ton"-occurrences, e.g. Freienwalde/Oder and Berlin-Hermsdorf (Müller 1970; Martini and Müller 1971; Locker 1972), Nennhausen and Waßmannsdorf (Locker 1972), and to the upper Lintfort beds (Obere Lintforter Schichten) to the lower Rhine valley (Benedek and Müller 1974), which can be correlated to foraminiferal horizons C_2 and C_3 of Indans (1958) and which also can be placed in nannoplankton zone NP 24. They are younger than the assemblages found in the type Rupelian, in which *Coccolithus abisectus* and *Helicosphaera recta* are not yet present, and which belong to zone NP 23 (*Sphenolithus predistentus* Zone) of the standard calcareous nannoplankton zontation (Müller 1970; Martini and Müller 1971). For correlations to the Mainz basin and the upper Rhine valley see Müller 1971. Zone NP 24 is present in some famous foraminiferal localities in Trinidad and can be correlated to the *Globorotalia opima opima* zone of the planktonic foraminifera zonation (Bramlette and Wilcoxon 1967).

Instytut Geologiczny
Zakład Stratygrafii
ul. Rakowiecka 4
00-975 Warszawa
Poland
E. Odrzywolska-Bieńkowa

Polska Akademia Nauk
Zakład Paleobiologii
Al. Żwirki i Wigury 93
02-089 Warszawa
Poland
K. Pożaryska

Geologisch-Paläontologisches
Institut
Johann-Wolfgang-Goethe
Universität
Senckenberg-Anlage 32-34
D-6000 Frankfurt am Main
FRG
E. Martini

REFERENCES

ANDREAE, A. 1884. Ein Beitrag zur Kenntnis de Elsässer Tertiärs. — *Abh. Geol. Spec. Kte. Els.-Lothr.*, **2**, 3, 1—239.

AREŃ, B. 1957. Atlas Geologiczny Polski. Zagadnienie stratygraficzno-facjalne. Zesz. II. Trzeciorzęd 1:3 000 000 Warszawa.

BANDY, O. L. 1949. Eocene and Oligocene Foraminifera from Little Stave Creek Clarke Country, Alabama. — *Bull. Amer. Paleontol.*, **32**, 131, 1—207.

BARTENSTEIN, H. *et al.* 1962. Tertiär Norddeutschlands (*in*: Leitfossilien der Mikropaläontologie), 1—432 Berlin.

BATJES, D. A. J. 1958. Foraminifera of the Oligocene of Belgium. — *Kon. Belg. Inst. Naturw. Verh.*, **143**, 1—188.

BENEDEK, P. N. v. and MÜLLER, C. 1974. Nannoplankton-Phytoplankton-Korrelation im Mittel- und Ober-Oligozän von NW-Deutschland. — *N. Jb. Geol. Paläont., Mh.*, **7**, 385—397.

BERTELS, A. 1975. Biostratigrafia de Paleogene en la Republica Argentina. — *Rev. Esp. de Microp.*, **7**, 3, 429—453.

BETTENSTAEDT, F. 1949. Paläogeographie des nordwestdeutschen Tertiär mit besonderer Berücksichtigung der Mikropaläontologie. Erdöl und Tektonik in Nordwestdeutschland, 143—172.

BOJARSKI, L. and MAREK, S. 1974. Gołdap IG-1, Trzeciorzęd. Profile głębokich otworów wiertniczych IG, 16, 72. Wydawnictwa Geologiczne, Warszawa.

BOLLI, H. M. 1957. The genera *Globigerina* and *Globorotalia* in the Paleocene-Lower Eocene Lizardspringformation of Trinidad. — *B. W. J. U. S. Nat. Mus. Bull.*, **215**, 61—82.

BORNEMANN, J. G. 1855. Die Mikroskopische Fauna des Septarienthones von Hermsdorf bei Berlin. — *Zeitschr. geol. Ges.*, **7**, 307—371.

BRAMLETTE, M. N. and WILCOXON, J. A. 1967. Middle Tertiary calcareous nannoplankton of the Cipero section, Trinidad, W. I. — *Tulane Stud. Geol.*, **5**, 93—132.

BROTZEN, F. 1948. The Swedish Paleocene and its foraminiferal fauna. — *Sver. Geol. Unders. ser. C.*, **493**, 3—140.

BUCHARDT, B. 1977. Oxygen isotope palaeotemperatures from the Danish Tertiary. A preliminary report. *In*: IGCP Project 124: The Nordwestern European Tertiary Basin. Report No. 2. 1—9.

BUTT, A. A. 1966. Late Oligocene Foraminifera from Escornebeou, SW France, 1—106, Schotanus & Jens-Utrecht /NV/, Utrecht.

CAUS, E. 1975. Bioestratigrafia del Eoceno medio y superior del Prepireneo catalán (y la zona de tránsito entre esta unidad y la cordillera prelitoral catalana). — *Rev. Esp. Microp.*, **7**, 2, 297—317.

CAVELLIER, C. and POMEROL, CH. 1976. Les rapports entre le Bartonien et le Priabonien. Incidence sur la position de la limite Eocène supérieur. — *Bull. Soc. Géol. France, C. R. Somm. Séances.*, **2**, *Suppl. Bull.*, **18**, 2, 49—51.

CIUK, E. 1972. Utwory paleogeńskie w rejonie szczecińskim. — *Przegl. Geol.*, **11**, 498—502.

— 1973. Szczecin IG-1. Profile głębokich otworów wiertniczych IG, zesz. 6, 18—23.

CLODIUS, G. 1922. Die Foraminiferen des obermiozänen Glimmertons in Norddeutschland mit besonderer Berücksichtigung der Aufschlüsse in Mecklemburg. — *Archiv. Ver. Freunde. Natur. Meckl.*, 76—145.

CUSHMAN, J. A. 1918. The Foraminifera of the Atlantic Ocean. — *U. S. Nat. Mus. Bull.* **104**, 1—111.

— and EDWARDS, P. G. 1937. Notes on the early described Eocene species of *Uvigerina* and some new species. — *Contr. Lab. Foram. Res.*, **13**, 54—61.

— and OZAWA, Y. 1930. A monograph of the foraminiferal family Polymorphinidae recent and fossil. — *Proc. U. S. Nat. Mus.*, **77**, 6, 1—185.

— and PONTON, G. M. 1932. An Eocene foraminiferal fauna of Wilcox Age from Alabama. — *Contr. Cush. Lab. Foram, Res.*, **8**, 3, 51—72.

— and STAINFORTH, R. 1945. The Foraminifera of the Cipero Marl Formation of Trinidad British West Indies. — *Cush. Lab. Foram. Res. Spec. Publ.*, **14**, 1—75.

DAM, A., TEN, and REINHOLD, T. 1942. Die stratigraphische Gliederung des niederländischen Oligo-Miozäns nach Foraminiferen (Mit Ausnahme von Süd Limburg). — *Med. Geol. Stichting, C.-V.*, 2, 1—106.

DIDKOVSKIJ, V. Ja and SATANOVSKAJA, Z. N. (ДИДКОВСКИЙ, В. Я., САТАНОВСКАЯ, З. Н.) 1970. Палеонтологический справочник 4. Фораминиферы миоцена Украины. Наукова Думка. 1—165. Киев.

DROOGER, C. W. 1962. Les microfaunes de l'éocène-oligocène du Bassin Nordique. — *Coll. sur le Paléog. II. Mém. Bur. Rech. Géol. Min.*, **28**, 547—552.

EAMES, F. E., BANNER, F. T., BLOW, W. H., CLARKE, W. J. 1962. Fundamentals of Mid Tertiary Stratigraphical correlations. 1—163, Cambridge.

ELLERMANN, C. 1958. Foraminiferen aus dem Oligozän des Schachtes Kapellen bei Moers. — *Fortschr. Geol. Rheinl. Westf.*, **1**, 2, 205—214.

ELLIS, B. F. and MESSINA, A. R. 1940. Catalogue of Foraminifera. — *Amer. Mus. Nat. Hist. Spec. Publ.* New York (cum suppl.).

GALLOWAY, J. J. and HEMINWAY, C. E. 1941. The Tertiary Foraminifera of Porto Rico. — *New York. Acad. Sci. Surv. Porto Rico and Virgin Islands*, **21**, 1—37.

GAWOR-BIEDOWA, E. 1973. Stratygrafia paleocenu z otworu Iława na podstawie badań mikropaleontologicznych. — *Kwart. Geol.*, **17**, 1, 124—130.

GORTYŃSKA, S., WOŹNY, E. and WOLAŃSKA, H. 1962. Kilka uwag o oligocenie w Polsce zachodniej. — *Ibidem*, **6**, 1, 125—156.

GRABOWSKA, I. 1972. Palinologiczne opracowanie profili trzeciorzędowych obszaru woj. olsztyńskiego. — *Spraw. Pos. Nauk. IG, Kwart. Geol.*, **16**, 4, 1009—1010.

— 1974. Stratygrafia osadów paleogeńskich na Niżu Polskim w świetle badań mikroflorystycznych (English summary). *In*: J. Raniecka-Bobrowska and E. Ciuk (eds.); Tertiary Research in Poland, vol. 7 — *Biul. Inst. Geol.*, **281**, 67—90.

GRAMANN, F. 1975. Sarstedt, Lehrte und Helmstedt. Tonig-sandiges Alttertiär in Salzstocknähe. — Paläont. Ges. Exc. D, 1—20, Hannover.

GROSSHEIDE, K. and TRUNKO, L. 1965. Die Foraminiferen des Doberges bei Bünde und von Astrup. — *Geol. Jahrb. Beih.*, **60**, 10, 1—213.

GÜMBEL, C. 1868. Beiträge zur Foraminiferenfauna der nordalpinen Eozängebilde. — *Abh. K. Bayer. Akad. Wiss. Cl.*, **2**, 581—730.

INDANS, J. 1958. Mikrofaunistische Korrelation im marinen Tertiär der Niederrheinischen Bucht. — *Fortschr. Geol. Rheinl. Westf.*, **1—2**, 223—238.

JASKOWIAK-SCHOENEICH, M. (*editor*) 1973. Szczecin IG-1. Profile głębokich otworów wiertniczych IG, **6**, 1—134. Wydawnictwa Geologiczne. Warszawa.

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

KAPTARENKO-TSCHERNOUSOVA, O. K. (КАПТАРЕНКО-ЧЕРНОУСОВА, О. К.) 1956. Фораминиферы киевского яруса днипровско-донецкой западины та пивнично-захидных окраин донецкого басейну. — *Труды Инст. Геол. Наук, Сер. страт. палеонт.*, **8**, 7—188.

KHALILOV, D. M. 1956. On the pelagic foraminiferal fauna of the Paleogene of Azerbeidzhan. — *Akad. Nauk. Azerb. SSR, Inst. Geol. Baku*, **17**, 234—361.

KIESEL, Y. 1962. Die oligozänen Foraminiferen der Tiefbohrung Dobbertin (Mecklemburg). Ein Beitrag zur Feinstratigraphie des mitteldeutschen Rupels. — *Freib. Forschr.-Hefte. C.* 122, 1—123.

— 1970. Die Foraminiferen der paläozänen und eozänen Schichtenfolge der Deutschen Demokratischen Republik. — *Paläont. Abh., A, Paläontologie*, **4**, 2, 270—394.

KOENEN, A. v. 1867. Das marine Mitteloligozän Norddeutschlands. — *Paläontographica*, **16**, 1—148.

KOROBKOV, I. A. 1962. Historique de la définition de l'Oligocène. — Colloque sur le Paléog., Bordeaux, *Mém. Bur. Rech. Géol. Min.*, **28** (2), 747—760.

KRAEVA, E. Ja., ZERNECKIJ, B. F. (КРАЕВА, Е. Я., ЗЕРНЕЦКИЙ, Б. Ф.) 1969. Палеонтологический справочник, 3, Фораминиферы палеогена Украины. Наукова Думка, Киев. 1—197.

KRUTSCH, W. and LOTSCH, D. 1962. Propositions à l'appui d'une tentative en vue subdiviser les dépôts de l'Eocène et ceux de l'Oligocène inférieur et moyen et de mettre en parallèle ces dépôts d'Europe occidentale entre eux et avec ceux d'Europe centrale, et étude de la position à assigner à la limite entre l'Eocène et l'Oligocène dans ces régions. — Coll. sur le Paléog., Bordeaux, *Mém. Bur. Rech. Géol. Min.*, **28**, 949—963.

LOCKER, S. 1968. Biostratigraphie des Alttertiärs von Norddeutschland mit Coccolithophoriden. — *Mb. deutch. Akad. Wiss. Berlin*, **10**, 3, 220—229.

— 1972. Coccolithineen aus dem Paläogen Mitteleuropas. — *Paläontol. Abh.*, *B*, **3**, 5, 735—853.

MARTINI, E. 1971. Standard Tertiary and Quaternary calcareous nannoplankton zonation. — *Proc. II. Plankton. Conf.*, Roma 1970, **2**, 739—785. Roma.

— and MÜLLER, C. 1971. Das marine Alttertiär in Deutschland und seine Einordnung in die Standard Nannoplankton Zonen. — *Erdöl Kohle, Erdgas, Petrochemie*, **24**, 6, 381—384.

— and — 1975. Calcareous nannoplankton from the type Chattian (Upper Oligocene). *Proc. VI. Congr. Mediterran. Neogene Strat.*, **1**, 37—41, Bratislava.

MARZEC, M. and WOŹNY, E. 1972. Litologia i stratygrafia utworów trzeciorzędu okolic Jastrzębiej Góry koło Pucka. — *Przegl. Geol.*, **12**, 562—570.

MATL, K. and ŚMIGIELSKA, T. 1977. Palaeogene marine sediments between Głogów and Sieroszowice (Lower Silesia — Poland). — *Rocz. PTGeol.*, **47**, 1, 11—22.

MENNER, V. V. and KRASHENINNIKOV, V. A. 1970. Contribution towards a stratigraphic scale for the ECAFE region. United Nations ECAFE Mineral Resources Devel. Ser. 36, 19—25.

MÜLLER, C. 1970. Nannoplankton aus dem Mittel-Oligozän von Norddeutschland und Belgien. — *N. Jb. Geol. Paläontol., Abh.*, **135**, 1, 82—101.

— 1971. Nannoplankton-Gemeinschaften aus dem W-deutschen Mittel-Oligozän. — *Notizbl. hess. L.-Amt. Bodenforsch.*, **99**, 43—53.

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

NOWAK, J., and UBERNA, T. 1976. Trzeciorzęd i rzeźba podłoża czwartorzędowego rejonu Okuniewa w świetle profilu Hipolitów. — *Kwart. Geol.*, **20**, 2, 343—364.

ODRZYWOLSKA-BIEŃKOWA, E. 1967. Utwory trzeciorzędowe z otworu Szczecin IG 1 w świetle badań mikropaleontologicznych. — *Ibidem*, **1**, 118—130.

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

— 1972. Opracowanie mikropaleontologiczne wierceń w rejonie Mińska Mazowieckiego. MS, — Archiwum Inst. Geol., Warszawa.

— 1973. Wyniki badań mikropaleontologicznych trzeciorzędu wiercenia Szczecin IG 1. Profile głębokich otworów wiertniczych IG. Zesz. 6. Szczecin IG 1. 92—93.

— 1974. Wyniki badań mikropaleontologicznych starszego trzeciorzędu w otworze wiertniczym Mikaszówka. — *Biul. Inst. Geol.*, **281**, 109—117.

— 1975. Osady paleogenu z wiercenia Miechów (monoklina przedsudecka) w świetle badań mikropaleontologicznych. — *Przegl. Geol.*, **8**, 407—408.

— 1976. Mikrofauna górnoeoceńska w wierceniu Gołdap IG-1. — *Ibidem*, **7**, 430.

— 1977. Ciekawe stanowisko mikrofauny młodszego paleogenu w wierceniu Machowinko koło Słupska. — *Ibidem*, **5**, 243—246.

— Obserwacje mikropaleontologiczne osadów rupelu w wierceniach Żelechowo i Góralice. — *Ibidem*, (in press).

— and BŁASZAK, M. Budowa geologiczna i stratygrafia osadów paleogenu okolic Możdżanowa koło Słupska. — *Kwart. Geol.* (in press).

ORBIGNY, A. d'. 1826. Tableau méthodique de la classe des Céphalopodes. — *Ann. Sci. Nat. Zool.*, **7**, 245—314.

— 1846. Foraminifères fossiles du Basin tertiaire de Vienne. 1—299.

PALMER, D. K. 1941. Foraminifera of the Upper Oligocene Cejinas Formation of Cuba. Part 4. — *Mem. Soc. Cubana Hist. Nat. de Habana*, **15**.

PAZDRO, O. 1969. Middle jurassic Epistominidae (Foraminifera) of Poland. — *Studia Geol. Pol.*, **27**, 1—92.

PLUMMER, H. J. 1926. Foraminifera of the Midway Formation in Texas. — *Texas, Univ. Bull.*, **2644**, 1—206.

POMEROL, CH. 1973. Ère Cénozoique. In: Stratigraphie et Paléogéographie. Doin, ed.

POSTUMA, J. A. 1971. Manual of planktonic foraminifera. — Elsevier Publ. Comp. Amst. London, New York.

POŻARYSKA, K. 1957. Lagenidae du crétacé supérieur de Pologne. — *Palaeont. Pol.*, **8**, 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 Pal. Pol.*, **22**, 1, 3—54.

— and ODRZYWOLSKA-BIEŃKOWA, E. 1977*a*. O górnym eocenie w Polsce. — *Kwart. Geol.*, **21**, 1, 57—72.

— and — 1977*b*. Wstępny projekt tabeli biostratygraficznej trzeciorzędu w Polsce pozakarpackiej. — *Przegl. Geol.*, **3**, 119—124.

REUSS, A. E. 1851. Über die fossilen Foraminiferen und Entomostracen der Septarienthone der Umgebung von Berlin. — *Z. deutsch. geol. Ges.*, **3**, 49—92.

— 1852. Briefliche Mittheilung Herr Reuss and Herrn Beyrich (Über Foraminiferen aus verschiedenen Septarienthonen). — *Ibidem*, 4, 16—19.

— 1865. Die Foraminiferen, Anthozoen und Bryozoen des deutschen Septarienthones. Ein Beitrag zur Fauna der mitteloligozänen Tertiär Schichten. — *Denkschr. Akad. Wiss. Math.-Nat. Cl.*, **25**, 117—214.

— 1858. Die Foraminiferen Familie der Lageniden. — *Sitzb. K. Akad. Wiss. Wien Math. Naturev. Cl*, **46**, 1, 308—342.

— 1863. Beiträge zur Kenntnis der Tertiären Foraminiferenfauna. III Die Foraminiferen des Septarienthones von Offenbach. IV. Die Foraminiferen des Septarienthones von Kreutznach. — *Ibidem*, **48**, 36—71.

RITZKOWSKI, S. 1965. Das marine Oligozän im nördlichen Hessen Stratigraphie und Paläogeographie, Doktor Dissert. Görich und Weiershäuser, 1—194. Marburg.

SINDOWSKI, K. H. 1936. Faziesprobleme der mitteleuropeischen Tertiärmeere. Sediment und Fauna von Septarienthon und Stettiner sand bei Stettin. — *Zbl. Min. Usw.*, B, s., 192—206.

SPANDEL, E. 1901. Untersuchungen an dem Foraminiferengeschlecht. *Spiroplecta* (= *carinata*). — *Abh. Naturh. Ges. Nürnberg*, 2—12.

SPIEGLER, D. 1960. Mikropaläontologische Gliederung des oberen Eozän und Oligozän von SW Brandenburg. Manuscript (*fide* Y. Kiesel, 1962).

— 1965. Biostratigraphie des Rupels auf Grund von Foraminiferen im nördlichen Deutschland. — *Geol. Jahrb.*, **82**, 447—486.

STAESCHE, K., and HILTERMANN, H. 1940. Mikrofaunen aus dem Tertiär Nordwestdeutschlands. — *Abh. Reichstelle. Bodenf. N. F.*, 201.

STAINFORTH, R. M., *et al.* 1975. Cenozoic planktonic foraminiferal zonation and characteristics of index forms. — *Univ. Kans. Paleont. Contrib. Art.* 62.
STUCHLIK, L. 1964. Pollen analysis of the Miocene deposits at Rypin. — *Acta Palaeobot.*, 5, 2, 1—111.
SUBBOTINA, N. N. (СУББОТИНА, Н. Н.) 1953. Глобигериниды, ханткениниды и глобороталииды. Ископ. Фораминиферы СССР, *Труды ВНИГРИ*, нов. сер. **76**, 1—296.
THURSCH, H. 1956. Die Gliederung des Unteren Rupelton im Mainzer Becken auf Grund seiner Foraminiferenfauna. — *Notizbl. Hess. L.-Amt., Bodenf.*, **84**, 216—231.
UBERNA, J. and ODRZYWOLSKA-BIEŃKOWA, E. 1977. Nowe stanowiska osadów górnoeoceńskich na obszarze północnej Lubelszczyzny. — *Kwart. Geol.*, **20**, **1**, 343—364.
ULLEBERG, K. 1974. Foraminifera and stratigraphy of the Viborg Formation in Sofienlund, Denmark. — *Bull. Geol. Soc. Denmark*, **23**, 269—292.
VASIČEK, M. 1956. Analysa rodu Sphaeroidina d'Orb. — *ČS A. V. Rozprawy UUG*, **19**, 1—163.
WOLAŃSKA, H. 1962. M. S. Otwornice oligocenu środkowego Polski północno-zachodniej. — Uniwersytet Warszawski, Biblioteka Główna, Archiwum Rękopisów, Warszawa.
ZIEMBIŃSKA-TWORZYDŁO, M. 1974. Palynological characteristics of the Neogene of Western Poland. — *Kwart. Geol.*, **19**, 3, 309—432.

EWA ODRZYWOLSKA-BIEŃKOWA, KRYSTYNA POŻARYSKA I ERLAND MARTINI

ŚRODKOWOOLIGOCEŃSKIE MIKROSKAMIENIAŁOŚCI Z NIŻU POLSKIEGO I ICH ZNACZENIE STRATYGRAFICZNE I PALEOGEOGRAFICZNE

Streszczenie

W okolicach Szczecina (wiercenie Szczecin IG 1) stwierdzono występowanie osadów środkowego oligocenu zawierających liczne gatunki otwornic. Badany zespół otwornic zawiera zarówno gatunki planktoniczne jak i bentoniczne wykazujące analogie do zespołów z osadów stratotypowych iłów septariowych Niemiec. Zespół ten był związany z morzem środkowego oligocenu bruzdy północno europejskiej, które objęło Polskę zachodnią aż do antyklinorium środkowo polskiego stanowiącego jej wschodnie obrzeżenie. Zamieszczona tu lista otwornic jest uzupełniona gatunkami pochodzącymi z równowiekowych osadów licznych otworów wiertniczych Instytutu Geologicznego z innych rejonów Polski. Badany zespół otwornic składa się z osobników drobnych o cienkich skorupkach. Cienkoskorupowość była spowodowana zarówno chemizmem środowiska (słaba wapnistość osadów) jak i niską temperaturą zbiornika. Zespół otwornic bentonicznych, zawierający ważny stratygraficznie gatunek *Rotaliatina bulimoides* (Reuss), przemawia za powstaniem osadu w strefie szelfowej basenu.

Gatunki planktoniczne umożliwiły korelację osadów badanego obszaru z osadami wyższego rupelu NRD, RFN, Belgii i Holandii a także krajów pozaeuropejskich. Badany zespół otwornic planktonicznych jest w większym stopniu podobny do zespołów z Europy Zachodniej niż do zespołu z basenu majkopskiego, ZSRR. Wynikło to zapewne ze słabych kontaktów między morzem środkowo oligoceńskim bruzdy północno europejskiej a basenem majkopskim, oddzielonym lądowym obszarem hipotetycznym rygla mazursko-mazowieckiego. O istnieniu tej zapory utrudniającej połączenie wyżej wymienionych zbiorników wydają się świadczyć negatywne wyniki poszukiwań fauny morskiej w osadach środkowego oligocenu w Polsce północno wschodniej i wschodniej. Wiek osadów środkowo oligoceńskich określony na podstawie otwornic został poparty badaniami nannoplanktonu wapiennego (Zona *Sphenolithus distentus* NP 24). Omówiony w niniejszym opracowaniu zespół nannoplanktonu wykazuje ścisłe podobieństwa do zespołów występujących w iłach septariowych NRD i RFN.

ЭВА ОДЖИВОЛЬСКА-БЕНЬКОВА, КРЫСТЫНА ПОЖАРЫСКА, ЭРЛЭНД МАРТИНИ

СРЕДНЕОЛИГОЦЕНОВЫЕ МИКРООКАМЕНЕЛОСТИ ИЗ ПОЛЬСКОЙ НИЗМЕННОСТИ И ИХ СТРАТИГРАФИЧЕСКОЕ И ПАЛЕОГЕОГРАФИЧЕСКОЕ ЗНАЧЕНИЕ

Резюме

В окрестностях Щецина (скважина — Щецин IG I) обнаружено выступление осадков среднего олигоцена, содержащих многочисленные виды фораминифер. Исследованный сбор фораминифер содержит как планктонные, так и бентонные виды, проявляющие аналогию со сбором стратотиповых осадков септариевых глин Германии. Этот сбор был связан с морем среднего олигоцена северо-европейской борозды, которое охватывало Западную Польшу, вплоть до среднего польского антиклинориума, являющегося его восточным окаймлением. Представленный комплекс фораминифер дополнен видами, происходящими из осадков равного возраста обильних скважин Геологического Института в разных районах Польши. Исследованный сбор фораминифер состоит из мелких особей с тонкой скорупкой. Тонкость скорупки была вызвана как химизмом среды (слабая известковость осадков), так и низкой температурой бассейна. Коллекция бентонных фораминифер, содержащая стратиграфически важный вид *Rotaliatina bulimoides* (Reuss), указывает на образование осадка в шельфовой зоне бассейна. Планктонные виды позволяли сделать корреляцию осадков, исследуемого района с осадками верхнего рупеля ГДР, ФРГ, Бельгии и Голландии, а также из позаевропей-

ских стран. Исследованный сбор фораминифер в большей степени подобный сборам из Западной Европы, чем до сбора из майкопского бассейна, СССР. Это объясняется слабыми контактами моря среднего олигоцена северо-европейской борозды и майкопского бассейна, разделённым материком гипотетичного мазурско-мазовецкого ригеля. О существовании этого порога, осложняющего связь выше названных бассейнов, по всей вероятности, свидетельствуют отрицательные результаты поисков морской фауны в осадках среднего олигоцена в северо-восточной и восточной Польше. Возраст осадков среднего олигоцена был определён на основании фораминифер, и он подтвердился при исследованиях известнякового наннопланктона (зона *Sphenolithus distentus* NP 24). Рассмотренный в настоящей статье сбор наннопланктона проявляет близкое сходство со сборами, выступающими в септариевых глинах ГДР и ФРГ.

EXPLANATION OF THE PLATES 7—16

All specimens from Szczecin IG 1 borehole, Middle Oligocene, calcareous nannoplankton zone NP 24 (*Sphenolithus distentus* Zone)
Foraminifera (pls 7 to 14) × 80; calcareous nannoplankton (pls 15 and 16) approximately × 2000

Plate 7

1. *Haplophragmoides latidorsatus* (Bornemann): *a* front view, *b* side view, IGeol Pal 1.
2. *Spiroplectammina carinata intermedia* Spandel: microspheric form, front view, IGeol Pal 2.
3. *Spiroplectammina carinata intermedia* Spandel: microspheric form, front view, IGeol Pal 9.
4. *Spiroplectammina attenuata* Reuss: microspheric form, *a* front view, *b* side view, IGeol Pal 3.
5. *Spiroplectammina attenuata* Reuss: macrospheric form, *a* front view, *b* side view, IGeol Pal 10.

6, 7. *Spiroplectammina attenuata* Reuss: intraspecific variability, IGeol Pal 11.

8. *Gaudryina siphonella* Reuss: *a* apertural view, *b* side view, IGeol Pal 4.
9. *Gaudryina siphonella asiphonia* Andreae: side view, IGeol Pal 5.
10. *Gaudryina chilostoma* (Reuss): side view, IGeol Pal 6.

Plate 8

1. *Quinqueloculina ludwigi* Reuss: *a*, *b* opposite sides, *c* apertural view, IGeol Pal 7.
2. *Quinqueloculina ludwigi* Reuss: intraspecific variability: *a* side view, *b* apertural view, IGeol Pal 126.
3. *Quinqueloculina impressa* Reuss: *a*, *b* opposite sides, *c* apertural view, IGeol Pal 8.

4. *Stilostomella ewaldi* (Reuss): IGeol Pal 50.
5. *Nodosaria multilineata* Reuss: IGeol Pal 10.
6, 7, 8, 9. *Lenticulina depauperata* (Reuss): intraspecific variability: *a* side view, *b* apertural view, IGeol Pal 14.

Plate 9

1. *Lenticulina inornata* (d'Orbigny): *a* side view, *b* apertural view, IGeol Pal 18.
2. *Lenticulina umbonata* (Reuss): IGeol Pal 19.
3. *Lenticulina subangulata* (Reuss): *a* side view, *b* apertural view, IGeol Pal 25.
4. *Lenticulina subangulata* (Reuss): intraspecific variability, IGeol Pal 24.
5. *Dentalina grandis* Reuss: IGeol Pal 120.
6. *Dentalina spinescens* Reuss: IGeol Pal 26.
7. *Dentalina obliquestriata* Reuss: IGeol Pal 27.
8, 10. *Dentalina soluta* Reuss: IGeol Pal 28.
9. *Dentalina inornata* d'Orbigny: IGeol Pal 29.

Plate 10

1, 2. *Sphaeroidina variabilis* Reuss: *a* side view, *b* apertural view, IGeol Pal 56.
3, 4. *Raphanulina minuta* (Roemer): *a*, *b* views from opposite sides, IGeol Pal 31, 42.
5. *Fissurina lucida* Williamson: IGeol Pal 44.
6. *Raphanulina gibba globosa* (Roemer): *a*, *b* views from opposite sides, IGeol Pal 30.
7. *Uvigerina batjesi* Kaasschieter: IGeol Pal 58.
8, 9, 10. *Bolivina beyrichi* Reuss: intraspecific variability, IGeol Pal 48.

Plate 11

1, 2, 3. *Hopkinsina gracilis* (Reuss): intraspecific variability, IGeol Pal 62.
4. *Trifarina germanica* (Cushman and Edwards): IGeol Pal 63.
5. *Valvulineria petrolei* Andreae: *a* dorsal view, *b* ventral view, IGeol Pal 64.
6. *Cassigerinella* cf. *chipolensis* Cushman and Ponton: *a* side view, *b* apertural view, IGeol Pal 71.
7, 8. *Globigerina corpulenta* Subbotina: intraspecific variability; *a* dorsal view, *b* ventral view, IGeol Pal 67.
9. *Globigerina senilis* Bandy: *a* ventral view, *b* dorsal view, IGeol Pal 71.
10. *Globigerina officinalis* Subbotina: *a* ventral view, *b* dorsal view, IGeol Pal 69.
11. *Globigerina turkmenica* Khalilov: *a* dorsal view, *b* ventral view, IGeol Pal 72.
12. *Globigerina turrilina praeturrilina* Blow and Banner: *a* dorsal view, *b* ventral view, IGeol Pal 73.
13, 14. *Globigerina* sp.: intraspecific variability; *a* dorsal view, *b* ventral view, IGeol Pal 74.

Plate 12

1. *Globigerina angustiumbilicata* Bolli: *a* dorsal view, *b* ventral view, IGeol Pal 65.
2. *Globigerina inaequispira* Subbotina: *a* dorsal view, *b* ventral view, IGeol Pal 68.
3. *Globigerina* aff. *ciperoensis* Bolli: *a* dorsal view, *b* ventral view, IGeol Pal 66.
4. *Globigerina pseudoeocaena* Subbotina: *a* dorsal view, *b* ventral view, IGeol Pal 70.
5, 6. *Cibicides reussi* Ten Dam: intraspecific variability; *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 76.
7. *Cibicides ungerianus* (d'Orbigny): *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 82.
8, 9. *Rotaliatina bulimoides* (Reuss): intraspecific variability, IGeol Pal 86.

Plate 13

1. *Globocassidulina oblonga* (Reuss): *a, b* views from opposite sides, *c* apertural view, IGeol Pal 89.
2, 3. *Pullenia bulloides* d'Orbigny: intraspecific variability; *a* side view, *b* apertural view, IGeol Pal 90.
4. *Pullenia quinqueloba* Reuss: *a* side view, *b* apertural view, IGeol Pal 96.
5. *Alabamina tangentialis* (Clodius): *a* ventral view, *b* dorsal view, IGeol Pal 101.
6. *Gyroidina soldanii* (d'Orbigny): *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 10:.
7. *Gyroidina girardana* (Reuss): *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 108.

Plate 14

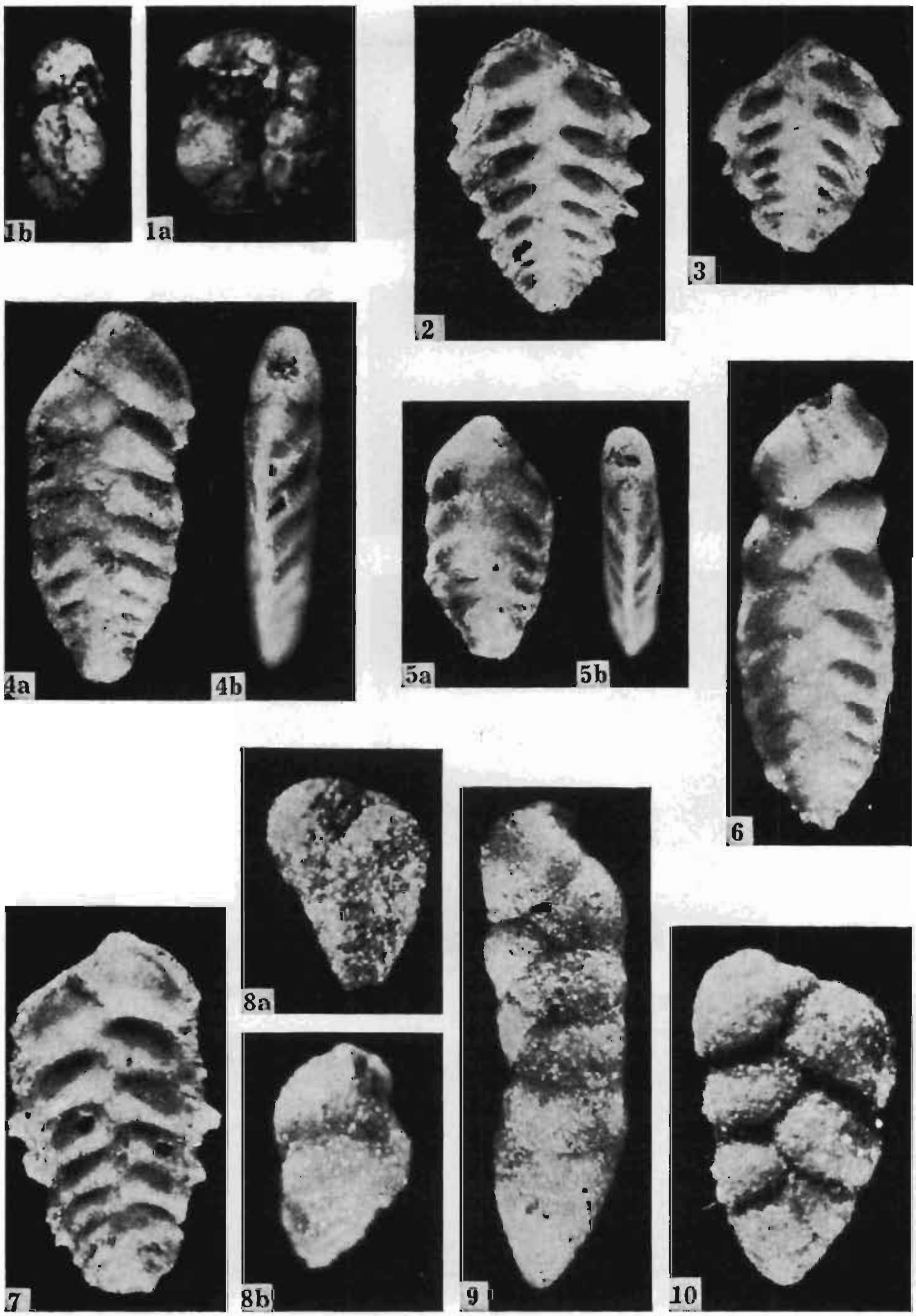
1, 2. *Melonis affine* (Reuss): intraspecific variability; *a* side view, *b* apertural view, IGeol Pal 110.
3. *Oridorsalis umbonatus* (Reuss): *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 52.
4, 5. *Svratkina perlata* (Andreae): intraspecific variability; *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 43.
6, 7. *Epistomina elegans* (d'Orbigny): intraspecific variability; *a* dorsal view, *b* ventral view, *c* apertural view, IGeol Pal 56.

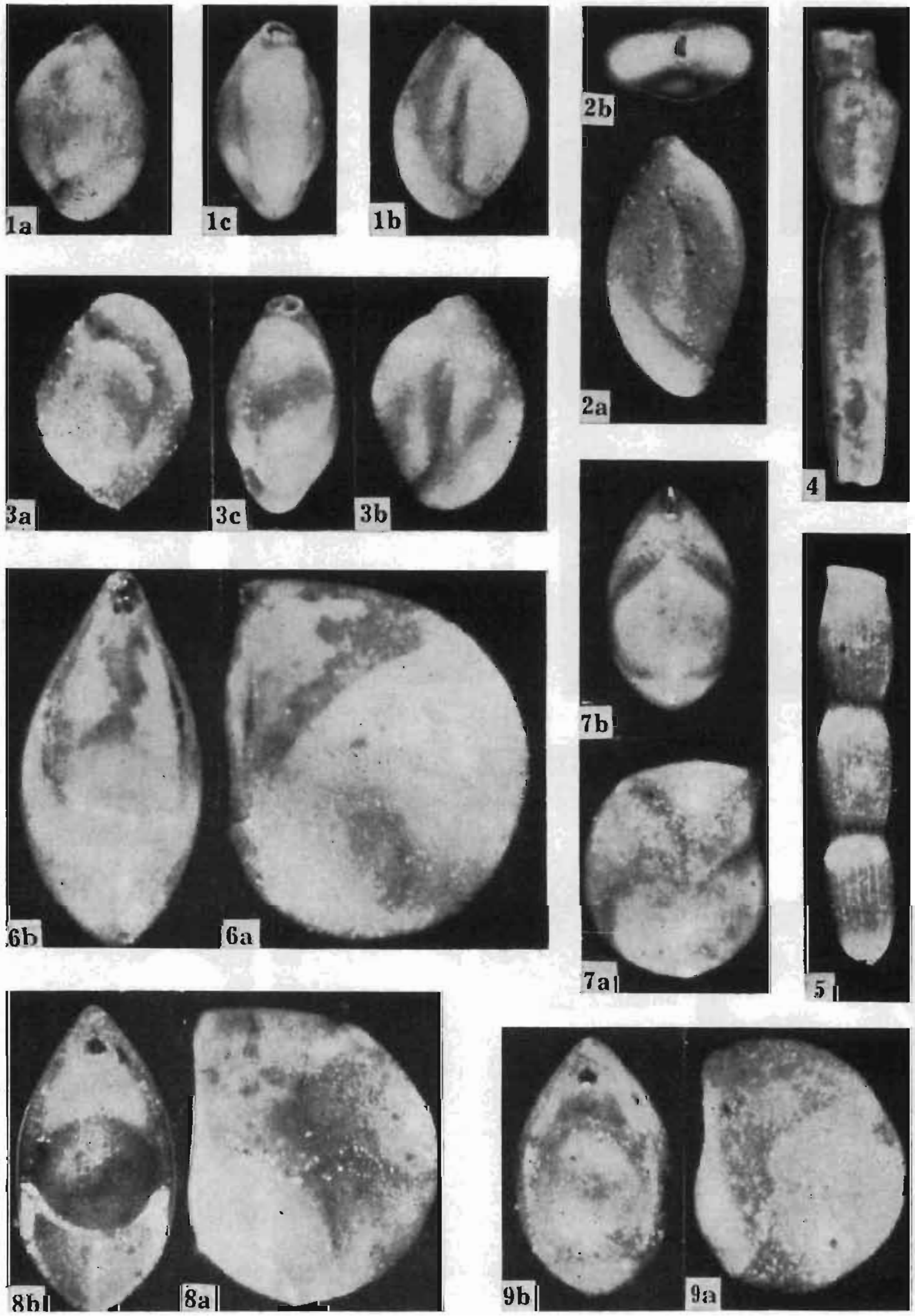
Plate 15

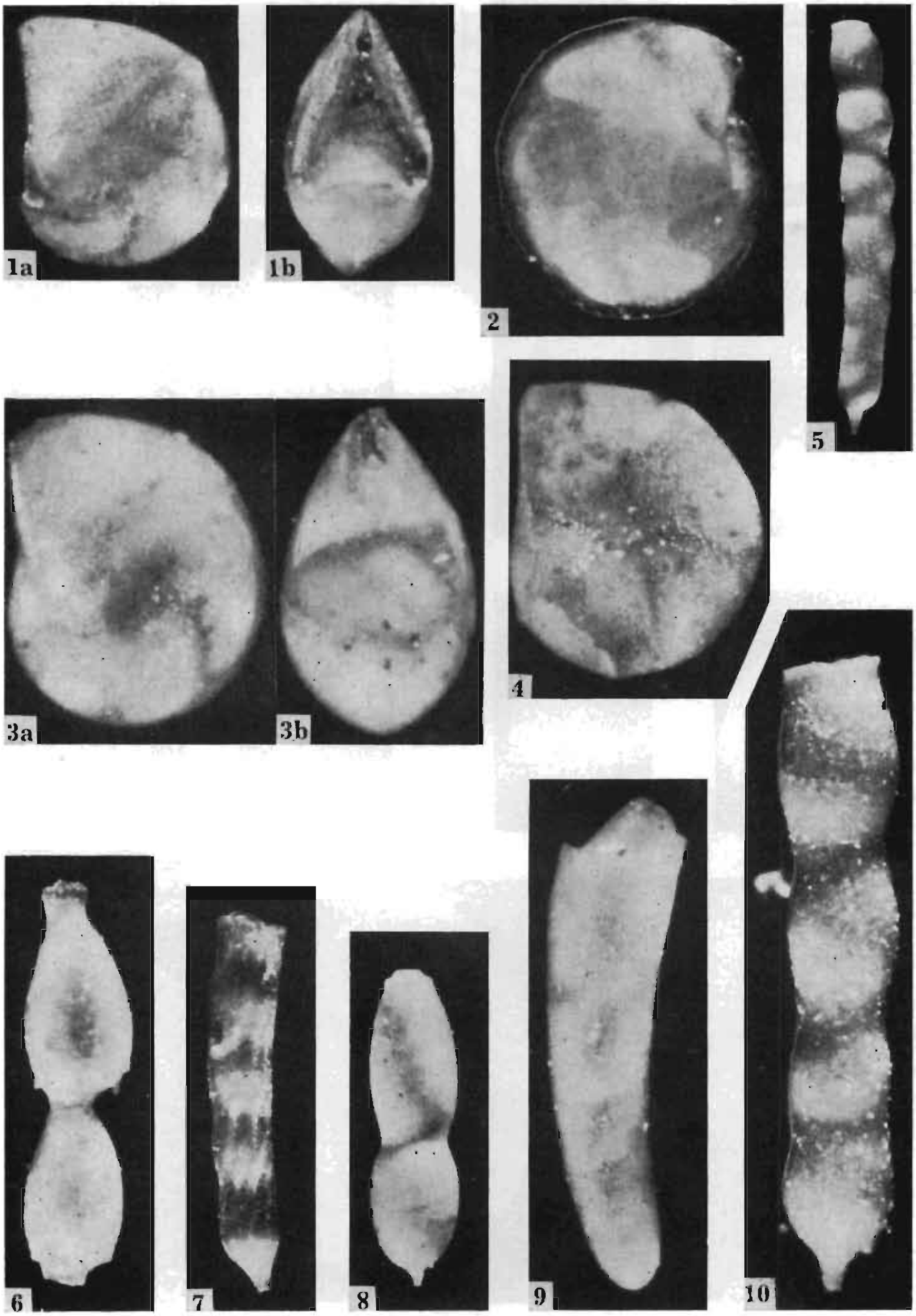
1. *Braarudosphaera bigelowi* (Gran and Braarud) Deflandre. Sample 137.2—143.2 m H. 1*b* Crossed nicols.
2. *Coccolithus abisectus* Müller. Sample 131.2—137.2 m A. 2*b* Crossed nicols.
3. *Coccolithus eopelagicus* (Bramlette and Riedel) Bramlette and Sullivan. Sample 137.2—143.2 m H. 3*b* Long axis 30° to crossed nicols.
4. *Cyclococcolithus floridanus* (Roth and Hay) Müller. Sample 131.2—137.2 m A. 4*b* Crossed nicols.
5. *Dictyococcites dictyodus* (Deflandre and Fert) Martini. Sample 131.2—137.1 m B. 5*b* Long axis 0° to crossed nicols.
6. *Discolithina multipora* (Kamptner) Martini. Sample 137.2—143.2 m H. 6*b* Long axis 45° to crossed nicols.

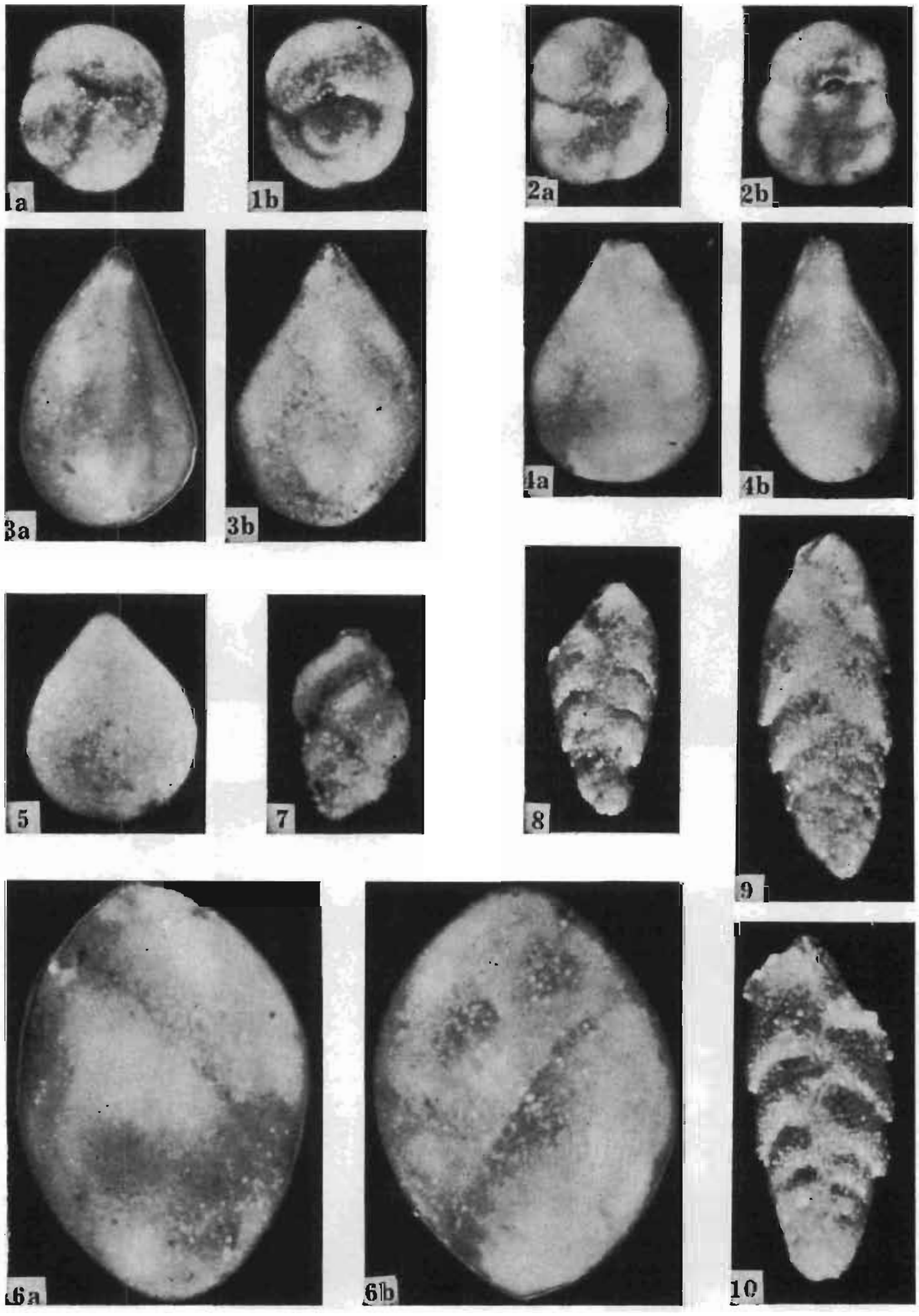
Plate 16

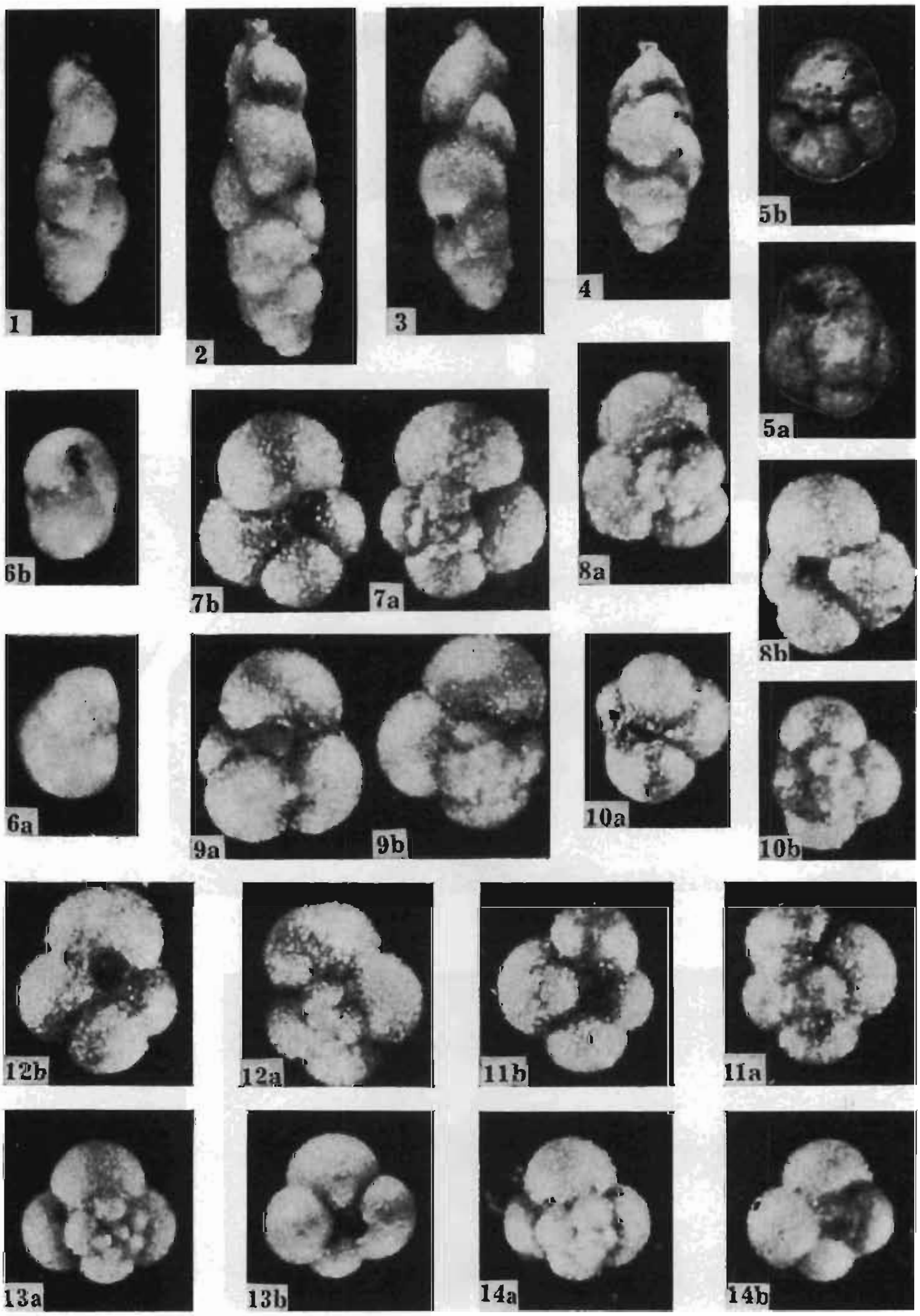
1, 2. *Discolithina pygmaea* Locker. Two different specimens. Sample 137.2—143.2 m H. 2 Long axis 90° to crossed nicols.
3. *Helicosphaera bramlettei* (Müller) Jafar and Martini. Sample 143.2—149.7 m A. 3*b* Long axis 45° to crossed nicols.
4. *Helicosphaera recta* (Haq) Jafar and Martini. Sample 143.2—149.7 m E. 4*b* Long axis 30° to crossed nicols.
5. *Reticulofenestra lockeri* Müller. Sample 131.2—137.2 m B. 5*b* Long axis 45° to crossed nicols.
6. *Sphenolithus* sp. Sample 137.2—143.2 m H. 6*b* Crossed nicols.
7. *Zygrhablithus bijugatus* (Deflandre) Deflandre. Sample 131.2—137.2 m A. 7*b* Long axis 0° to crossed nicols.

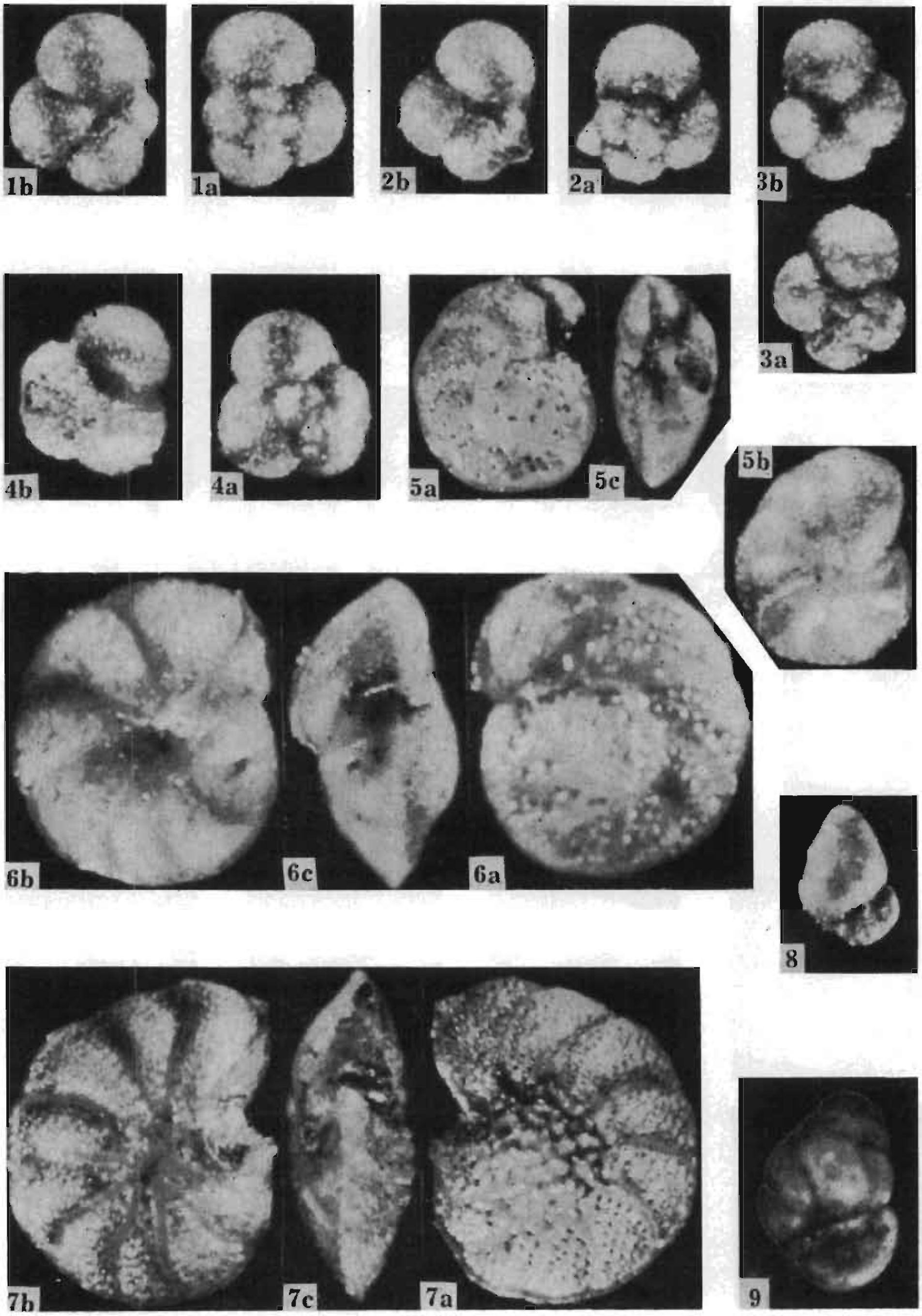

1b
1a
2
3
4a
4b
5a
5b
6
7
8a
8b
9
10

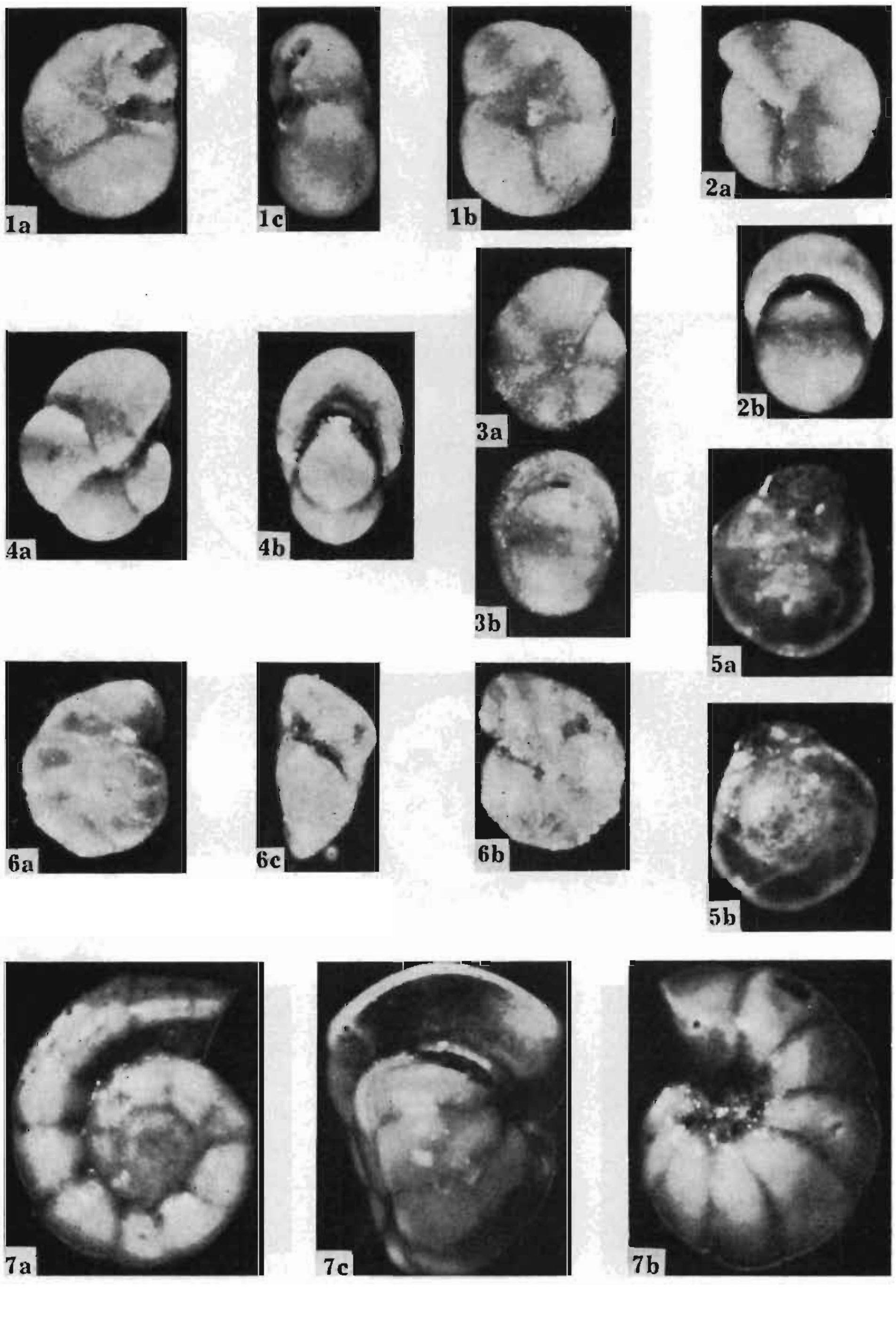

1a
1c
1b
2b
2a
4
3a
3c
3b
7b
6b
6a
7a
5
8b
8a
9b
9a

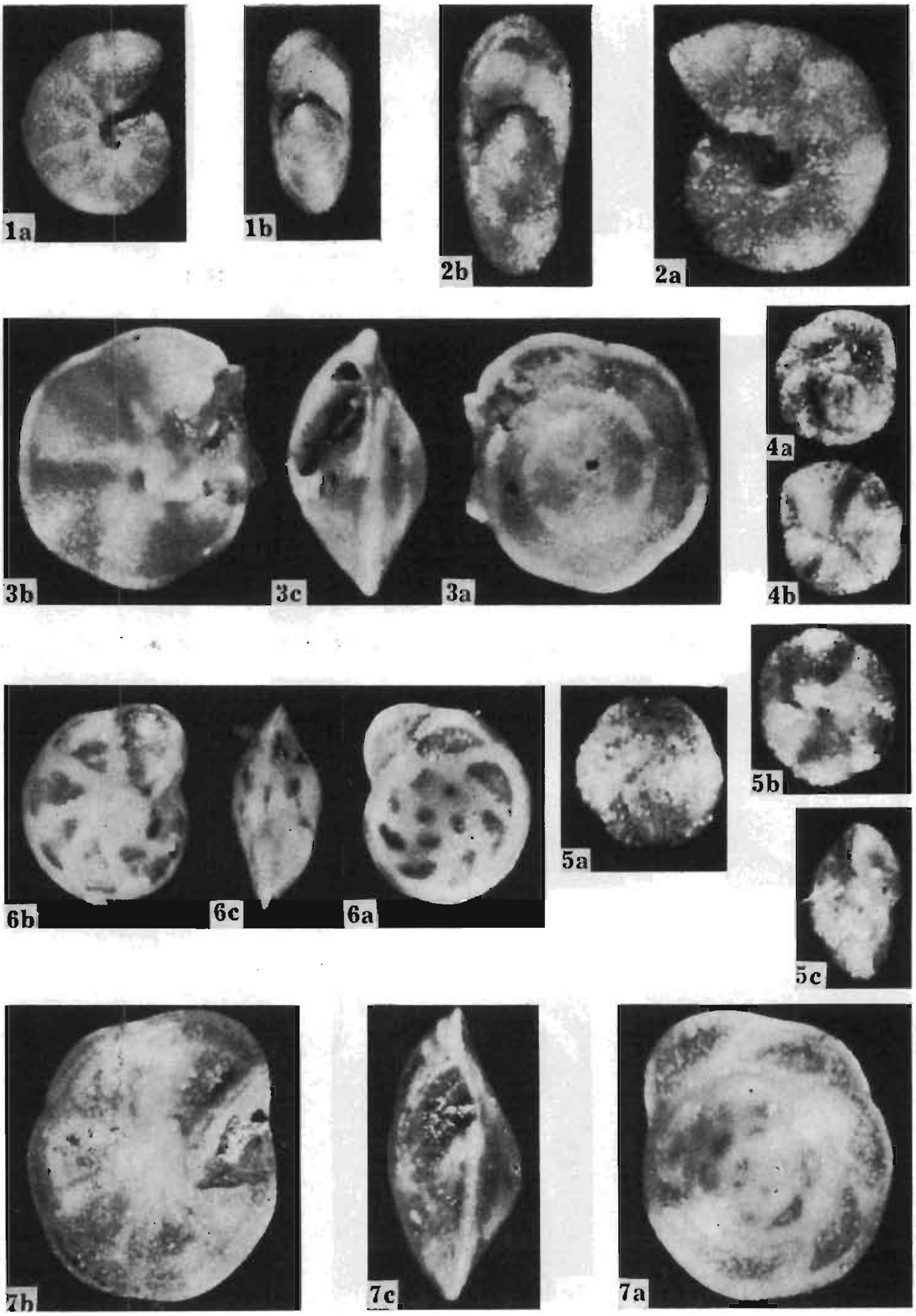

1a
1b
2
3a
3b
4
5
6
7
8
9
10

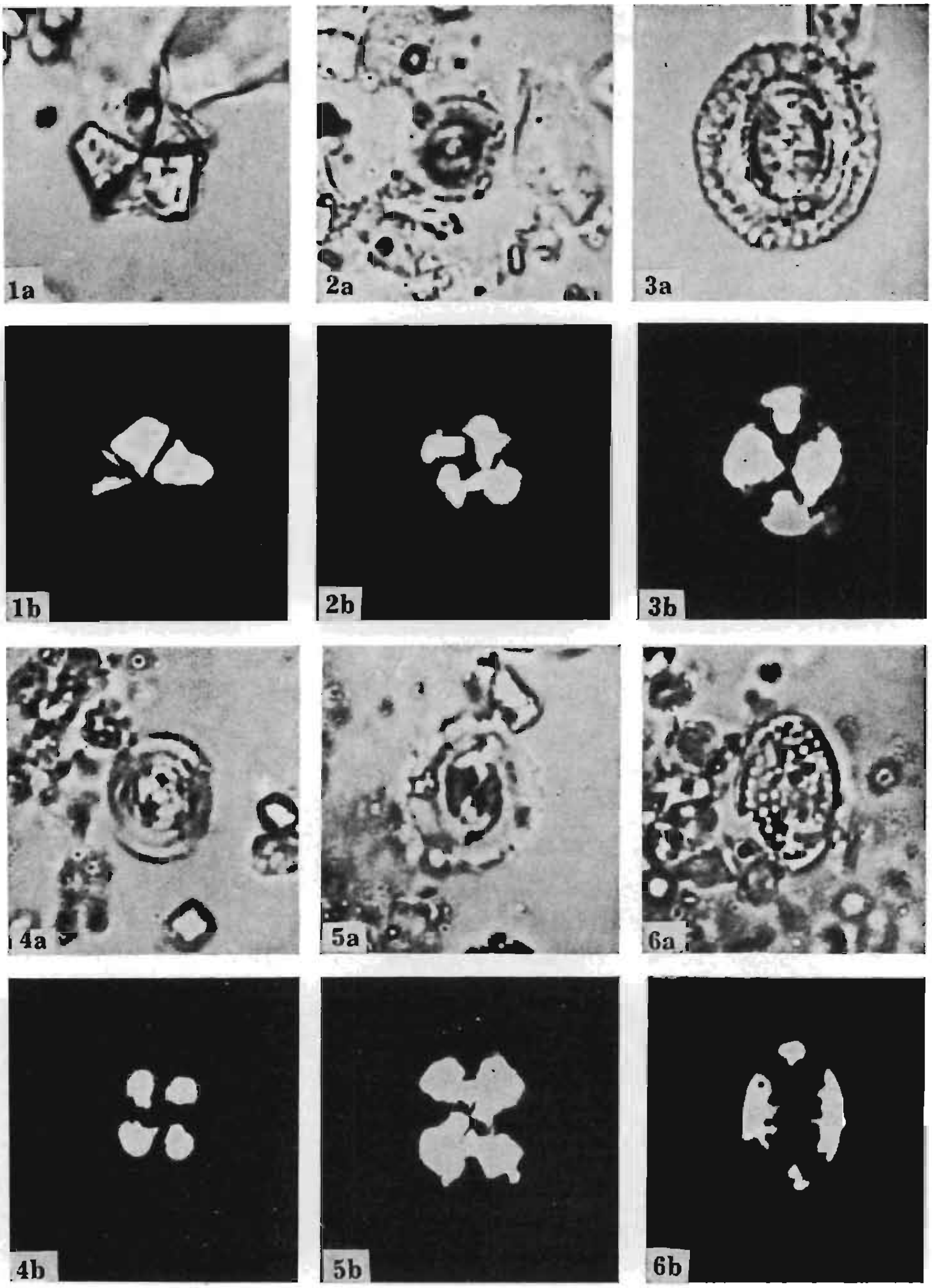

1a
1b
2a
2b
3a
3b
4a
4b
5
7
8
9
6a
6b
10


1
2
3
4
5b
5a
6b
7b
7a
8a
8b
6a
9a
9b
10a
10b
12b
12a
11b
11a
13a
13b
14a
14b


1b
1a
2b
2a
3b
3a
4b
4a
5a
5c
5b
6b
6c
6a
8
7b
7c
7a
9


1a
1c
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6c
6b
7a
7c
7b


1a
1b
2b
2a
3b
3c
3a
4a
4b
5b
5a
6b
6c
6a
5c
7b
7c
7a


1a
2a
3a
1b
2b
3b
4a
5a
6a
4b
5b
6b